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WIC Participation and Breastfeeding at 3 Months Postpartum

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Abstract

Objectives—Participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) has been associated with lower breastfeeding initiation and duration. This study examines breastfeeding-related factors among WIC participants and nonparticipants that might explain these previous findings.

Methods—Respondents to the 2007 Infant Feeding Practices Study II who were income-eligible for WIC were categorized as follows: no WIC participation (No-WIC); prenatal participation and infant entry while ≥60 % breastfeeding (WIC BF-high); prenatal participation and infant entry while <60 % breastfeeding (WIC BF-low). Percent breastfeeding was the number of breast milk feeds divided by the total number of liquid feeds. Using propensity scores, we matched WIC BF-high respondents to No-WIC respondents on demographic and breastfeeding factors. We used logistic regression to estimate the impact of WIC participation on breastfeeding at 3 months postpartum in the matched sample. Within-WIC differences were explored.

Results—Of 743 income-eligible respondents, 293 never enrolled in WIC, 230 were categorized as WIC BF-high, and 220 as WIC BF-low. Compared to matched No-WIC respondents, WIC BF-high respondents had increased odds of breastfeeding at 3 months, though this difference was not statistically significant (OR 1.92; 95 % CI 0.95–3.67; *p* value 0.07). WIC BF-high respondents were more similar on breastfeeding-related characteristics to No-WIC respondents than to WIC BF-low respondents.

Conclusions for Practice—Accounting for prenatal breastfeeding intentions and attitudes, we find no negative association between WIC participation and breastfeeding at 3 months postpartum. This is in contrast to prior studies, and highlights the importance of understanding within-WIC differences.

Keywords

Breastfeeding; WIC; Health promotion; Low-income women

Significance

WIC participants and income-eligible nonparticipants differ on factors known to predict breastfeeding, calling into question prior claims that WIC negatively influences breastfeeding. Using propensity score matching methods to identify an appropriate No-WIC control group, we find no negative association between WIC participation and breastfeeding at 3 months. In addition, this study highlights differences within the WIC population on breastfeeding-related factors. We find that women who are still breast-feeding at postnatal WIC entry are more similar to non-participants in their breastfeeding attitudes and intentions than they are to other WIC participants.

Introduction

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides nutritional supplementation, assessment, and counseling for pregnant, postpartum, and breastfeeding women and for children up to age five in the United States (US). In 2014 WIC cost \$6.2 billion and served an estimated 8.2 million individuals. The population served by WIC included approximately 2.0 million infants, or about half of all infants born in the US that year [31]. One goal of the WIC program is breastfeeding [33]. However, in cross-sectional studies WIC participants have been less likely to breastfeed, and have shorter breastfeeding durations than WIC-eligible nonparticipants [13, 26].

Drawing conclusions on the impact of WIC from cross-sectional data is problematic because women who enroll in WIC differ systematically from eligible nonparticipants. Compared to participants, eligible nonparticipants have characteristics associated with increased breastfeeding. Non-participants are older, more highly educated, more likely to be married, and more likely to report White race than participants [13, 15]. Reported demographic differences are frequently large enough that accounting for them using regression analysis may be inadequate to eliminate bias [29].

In addition to concerns about demographic comparability, the monetary value of infant formula provided by WIC exceeds the value of the food package provided to breastfeeding mothers. Therefore, families who formula-feed may disproportionately select into WIC because they receive a greater financial benefit from WIC participation than do breastfeeding families. Revisions to the food packages were introduced starting in 2007, and may have improved nutritional choices among WIC participants. However the new food packages continue to provide a greater financial value to formula-feeding families than to breastfeeding families [17, 27, 34].

Both demographic characteristics and differential financial value suggest that WIC participants may be less likely to breastfeed than nonparticipants for reasons unrelated to the WIC program. Some families may enroll in WIC only when they decide to reduce or stop

breastfeeding [4, 10]. If true, the impact of WIC on breastfeeding may be limited to infants who are still predominantly breastfeeding at infant WIC entry.

In contrast to cross-sectional designs, studies employing analytic methods that better address selection bias into WIC have reported mixed results in assessing the relationship between WIC and breastfeeding. Two studies found a positive relationship between WIC and breastfeeding. However, these studies also had limitations. In particular, one analyzed data from a single state only [20], while the other measured breastfeeding duration by self-report from parents of children up to 12 years old [14]. Neither was able to adjust for breastfeeding attitudes or intentions.

Our study explores the impact of WIC on breastfeeding by focusing on the subgroup of WIC participants most ready to breastfeed. By matching them to nonparticipants on both demographics and on baseline breastfeeding attitudes and intentions, our study aims to produce an unbiased estimate of WIC program influence on this subgroup.

Methods

Study Design

We used the quasi-experimental design of propensity score matching within a cohort study to compare breastfeeding outcomes between WIC participants and a matched group of income-eligible nonparticipants. We aimed to compare groups that were as distinct as possible with respect to WIC exposure, assuming a true effect would be most evident between such groups [35]. Therefore, all WIC participants in our analysis participated in WIC prenatally and accessed WIC postnatally prior to cessation of breastfeeding. Matched nonparticipants had no WIC participation. This study was approved by the Institutional Review Board at Johns Hopkins School of Medicine.

Conceptual Model

Participation in public benefits programs, including WIC, is influenced by demographics, socioeconomic status, perceived norms and attitudes, and barriers to entry [5, 16]. We developed a conceptual model to guide our analysis, based on the Integrated Behavioral Model. This model is validated for behavior change in several settings and highlights attitudes and norms as well as environmental constraints [7, 8]. Figure 1 illustrates this model with both available data from the IFPSII and constructs that were unmeasured.

Data Source

The Infant Feeding Practices Study II (IFPSII) was a panel survey conducted in the US between 2005 and 2007 by the Centers for Disease Control and Prevention and the Food and Drug Administration. All surveys were conducted by mail. The IFPSII drew respondents from an existing nationally distributed consumer opinion panel. Respondents were eligible for the IFPSII cohort if they were pregnant with a singleton during the enrollment period. Postnatal exclusions included infant birth weight less than five pounds, gestational age less than 35 weeks, NICU stay more than 3 days, or health problems that could interfere with feeding (e.g., cleft palate). After exclusions, 3033 women continued on the IFPSII panel [6].

Though the IFPSII was nationally distributed, it was not nationally representative. IFPSII respondents were more highly educated, and more likely to be employed and married than pregnant women overall at the time. In addition, the IFPSII was a written survey available only in English, so respondents were universally literate in English [6].

The financial cutoff for WIC eligibility is household income of 185 % of the Federal Poverty Level (FPL). Sample construction is described in Fig. 2 and started with the 3033 respondents on the IFPSII postnatal panel. Of these, 1292 reported household income at or below 185 % FPL. We excluded 232 respondents who never initiated breastfeeding. WIC participation data was collected both prenatally and postnatally. To create distinct subgroups with respect to WIC participation, we excluded 17 respondents who reported prenatal but not postnatal WIC participation, 180 respondents who reported postnatal but no prenatal WIC participation, and 38 respondents who were missing data on timing of WIC participation. We excluded 35 WIC respondents for whom we couldn't establish breastfeeding intensity at the time of infant WIC entry; this exclusion did not impact WIC nonparticipants. Of the remaining 790 respondents, 47 lacked data on breastfeeding duration because of censoring (i.e., respondents were still breastfeeding when they dropped out of the study prior to the 3 month survey). The remaining 743 individuals comprised our analytic sample, including 450 who participated in WIC prenatally & postnatally and 293 WIC nonparticipants. We used data from four IFPSII time points: prenatal, neonatal, 2-, and 3-month.

Outcome: Breastfeeding to 3 Months Postpartum

The primary outcome was continuation of breastfeeding to 3 months postpartum. Breastfeeding duration (in weeks) is a composite variable in the IFPSII. We dichotomized breastfeeding duration at 13 weeks or greater versus less than 13 weeks.

We considered conducting a survival analysis following matching. This would have allowed us to use breastfeeding as a continuous variable and to include censored data. However survival analysis assumes non-informative censoring, while IFPSII respondents with censored data differed systemically from those with non-censored data [1]. In particular censored respondents had shorter intended durations of exclusive breastfeeding.

We ultimately chose to dichotomize breastfeeding at 3 months because this is a clinically meaningful outcome that minimizes potential bias from censoring. Three months of breastfeeding was the measure of interest in multiple studies addressing the benefits of breastfeeding [12], and 3 months of exclusive breastfeeding is a goal of *Healthy People 2020*.

WIC Entry Category

Each postnatal survey included intensity of breastfeeding and infant WIC participation. Intensity of breastfeeding relied on food frequency questionnaires. Intensity of breastfeeding was determined by dividing the number of breast milk feeds by the total number of liquid feeds. Infant WIC participation was defined as checking a box noting “Yes, my baby was enrolled and got WIC formula or food (in the past month).” This item was included on all post-natal surveys.

Based on breastfeeding intensity and WIC participation, respondents were categorized into three WIC groups: infant and mother never participated in WIC (No-WIC), infant entered WIC while still breastfeeding $\geq 60\%$ (WIC BF-high), and infant entered WIC when breastfeeding $<60\%$ (WIC BF-low). We chose this cutoff for breast-feeding intensity to approximate existing categories used by WIC. In this analysis, WIC BF-high approximates the WIC category of “mostly breastfeeding” [32]. However most infants were either exclusively formula fed or almost exclusively breastfeeding in the month of WIC entry. In a sensitivity analysis, we varied this cut-point from 10 to 90 % without significantly influencing group assignment or outcome. All respondents in both WIC groups participated in WIC prenatally and no respondents in the No-WIC group participated in WIC prenatally. We did not have data on the timing of prenatal WIC entry or the number of prenatal WIC visits.

Propensity Score Calculations: Baseline Characteristics

Variables used to generate propensity scores (representing IFPSII respondents’ propensity to enroll in WIC) were selected based on the conceptual model (Fig. 1). We identified IFPSII variables that might influence the main constructs in our model. Demographic variables were all reported prenatally and included: maternal age, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and other), educational attainment (high school versus less than high school), intended workforce participation prior to 12 weeks postpartum, household income (percent FPL), and parity.

Breastfeeding factors included: prenatal breastfeeding intentions, attitudes towards breastfeeding, and perceived social support for breastfeeding. Intended durations of exclusive and partial breastfeeding were captured by the questions “How old do you think your baby will be when you first feed him or her formula or any other foods besides breast milk?” and “How old do you think your baby will be when you completely stop breastfeeding?” Mothers’ beliefs included whether “infant formula is as good as breast milk” and whether “babies should be exclusively breastfed for the first 6 months.”

Measures of breastfeeding support from the baby’s father, maternal grandmother, and the mother’s “obstetrician or other doctor” were created based on respondents’ perceptions of these individuals’ opinions on infant feeding (breastfeeding, formula feeding, or both) and information about the importance of these individuals in respondents’ lives. The importance of opinions was measured on a four-point Likert scale from 1 = not at all important to 4 = very important. For example, a respondent was considered to have support for breastfeeding from the father if he favored partial or exclusive breastfeeding and the respondent perceived his opinion to be somewhat or very important. We dichotomized respondents’ report of the number of “friends and relatives (who) have breastfed their babies” at three or more friends and relatives.

The only baseline health factor available was self-reported maternal pre-pregnancy body mass index (BMI). Elevated maternal BMI is associated with decreased breastfeeding [11].

Analysis

We first examined unadjusted relationships between breastfeeding duration by WIC entry category and baseline characteristics. Because 68 % of WIC BF-low respondents had stopped breastfeeding completely by infant WIC entry, we could not assess whether postnatal WIC participation influenced breastfeeding duration. Therefore, we did not examine the association between WIC participation and breastfeeding duration for WIC BF-low. The final analysis relating WIC participation to breastfeeding duration is restricted to WIC BF-high ($n = 230$), in comparison to respondents with similar baseline characteristics in the No-WIC group ($n = 293$). We also described within-WIC differences on baseline characteristics.

Propensity scores (i.e., probabilities of being a WIC participant given baseline characteristics) were used to find a No-WIC respondent match for each WIC BF-high respondent. The goal of matching is to create treatment and control groups that are similar with respect to characteristics that predict treatment. If successful, this creates groups that could plausibly have been the result of randomization. We used nearest-neighbor matching with a caliper of 0.5 standard deviations on the propensity score, and with replacement [29]. We checked the balance of baseline characteristics in the matched dataset by comparing standardized mean differences between the two groups before and after matching.

Because propensity score matching rarely creates exact balance between subgroups, we then fit a logistic regression to adjust for residual confounding in the matched dataset [29]. In this regression, WIC participation predicted the outcome of breastfeeding at 3 months postpartum.

Item-level missing data ranged from 0 (e.g., household income) to 6 % (expected breastfeeding duration) leading to 16 % missing at least one of the analysis variables. We therefore used multiple imputation to address missing data. Imputation using chained equations was used to create 30 imputed datasets [23]. Outcome regression models were estimated for each imputed dataset and the results were pooled across datasets [21].

Analysis was conducted using Stata (Version 12.1, StataCorp LP, College Station, Texas) for imputation and R (Version 3.1.1, R Foundation for Statistical Computing, Vienna, Austria) for propensity score matching and regression analysis [18, 22, 28].

Results

WIC participation and breastfeeding duration are shown in Table 1. Of the 743 respondents, 293 (39.4 %) never participated in WIC (No-WIC), 230 (31.0 %) were categorized as WIC BF-high, and 220 (29.6 %) were WIC BF-low. More WIC BF-low infants entered WIC in the first month of life compared to WIC BF-high infants (WIC BF-high 83.5 %; WIC BF-low 92.3 %; $p < 0.001$). Intensity of breastfeeding at WIC entry also differed between subgroups (WIC BF-high 93.5 %; WIC BF-low 11.1 %; $p < 0.001$).

WIC nonparticipants were older, more likely to report White race and to be married, and more highly educated than WIC participants (Table 2). However within-WIC differences

were also notable. Comparing across all subgroups, nonparticipants were the most socioeconomically advantaged, WIC BF-low were the most disadvantaged, and WIC BF-high were intermediate. For example, among nonparticipant respondents, mean household income was 130.0 % FPL and 36.8 % completed high school. Meanwhile, among WIC BF-low respondents, mean household income was 96.2 % FPL and only 6.2 % completed high school. WIC BF-high respondents were intermediate in both categories with mean household income of 106.1 % FPL and 15.0 % high school completion.

For breastfeeding-related factors WIC BF-high respondents were more similar to No-WIC respondents than to WIC BF-low respondents (Table 3). This was particularly true of maternal expected duration of breastfeeding (exclusive and any breastfeeding), maternal belief that babies should be exclusively breastfed for 6 months, and support for breastfeeding from fathers, maternal grandmothers, and “obstetricians or other doctors.”

As intended, matching reduced standardized mean differences between groups on all baseline variables (Fig. 3). Matching particularly improved balance on maternal age, maternal educational attainment, and household income. Regression analysis using the matched imputed data found no significant association between WIC participation and breastfeeding at 3 months (OR 1.92, 95 % CI 0.95, 3.67, *p* value 0.07) (Table 4).

Discussion

We find no association between WIC participation and breastfeeding at 3 months postpartum. This stands in contrast to prior literature suggesting a negative impact of WIC on breastfeeding outcomes [13, 26].

Our study contributes to a growing literature using statistical methods to reduce differences or biases between WIC participants and nonparticipants. Prior studies have addressed selection bias by limiting sample selection, for example by evaluating only WIC participants who were primiparous, had early entry into prenatal care, and were also enrolled in Medicaid, [15] or by evaluating WIC participants only, and comparing those with early prenatal, late prenatal or postnatal participation only [20]. The latter of these studies addressed breastfeeding outcomes and found that increased exposure to WIC increased both breastfeeding initiation and duration [20].

Selection bias in WIC studies has also been addressed using propensity scores. For example, an analysis of the Panel Study of Income Dynamics found that the negative association between WIC and breastfeeding disappeared when propensity score matching was used, and was reversed when looking only at within-family comparisons [14]. A prior analysis of IFPSII data also used propensity score matching, developing a score for propensity to breastfeed and then evaluating the association between breastfeeding duration and WIC participation. This analysis, which did not account for heterogeneity among WIC participants, found a negative association between WIC enrollment and breast-feeding [19]. Our study adds to this literature by providing the first analysis that included baseline breastfeeding characteristics and prospectively collected breastfeeding outcomes for both WIC participants and nonparticipants.

Our findings also highlight within WIC differences. To our knowledge, these differences are not well described in the literature. When we stratified WIC participants by breastfeeding intensity at infant WIC entry, we found that WIC BF-high participants were more similar to WIC nonparticipants than to other WIC participants. This finding has implications for both WIC practice and future research.

From a practice perspective, this finding suggests that new strategies are necessary to reduce breastfeeding disparities. Unlike other health behaviors which can be adopted at various time points, breastfeeding must be initiated at birth and continuously supported to be successful. Continued focus on early prenatal WIC enrollment and counseling is critical. This should be augmented by innovative incentives for women who do not intend breast-feeding, targeting, for example, partner education, identification of friends or family members who could provide support, or focusing on the benefits of short-term breastfeeding for women with limited parental leave. There is evidence to support such strategies [30] and WIC is uniquely positioned to disseminate them to large numbers of women at risk for not breastfeeding. Though these strategies may be standard practice in some places, we are unaware of prior reports in the literature describing or reporting outcomes from such approaches in a WIC setting. Respondents in the WIC BF-low category initiated breastfeeding but most had stopped before reaching WIC postnatally. Increased coordination between hospitals, medical homes and WIC is required to ensure that all women have continuous access to high-quality lactation support in the first weeks postpartum.

From a research perspective, within-WIC differences suggest that evaluations of WIC-related breastfeeding interventions should clarify at the outset the intended population by describing their baseline readiness to breastfeed and breastfeeding intentions. There may be some subsets of WIC participants for whom no appropriate nonparticipant controls can be found.

Our analysis has several limitations. The IFPSII lacks information specifically addressing women's decisions to enroll in WIC. Indeed, we identified few studies addressing participant perspectives on WIC enrollment. Existing studies identified barriers such as geographic factors and conflicts between work hours and WIC appointment times [4, 24, 25]. While our model is empirically grounded in both behavior theory and literature on use of public benefits, gaps in this literature may have limited our ability to develop a matching algorithm that plausibly mimics randomization to treatment. Finally, though we find no statistically significant association between WIC and breastfeeding, the cutoff for statistical significance is arbitrary. Our results are highly suggestive of a true positive association that we may have been underpowered to detect.

Our study was also limited by limitations in the IFPSII. The IFPSII is uniquely suited to our analysis as a nationally distributed prospective cohort with baseline data on infant feeding and socioeconomic factors. However this is not a nationally representative dataset [6]. Respondents are universally English speaking, literate, and primarily non-Hispanic White, which is not consistent with the WIC program as a whole [31]. In addition, this sample lacked WIC participants who were breastfeeding at medium or lower intensities at postnatal WIC entry.

These limitations are notable given that the IFPSII is the most comprehensive dataset on infant feeding in the US. Concerns have also been raised about other surveys that provide national estimates of breastfeeding in the US [2, 9]. National surveillance of infant feeding should employ strategies that obtain valid data from those most at risk for poor health outcomes. Appropriate translation is required and newer audio and video technologies may help reach and retain a more diverse respondent base [3].

Many states are now using electronic records for WIC. These records could be adapted to track breastfeeding behavior prospectively. The ability to flexibly add baseline factors on infant feeding intentions and attitudes could increase the utility of WIC administrative data to answer causal questions. Administrative hurdles to using WIC data for evaluation or research purposes should be identified and addressed.

In conclusion, our analysis finds no negative association between WIC and breastfeeding, and is suggestive that WIC may provide critical breastfeeding support to a subgroup of participants. Significant heterogeneity of factors known to predict breastfeeding exists between WIC participants and nonparticipants as well as among WIC participants. Future studies on WIC programming may benefit from further exploration and consideration of subgroups within the WIC population. Understanding WIC subgroups may increase program effectiveness by more closely matching services to the needs of individual WIC participants.

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References

1. Bland JM, Altman DG. Survival probabilities (the kaplan-meier method). *BMJ (Clinical Research Ed)*. 1998; 317(7172):1572.
2. Burnham L, Buczek M, Braun N, Feldman-Winter L, Chen N, Merewood A. Determining length of breastfeeding exclusivity: Validity of maternal report 2 years after birth. *Journal of Human Lactation*. 2014; 30(2):190–194. DOI: 10.1177/0890334414525682 [PubMed: 24632707]
3. Couper MP. The future of modes of data collection. *Public Opinion Quarterly*. 2011; 75(5):889–908.
4. Cricco-Lizza R. The milk of human kindness: Environmental and human interactions in a WIC clinic that influence infant-feeding decisions of black women. *Qualitative Health Research*. 2005; 15(4):525–538. [PubMed: 15761096]
5. Currie, J. The take-up of social benefits. In: Auerbach, A.; Card, D.; Quigley, J., editors. *Public policy and the income distribution*. New York: Russell Sage Foundation; 2006. p. 80
6. Fein SB, Labiner-Wolfe J, Shealy KR, Li R, Chen J, Grummer-Strawn LM. Infant feeding practices study II: Study methods. *Pediatrics*. 2008; 122(Suppl 2):S28–S35. DOI: 10.1542/peds.2008-1315c [PubMed: 18829828]
7. Fishbein M, Cappella JN. The role of theory in developing effective health communications. *Journal of Communication*. 2006; 56(s1):S1–S17.
8. Fishbein M. The role of theory in HIV prevention. *AIDS Care*. 2000; 12(3):273–278. [PubMed: 10928203]

9. Flaherman VJ, Chien AT, McCulloch CE, Dudley RA. Breastfeeding rates differ significantly by method used: A cause for concern for public health measurement. *Breastfeeding Medicine*. 2011; 6(1):31–35. [PubMed: 21091054]
10. Gross SM, Resnik AK, Nanda JP, Cross-Barnet C, Augustyn M, Kelly L, Paige DM. Early postpartum: A critical period in setting the path for breastfeeding success. *Breastfeeding Medicine*. 2011; 6(6):407–412. [PubMed: 21453122]
11. Hauff LE, Leonard SA, Rasmussen KM. Associations of maternal obesity and psychosocial factors with breastfeeding intention, initiation, and duration. *The American Journal of Clinical Nutrition*. 2014; 99(3):524–534. DOI: 10.3945/ajcn.113.071191 [PubMed: 24401717]
12. Ip S, Chung M, Raman G, Chew P, Magula N, DeVine D, et al. Breastfeeding and maternal and infant health outcomes in developed countries. Evidence Report/Technology Assessment. 2007; 153:1–186. [PubMed: 17764214]
13. Jensen E. Participation in the supplemental nutrition program for women, infants and children (WIC) and breast-feeding: National, regional, and state level analyses. *Maternal and Child Health Journal*. 2012; 16(3):624–631. [PubMed: 21505775]
14. Jiang M, Foster EM, Gibson-Davis CM. The effect of WIC on breastfeeding: A new look at an established relationship. *Children and Youth Services Review*. 2010; 32(2):264–273.
15. Joyce T, Gibson D, Colman S. The changing association between prenatal participation in WIC and birth outcomes in new york city. *Journal of Policy Analysis and Management*. 2005; 24(4):661–685. [PubMed: 16201053]
16. Kaiser L. Why do low-income women not use food stamps? Findings from the california women's health survey. *Public Health Nutrition*. 2008; 11(12):1288–1295. [PubMed: 18507889]
17. Langellier BA, Chaparro MP, Wang MC, Koleilat M, Whaley SE. The new food package and breastfeeding outcomes among women, infants, and children participants in los angeles county. *American Journal of Public Health*. 2014; 104(S1):S112–S118. [PubMed: 24354843]
18. Lumley T. Analysis of complex survey samples. *Journal of Statistical Software*. 2004; 9(1):1–19.
19. Martin-Anderson S. Prenatal attitudes and parity predict selection into a US child health program: A short report. *Social Science and Medicine*. 2013; 95:128–132. [PubMed: 23540358]
20. Metallinos-Katsaras E, Brown L, Colchamiro R. Maternal WIC participation improves breastfeeding rates: A statewide analysis of WIC participants. *Maternal and Child Health Journal*. 2015; 19(1):136–143. [PubMed: 24777674]
21. Mitra R, Reiter JP. A comparison of two methods of estimating propensity scores after multiple imputation. *Statistical Methods in Medical Research*. 2016; 25(1):188–204. DOI: 10.1177/0962280212445945 [PubMed: 22687877]
22. R Core Team. R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing; 2014.
23. Raghunathan TE, Lepkowski JM, Van Hoewyk J, Solenberger P. A multivariate technique for multiply imputing missing values using a sequence of regression models. *Survey Methodology*. 2001; 27(1):85–96.
24. Rosenberg TJ, Alperen JK, Chiasson MA. Why do WIC participants fail to pick up their checks? An urban study in the wake of welfare reform. *American Journal of Public Health*. 2003; 93(3):477–481. [PubMed: 12604499]
25. Rossin-Slater M. WIC in your neighborhood: New evidence on the impacts of geographic access to clinics. *Journal of Public Economics*. 2013; 102:51–69. [PubMed: 24043906]
26. Ryan AS, Zhou W. Lower breastfeeding rates persist among the special supplemental nutrition program for women, infants, and children participants, 1978–2003. *Pediatrics*. 2006; 117(4):1136–1146. [PubMed: 16585308]
27. Shafai T, Mustafa M, Hild T. Promotion of exclusive breastfeeding in low-income families by improving the WIC food package for breastfeeding mothers. *Breastfeeding Medicine*. 2014; 9(8):375–376. [PubMed: 25006876]
28. StataCorp. Stata statistical software: Release 12. College Station, TX: StataCorp LP; 2011.
29. Stuart EA. Matching methods for causal inference: A review and a look forward. *Statistical Science : A Review Journal of the Institute of Mathematical Statistics*. 2010; 25(1):1–21. DOI: 10.1214/09-STS313 [PubMed: 20871802]

30. U.S. Department of Health and Human Services. The surgeon general's call to action to support breastfeeding. Washington, DC: Department of Health and Human Services, Office of the Surgeon General; 2011.
31. United States Department of Agriculture. Monthly data—state level participation by category and program costs: 2013. 2014a. <http://www.fns.usda.gov/pd/wic-program>
32. United States Department of Agriculture. Special supplemental nutrition program for women, infants and children (WIC): Revisions in the WIC food packages; final rule. Federal Register. 2014b; 79(42):12273.
33. USDA/FNS Supplemental Food Programs Division. WIC breastfeeding data local agency report: 2013. 2014. <http://www.fns.usda.gov/sites/default/files/wic/FY-2013-Breastfeeding-Data-Local-Agency-Report.pdf>
34. Wilde P, Wolf A, Fernandes M, Collins A. Food-package assignments and breastfeeding initiation before and after a change in the special supplemental nutrition program for women, infants, and children. The American Journal of Clinical Nutrition. 2012; 96(3):560–566. DOI: 10.3945/ajcn.112.037622 [PubMed: 22836028]
35. Zubizarreta JR, Cerda M, Rosenbaum PR. Effect of the 2010 Chilean earthquake on posttraumatic stress: Reducing sensitivity to unmeasured bias through study design. Epidemiology (Cambridge, Mass). 2013; 24(1):79–87. DOI: 10.1097/EDE.0b013e318277367e

Fig. 1. Conceptual model for factors influencing maternal WIC participation. Based on the Integrated Behavioral Model. Items in *italics* are directly measured in IFPSII dataset. Arrows highlight key relationships

Fig. 2.
Construction of sample from IFPSII dataset

Fig. 3.

Standardized mean difference for matched and unmatched data. This figure shows standardized mean differences between WIC participants and income-eligible nonparticipants for unmatched (*unshaded boxes*) and matched (*solid dots*) data from one imputed dataset. *Boxes or dots* closer to the vertical line at 0.0 represent better balance. As intended, after matching the WIC treatment group was more similar to the non-WIC control group, increasing the likelihood that findings were due to WIC treatment. This is illustrated by the *solid dots* which are closer to the vertical line at 0.0 than are the *unshaded boxes*

Table 1

Breastfeeding duration and WIC participation by WIC category

	A. No infant WIC enrollment n = 293	B. Infant WIC enrollment when breastfeeding 60 % n = 230	C. WIC enrollment when breastfeeding <60 % n = 220	p value ^d (difference between A and B)	p value ^d (difference between B and C)
% or mean (SD)					
Duration of breastfeeding (weeks)	33.2 (20.1)	37.4 (18.5)	8.6 (11.0)	0.02	< 0.001
Mother participated in WIC prenatally	0 %	100 %	100 %	–	–
Infant WIC entry	–			–	< 0.001
<1 month		83.5 %	92.3 %		
1–2 months		14.8 %	3.6 %		
>2 months		1.7 %	4.1 %		
Breastfeeding intensity ^b at WIC enrollment	–	93.5 (10.5)	11.1 (18.7)	–	< 0.001

^a p values represent results of t tests for continuous variables and Chi squared tests for categorical variables^b Breastfeeding intensity is defined as the percentage of liquid feeds that are breast milk

Table 2

Baseline demographic characteristics by WIC category

	A. No infant WIC participation n = 293	B. Infant WIC entry when breastfeeding 60 % n = 230	C. WIC entry when breastfeeding < 60 % n = 220	p value ^a (difference between A and B)	p value ^a (difference between B and C)
% or mean (SD)					
Household income (% FPL)	130.0 (42.0)	106.1 (44.1)	96.2 (47.5)	<0.001	0.02
Maternal factors					
Age (years)	28.7 (5.2)	27.2 (5.4)	25.1 (5.1)	0.001	<0.001
Race/ethnicity				0.04	0.004
Non-Hispanic White	88.8 %	79.7 %	74.8 %		
Non-Hispanic Black	2.5 %	3.5 %	12.9 %		
Hispanic	5.8 %	10.6 %	9.2 %		
Other	2.8 %	6.2 %	5.1 %		
HS grad or greater education	36.8 %	15.0 %	6.2 %	<0.001	0.004
Married	80.7 %	73.9 %	53.6 %	0.07	<0.001
Multiparous	79.3 %	80.6 %	69.0 %	0.71	0.005
BMI (kg/m ²)	25.7 (5.7)	27.2 (6.4)	28.3 (8.8)	0.006	0.12

^a p values represent results of t tests for continuous variables and Chi squared tests for categorical variables

Table 3

Baseline (prenatal) breastfeeding expectations and support, by WIC category

	A. No infant WIC participation n = 293	B. Infant WIC entry when breastfeeding 60 % n = 230	C. WIC entry when breastfeeding < 60 % n = 220	p value ^d (difference between A and B)	p value ^d (difference between B and C)
When expect to give baby something other than breastmilk?				0.92	< 0.001
<3 month	32.7 %	31.9 %	65.9 %		
3–6 month	52.9 %	54.6 %	25.5 %		
>6 month	14.4 %	13.5 %	8.6 %		
Postnatal month expect to completely stop breastfeeding?	10.5 (5.5)	11.2 (4.9)	7.2 (4.0)	0.15	< 0.001
Formula as good as breastmilk ^b	2.2 (1.2)	2.0 (1.1)	2.7 (1.3)	0.01	< 0.001
Babies should exclusively breastfeed for 6 months ^b	3.6 (1.2)	3.8 (1.2)	3.2 (1.3)	0.10	< 0.001
Infant's father supports breastfeeding	61.9 %	60.8 %	34.4 %	0.79	< 0.001
Infant's maternal grandmother supports breastfeeding	33.9 %	37.1 %	22.3 %	0.46	0.001
Mother's "obstetrician or other doctor" supports breastfeeding	40.1 %	48.7 %	38.1 %	0.05	0.03
Mother has 3 or more friends who breastfed	72.8 %	63.3 %	49.8 %	0.02	0.004
Mother plans return to work < 12 weeks	17.6 %	19.7 %	25.8 %	0.55	0.12

^a p values represent results of t tests for continuous variables and Chi square tests for categorical variables^b Five point likert scale where five is "very confident" or "strongly agree"

Table 4

Association between breastfeeding at 3 months and WIC participation

Beta coefficient (95 % CI)	
WIC participation ^a	1.92 (0.95, 3.67) *

Pooled outcome from imputed data (30 imputations)

N = 523

*
 $p = 0.07$ ^aIncome-eligible non-WIC participants versus participants who certified while still breastfeeding 60 %