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Trends in Breastfeeding Disparities in U.S. Infants by WIC Eligibility and Participation

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Abstract

Objective: To examine the trends in breastfeeding disparities across WIC eligibility and participation statuses in the last two decades.

Design: Multiple cross-sectional surveys.

Setting: U.S.

Participants: The National Health and Nutrition Examination Survey (NHANES) 1999-2014 included 10,696 children younger than 60 months. Birth cohorts in four-year increments were created from 1994 to 2014.

Main Outcome Measures: Ever-breastfed status and breastfed-at-6-months status.

Analysis: The prevalence rates of ever-breastfed and breastfed at 6 months were estimated between WIC-eligible vs. non-eligible children and WIC-eligible participants vs. eligible nonparticipants. Prevalence rates and their 95% confidence intervals were plotted across birth

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Ethics Statement: The study was approved as exempt by the Institutional Review Board at Old Dominion University.

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cohorts. Log-binomial regression was conducted to test the trends of breastfeeding in each subgroup.

Results: The ever-breastfeeding rates increased from 52% (WIC participants) vs. 57% (WIC-eligible non-participants) in the 1994-1997 birth cohort to 71% vs. 77% in the 2010-2014 birth cohort—a 36% vs. 34% relative increase for participants vs. eligible non-participants, respectively ($P < 0.001$). Breastfeeding-at-6-month rates increased from 28% (participants) vs. 30% (eligible non-participants) to 34% vs. 49% in the same time period—a 21% vs. 66% relative increase, respectively ($P < 0.001$).

Conclusion and Implications: Sustainable postpartum breastfeeding education and interventions are needed to promote breastfeeding at 6 months among WIC participants. Future research should focus on identifying the causal relationship between WIC participation and breastfeeding outcomes.

INTRODUCTION

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is a USDA food assistance program targeting low-income pregnant and post-partum women, infants, and children younger than five years.¹ The WIC program has far-reaching public health implications in the U.S., as roughly half of all newborn infants nationwide participate in it. One key aspect of WIC is to support breastfeeding among participating mothers and infants, in accordance with the recommendations of the American Academy of Pediatrics (AAP) and other health associations.² Despite these goals, studies consistently observe lower breastfeeding rates for WIC participants compared to non-participants, since WIC mothers may choose full formula feeding.^{3, 4}

WIC policy regarding breastfeeding has continually changed over the years and has been implemented through various channels of the program. For instance, the Child Nutrition and WIC Reauthorization Act of 1989 required WIC state agencies to incorporate breastfeeding into nutrition education curricula and to assign breastfeeding coordinators to WIC participants.⁵ In 2004, WIC enhanced the breastfeeding coordination program by instituting a peer counselor program for breastfeeding.⁶ WIC also has funded multiple promotional campaigns, such as *Loving Support Makes Breastfeeding Work*, since 1997.^{6, 7} The USDA implemented a WIC food package revision in 2009, the first comprehensive revision in three decades.⁸ This revision limited the availability of formula for partially breastfed infants and increased additional food benefits for fully breastfeeding mother-infant dyads as an incentive for exclusive breastfeeding.⁹

Despite these program changes and the important role WIC plays in providing adequate nutrition for women, infants, and children, not enough is known about how breastfeeding disparities have changed at the national level across time, especially after the 2009 WIC food package revision, including disparities across WIC eligibility and participation statuses, i.e., WIC-eligible vs. WIC-non-eligible or WIC-eligible participants vs. eligible non-participants, which previous studies have not compared. Moreover, it is important to examine how these disparities have varied across time given the changing socio-demographics of WIC participants and the increasing WIC program efforts to promote

breastfeeding. For example, mixed evidence exists in regional studies about whether breastfeeding improved after the 2009 WIC food package revision.¹⁰⁻¹²

This paper used nationally representative data to examine the trends in breastfeeding disparities across eligibility and participation statuses in 1999-2014. Specifically, this study examines whether breastfeeding disparities have decreased over time at the national level, given the increases in breastfeeding support in WIC. This study provides a long-term view of the relationship between WIC eligibility, WIC participation, and breastfeeding outcomes. By measuring the breastfeeding outcomes with comparable non-participants, this study provides a new perspective to evaluate the WIC nutrition education and interventions on breastfeeding behaviors.^{13, 14} The results will also help measure the gap between the breastfeeding outcome among WIC participants and the Healthy People 2020 objectives of ever-breastfeeding and breastfeeding-at-6-months rates at 81.9% and 60.6%, respectively.¹⁵

METHODS

Data

The data include infants and children younger than 5 years of age surveyed in the National Health and Nutrition Examination Survey 1999-2014. Since 1999, the NHANES has conducted biennial, cross-sectional surveys that sample nationally representative U.S. civilian populations at all ages. NHANES 2013-2014 was the latest wave available with complete information on WIC participation and breastfeeding. NHANES uses a stratified, multistage probability cluster sampling design and standardized protocols for interviews and physical examinations. More detailed descriptions of the sampling methodology, survey design, and interview procedures can be found in the NHANES survey methods and analytic guidelines.¹⁶ Since the sample size of WIC-eligible infants or children is small, multiple waves of NHANES were used to create five birth cohorts based on the interview year and the infant or child's age in months: 1994-1997, 1998-2001, 2002-2005, 2006-2009, and 2010-2014.^{9, 17}

Measurement

Two binary breastfeeding outcomes were used: ever-breastfeeding and breastfeeding at 6 months. Ever-breastfeeding was defined as an affirmative answer to the question "Was the child ever breastfed or fed breast milk?" Breastfeeding at 6 months was defined as "yes" if the answer to the question "How old was the child when the child completely stopped breastfeeding or being fed breast milk?" was "more than 6 months." Because a third NHANES question about exclusive breastfeeding was not consistent with the WHO's definition and was significantly changed after 2009, it was not used as an outcome in this study.^{18, 19}

Eligibility for WIC was determined based on the poverty income ratio (PIR), which is the ratio of household income to the federal poverty line given a certain family size in a certain year.²⁰ Since only women, infants, and children with household incomes below or equal to 185% of the federal poverty line are eligible based on income criteria for WIC, WIC eligibility was defined as $PIR \leq 1.85$. Approximately 6-12% of subjects across birth cohorts

who had missing income were excluded from the analysis. Since WIC allows infants or children younger than 5 years old to participate, infants or children younger than 60 months were included in the analyses. WIC participation was defined as the number of WIC participation months greater than zero. Socio-demographics served as control variables in the analyses: gender and age of the infant or child in months, race or ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, and others), household income, and household size.

Statistical Analyses

The prevalence rates of ever-breastfeeding and breastfeeding at 6 months were estimated based on WIC eligibility and by WIC participation among the eligible group.²¹ Since changing socio-demographics can contribute to varying breastfeeding rates across time, inverse probability weight (IPW) methods were applied to adjust the socio-demographic distribution in the subgroups and then to calculate the adjusted breastfeeding prevalence rates.²² The technical details of the IPW application are in the supplemental materials. The bootstrapping method was applied to calculate the standard errors of the ratios. The ratios of these rates were calculated for WIC-eligible vs. non-eligible groups and for eligible participants vs. eligible non-participants. T-tests were applied to test the difference between these groups.

The data were pooled across birth cohorts for the log binomial regression, since the breastfeeding outcome is common ($\geq 10\%$).²³ Socio-demographics were controlled for in the logistic regression. Binary indicators for the birth cohorts were created, and the birth cohort of 1994-1997 served as a reference group. Relative risk (RR), P-values, and 95% confidence intervals (CI) were estimated. The significance level was $P < 0.05$. Sampling weights were applied to adjust for the complex survey design of NHANES.²⁴ All analyses were conducted using Stata (version 14, StataCorp, College Station, TX, 2016).

RESULTS

Table 1 presents the sample size by NHANES waves, birth cohorts, WIC eligibility, and WIC participation status. A total of 10,696 American infants and children were included. Note that the infants or children in one birth cohort could have been sampled in multiple NHANES waves, e.g., infants or children born in 2002-2005 could be in NHANES 2001-2002, 2003-2004, or 2005-2006. Infants or children in the first birth cohort (1994-1997) can only be in NHANES 1999-2000 because they aged out after that. Therefore, the sample size of the first birth cohort was smaller than other cohorts. Also note that the number of WIC-eligible infants or children was greater than that of non-eligible counterparts, 6,588 vs. 3,800, respectively, since NHANES oversampled the low-income population. Since WIC participation rates were influenced by the macroeconomic cycles, the number of WIC-eligible participants and non-participants also fluctuated across NHANES waves and birth cohorts.

Figure 1 presents the trends in ever-breastfeeding rates across WIC eligibility and participation. The average ever-breastfeeding rates of the WIC-eligible vs. non-eligible groups were 63% vs. 80%, respectively ($P < 0.001$). The gap of ever-breastfeeding between

these two groups existed in all birth cohorts ($P < 0.001$) and remained at a similar scale across time. Figure 2 presents the rate trends in breastfeeding at 6 months by WIC eligibility and participation. The improvement in breastfeeding at 6 months among the eligible group was smaller by a wide margin than that in the non-eligible group (25% vs. 35% increase in the rates, respectively). Among the WIC-eligible group, participants experienced a 21% increase in breastfeeding at 6 months across two decades, while non-participants generated a 65% increase during the same time period. The gaps of ever-breastfeeding or breastfeeding at 6 months were insignificant in the first two cohorts, increased in the next two cohorts, but was reduced in the last cohort.

Table 2 presents the ratios of the raw and adjusted prevalence rates, which controlled for the shifting socio-demographics across birth cohorts. The gap of ever-breastfeeding between eligible and non-eligible groups still existed in 2006-2009 and 2010-2014, even after socio-demographic adjustment. The socio-demographic adjustment reduced the disparities in breastfeeding rates at 6 months between eligible and non-eligible children, and the ratios were even over 1 in the cohorts of 1998-2001 and 2002-2005. The disparity still existed in the last cohort. The gap of breastfeeding rates at 6 months between eligible participants and nonparticipants was expanded in the middle two birth cohorts (2002-2005 and 2006-2009), but then slightly reduced in the last cohort (2010-2014). Table 3 presents the RRs of different birth cohorts for ever-breastfeeding and breastfeeding at 6 months after adjusting for sociodemographic factors. Among all infants and children, the RRs increased for both ever-breastfeeding and breastfeeding at 6 months, but the RRs of ever-breastfeeding increased more slowly than for breastfeeding at 6 months. The RRs of ever-breastfeeding were significant and similar in scale in the last two cohorts in all subgroups. The RRs of breastfeeding at 6 months among the WIC-eligible group were not statistically significant compared with the cohort of 1994-1997. However, the RRs of breastfeeding at 6 months were significant in non-eligible groups or eligible non-participants.

DISCUSSION

This study used nationally representative data to examine trends in breastfeeding by WIC eligibility and participation. The results not only confirmed the positive changes in breastfeeding in the last two decades but also pointed out the different scale of the changes in different groups as defined by their WIC participation status.²⁵ For example, the gap in breastfeeding between participants and eligible non-participants was not significant initially, then expanded, and then reduced again in more recent years—an inverted, U-shaped trend. Even after the socio-demographic adjustment, similar patterns hold. This finding is robust regardless of what breastfeeding outcome was chosen or whether the socio-demographics were controlled. The U-shaped trend can be attributable to changes in breastfeeding outcomes both in the WIC participants and non-participants. Changing social norms, general breastfeeding policies, and WIC nutrition education and breastfeeding promotion may all have played into play into the non-linear changes in the gaps.^{26, 27}

Moreover, this study provides additional evidence beyond that available in the existing literature regarding breastfeeding outcomes before and after the 2009 food package change.⁹ An improvement in breastfeeding initiation was reported at the state level right after the

2009 food package change, e.g., in California and New York. However, there has been a lack of evidence about improvement in breastfeeding outcomes at the national level.^{28, 29} The results of this study show the change in the disparities in ever-breastfeeding and breastfeeding at 6 months after the birth cohort of 2006-2009. Since the WIC breastfeeding promotion was enhanced almost simultaneously with the food package change, this study cannot determine whether the changes in breastfeeding were linked with either one of the interventions in the WIC program.

There has been little evidence provided at the national level to answer this important policy question. Only a few regional studies are available. For example, one regional study in Los Angeles County found a small but statistically significant increase in breastfeeding initiation after the food package revision of 2009, but the impact was not significant on breastfeeding at 3 or 6 months.¹⁰ Another study selected 17 local WIC agencies and compared the breastfeeding outcomes in the birth month before and after the implementation of the 2009 food package.^{11, 12} The breastfeeding initiation rate and duration were essentially unchanged. Both of these studies, however, were limited in that they were either regional or covered only a very short study period. More importantly, they did not have good comparison groups, such as WIC non-eligible infants or eligible non-participating infants. This study complemented these lines of research by using multiple years' birth cohorts with comparison groups to measure the gap in breastfeeding outcomes at the national level, although regional studies remain valuable in their ability to link specific WIC participation timing and breastfeeding education with the breastfeeding outcome.

This study has a few limitations that must be acknowledged. The first one is that the analyses did not control the unobservable factors that may self-select eligible mothers into the WIC program. Moreover, NHANES is a cross-sectional survey without precise information about entry time into WIC (e.g., during pregnancy or postpartum). Therefore, a causal relationship cannot be established between WIC participation and breastfeeding outcomes based upon this study. The second study limitation lies in the limitation of NHANES data, itself. Due to the small data size for each wave, multiple waves were combined to create a reasonably sizable sample. Therefore, the analyses cannot be stratified into smaller subgroups, such as by race or ethnicity or by younger age groups. Moreover, due to the inconsistent definition of exclusive breastfeeding, it is infeasible to examine the trends in that particular breastfeeding outcome. Since breastfeeding outcomes were reported by respondents, self-reporting and recall biases could exist, although these biases were assumed to be equally likely across WIC eligibility and participation. Last but not least, since NHANES does not directly measure the participants' breastfeeding education in WIC, it is difficult to link the changes in breastfeeding outcomes directly with WIC nutrition education and interventions. However, given the limited alternative data available, NHANES is still one of the best-quality sets of data for breastfeeding trend analyses.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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IMPLICATIONS FOR RESEARCH AND PRACTICE

Although there has been significant improvement in breastfeeding in the past two decades, it is still challenging to reach the breastfeeding goal in Healthy People 2020 for WIC-eligible infants and WIC-eligible participants.¹⁵ For example, the Healthy People 2020's objectives for infants who are ever-breastfed and breastfed at 6 months are 81.9% and 60.6%, respectively. The WIC-eligible infants or participating infants born in 2010-2014 were almost ten percentage points short of the ever-breastfeeding objective and twenty-seven percentage points below the objective of breastfeeding at 6 months. Further research is needed to identify the exact contributing factors behind these patterns. How to achieve the Healthy People 2020's goal, e.g., 60.6% of WIC infants being breastfed at 6 months, remains a significant challenge for the WIC program and policy makers.

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P*: P-value from the logit model whether WIC eligibility was significantly associated with ever-breastfeeding

(A)

P*: P-value from the logit model whether WIC participation was significantly associated with ever-breastfeeding

(B)

Figure 1.

Trends in Prevalence Rate of Ever-Breastfeeding by WIC Eligibility and Participation Status for Each Birth Cohort, NHANES 1994-2014

P*: P-value from the logit model whether WIC eligibility was significantly associated with breastfeeding at 6 months

(A)

P*: P-value from the logit model whether WIC participation was significantly associated with breastfeeding at 6 month

(B)

Figure 2.

Trends in Prevalence Rate of Breastfeeding at 6 months by WIC Eligibility and Participation Status for Each Birth Cohort, NHANES 1994-2014

Table 1.

Sample Size of NHANES Children (< 5 years) by Waves and Birth Cohorts

	Time Periods	All	WIC-eligible*	WIC non-eligible	WIC-eligible participants	WIC-eligible non-participants
NHANES WAVES	1999-2000	1,129	745	384	555	190
	2001-2002	1,535	996	539	705	291
	2003-2004	1,386	952	434	685	267
	2005-2006	1,538	954	584	709	245
	2007-2008	1,332	828	504	715	113
	2009-2010	1,340	880	460	779	101
	2011-2012	1,218	778	440	692	86
	2013-2014	1,218	763	455	668	95
Birth Cohort	1999-2014	10,696	6,588	3,800	5,508	1,388
	1994-1997	687	425	262	264	161
	1998-2001	2,825	1,885	940	1,329	556
	2002-2005	2,910	1,863	1,047	1,502	361
	2006-2009	2,693	1,734	959	1,543	191
	2010-2014	1,581	989	592	870	119
	1994-2014	10,696	6,896	3,800	5,508	1,388

* WIC income eligibility: 185% federal income poverty guideline.

Table 2.

Ratios of Prevalence Rates of Ever-Breastfeeding and Breastfeeding at 6 Months among NHANES Children (< 5y) born in 1994-2014

Ever-breastfed						
	1994	1998	2002	2006	2010	1994
	-	-	-	-	-	-
	1997	2001	2005	2009	2014	2014
Raw ratio of WIC-eligible to non-eligible: (Standard error)	0.76 (.16)	0.76 (.06)	0.80 (.07)	0.81 (.14)	0.81 (.07)	.79 (.05)
Adjusted ratio: (Standard error)	0.82 (.16)	0.96 (.06)	0.99 (.07)	0.86 (.14)	0.89 (.07)	0.91 (.05)
Raw ratio of WIC-eligible participants to eligible non-participants: (Standard error)	0.91 (.38)	0.98 (.12)	0.82 (.10)	0.81 (.04)	.92 (.07)	0.95 (.07)
Adjusted ratio: (Standard error)	0.86 (.38)	1.00 (.12)	0.87 (.10)	0.82 (.04)	0.96 (.07)	0.96 (.07)
Breastfeeding at 6 months						
	1994	1998	2002	2006	2010	1994
	-	-	-	-	-	-
	1997	2001	2005	2009	2014	2014
Ratio of WIC-eligible to Non-Eligible: (Standard error)	0.83 (.15)	0.74 (.10)	0.74 (.09)	0.64 (.11)	0.60 (.11)	0.69 (.09)
Adjusted Ratio: (Standard error)	0.95 (.15)	1.08 (.10)	1.16 (.09)	0.97 (.11)	0.80 (.11)	.97 (.09)
Ratio of WIC-eligible participants to eligible non-participants: (Standard error)	0.95 (.26)	0.85 (.31)	0.61 (.29)	0.55 (.11)	0.66 (.12)	0.76 (.08)
Adjusted ratio: (Standard error)	1.07 (.26)	0.84 (.31)	0.68 (.29)	0.69 (.11)	.79 (.12)	0.81 (.08)

Note: Adjusted ratios produced using inverse probability weighting methods. Reweighting for WIC-eligible participants is based on adult respondent age, child race, mother's education level, household size, and the household's poverty level. Bootstrapped standard errors based on 100 bootstrap replications in parenthesis.

Table 3.

Log-binomial Regression Results of the Birth Cohorts' Effects on Breastfeeding among NHANES Children (< 5y) *

Groups by birth cohorts	Ever-breastfeeding			Breastfeeding at 6 m		
	Risk ratio	95% CI	P	Risk ratio	95% CI	P
ALL						
1994-1997	Ref			Ref		
1998-2001	1.07	(0.96, 1.28)	0.23	1.08	(0.89, 1.30)	0.44
2002-2005	1.13	(1.02, 1.26)	0.02	1.23	(1.01, 1.49)	0.04
2006-2009	1.2	(1.08, 1.33)	< 0.01	1.29	(1.05, 1.57)	0.02
2010-2014	1.28	(1.14, 1.43)	< 0.01	1.45	(1.18, 1.80)	< 0.01
WIC-eligible						
1994-1997	Ref			Ref		
1998-2001	1.08	(0.91, 1.30)	0.37	1.05	(0.79, 1.40)	0.72
2002-2005	1.16	(0.96, 1.40)	0.12	1.16	(0.86, 1.57)	0.34
2006-2009	1.25	(1.04, 1.50)	0.02	1.14	(0.84, 1.55)	0.39
2010-2014	1.34	(1.10, 1.62)	0.01	1.3	(0.92, 1.84)	0.14
WIC non-eligible						
1994-1997	Ref			Ref		
1998-2001	1.08	(0.95, 1.24)	0.23	1.13	(0.88, 1.45)	0.34
2002-2005	1.1	(0.97, 1.26)	0.15	1.26	(0.98, 1.60)	0.07
2006-2009	1.18	(1.04, 1.34)	0.01	1.41	(1.09, 1.80)	0.01
2010-2014	1.25	(1.10, 1.42)	< 0.01	1.62	(1.28, 2.05)	< 0.01
WIC-eligible participants						
1994-1997	Ref			Ref		
1998-2001	1.12	(0.91, 1.38)	0.3	0.98	(0.72, 1.34)	0.92
2002-2005	1.14	(0.92, 1.42)	0.23	1	(0.72, 1.39)	0.98
2006-2009	1.26	(1.01, 1.56)	0.04	1.05	(0.75, 1.45)	0.79
2010-2014	1.38	(1.10, 1.72)	0.01	1.26	(0.88, 1.81)	0.21
WIC-eligible non-participants						
1994-1997	Ref			Ref		
1998-2001	1.03	(0.83, 1.27)	0.82	1.11	(0.79, 1.56)	0.54
2002-2005	1.25	(0.99, 1.57)	0.06	1.57	(1.08, 2.30)	0.02
2006-2009	1.39	(1.12, 1.73)	< 0.01	1.73	(1.20, 2.49)	< 0.01
2010-2014	1.3	(1.00, 1.70)	0.05	1.68	(0.93, 3.02)	0.09

* Controlled for age, race or ethnicity, gender, household income, and household size