University of Cincinnati

Date: 3/9/2022

I, Shannon H Trinh, hereby submit this original work as part of the requirements for the degree of Master of Science in Nutrition.

It is entitled:

The Association between WIC Participation and Breastfeeding Outcomes among Black Women in Hamilton County

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The Association between WIC Participation and Breastfeeding Outcomes among Black Women in Hamilton County

A thesis submitted to the

Graduate School

of the University of Cincinnati

in partial fulfillment of the

requirements for the degree of

Master of Science

in the Department of Rehabilitation, Exercise, and Nutrition Sciences

of the College of Allied Health Sciences

by

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Abstract

Breastmilk is the optimal source of nutrition for infant development and growth and can lead to long-term health benefits for both mother and child. However, Black infants have the lowest breastfeeding rates compared to infants of other races and ethnicities, and WIC participants have lower breastfeeding rates than nonparticipants despite WIC efforts to promote breastfeeding. Studies have shown that although breastfeeding outcomes have increased among all populations over the years, particularly after the WIC 2009 food package revision, breastfeeding outcomes remain lower among Black women and WIC participants and disparities still remain. Many studies have examined the effects of factors related to WIC participation on breastfeeding outcomes, however, few studies have examined these factors among Black women specifically. Additionally, breastfeeding disparities experienced by Black women can lead to health inequities across the life course.

We conducted a systematic review and secondary analysis of public health data to examine the association between WIC participation and breastfeeding outcomes among Black mothers in Hamilton County, Ohio. Included articles showed mix results regarding the association between WIC participation and breastfeeding initiation among Black women, and WIC participation was negatively associated with breastfeeding duration. Noteworthy factors included regional differences, socioeconomic status, marital status, and educational level. Based on the epidemiological data from Hamilton County, while WIC participation is weakly associated with lower breastfeeding outcomes among Black women, other factors such as maternal education, marital status, and type of insurance used may contribute to the lower breastfeeding outcomes among WIC participants. Future research should evaluate differences in factors between WIC participants and nonparticipants as well as how these factors affect

breastfeeding outcomes. By implementing breastfeeding promotion to address these specific factors, WIC can improve breastfeeding outcomes and eliminate the disparities in breastfeeding experienced by WIC participants and Black women.

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1. Introduction

Breast milk is the optimal source of nutrition for infant development and growth, and it provides all the energy and nutrient requirements for the first six months of an infant's life [1]. Due to the positive health impact on the life course of mother and child, the American Academy of Pediatrics (AAP) recommends that mothers breastfeed their infants exclusively the first 6 months and continue to breastfeed for at least 12 months in combination with complementary foods [2]. However, national data on breastfeeding reveal that non-Hispanic Black/African American infants have the lowest breastfeeding rates among racial groups in the US. Even among the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participants, non-Hispanic Black/African American infants have the lowest breastfeeding initiation rates. Regardless of race or ethnicity, WIC participants have lower breastfeeding rates than nonparticipants. The WIC program was established to ensure nutritional adequacy based on the United States Department of Agriculture (USDA) guidelines. Since its inception, WIC has provided supplemental foods, nutrition education, and counseling related to healthy food choices and nursing options as well as support for breastfeeding. However, the promotion of breastfeeding has been obscured by readily-available WIC-provided infant formula. In recent years, there has been a cultural shift within WIC, and this has prompted greater advocacy and support for breastfeeding via peer breastfeeding support groups and the availability of lactation consultants in WIC clinics. In order to closely evaluate the association between WIC participation and breastfeeding outcomes among Black women, a systematic review was conducted to explore current literature and identify knowledge gaps and a secondary data analysis was conducted to examine public health records collected in Hamilton County, Ohio.

2. Background

Benefits of Breastfeeding

Breastfeeding is an important modifiable risk factor for various diseases in both mothers and infants. Numerous research studies have demonstrated the ability of human milk to confer health benefits. These conferred benefits are inclusive of mothers and infants and have implications for chronic diseases and mental health [3]. Evidence shows many protective effects of breastfeeding, including a reduction in the risk of a multitude of infant diseases and conditions such as bacteremia, respiratory tract infection, necrotizing enterocolitis, type 1 and type 2 diabetes, leukemia, and childhood obesity. Breastfeeding is also associated with maternal health benefits such as more rapid uterine involution, increased lactational amenorrhea, earlier return to pre-pregnancy weight, and decreased risk of breast and ovarian cancers [4]. Therefore, breastfeeding has the potential to mitigate morbidity and lower the cost of medical care.

While mother and child can reap the most benefits from exclusive breastfeeding for longer durations, breastfeeding initiation also provides a unique benefit for the infant through the provision of colostrum. Components of colostrum include immunoglobulins, leukocytes, enzymes, and human milk oligosaccharides [5] that are not simulated in infant formula. The colostrum provides immunity, nutrition, and helps establish a healthy gut microbiome, which can lead to long-term health benefits [6]. The colostrum transitions to mature milk within 2 to 3 days, therefore, exclusive breastfeeding during the short hospital stay after birth is important to improve immune function, gut function, and reduce risk of infection in infants.

Breastfeeding Prevalence and Trends

Despite known benefits of breastfeeding, there is low prevalence in breastfeeding among US mothers. Only 1 in 4 infants meet the recommendation of 6 months of exclusive breastfeeding [7].

Healthy People 2020 (HP 2020) was launched in 2010 with established goals to improve the nation's health through the health promotion and disease prevention approach. Healthy People 2030 (HP 2030) launched in 2020 with changes to prioritize the most pressing public health issues. Five breastfeeding objectives in HP 2020 included breastfeeding initiation, breastfeeding duration at 6 months and 1 year, and exclusive breastfeeding through 3 months and 6 months. HP 2030 prioritized to only two objectives related to breastfeeding: exclusive breastfeeding at 6 months and breastfeeding duration at 1 year. The target for these objectives was increased in Healthy People 2030, further expanding the breastfeeding disparity among Black mothers and emphasizing the need to promote breastfeeding among Black mothers.

According to Healthy People 2020 (HP 2020), from data gathered between 2009 and 2015, there was an overall trend of increased breastfeeding initiation, duration up to 12 months, and exclusive breastfeeding up to 3 months among non-Hispanic Black infants. However, Black infants continue to have the lowest rates compared to other races and ethnicities. The HP 2020 target for breastfeeding initiation was 81.9%, yet rates were lowest among non-Hispanic Black or African American children (69.4% to 70.6%). Breastfeeding at 6 months was also lowest among non-Hispanic Black or African American children (between 44.7% to 45.2%), lower than the HP 2020 target of 60.6%. The breastfeeding rates among non-Hispanic Black and African American children in 2015 were still lower than the baseline breastfeeding rate for the entire U.S.

population from 2009 [8]. Across all breastfeeding objectives of HP 2020, non-Hispanic Black infants consistently had the lowest rates compared to all other racial and ethnic groups and did not reach any breastfeeding targets of HP 2020.

According to the 2018 National Immunization Survey (NIS) conducted by the CDC, the breastfeeding initiation rate was 83.9% with continued breastfeeding at 6 months at 56.7% for the entire U.S. population. However, breastfeeding initiation is lowest for non-Hispanic Black children at 75.5%, while breastfeeding at 6 months was 49.3%, compared to children of other races or ethnicities(82.4-92.4% and 52.8%-75.6%, respectively). In the same dataset, the breastfeeding rates among WIC participants (76.9% initiation and 42.9% six-month duration) were lower than breastfeeding rates for both WIC-eligible nonparticipants (83.3% and 60.7%, respectively) and WIC-ineligible nonparticipants (91.6% and 70.7%, respectively) [9]. Compared to the 2011 NIS data [10] shortly after the WIC food package change, non-Hispanic Black children (regardless of WIC eligibility or participation) increased in both breastfeeding initiation and 6 month duration by about 14%, but WIC participants only increased in breastfeeding initiation and 6 month duration by about 5%. Low prevalence in breastfeeding among certain populations can be due to various barriers to breastfeeding.

Health and Breastfeeding Disparities

Health disparities experienced by ethnic minorities can lead to increased morbidity and mortality. Disparities exist in the quality, access, and utilization of healthcare and result in differing health outcomes despite medical science innovations. The health disparities

experienced by Black women are likely to result from the combination of genetic variations, environmental factors, specific health behaviors, implicit bias, and structural racism [11].

Regional variation of breastfeeding patterns in the US reflects cultural differences as well as hospital practices [12]. Stuebe found that breastfeeding rates were the lowest in the Southeast region, which is where the 2020 Census found to be highly represented by Black populations [13]. Due to hospital practices accounting for a considering proportion of breastfeeding duration disparities, improvements in perinatal breastfeeding support may impact the health of mothers and infants [12]. Jensen also found regional differences related to WIC participation and lower breastfeeding outcomes [14].

Bartick et al. showed that the burden of suboptimal breastfeeding was higher among non-Hispanic black population compared to non-Hispanic white population [15]. Non-Hispanic black children experience excess burden related to necrotizing enterocolitis, overall child deaths, sudden infant death syndrome, and more frequent incidences of acute otitis media and gastrointestinal infection. Suboptimal breastfeeding was associated with increased burden, death, and costs for both mother and child. The higher burden of disease and medical costs affect non-Hispanic black mothers particularly because they disproportionately hold lower wage jobs[15]. Suboptimal breastfeeding combined with increased rates of preterm birth and growth restriction experienced by Black infants lead to compounding health inequity across the life course [16].

Societal-level barriers such as institutionalized racism and disinvestment in communities of color result in Black families being more economically vulnerable. Not only do Black families possess just a fraction of the wealth of White families, but Black parents are also more likely to work in occupations with less family leave or breastmilk expression at work, leading to lack of

support for breastfeeding [16]. Black mothers also receive less breastfeeding support after delivery due to assumptions about their desire to breastfeed [16]. The normalization of early formula supplementation in Black communities, contributed by the targeting of formula companies, reduces breastfeeding duration and intensity. The collective effect of economic vulnerability, racism, and classism discourage Black mothers from breastfeeding their children [16].

Determinants of Breastfeeding

Disparities in breastfeeding rates are associated with a multitude of factors. Lack of ongoing support for breastfeeding and confusion surrounding breastfeeding can become barriers that limit mothers from providing breastmilk for their infants. Variation in hospital routines regarding infant formula distribution, practices that discourage exclusive breastfeeding, and lack of breastfeeding support after discharge [4]. African American/Black mothers have reported that some of the barriers to breastfeeding include lack of knowledge about benefits of breastfeeding and lack of family support [17]. In North Carolina, WIC clinics serving areas with higher African American populations are less likely to offer breastfeeding support services [18].

Gyamfi et al.'s scoping review identified cultural, sociological, and health dimensions that influenced breastfeeding experiences of African American women in the US. In the health dimension, having a supportive health care system and health care professionals facilitate breastfeeding through culturally sensitive educational interventions. Lack of support from staff leads to mothers relying more on their relatives or peers [19]. Living arrangement is one component of the sociological dimension. African American mothers mostly lived in multigenerational

households or as single parents, and this environment would greatly affect breastfeeding decisions and support [19].

The cultural dimension includes support or lack thereof from family, peers, and the community, which would greatly affect breastfeeding outcomes. African American mothers who breastfeed exhibit positive deviance, indicating that they chose to breastfeed contrary to cultural norms, which is possible through strong breastfeeding support. However, misconceptions of breastfeeding are held in the African American community that may discourage breastfeeding, such as the claim that breastfed infants become overly dependent [19]. Focus groups conducted by Felder et al. expressed that sexualization of breasts by society lead to African American women to reserve their breasts for sexual pleasure rather than providing for nutritional needs of their infants, and some many not want anyone else touching their breasts due to the internalized sexualization of breasts. Additionally, lack of appropriate support and breastfeeding education and encouragement from healthcare providers due to assumptions that African American women would not breastfeed present as an important barrier to be addressed [20].

There are many dimensions that influence breastfeeding outcomes among African American mothers that can tie closely together. For example, lack of support from healthcare professionals would lead to mothers relying on their relatives or peers, who may be living in the same household. Consequently, if the mother's support is lacking from relatives and peers, then she would become less motivated to breastfeed, unless she is able to find support from other parts of the community to encourage breastfeeding [19].

Among African American WIC participants, determinants of breastfeeding outcomes include influence from others on breastfeeding confidence and intention, positive benefits from

breastfeeding, pervasiveness of breastfeeding obstacles, and importance of social support [21]. Breastfeeding obstacles include pain, perceived low milk supply, latching issues, and other challenges that negatively impact breastfeeding. Breastfeeding confidence can come from previous breastfeeding experience or from the community's experience for first-time mothers. Schindler-Ruwisch et al.'s study suggest that community support of breastfeeding influences individual breastfeeding behavior, which in turn influences the community's perceptions of breastfeeding. Breastfeeding support can also come from peer counseling to make up for the lack of support from family or the community. Although the mothers acknowledged WIC's breastfeeding support offers, many did not take advantage of the resources and some were unaware of the extent of serves offered by WIC. Overall, the study found that mothers with greater intention to breastfeed and support from partner or mother were more likely to have improved breastfeeding outcomes. Support from peer counselors can help mothers resolve breastfeeding challenges and increase self-efficacy to breastfeed, thus, WIC may improve participants' breastfeeding outcomes by facilitating transition to peer counselors for ongoing support [21].

Gyamfi et al.'s finding of positive deviance among African American mothers is supported by other prior studies. Ma et al.'s study evaluated differences between WIC participants who were positive deviants in breastfeeding compared to the rest of the participants, and found that those classified as positive deviants differed significantly in factors such as race, Medicaid status, marriage status, and in-hospital breastfeeding behaviors. Positive deviants among black mothers were more likely to have a job prior to delivery, have in-hospital breastfeeding, received breastfeeding support from the hospital staff, urban residence, and low birth weight infant. The study strongly support the positive impact of effective in-hospital

interactions and breastfeeding support on breastfeeding rates of first-time WIC mothers with low educational level [22]. Focus groups also support that positive hospital and WIC experiences are associated with positive deviance in breastfeeding among African American mothers [23]. Barbosa et al. found that positive deviant mothers had more schooling and higher income, positive breastfeeding attitudes, higher self-efficacy, and greater comfort breastfeeding in public. On the other hand, formula-feeding mothers feared breastfeeding, perceived incompatibility with breastfeeding, and received strong support to use infant formula. Thus, increasing support, improving self-efficacy, and decreasing inappropriate formula promotion may improve breastfeeding among low-income African American women [23].

WIC Objectives and Breastfeeding Initiatives

WIC provides food, nutrition counseling, and access to health services to low-income women, infants, and children at nutritional risk. Federal grants allow states to provide supplemental foods, referrals, and nutrition education for women, whether she is breastfeeding or not. Food packages are provided in the form of vouchers for participants to use at stores. Additionally, mothers not fully breastfeeding are provided with infant formula packages by WIC to reduce food costs [24]. Despite WIC's numerous efforts to promote and support breastfeeding since before 2000 [25], breastfeeding rates among WIC participants continue to be low.

One possible factor for this discrepancy is the infant formula rebates system available to WIC participants, providing a perceived low-cost formula package to WIC participants while driving up formula costs which would deter WIC nonparticipants from using formula, further

increasing the breastfeeding disparities [14]. Although Murimi found that many of their WIC participants (88%) reported that the availability of free formula by WIC did not affect their breastfeeding decision, the participants reported that the additional breastfeeding food package also did not affect their decision to breastfeed (59%) [17]. However, 41% of participants were not aware of the additional food package and 49% were not aware of the availability of breast pump assistance, which would have assisted with breastmilk feeding, further highlighting the need for WIC to emphasize breastfeeding benefits, increase awareness of breastfeeding incentives, and potentially revise incentives to breastfeeding [17]. WIC's budget has a disproportionately larger allocation towards infant formula than peer counseling and breastfeeding initiatives [26].This finding contrasts with WHO and UNICEF's International Code of Marketing of Breast-milk Substitutes, which states that health workers should encourage breastfeeding and to only use marketing and distribution of breastmilk substitutes when necessary to avoid incentivizing mothers to choose infant formula over breastfeeding.

With the emergence of studies demonstrating various benefits of breastfeeding, there have been many interventions developed to improve breastfeeding rates. Breastfeeding is a learned behavior; mothers require active support to sustain breastfeeding practices [27]. Segura-Perez et al. reported that different breastfeeding-promoting policies impact US ethnic minorities differently. For example, Black mothers were more likely to initiate breastfeeding in states where there were laws protecting breastfeeding in public and private locations, but are less likely to continue breastfeeding for 6 months in states with laws providing breaks from work and workplace pumping [28]. WIC have also developed interventions to promote breastfeeding among participants. WIC aims to reduce the breastfeeding disparity by providing education, peer support, and incentives for eligible women to improve breastfeeding rates for infants of

low-socioeconomic status households. WIC implemented a food package revision in 2009 to promote breastfeeding by raising food benefits for exclusively breastfeeding mothers and reducing formula provisions for partially breastfeeding mothers [29]. The food package change in 2009 was designed to increase breastfeeding and improve nutrition of infants. The revision was proposed to align WIC food packages with the infant feeding practice guidelines of the American Academy of Pediatrics by promoting and supporting the establishment of long-term breastfeeding [30]. There was an increase in food package for mothers exclusively breastfeeding, and less infant formula is provided to mothers partially breastfeeding [31].

Although the WIC program has increased breastfeeding rates among WIC participants over the years [24], the 2018 NIS showed that the increased rates were not enough to reach HP 2020 targets or to reduce the difference between breastfeeding rates of WIC participants and nonparticipants [9]. Both WIC participants and nonparticipants improved in breastfeeding outcomes, but only the gap in breastfeeding initiation reduced between WIC participants and eligible nonparticipants (11.6% difference reduced to 6.4% difference), the difference in breastfeeding duration and exclusivity slightly decreased (duration at 6 months and exclusivity at 3 months) or slightly increased (duration at 12 months and exclusivity at 6 months) [9,10]. Langellier et al. evaluated change in breastfeeding outcomes after the WIC food package revision and found increase in breastfeeding initiation and exclusivity [32]. However, Langellier et al. acknowledged that their WIC participant samples were from the West, who were more likely to be breastfeeding than Midwest WIC participants, who were more likely to use more infant formula [32]. Whaley et al. found that the enhanced food package supported breastfeeding support and education from WIC, leading to increased fully breastfeeding package issuance to WIC mothers in California [33]. Whaley et al.'s study supported the regional differences in breastfeeding

for the West. On the other hand, Wilde et al. compared breastfeeding outcomes before and after the WIC food package revision using WIC records from randomly selected local WIC clinics in 10 states across different regions of the US, and found that breastfeeding initiation did not change [34]. Li et al. used propensity score matching analysis to evaluate WIC-eligible children from NHANES 2005-2014, which surveys nationally representative samples, and found that the 2009 revision reduced the disparity in breastfeeding initiation between WIC participants and eligible nonparticipants, but not for the disparity in breastfeeding duration at 6 months [35].

The difference in breastfeeding initiation and duration based on region was demonstrated by Jensen's article and may explain the mixed findings regarding the effect of WIC food package revision on breastfeeding outcomes. WIC-related regional differences include food packages offered, staff training, selected formula, and degree of breastfeeding support [14].

WIC Participation and Breastfeeding Patterns among Black Mothers

The systematic review by Jones et al. found that several studies showed that WIC participation is strongly associated with low breastfeeding initiation rates and shorter breastfeeding duration, particularly among African American women [36].

Beal et al. found that African American women are less likely than white women to report that they received breastfeeding advice from WIC counselors and are more likely to report that they received formula-feeding advice [37].

WIC participants' breastfeeding rates were lower than the nonparticipants' breastfeeding rates in the hospital and 6 months postpartum [17] despite increased breastfeeding rates among both WIC participants and nonparticipants over time [24], thus, disparities in breastfeeding between WIC participants and nonparticipants remain [9].

Breastfeeding Experiences during the COVID-19 Pandemic

The COVID-19 pandemic led to efforts to reduce transmission of the virus such as social distancing and lockdown, which impacted every aspect of life around the world. Due to fear of transmission, mothers were concerned about breastfeeding, but the World Health Organization supports the continuation of breastfeeding with necessary precautions [38]. A narrative review conducted by Pacheco et al. found that the pandemic had mixed influence on breastfeeding experiences. Mothers who perceived a positive impact reported spending more time at home for breastfeeding, experiencing less social pressure, and having fewer visitors to interrupt. On the other hand, mothers who perceived a negative impact reported perceiving less social and professional support, worrying about safety of breastfeeding, and feeling isolation. However, there is a strong association between breastfeeding perceptions and mothers' current feeding method, whether they were breastfeeding or not [38]. Another study included in the narrative review found that most mothers perceived a positive impact from the pandemic due to increased maternity leave and fear of formula shortages. However, these were mothers of multiple children who stated that they would have perceived a negative impact if the pandemic occurred during their first breastfeeding experience. A case study interviewed three mothers and they reported changes of lactation support to telehealth was perceived as negative, but spending more time at

home also positively impacted their breastfeeding [38]. The experience of breastfeeding differed between COVID-19-negative mothers and COVID-19-positive mothers, with negative mothers perceiving benefits of the lockdowns while positive mothers perceived frustration. The narrative review did not address differences in maternal race and ethnicity or socioeconomic status, however, based on the cultural dimension of barriers and facilitators to breastfeeding among African American mothers as discussed earlier, lockdown during the pandemic may lead to mothers being discouraged from breastfeeding if they live in the same household as family who do not support breastfeeding and do not have continual access to postpartum support from healthcare professionals.

Research Questions

What is the association between WIC participation and breastfeeding outcomes among non-Hispanic Black women? How does the COVID-19 pandemic change breastfeeding outcomes among Black women?

The systematic review was conducted to explore current literature to answer the first question and identify knowledge gaps. The secondary data analysis was conducted to evaluate public health data in Hamilton County, Ohio to answer both research questions.

Specific Aims

The secondary objectives of the systematic review were to assess whether WIC-provided infant formula and WIC income eligibility or socioeconomic status influenced breastfeeding rates among these women. The secondary objectives of the secondary data analysis were to explore the relationships of other maternal factors on changing breastfeeding patterns among Black women.

Hypothesis

WIC participation will be associated with lower breastfeeding outcomes among Black women. The COVID-19 pandemic would decrease breastfeeding outcomes among Black mothers.

3. Methods

3.1 Systematic Review

Inclusion criteria

The systematic review used PRISMA for systematic review protocol and the Institute of Medicine's published Finding What Works in Health Care: Standards for Systematic Reviews. All types of study designs and manners of publication were included for this review, including gray literature from references cited in the articles. The studies included are exclusively

published full text in English and within the last 10 years (2010-2020) to coincide with the launch of Health People 2020.

The participants of the studies included non-Hispanic African American/Black WIC-eligible women over 18 years old who have given birth. The intervention of interest was the target population's participation with WIC. The comparison group included the target population who are not WIC participants.

The primary outcome was the change of breastfeeding initiation and duration due to WIC participation. The secondary outcomes were the change of breastfeeding rates due to access to WIC-provided infant formula or income status related to WIC-eligibility.

Search Approach

Four online databases, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library, MEDLINE, and SCOPUS, were used to search for peer-reviewed articles and grey literature. An experienced Health Science Librarian created a search string and translated the string to fit the selected databases, then followed the PRISMA diagram for inclusion and exclusion of articles. Search terms included "breast feeding", "infant formula", "WIC participants", "African Americans", and "non-Hispanic Black". The search was completed in 2020.

For retrieved eligible studies, their abstracts, titles, and index terms used to describe the articles were reviewed by two independent reviewers for relevance based on the inclusion

criteria and research question. Articles not able to sufficiently address the research question were removed. The remaining articles were reviewed for inclusion in the systematic review by six individual reviewers. Consensus was achieved by discussion among reviewers for final inclusion of articles in the systematic review.

Data Extraction

Data extraction was conducted by one reviewer to extract study details including: study design, sample size, evidence level, participant characteristics race/ethnicity, WIC participation, breastfeeding outcomes, socioeconomic status, and formula feeding if applicable.

3.2 Secondary Analysis

Quantitative data were collected from the Hamilton County Public Health Department to examine the association between those factors and breastfeeding patterns of Black women in Hamilton County. Two sets of data were provided, one stratified by pre-COVID-19 and during-COVID-19, and the other stratified by quarters of the year.

Inclusion criteria

Demographic, socioeconomic, WIC participation, and breastfeeding data were gathered from Black women 18 years old or above who gave birth in Hamilton County between January 2019 and October 2021.

Statistical Analysis

Prevalence was calculated from the epidemiological data to compare breastfeeding outcomes between different maternal variables. Independent samples t-test was used to compare breastfeeding outcomes between pre-pandemic and during-pandemic. Binomial distribution test and phi coefficient were used to compare breastfeeding outcomes based on maternal variables. All statistical analyses were performed via SPSS or Excel using the pre-COVID-19 vs. during-COVID-19 dataset.

WIC participation

The epidemiological data only categorized mothers as WIC participants or "non-WIC", which includes both WIC-eligible and ineligible nonparticipants. The USDA stated that applicants were automatically determined income-eligible WIC if they are eligible to receive Medicaid [39]. Thus, the type of insurance used by mothers in the epidemiological data provides insight on WIC eligibility.

Socioeconomic status

Similarly to WIC eligibility, mothers' use of Medicaid insurance can infer lower socioeconomic status, while mothers' use of private insurance can infer higher socioeconomic status.

4. Results

4.1 Systematic Review

Search Results

Figure 1 shows the PRISMA flow diagram that depicts the search and inclusion of studies. The search string identified 218 articles which underwent initial screening and 59 were potentially eligible based on the abstracts. These full-text articles were further reviewed and 11 met the inclusion criteria and were included in this systematic review. Two studies reported breastfeeding initiation outcomes, five studies reported breastfeeding duration outcomes, and four studies reported both outcomes. Two studies used human milk feeding at NICU discharge as the outcome, which is assumed to be equivalent to breastfeeding (BF) duration due to the average length of NICU stay (73.0 ± 35.0 days). Fleurant et al. [41] and Riley et al. [46] used samples from the same population with slight differences in exclusion criteria. Shim et al. [47], Sparks [49], and Sparks [50] all obtained their samples from the same data set using different exclusion criteria.

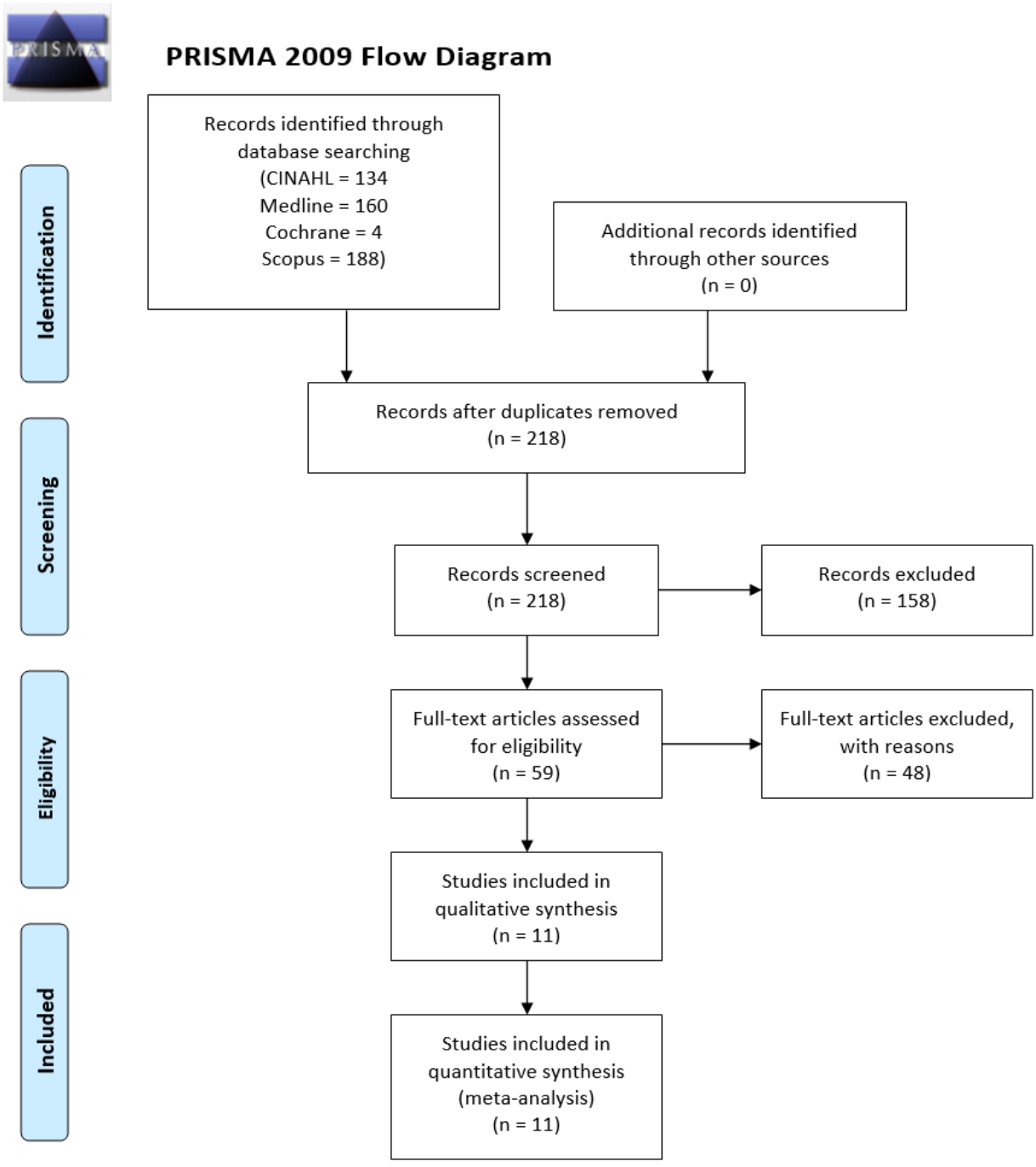


Figure 1: PRISMA [40] flow diagram

Table 1: Articles included in systematic review

Authors	Study Design	Population, Sample size	Comparison Groups	Study Description	Outcomes	EL[a]
Fleurant et al., 2017 [41]	Secondary Analysis of Prospective Cohort	2008-2012 Level 3 NICU in RUMC of Chicago, Illinois Total N = 362 Black mothers N = 183	WIC eligible and WIC ineligible	Identify differences in social factors associated with human milk (HM) feeding at discharge based on race/ethnicity	Human Milk (HM) feeding at NICU discharge	3a
Gregory et al., 2016 [42]	Quasi-experimental case control	IFPSII 2005-2007 Total N = 743 Black mothers N = 45	WIC participants (WIC BF-high and WIC BF-low) and eligible nonparticipants	Examine BF factors that might explain lower breastfeeding duration	BF duration (3 months postpartum)	3a
Jensen, 2011 [14]	Cross sectional	NIS 2007 dataset Total N = 24,807 Black mothers N = 1,365	WIC participants, ineligible nonparticipants, and WIC-eligible nonparticipants	Assess relationship between WIC participation and breastfeeding initiation and duration across 50 states	BF initiation and duration	4a
Ma et al., 2013 [43]	Cross sectional	South Carolina PRAMS 2009-2010 Total N = 1,796 Black mothers N = 569	WIC participants, ineligible nonparticipants, and WIC-eligible nonparticipants	Analyze association between WIC participation (and poverty level) and breastfeeding initiation and duration	BF initiation and duration	4a
Marshall et al., 2012 [44]	Cross sectional	Mississippi PRAMS 2004-2008 Total N = 3,714 Black mothers N = 1,975	WIC participants and nonparticipants	Examine association between WIC participation and BF behaviors among black and white women	BF initiation and duration	4a
McKinney	Prospective	NIH CCHN	WIC	Identify non	BF	3a

et al., 2016 [45]	Cohort	2008-2010 Total N = 1,632 Black mothers N = 907	participants and nonparticipants	demographic factors that might explain disparities in breastfeeding	initiation and duration	
Riley et al., 2016 [46]	Prospective Cohort	2008-2012 Level 3 NICU in RUMC of Chicago, Illinois Total N = 410 Black mothers N = 209	WIC eligible and WIC ineligible	Examine neighborhood structural factors associated with HM feeding at discharge	HM continuation at NICU discharge	3a
Shim et al., 2012 [47]	Cross sectional	ECLS-B 2001 Total N = 7,515 Black mothers N = 985	WIC participants and nonparticipants	Examine associations among BF duration, child care arrangement, and WIC participation	Short BF duration (<6 months)	4a
Sonchak, 2017 [48]	Case Control	South Carolina Vital Statistics 2004-2013 Total N = 275,482 Black mothers N = 129,477	WIC participants and eligible nonparticipants	Estimate effect of WIC participation on BF initiation	BF initiation	4a
Sparks, 2010 [49]	Longitudinal	ECLS-B 2001 Total N = 10,550 Black mothers N = 1,537	WIC participants and nonparticipants	Explore associations between rural/urban residence and race on BF initiation	BF initiation	4a
Sparks, 2011 [50]	Longitudinal	ECLS-B 2001 Total N = 3,550 Black mothers N = 650	WIC participants, eligible nonparticipants, and ineligible nonparticipants	Document racial differences in BF duration	BF duration at 6 months	4a

[a]Based on Cincinnati Children's Hospital Medical Center Table of Evidence Levels

Table 2: Summary of evidence regarding breastfeeding initiation among non-Hispanic Black women stratified by WIC participation

Authors, Year	Results	Conclusion
Jensen, 2011 [14]	non-Hispanic black mothers: 58% initiated breastfeeding 18.1% are WIC participants 8.5% are eligible nonparticipants non-Hispanic white mothers: 79% initiated breastfeeding 35.3% are WIC participants 58.3% are eligible nonparticipants WIC participants: 67% initiated breastfeeding Eligible nonparticipants: 79% initiated breastfeeding Ineligible nonparticipants: 84% initiated breastfeeding	Negative influence on breastfeeding initiation as a result of WIC participation at the regional level (only in 3 regions), no positive or negative influence at the state level for most states
Ma et al., 2013 [43]	WIC participants - Non-hispanic black: 44.3% of 1024 - Breastfeeding initiation: 55.5% Income ineligible nonparticipants - Non-hispanic black: 10.1% of 558 - Breastfeeding initiation: 84.0% Income eligible nonparticipants - Non-hispanic black: 26.8% of 214 - Breastfeeding initiation: 78.9% Logistic regression model for breastfeeding initiation: adjusted OR (95% CI) - WIC participants: 1.00 - Income ineligible: 2.14 (1.16, 3.96) - Income eligible: 2.61 (1.06, 4.34) - non-Hispanic black race: 1.00 - non-Hispanic white race: 1.89 (1.17, 3.05)	Both income eligible and income ineligible nonparticipants are more likely to initiate breastfeeding than WIC participants after adjusting for covariates. Black mothers are more less likely to be nonparticipants than white mothers.
Marshall et al., 2012 [44]	*Characteristics of black women*: WIC (82.1%) - Insurance: 16.3% private, 83.7% Medicaid - Initiated breastfeeding: 38.4% No WIC (17.9%) - Insurance: 45% private, 55% Medicaid - Initiated breastfeeding: 45.9% *Characteristics of white women*: WIC (52.2%)	For black women, WIC participation during pregnancy was not associated with breastfeeding initiation. Black mothers in Mississippi had overall low prevalence of breastfeeding initiation.

	- Insurance: 18% private, 82% Medicaid - Initiated breastfeeding: 50.8% No WIC (47.8%) - Insurance: 84.2% private, 15.9% Medicaid - Initiated breastfeeding: 70.8%	
McKinney et al., 2016 [45]	Breastfeeding initiation - Total: 72% - Black mothers: 61% WIC participation: - Total: 69% - Black mothers: 75% Fed formula at hospital: - Total: 66% - Black mothers: 76%	Compared to white mothers, black mothers had higher rates of poverty and lower levels of education and marriage, which are variables that predict lower rates of breastfeeding initiation
Sonchak, 2017 >48	WIC participation: - White: 75% - Black: 84% Breastfeeding initiation: - White WIC: 56% - White non-WIC: 65% - Black WIC: 41% - Black non-WIC: 39%	WIC has positive effect on breastfeeding initiation among black mothers by 6.82%. WIC program has potential to improve breastfeeding among black Medicaid mothers
Sparks, 2010 [49]	*Non-Hispanic Black (NHB) mothers*: Initiated breastfeeding - Urban: 51.50% - Rural: 25.25% - (Other mothers: urban 65.37% and higher, rural 58.21% and higher) Family lives below poverty threshold - Urban: 46.48% - Rural: 60.25% - (Other mothers: urban 46.55%, 35.11% and below, rural 67.25%, 43.60% and below) WIC benefits used in past 12 months: - Urban: 79.68% - Rural: 89.06% - (Other mothers: urban 83.31%, 71.42% and below, rural 84.98% and below)	NHB mothers have the lowest breastfeeding initiation rates for both urban and rural residencies compared to all other races and ethnicities. NHB mothers have high rates of family living below poverty threshold compared to other races and ethnicities.

Table 3: Summary of evidence regarding breastfeeding duration among non-Hispanic Black women stratified by WIC participation

Authors, Year	Results	Conclusion
Fleurant et al., 2017 [41]	Black mothers: 83.2% WIC eligible 24.3% HM feeding at NICU discharge Average of all mothers (black, white/Asian, Hispanic): 72.5% WIC eligible 34.3% HM feeding at NICU discharge Logistic Regression of Social factors and HM feeding at discharge: WIC eligible: OR 0.34 (0.15-0.75) Correlation of Social factors with HM feeding at discharge: White: WIC eligibility -0.33 Hispanic: WIC eligibility -0.26 Black: WIC eligibility -0.35	WIC eligibility is significant negative predictor of HM feeding at discharge, a relationship that likely reflects effect of economic status rather than WIC lactation support
Gregory et al., 2016 [42]	No infant WIC participation - BF duration: 33.2 weeks (20.1 SD) - Household income: 130% FPL (42.0) - Maternal race: 2.5% non-Hispanic black Infant WIC entry when BF ≥60% (BF-high) - BF duration: 37.4 weeks (18.5) - Household income: 106.1% FPL (44.1) - Maternal race: 3.5% non-Hispanic black Infant WIC entry when BF <60% (BF-low) - BF duration: 8.6 weeks (11.0) - Household income: 96.2% FPL (47.5) - Maternal race: 12.9% non-Hispanic black	Within WIC differences: WIC BF-high participants are more similar to WIC nonparticipants than to WIC BF-low participants. No negative association found between WIC and breastfeeding
Jensen, 2011 [14]	non-Hispanic black mothers: Mean breastfeeding duration 6.5 months non-Hispanic white mothers: Mean breastfeeding duration 7.9 months WIC participants: 6.7 months Eligible nonparticipants: 9.3 months	Negative influence on breastfeeding duration as a result of WIC participation at the regional level (in all regions), no positive or negative influence at the state level

	Ineligible nonparticipants: 8.2 months	
Ma et al., 2013 [43]	WIC participants - Non-hispanic black: 44.3% - Breastfeeding duration: 7.69 weeks (0.48 SD) Income ineligible nonparticipants - Non-hispanic black: 10.1% - Breastfeeding duration: 11.13 (0.40) Income eligible nonparticipants - Non-hispanic black: 26.8% - Breastfeeding duration: 10.08 (0.79) Cox proportional hazard models for discontinuing breastfeeding: adjusted HR (95% CI) - WIC participants: 1.00 - Income ineligible: 0.97 (0.64, 1.47) - Income eligible: 0.66 (0.41, 1.05) - non-Hispanic black race: 1.00 - non-Hispanic white race: 0.92 (0.64, 1.30)	Among mothers who initiated breastfeeding, income ineligible nonparticipants experienced longest breastfeeding duration, followed by income eligible nonparticipants, but results are not significant after controlling covariates
Marshall et al., 2012 [44]	*Characteristics of black women*: WIC - Insurance: 16.3% private, 83.7% Medicaid - Breastfeeding at 10 weeks: 0.22 Non-WIC - Insurance: 45% private, 55% Medicaid - Breastfeeding at 10 weeks: 0.22 *Characteristics of white women*: WIC - Insurance: 18% private, 82% Medicaid - Breastfeeding at 10 weeks: 0.18 Non-WIC - Insurance: 84.2% private, 15.9% Medicaid - Breastfeeding at 10 weeks: 0.33	WIC participation was not associated with breastfeeding duration among black mothers
McKinney et al., 2016 [45]	Breastfeeding duration: - Total: mean 10.29 weeks ± 13.13 - Black mothers: mean 6.40 weeks ± 9.86 WIC participation: - Total: 69% - Black mothers: 75% Fed formula at hospital: - Total: 66% - Black mothers: 76%	Breastfeeding duration disparities between black and white mothers were not fully explained by demographic factors. In-hospital formula introduction is biggest predictor of breastfeeding duration. If hospital formula introduction were eliminated, the disparity in breastfeeding duration could be reduced by approximately 1.8 weeks

Riley et al., 2016 [46]	WIC eligible: - Total: 72.9% - Black mothers: 84.2% HM continuation at NICU discharge: - Total: 33.2% - Black mothers: 23.4% Bivariate logistic regression analysis for HM feeding at discharge: OR (95% CI) - non-Hispanic black: 0.41 (0.24, 0.70) - WIC eligible: 0.26 (0.16, 0.41)	Race/ethnicity, WIC eligibility, and length of NICU hospitalization significantly predicted HM feeding at discharge. Socioeconomic status disproportionately affected breastfeeding rates of black mothers to a greater degree than white or Hispanic mothers.
Shim et al., 2012 [47]	WIC - Black race: 21.3% - Income > 185% FPL: 17.7% - Income ≤ 185% FPL: 82.3% - Breastfeeding duration < 6 mo: 79.8% Non-WIC - Black race: 4.9% - Income > 185% FPL: 82.6% - Income ≤ 185% FPL: 17.4% - Breastfeeding duration < 6 mo: 55.9%	Child care type is associated with short breastfeeding duration, where infants in relative care negatively impacts breastfeeding duration compared to parental care. WIC participation and child care are risk factors of short breastfeeding duration.
Sparks, 2011 [50]	Non-Hispanic Black (NHB) mothers breastfed for 6 months: 5.88% (Other mothers: 10.10% and higher) WIC-eligible mothers who initiated breastfeeding: - NHB, breastfed for 6 months: 9.98% - (Other mothers: 11.37% and higher) Among NHB mothers: - Mother or child used WIC benefits in past 12 months: 88.42% - Family lives below poverty threshold: 53.88%	NHB mothers used WIC at the highest rates and were least likely to breastfeed for 6 months. Low income, minority women, and WIC participants are less likely to continue breastfeeding. WIC participants were more likely to discontinue breastfeeding over the 12-month period.

Breastfeeding Initiation

Six total studies reported breastfeeding initiation outcome. One study [48] found that WIC participation is associated with higher breastfeeding initiation for black mothers, but not white mothers, while three studies [14, 43, 45] found that WIC participation is associated with lower breastfeeding initiation regardless of race or ethnicity. Marshall et al. [44] found no significant association between WIC participation and breastfeeding initiation among Black women. Black mothers are shown to have the lowest rate of breastfeeding initiation in all of the studies. One study measured formula feeding at the hospital and found higher rates of usage among black mothers [45].

Breastfeeding Duration

Nine total studies reported breastfeeding duration outcome. One study found that black mothers make up a higher percentage of WIC participants who entered with low-intensity breastfeeding (breastfeeding < 60% of total liquid feeds), which is the group with the shortest breastfeeding duration [42]. Five studies found that WIC participants have the shortest breastfeeding duration [41, 14, 46, 47, 50]. Three studies found that WIC participation was not associated with breastfeeding duration among black women [42, 43, 44]. Six studies found that black mothers have the shortest breastfeeding duration [41, 14, 43, 45, 46, 50].

WIC Participation

Seven studies found higher WIC eligibility and participation among black mothers, and one study found fewer black mothers among nonparticipants compared to white mothers. One study[14] found that WIC participation had a negative influence on breastfeeding duration among all regions of the US. One study [42] found that participants entering WIC while having high breastfeeding frequency are more similar to WIC nonparticipants than participants who entered WIC while having low breastfeeding frequency. Another study [44] found that WIC participation during pregnancy was not associated with breastfeeding initiation among black mothers, but was negatively associated with breastfeeding initiation among white mothers.

Healthy People 2020

Healthy People 2020 (HP2020) set goals for breastfeeding initiation and breastfeeding duration at 6 months, which correspond to the two breastfeeding outcomes assessed by this literature review. The target for ever breastfeeding is 81.9% and the target for breastfeeding duration at 6 months is 60.6%. The most recent data (2015) for non-Hispanic Black children were 69.4% ever breastfed and 44.7% breastfed at 6 months, both of which did not reach the target.

The HP2020 target for ever breastfeeding is 81.9%. Out of the six studies reporting breastfeeding initiation outcome data, all seven studies consistently showed that non-Hispanic black mothers had the lowest breastfeeding initiation, regardless of WIC participation, compared to mothers of other race and ethnicities and consistently did not reach the HP2020 target for breastfeeding.

The HP2020 target for breastfeeding duration at 6 months is 60.6%. However, included studies do not have consistent measurements for breastfeeding duration. Two studies [41, 46] measured continued human milk feeding at NICU discharge, some studies measured rate of short breastfeeding duration, one study reported rate of breastfeeding at 10 weeks [44], and others reported the mean duration of breastfeeding. Sparks [50] reported rate of breastfeeding duration at 6 months and showed that breastfeeding duration among non-Hispanic black mothers were the lowest, regardless of WIC participation, and did not reach the HP2020 target (5.88% and 9.98%, respectively). Gregory et al. [42] found that WIC entry when breastfeeding was already low was associated with the lowest breastfeeding duration, but did not link this outcome to maternal race or ethnicity. Marshall et al. [44] showed the probability of breastfeeding at 10 weeks and found that black mothers are less likely to breastfeed at 10 weeks compared to white mothers, but black mothers' probability of continuing breastfeeding did not differ with WIC participation.

4.2 Secondary Analysis

Data was obtained from the Hamilton County Public Health Department stratified in two ways: pre- versus during-COVID-19 pandemic and quarterly. The data stratified by pre- versus during-COVID-19 pandemic included breastfeeding data from January 2019 to October 2021. Pre-COVID-19 time period from January 2019 to February 2020 included 31.88% of all births from non-Hispanic Black women (n = 3,916). During-COVID-19 time period from March 2020 to October 2021 included 30.35% of all births from non-Hispanic Black women (n = 5,200). The data stratified by quarters included breastfeeding data from January 2019 to September 2021 and included a total of 8,897 births from non-Hispanic Black women.

The public health data was collected through mothers' self-report during the short hospital stay after birth and before discharge, which is an average of one to four days [51]. Breastfeeding outcome variables include breastfeeding at discharge, which is equivalent to breastfeeding initiation, and exclusive breastfeeding at discharge, which refers to the mother exclusively breastfeeding her infant during the few days of hospital-stay after birth.

Pre-COVID-19 versus During-COVID-19 Breastfeeding Outcomes

Table 4: Breastfeeding outcomes based on different maternal variables, stratified by pre- versus during-COVID-19 pandemic

	Pre-COVID-19 Pandemic		**During-COVID-19 Pandemic**	
	Breastfeeding at discharge	Breastfeeding exclusively	Breastfeeding at discharge	Breastfeeding exclusively
WIC participation				
WIC	64.8%	29.8%	62.6%	29.9%
non-WIC	68.4%	35.9%	71.1%	37.7%
Maternal Age				
18 to 24 years	65.1%	32.6%	63.3%	32.0%
25 to 45 years	67.4%	33.4%	69.3%	35.1%
Educational Status				
8th grade or less	66.7%	27.8%	74.4%	32.5%
9th through 12th grade; no diploma	46.7%	18.9%	49.0%	20.5%
High School Graduate or GED Completed	61.6%	28.0%	60.9%	28.8%

Some college credit, but no degree	74.6%	38.8%	72.8%	40.3%
Associate Degree	71.6%	36.5%	77.8%	39.2%
Bachelor's Degree	90.6%	51.9%	87.4%	47.7%
Marital Status				
Married	85.8%	47.5%	85.2%	48.8%
Not Married	62.1%	29.4%	62.5%	30.1%
Insurance Status				
Medicaid	62.3%	29.4%	61.8%	29.7%
Private	82.2%	44.5%	83.4%	45.0%
Timing of Prenatal Care				
No prenatal care	39.7%	14.3%	39.8%	18.3%
Early prenatal care (1-3 months)	69.3%	34.8%	69.8%	35.5%
Second trimester care (4-6 months)	65.4%	31.9%	64.8%	32.0%
Late prenatal care (7-9 months)	62.8%	29.3%	65.2%	30.3%

The epidemiological data stratified by time period relative to the pandemic included data from 3,916 births (pre-COVID-19) and 5,200 births (during-COVID-19). All data that were unknown or missing were excluded from analysis. Table 4 shows the percentage of mothers answering “Yes” to the questions regarding breastfeeding at discharge and breastfeeding exclusively, stratified by pre-COVID-19, during-COVID-19, as well as maternal variables.

Quarterly Breastfeeding Outcomes

Table 5: Breastfeeding at discharge by quarter

Breastfeeding at Discharge (%)												
Year	**2019**				**2020**				**2021**			**Avg**[a]
Quarter	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	
All mothers (n = 8,897)												66.7
WIC participants (n = 4,529)	67.1	64.5	64.8	67.6	59.5	64.5	63.8	62.5	59.8	60.3	63.9	63.5
Nonparticipants (n = 4,242)	71.4	68.8	68.7	66.4	70.0	71.3	67.2	75.9	67.9	75.1	67.9	70.1
Medicaid Insurance (n = 6,665)	66.2	61.5	63.0	62.7	59.4	64.1	60.9	63.1	57.3	62.2	61.9	62.0
Private Insurance (n = 1,902)	83.1	81.6	81.7	82.3	84.4	81.2	80.2	87.1	84.2	87.7	80.0	83.0
Age 18-24 (n = 2,931)	68.2	65.3	66.9	66.3	58.9	63.9	56.3	66.4	59.2	65.8	66.8	64.0
Age 25-45 (n = 5,654)	69.8	67.9	66.2	67.6	68.1	71.1	69.9	71.1	67.0	68.7	66.5	68.5
Married (n = 1,657)	82.0	90.1	82.1	89.0	85.9	83.3	84.4	89.2	87.8	87.2	80.3	85.6
Not Married (n = 7,180)	66.1	61.3	63.5	62.0	58.7	64.0	60.4	64.5	58.7	62.8	63.0	62.3
9th through 12th grade; no diploma (n = 1,245)	49.1	44.7	54.3	46.2	40.1	49.1	48.4	55.3	49.5	51.1	46.4	48.6
High School Graduate or GED	64.5	63.6	59.6	63.6	58.9	63.1	58.4	64.4	56.3	61.3	59.6	61.2

Completed (n = 3,675)												
Some college credit, but no degree (n = 1,973)	76.7	72.2	73.1	75.6	78.3	72.0	71.8	69.4	71.9	71.4	75.4	73.4
Early prenatal care (1-3 months)(n = 5,583)	73.5	68.2	70.6	69.6	66.4	73.0	70.4	70.1	66.7	70.7	65.6	69.5
Second trimester care (4-6 months) (n = 1,935)	67.3	66.8	62.4	66.1	67.8	58.6	57.4	69.4	64.3	65.7	70.5	65.1

[a]Average breastfeeding outcome across eleven quarters

Note: Quarterly data variables that had missing values were not included

Table 6: Breastfeeding exclusively by quarter

Breastfeeding Exclusively (%)												
Year	**2019**				**2020**				**2021**			**Avg[a]**
Quarter	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	
All mothers												33.2
WIC participants	31.3	26.0	29.2	30.9	32.3	31.9	28.3	28.8	27.7	31.0	30.2	29.8
Nonparticipants	35.8	34.1	34.9	39.8	35.7	39.3	35.1	38.6	34.8	39.5	38.1	36.9
Medicaid Insurance	30.3	26.2	28.3	31.8	30.6	32.3	26.0	31.2	27.1	30.7	31.3	29.6
Private Insurance	46.4	42.6	45.5	45.7	45.8	45.0	47.1	40.0	40.0	48.8	42.1	44.5
Age 18-24	34.0	30.6	34.3	32.0	31.7	33.2	26.9	33.7	32.4	33.6	33.7	32.4
Age 25-45	33.5	30.1	31.3	38.2	36.0	37.7	33.8	33.5	30.8	36.3	35.0	34.2
Married	44.5	45.4	43.2	56.9	45.5	48.4	47.8	50.0	47.5	55.5	44.2	48.1

Not Married	30.9	26.5	29.5	30.4	30.8	32.3	27.1	29.9	27.8	29.7	32.2	29.7
9th through 12th grade; no diploma	21.0	16.0	23.6	16.9	16.1	21.6	19.5	15.8	20.2	28.6	21.4	20.1
High School Graduate or GED Completed	30.1	24.9	24.0	31.0	32.7	32.7	26.9	30.7	24.1	27.2	27.8	28.4
Some college credit, but no degree	35.9	35.2	39.4	42.1	43.5	38.2	33.5	37.4	43.3	40.4	45.5	39.5
Early prenatal care (1-3 months)	37.0	31.8	33.3	37.0	36.9	38.4	34.1	34.0	31.3	39.2	32.8	35.1
Second trimester care (4-6 months)	32.3	29.8	28.6	36.9	31.6	28.7	31.0	34.3	30.2	28.3	39.6	31.9

[a]Average breastfeeding outcome across eleven quarters
Note: Quarterly data variables that had missing values were not included

The epidemiological data stratified by quarters of the year included data from a total of 8,897 non-Hispanic Black women. All data that were unknown or missing were excluded from analysis. Table 5 and table 6 show the percentage of mothers answering “Yes” to the questions regarding breastfeeding at discharge and breastfeeding exclusively, stratified by quarters (3-month periods) of the year as well as maternal variables. The average rate of breastfeeding outcomes is taken for the entire time period from quarter 1 of 2019 through quarter 3 of 2021.

Change in Breastfeeding Outcomes by Quarter

Figure 2.1: Breastfeeding Outcomes by WIC participation

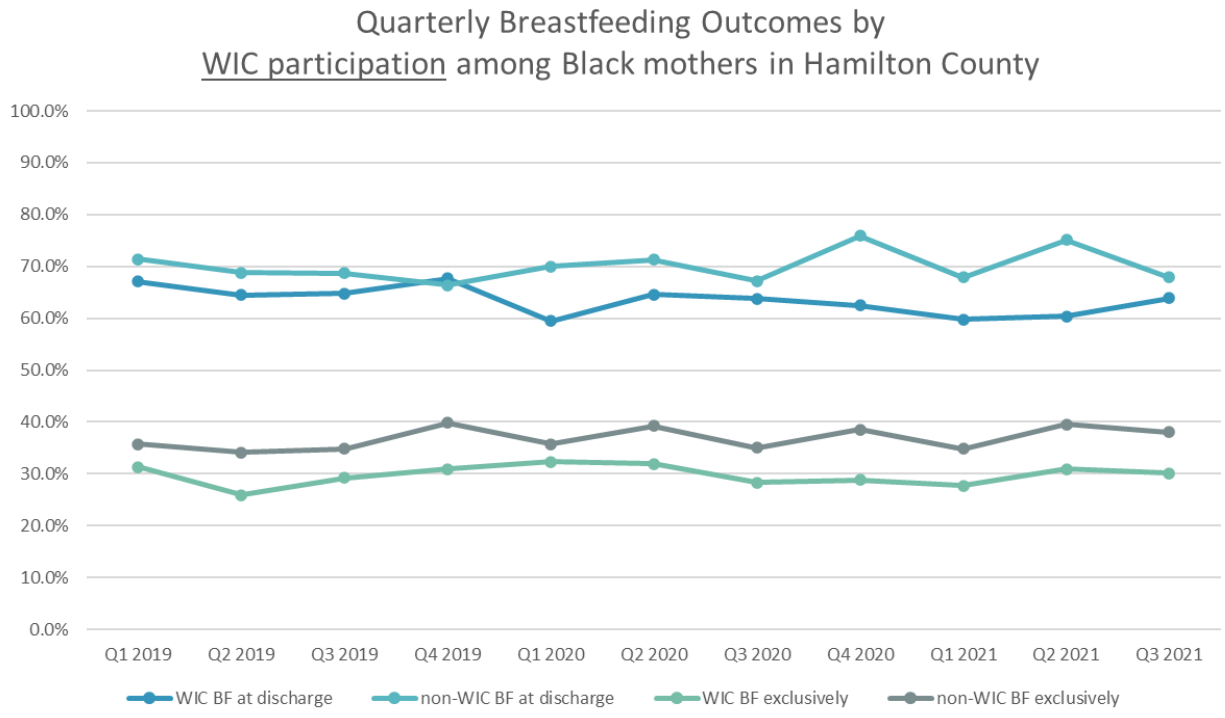


Figure 2.2: Breastfeeding Outcomes by Type of Insurance Used

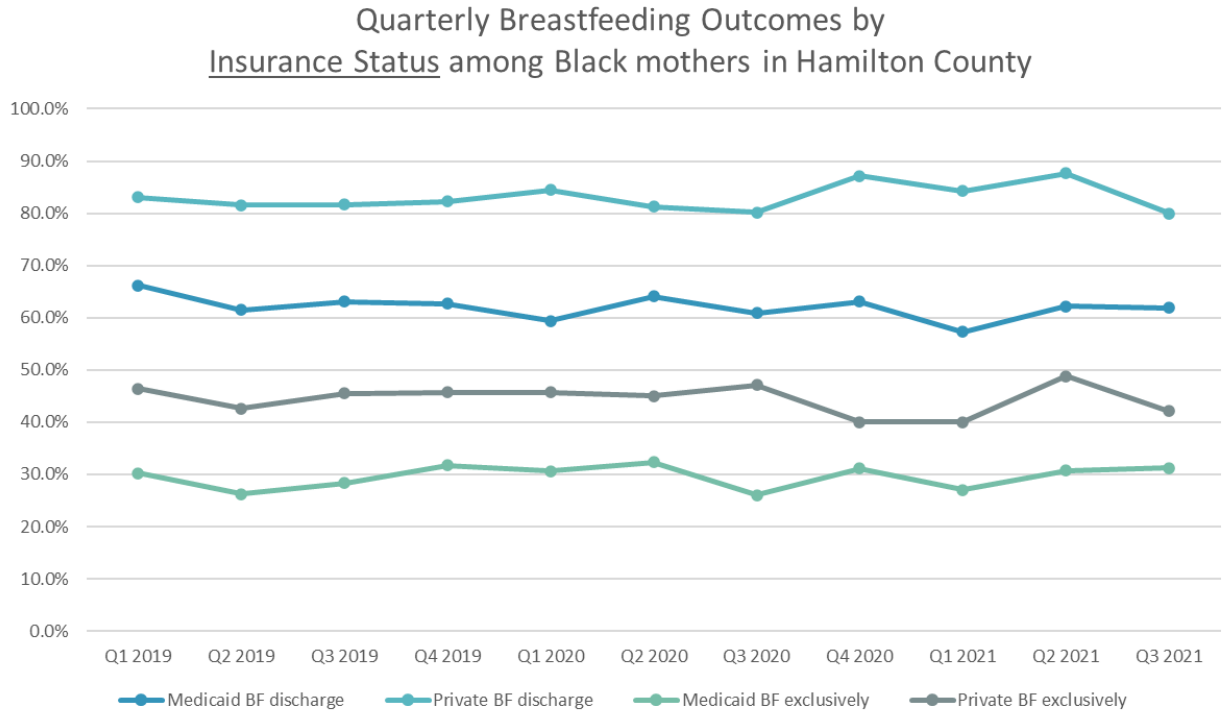


Figure 2.3: Breastfeeding Outcomes by Maternal Age

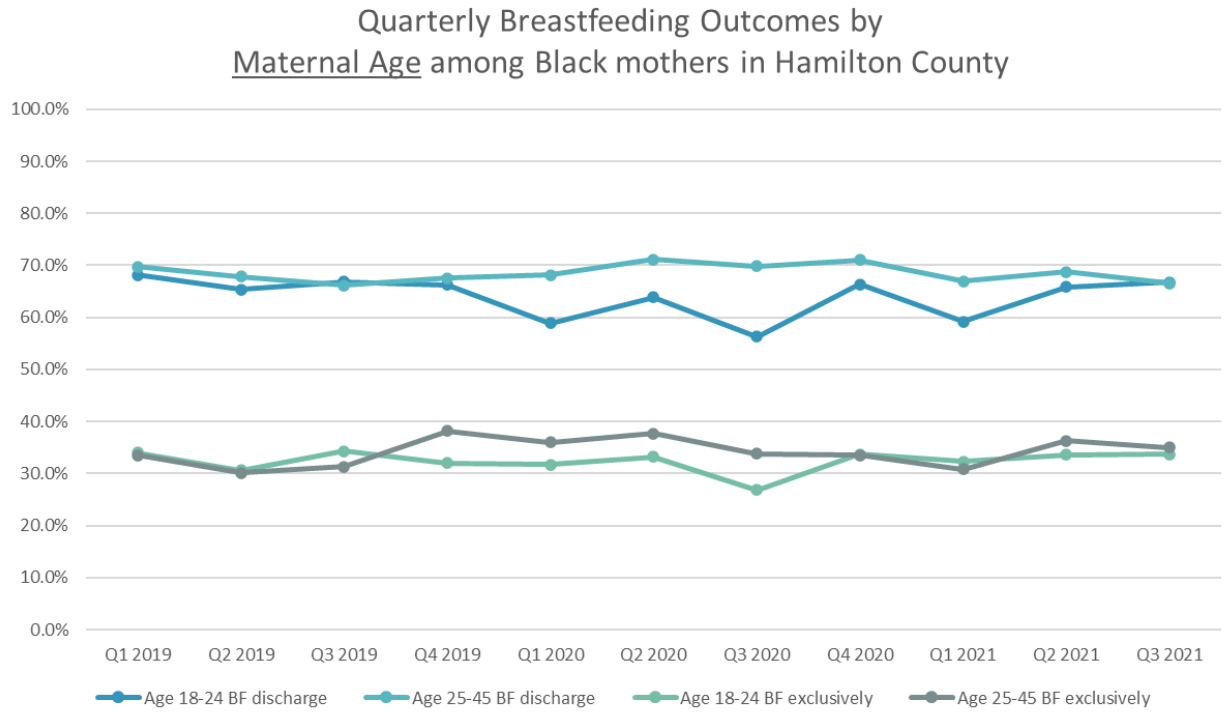


Figure 2.4: Breastfeeding Outcomes by Marital Status

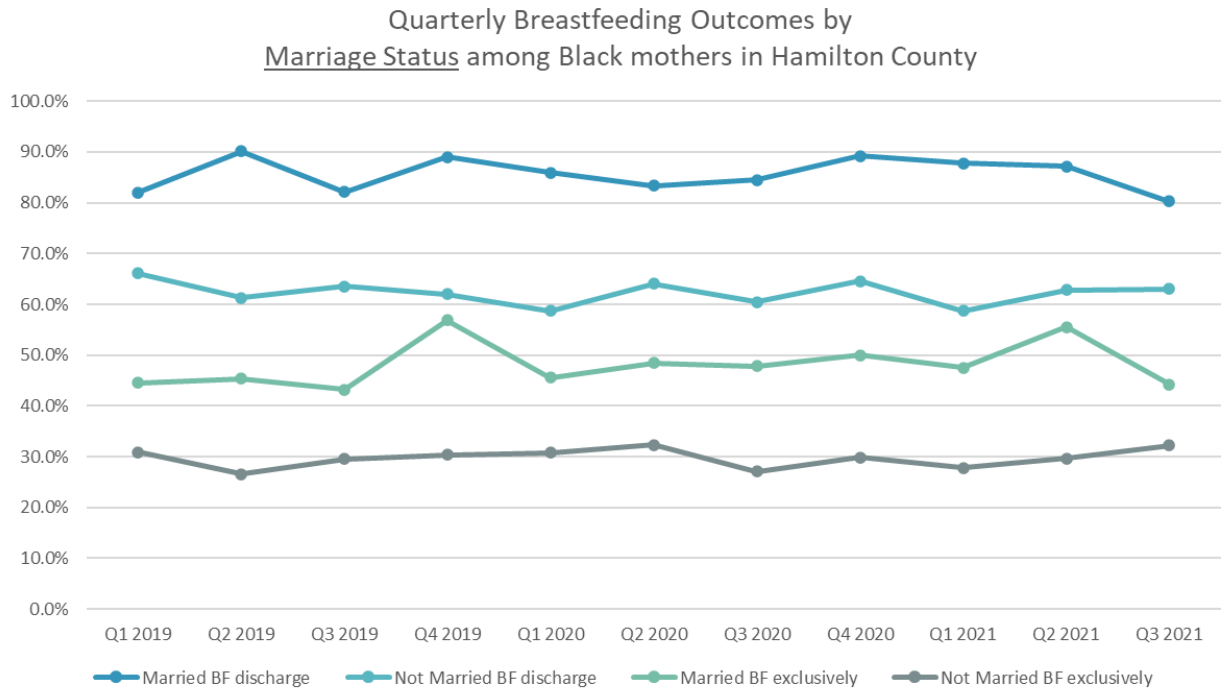


Figure 2.5: Breastfeeding Outcomes by Educational Level

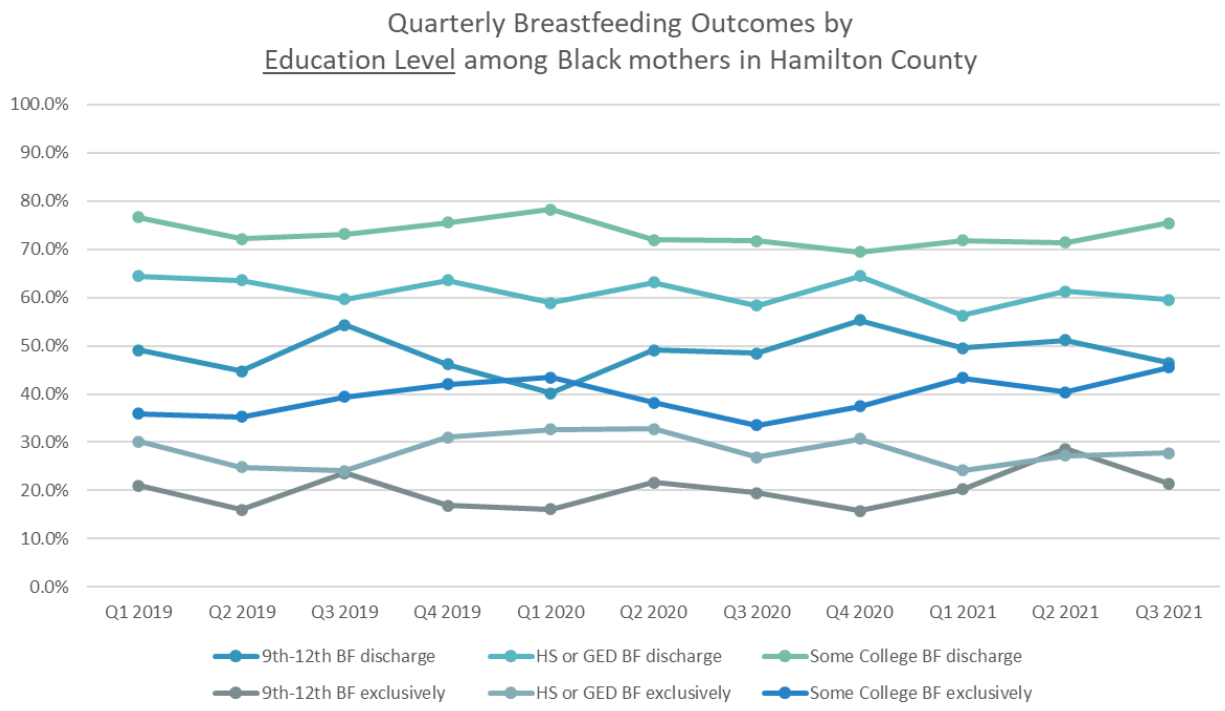
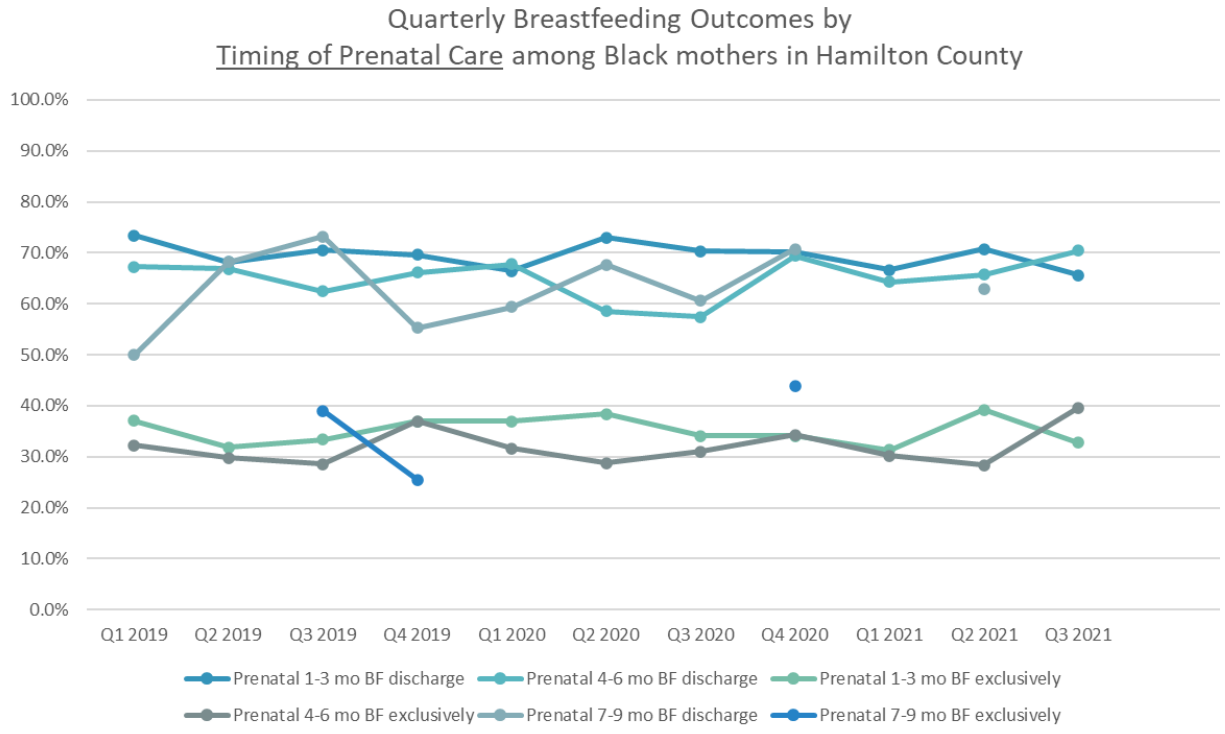


Figure 2.6: Breastfeeding Outcomes by Timing of Prenatal Care



Figures 2.1 to 2.6 show the graph of percentage of both breastfeeding at discharge and exclusive breastfeeding related to each maternal variable and how the breastfeeding rates changed throughout the eleven quarters.

Figure 3: Comparison of Breastfeeding at Discharge by Quarter between WIC Participants and Medicaid Insurance Users

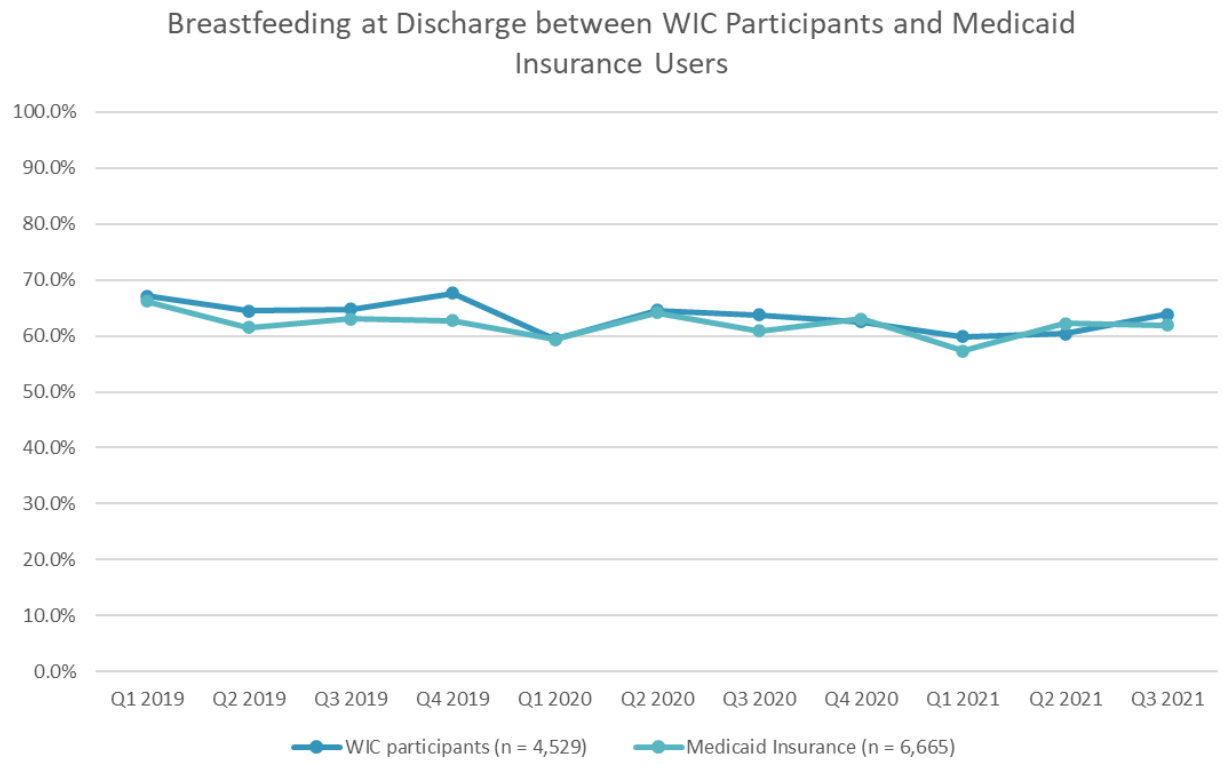


Figure 3 shows a graph comparison of breastfeeding at discharge between WIC participants and Medicaid insurance users, who are considered WIC-eligible.

Statistical Analysis

Table 7: Independent Samples t-test, difference between pre-COVID-19 and during-COVID-19, and Effect Sizes

	Comparison	**t**	**Sig.**	**95% CI**	**Cohen's d**	**95% CI**
Pre- vs. During-COVID	*WIC participation*	-3.928	< 0.001	-0.099, -0.033	-0.083	-0.125, -0.042

	BF at Discharge	5.263	< 0.001	0.054, 0.118	0.111	0.070, 0.153
	Exclusive BF	5.541	< 0.001	0.059, 0.124	0.118	0.076, 0.159
WIC Participants vs. Nonparticipants	*BF at Discharge*	-6.464	< 0.001	-0.084, -0.045	-0.136	-0.178, -0.095
	Exclusive BF	-6.768	< 0.001	-0.087, -0.048	-0.184	-0.184, -0.102

Independent samples t-test was used to examine the difference in WIC participation and breastfeeding outcomes between pre-COVID-19 and during-COVID-19 and the difference in breastfeeding outcomes between WIC participants and nonparticipants. Cohen's d was also used to determine the effect size of the differences, and values around 0.2 is considered small effect sizes. All values were statistically significant in differences with small effect sizes.

Table 8: Binomial distribution and phi coefficient, comparing breastfeeding outcomes pre-COVID-19 pandemic and during-COVID-19 pandemic

Breastfeeding Outcomes	**WIC Participation**	**Binomial Sig.**	**Phi**
Breastfeeding at discharge	*WIC participants*	0.011	-0.022
	Nonparticipants	0.001	0.029
Exclusive breastfeeding	*WIC participants*	0.574	0.001
	Nonparticipants	0.0268	0.019

Table 9: Binomial distribution to compare breastfeeding outcomes between different maternal variables, and Phi Coefficient test to measure association between maternal variables and breastfeeding outcomes

Variable	BF outcomes	Binomial Sig.	Phi value
WIC x non-WIC	*BF at Discharge*	< 0.001	-0.068
	Exclusive BF	< 0.001	-0.075
Age 18-24 x Age 25-45	*BF at Discharge*	< 0.001	-0.045
	Exclusive BF	0.008	-0.021
HS and below x College and above	*BF at Discharge*	< 0.001	-0.195
	Exclusive BF	< 0.001	-0.156
Not married x Married	*BF at Discharge*	< 0.001	-0.191
	Exclusive BF	< 0.001	-0.153
Medicaid x Private	*BF at Discharge*	< 0.001	-0.184
	Exclusive BF	< 0.001	-0.134
Late (7-9 mo) x Early (1-3 mo) Prenatal Care	*BF at Discharge*	0.011	-0.060
	Exclusive BF	0.014	-0.035
WIC x Medicaid	*BF at Discharge*	0.004	

The binomial distribution tests determined whether breastfeeding rates were significantly different between different variables. For example, rates of breastfeeding at discharge among WIC participants were statistically significant from rates of breastfeeding at discharge among nonparticipants. The binomial distribution does not indicate directionality or magnitude of change.

The phi coefficient is a measure of association between two binomial variables, where 1 or -1 indicate strong positive or negative association between the variables, and 0 indicates no association. For example, the phi value is calculated for WIC participants and nonparticipants whether they breastfed at discharge or not. The negative phi values indicate that the first variable (WIC) is associated with lower breastfeeding rates than the second variable (non-WIC) of each variable pair. Education levels were combined to create a variable pair of those receiving complete high school education or less and those receiving some college education or more.

5. Discussion

5.1 Systematic Review

Breastfeeding Initiation

Jensen's [14] results found that non-Hispanic black mothers had the lowest breastfeeding initiation rate and are more likely to be WIC participants than eligible-nonparticipants. The study's adjusted model found that the odds of breastfeeding for WIC participants were significantly lower than that of eligible nonparticipants. Three of the seven regions analyzed by Jensen indicated a significant negative association between WIC participation and breastfeeding initiation, whereas the other regions had insignificant negative associations. However, Jensen's article used data from 2007, before the WIC food package revision in 2009 that have been demonstrated to decrease breastfeeding initiation disparities among WIC participants.

Marshall et al. [44] found that black mothers are more likely than white mothers to be WIC participants and are more likely to use Medicaid, even among nonparticipants. Despite black mothers having lower breastfeeding initiation overall compared to white mothers, their adjusted regression models found no significant decrease in breastfeeding initiation between black WIC participants and black nonparticipants. One potential reason for this finding is because black mothers already have overall low breastfeeding rates coupled with high rates of WIC participation among black mothers. However, Marshall et al. only analyzed data in Mississippi from 2004 to 2008, before the WIC food package revision. Their finding related to black mothers is supported by Jensen's [14] adjusted model that found most states, including Mississippi, had no association between WIC participation and rates of breastfeeding initiation compared to nonparticipants. However, Marshall et al. found that WIC participation is associated with lower breastfeeding initiation among white mothers, citing potential WIC contributions such as food package content, education and counseling, support, and formula supplementation.

Sparks' [49] results found that non-Hispanic black mothers not only had the lowest breastfeeding initiation rates compared to mothers of other races and ethnicities in both urban and rural settings, but they also had the highest rate of family living below the poverty threshold and the lowest rate of being married. In their logistic regression model, living below the poverty threshold is consistently shown to lower odds of breastfeeding initiation, and non-Hispanic black mothers, especially those living in rural settings, had the lowest odds of breastfeeding initiation compared to mothers being other races and ethnicities. On the other hand, rural mothers of other races and ethnicities have higher odds of breastfeeding initiation. The model also showed that non-Hispanic black mothers participating in WIC had slightly higher odds of initiating breastfeeding (OR = 1.13) but this effect is not statistically significant and is lower than most

mothers of other races and ethnicities. Sparks discussed that rural non-Hispanic black mothers had significantly lower odds of initiating breastfeeding than urban non-Hispanic black mothers and noted the differences between the groups. The majority of rural non-Hispanic Black mothers used WIC, lived in poverty, and were least likely to be married. Additionally, both rural and urban non-Hispanic Black mothers were more likely to work during pregnancy. Sparks concluded that factors such as lack of marital partner support, poor economic circumstances, WIC formula, and employment barriers may explain lower breastfeeding initiation rates among rural non-Hispanic black mothers. However, WIC usage is only assessed by Sparks based on whether the mother or infant received benefits from WIC without specification about formula usage. WIC participation can impact breastfeeding outcomes due to lack of breastfeeding support or education, not just from infant formula access. Additionally, the data used was from 2001, before the WIC food package revision.

Due to the WIC revision of the food package to promote breastfeeding in 2009, evaluating the association between WIC participation and breastfeeding initiation using data collected from 2009 and after would provide relevant insight on what other factors may be contributing to breastfeeding disparities.

Sonchak [48] found that black WIC participant mothers were more likely to breastfeed (41%) compared to black nonparticipant mothers (39%). However, Sonchak stated that the black WIC mothers were less likely to be high school dropouts (28% vs. 31%) and more likely to have some college education (32% vs. 29%) compared to the black nonparticipant mothers. This is in contrast with Marshall et al.'s [44] sample in which black WIC mothers are more likely to be high school dropouts (31.5% vs. 20.6%) and less likely to have some college education (33.5% vs.

53.0%) compared to black nonparticipant mothers. The other included studies show that WIC participants are more likely to have less education than nonparticipants, but the data were not stratified by both WIC participation and Black mothers, so there may be different patterns of education based on different maternal races and ethnicities. While Sonchak controlled for socioeconomic status by including only Medicaid insurance users, they also only focused on mothers with multiple births, so their findings may not be generalizable to mothers with a singular birth. Regardless, Sonchak's sample size is the largest of the eleven included articles and includes the most recent data in 2013, likely having more data after the WIC food package revision that may explain the different results.

Ma et al.'s [43] results found that not only are Black mothers more likely to be WIC participants, but also WIC participants still had significantly lower breastfeeding initiation rates (55.5%) despite more participants receiving breastfeeding information through WIC (91.6%) compared to both eligible and ineligible nonparticipants. In the adjusted regression models, both ineligible and eligible nonparticipants had significantly higher odds of breastfeeding compared to WIC participants, and mothers of other races and ethnicities have significantly higher odds of breastfeeding compared to non-Hispanic black mothers. Ma et al. discussed that providing breastfeeding information is a good approach to encourage breastfeeding among WIC participants, but breastfeeding education was already on a desirable level (overall 84.9%). The regression model showed that mothers receiving breastfeeding information had an insignificantly lower odds of breastfeeding. Ma et al.'s sample were taken from 2009 to 2010, which would include mothers receiving the revised WIC food package. However, the study found that breastfeeding initiation disparity remain large between WIC participants and nonparticipants, and receiving breastfeeding information did not significantly improve breastfeeding outcomes. There

may be other factors that still act as barriers to breastfeeding among WIC participants independent of breastfeeding education, so future WIC interventions should be addressing other barriers to promote breastfeeding.

McKinney et al.'s [45] results found that breastfeeding initiation was lowest among Black mothers and analyzed various mediators that may contribute to disparities between racial and ethnic groups. In relation to the breastfeeding initiation disparities between black and white mothers, black mothers had higher rates of poverty and lower rates of having a college degree or being married, all of which fully mediated the difference in breastfeeding initiation. Second, in relation to the breastfeeding initiation disparities between black and Spanish-speaking Hispanic mothers as well as English-speaking Hispanic mothers, black mothers were less likely to have a mother who had breastfed, which would have predicted greater breastfeeding initiation in the next generation and thus, partially mediated the difference in breastfeeding initiation. Overall, the study showed that black mothers had higher rates of poverty, lower levels of education and marriage, which predicted lower breastfeeding initiation. These may be factors that breastfeeding promotion interventions should target to mitigate disparities experienced by black mothers. This study examined data between 2008 and 2012, most of which were after the WIC food package revision, which may explain why factors other than WIC participation mediated differences in breastfeeding initiation among black mothers.

Three of the articles evaluating breastfeeding initiation using data before 2009 [14, 44, 49] had mixed results regarding the association between WIC participation and breastfeeding initiation. Three articles that included data after 2009 [43, 45, 48] still showed mixed results regarding the association between WIC participation and breastfeeding initiation. The WIC 2009 food package

revision did not appear to reduce the disparities in breastfeeding initiation, especially among Black mothers.

Breastfeeding Duration

Fleurant et al. [41] concluded that WIC eligibility negatively predicting human milk feeding at NICU discharge (average 73 days length of NICU stay) may reflect economic status rather than lack of WIC lactation support. Their finding is due to the article only determining whether participants are WIC eligible or ineligible, not whether they participated in WIC or not, as nonparticipants may either be eligible or ineligible due to income. Additionally, the article found that neither breastfeeding support nor lack thereof from friends, family, and peers were correlated with human milk feeding at discharge. This contrasts with other studies that show support from friends, family, and community can facilitate breastfeeding and lack of support can become a barrier to breastfeeding. For example, Gyamfi et al. [19] described the cultural dimension that influences breastfeeding experiences of African American women in the US, stating that breastfeeding support or lack thereof from family, peers, and the community greatly affect breastfeeding outcomes. The difference in correlation may be due to different settings inside the hospital versus community setting or home setting.

Jensen [14] found that the difference in breastfeeding duration is seen based on regions of the US, with WIC participants in western regions having a smaller decrease in breastfeeding duration compared to nonparticipants, and WIC participants in eastern regions having a larger decrease in breastfeeding duration compared to nonparticipants. Factors may differ based on

regional differences, so WIC may improve breastfeeding disparities by addressing region-specific factors that contribute to breastfeeding differences.

Marshall et al. [44] was one of the three articles that found no association between WIC participation and breastfeeding duration among black mothers. However, this article did not stratify the data among nonparticipants based on eligibility criteria. Furthermore, the breastfeeding duration outcome measured only whether mothers breastfed at 10 weeks or not, which is much shorter than the mean breastfeeding duration of 6 months among Black mothers in Jensen's article, so the study would not be able to capture the potential differences in breastfeeding duration between WIC participants and nonparticipants.

McKinney et al.'s [45] results showed that black mothers had shorter breastfeeding duration than white mothers, and black mothers are significantly more likely to experience in-hospital formula introduction, which was the biggest predictor of breastfeeding duration. On one hand, black mothers' lower likelihood of having a college degree or being married predicted shorter breastfeeding duration, but on the other hand, black mothers' higher rates of poverty was not a unique predictor of breastfeeding duration. Compared to Spanish-speaking Hispanic mothers, black mothers were less likely to have a family history of breastfeeding and less likely to live with the infant's father, both of which partially predicted lower breastfeeding duration among black mothers. The study included WIC participation as one of the multiple mediators of breastfeeding, and it was excluded from consideration due to not having a significant association on breastfeeding outcomes. McKinney et al.'s study highlights the factors independent of WIC-participation that may contribute to breastfeeding disparities experienced by Black mothers.

Riley et al.'s [46] findings may explain the mixed findings regarding the association between WIC participation and breastfeeding outcomes, especially in relation to socioeconomic status that indicates eligibility for WIC. The article found that both WIC eligibility and maternal Black race negatively predicted human milk feeding at discharge. Additionally, socioeconomic status affected breastfeeding outcomes of all race and ethnic groups, but disproportionately affected Black mothers to a greater degree. The disparity in socioeconomic status effect may partially explain why other studies have found no association with WIC participation on breastfeeding outcomes. However, Riley et al.'s article also only included WIC eligibility, not whether the mothers were WIC participants or not.

Shim et al.'s [47] results showed that WIC participants are more likely to have short breastfeeding duration (less than 6 months) compared to nonparticipants. The study categorized the data by child care and found that infants receiving parental care were less likely to have short breastfeeding duration than infants who received nonparental (relative or center-based) care. Therefore, both WIC participation and child care are risk factors for breastfeeding duration, and future studies should include child care setting as a variable when evaluating breastfeeding outcomes. The effects were found after adjusting for confounding factors between WIC participants and nonparticipants, which includes higher proportion of white infants, married mothers, mothers having some college education, and mothers having incomes higher than 185% of the poverty threshold among nonparticipants. However, the sample used in this study was from 2001, more than 2 decades old. Additionally, this study included mothers who did not initiate breastfeeding among those with short breastfeeding duration. Furthermore, the study did not specify WIC eligibility among nonparticipants.

To evaluate whether breastfeeding duration may be due to WIC participation or socioeconomic status related to income requirements for WIC eligibility, it's beneficial for studies to discern nonparticipation of WIC between income-eligible and income-ineligible mothers.

Gregory et al.'s [42] results support Fleurant et al.'s conclusion, as their results show that breastfeeding duration is higher (37 weeks) among mothers who entered WIC while frequently breastfeeding than eligible nonparticipant mothers (33 weeks), potentially indicating successful WIC lactation support for certain mothers participating in WIC. Meanwhile, mothers who entered WIC while infrequently breastfeeding had the shortest breastfeeding duration (8 weeks). The finding highlights differences within WIC participants, and identifying factors contributing to these differences would be potential targets for future interventions to reduce breastfeeding disparities.

Ma et al. [43] compared breastfeeding duration between WIC participants, eligible nonparticipants, and ineligible nonparticipants and found that the shortest breastfeeding duration was among participants (7 weeks) and the highest duration was among ineligible nonparticipants (11 weeks). The unadjusted association between breastfeeding duration and WIC participation is significant, but became insignificant after adjusting for covariates, indicating that differences in breastfeeding duration may be due to other factors independent of WIC participation. One of the covariates was maternal race. However, this article determined WIC eligibility based on Medicaid use, which is shown in Marshall et al.'s results that even WIC participants may be using private insurance.

Sparks' [50] study only included mothers who were WIC-eligible and found that non-Hispanic black mothers were the least likely to breastfeed for 6 months compared to mothers of other races and ethnicities. Black mothers had the highest rate of WIC participation and were most likely to be single, which highlight the potential lack of support from the infant's father and the importance for WIC program to address the breastfeeding disparity among their participants. Additionally, the study's analysis found that WIC participants were more likely to discontinue breastfeeding. However, this study was published one decade ago, using data from almost one decade before publication.

Of the included articles, none found a positive association between WIC participation and breastfeeding duration. Instead, three articles [42, 44, 45] found no association and six articles found a negative association between WIC participation and breastfeeding duration. Among studies using data before 2009, two found no association [44, 45] and three found a negative association [41, 14, 47]. Among studies including data after 2009, one found no association [42] and three found a negative association [43, 46, 50]. The WIC 2009 food package revision did not appear to reduce disparities in breastfeeding duration, which is supported by Li et al.'s study [29].

WIC Provided Infant Formula

Although Marshall et al. [44] and Sparks [49] both discussed infant formula access through WIC may be factors that lower breastfeeding initiation among WIC participants, only McKinney et al.'s study [45] evaluated formula use in their methods and that variable referred to in-hospital

formula use which is not specific to WIC-provided infant formula. There is a gap in knowledge in evaluating use of infant formula provided by WIC to participants.

Socioeconomic Status

Studies assessing socioeconomic status evaluated either type of health insurance or income relative to poverty threshold. Marshall et al. [44] found that black women are more likely to have Medicaid than private insurance compared to white women. Riley et al. [46] found that socioeconomic status disproportionately affected breastfeeding rates of black mothers to a greater degree than white or Hispanic mothers. Sparks [49] found that black mothers were more likely to work during their pregnancies and had the highest rate of living below the poverty threshold, which is a factor that lowers odds of breastfeeding initiation. McKinney et al. [45] found that black mothers had higher rates of poverty, which mediated differences in breastfeeding initiation compared to white mothers, but did not predict short breastfeeding duration. Overall, low socioeconomic status is associated with poorer breastfeeding outcomes, especially among Black mothers.

Education Level

Education has been evaluated by several studies and may be a contributing factor to differences between mothers. Sonchak [48] and Marshall et al. [44] found conflicting results regarding the likelihood of being high school dropouts or having some college education among black WIC

participant mothers. McKinney et al. [45] found that black mothers were less likely to have a college degree, which is a variable that predicted short breastfeeding duration and mediated the difference in breastfeeding initiation rates compared to white mothers. Riley et al. [46] found that Black mothers were more likely to graduate high school and have some college, but less likely to complete 4 years of college. Jensen [14] found that mothers with increasing educational levels had higher breastfeeding initiation and longer breastfeeding duration. Overall, other studies that stratified data by WIC participation showed that education was generally lower among participants than nonparticipants.

Marriage Status

Marriage status may indicate presence of breastfeeding support from the partner. Sparks[49] found that black mothers had the lowest rate of being married compared to other mothers, which may or may not contribute to differences in breastfeeding outcomes. Marshall et al. [44] found that while black WIC participants had lower rates of being married than nonparticipants, overall, black mothers had lower rates of being married compared to white mothers. However, McKinney et al. [45] found that black mothers were less likely to be married, which predicted short breastfeeding duration and mediated differences in breastfeeding initiation compared to white mothers. Gregory et al. [42] found that mothers who entered WIC while breastfeeding less frequently had significantly lower rates of marriage than mothers who entered WIC while breastfeeding more frequently. Studies that stratified data by WIC participation showed that marriage rates were generally lower among participants than nonparticipants. Jensen [14] found

that mothers who were married were more likely to initiate breastfeeding and continue breastfeeding for longer than mothers who were not married.

Limitations

One of the aims of this study was to assess available data regarding the use of WIC-provided infant formula among WIC participants and how that is associated with breastfeeding initiation and duration. However, none of the included studies evaluated the use of WIC-provided infant formula among WIC participants. Future research evaluating the association between WIC participation and breastfeeding outcomes should collect data regarding WIC-provided infant formula use, socioeconomic status, and breastfeeding education and support.

The number of articles available to address the research question was limited, as only 11 articles were included. Many of the eligible articles that were excluded were due to lack of WIC nonparticipant subjects and not addressing or stratifying data by WIC participation or race/ethnicity that includes non-Hispanic Black. The included studies had variations in measurement of breastfeeding outcomes. For example, some studies measured breastfeeding at discharge or short breastfeeding duration (less than 6 months) instead of breastfeeding initiation or breastfeeding duration. Some studies had relatively low sample size of black mothers compared to the entire sample. Although one inclusion criteria for the articles search included studies being published within the past 10 years from 2020, most of the data used by the articles were up to 2 decades old and may not reflect more recent trends in breastfeeding outcomes.

Many of the studies used data collected before 2009, when WIC revised their food package to promote breastfeeding, so these data are not likely to reflect current breastfeeding outcomes.

Many studies stratified data based on WIC participation for the entire sample but did not stratify by both race or ethnicity and WIC participation. Of the studies that stratified the data by both race or ethnicity and WIC participation, they only specified the percentage of each race or ethnicity within the WIC participation category, and the breastfeeding outcome was an aggregate for the entire WIC participation category. Only two of the included studies stratified breastfeeding data by both race/ethnicity and WIC participation. However, some of the other studies adjusted for covariates which included WIC participation. Future research should stratify breastfeeding data by both variables to illustrate the association of both race/ethnicity and WIC participation on breastfeeding outcomes as well as distinguish between eligible and ineligible WIC nonparticipants.

5.2 Secondary Analysis

Non-Hispanic Black women who were WIC participants, used Medicaid insurance, not married, between 18 and 24 years old, had lower education level, and received late prenatal care had lower breastfeeding outcomes than those who were WIC nonparticipants, used private insurance, married, between 25 and 45 years old, had higher education level, and received early prenatal care.

WIC participants had lower breastfeeding at discharge rates than nonparticipants throughout all of the quarters except one. WIC participants also have lower exclusive breastfeeding rates than nonparticipants throughout all of the quarters (Figure 2.1).

When comparing mothers using different health insurances, mothers using Medicaid insurance had lower rates of breastfeeding at discharge and exclusively breastfeeding than mothers using private insurance throughout all quarters (Figure 2.2). Use of private insurance may indicate higher socioeconomic status, and the insurance is potentially covered by employers from jobs that provide maternal leave.

Mothers who use Medicaid insurance are eligible for WIC. In Figure 3, rates of breastfeeding at discharge were slightly higher among WIC participants than mothers who are WIC eligible for most of the quarters, and the binomial distribution (Table 9) indicate that the difference is significant, thus suggesting that WIC participation may improve breastfeeding rates and socioeconomic status may be the confounding variable that influences the negative effect that WIC participation has on breastfeeding outcomes.

Mothers between the ages of 25 and 45 years old have slightly higher breastfeeding at discharge and exclusive breastfeeding rates than mothers between the ages of 18 and 24 years old (Figure 2.3). The difference in breastfeeding outcomes based on age may be due to experience, as older mothers may have had previous breastfeeding experience with prior infants.

Mothers who were married had much higher rates of breastfeeding at discharge and exclusively breastfeeding than mothers who were not married (Figure 2.4). Married mothers may have higher breastfeeding outcomes due to support from their husbands. McKinney et al.'s [45]

results support this finding as Black mothers generally have lower rates of marriage compared to mothers of other races, and marriage mediated the differences in breastfeeding outcomes. Previous research, including McKinney et al.'s study [45], support the role of the infant's father in improving breastfeeding outcomes.

Mothers with increasing educational levels had increasing rates of breastfeeding at discharge and exclusively breastfeeding (Figure 2.5). Xiang et al.'s study supports this finding as they also found that maternal age and education level contributed to differences in breastfeeding outcomes, and that breastfeeding promotion should be emphasized for women with lower education, less than 25 years of age, and from non-Hispanic black race and ethnicity to improve breastfeeding rates and reduce disparities [52].

Mothers who received earlier prenatal care had slightly higher rates of breastfeeding at discharge and exclusively breastfeeding than mothers who received prenatal care during the second trimester. However, including data for late prenatal care (during third trimester) showed that there is weak association between timing of prenatal care and breastfeeding outcomes. One potential explanation is the inconsistent implementation of lactation education or consultation by midwives, obstetricians, WIC staff, or others whom mothers visit for prenatal care. Brumley et al. supports this finding by explaining that the traditional model of prenatal care of short visits would be inadequate to provide education to sustain behavior changes for optimal breastfeeding behaviors [53].

The t-test (Table 7) showed that there is a significant difference in WIC participation, breastfeeding at discharge, and exclusive breastfeeding between pre-COVID-19 pandemic and during-COVID-19 pandemic times. The Cohen's d effect size was small for WIC participation,

breastfeeding at discharge, and exclusive breastfeeding differences between pre- and during-COVID-19. The t-test evaluating the difference in breastfeeding outcomes between WIC participants and nonparticipants found a significant decrease in breastfeeding at discharge and exclusive breastfeeding. The Cohen's d effect size was a small decrease for both breastfeeding outcomes.

The binomial distribution and phi coefficient (Table 8) showed that during-COVID-19 breastfeeding at discharge significantly decreased for WIC participants and significantly increased for nonparticipants, while during-COVID-19 exclusive breastfeeding was not significantly changed for WIC participants and was significantly increased for nonparticipants. All phi coefficients were closer to 0 than 1, suggesting that there is a weak relationship between breastfeeding outcomes and the COVID-19 pandemic.

Binomial distribution (Table 9) to compare the difference in breastfeeding outcomes between pairs of variables showed that all variables had significantly different breastfeeding outcomes. The phi coefficient (Table 9) evaluated the magnitude of differences in breastfeeding outcomes between variables. Black mothers who were WIC participants, between the age of 18 and 24 years old, had a high school degree or less in education, not married, used Medicaid insurance, and received late (third trimester) prenatal care had lower breastfeeding outcomes. However, all phi coefficients were closer to 0 than 1, so each variable had a weak negative relationship with breastfeeding outcomes. While WIC participation had a relatively weak negative association with breastfeeding outcomes, variables related to education level, marriage status, and insurance type had relatively stronger association with breastfeeding outcomes.

While WIC participation is not strongly associated with lower breastfeeding outcomes, other factors related to differences between WIC participants and nonparticipants, such as educational level, insurance use, and marriage status, may be confounding factors that contribute to the lower breastfeeding outcomes observed among WIC participants. Peer counseling and support have been shown by previous studies to improve breastfeeding outcomes, thus leading to positive deviance among Black women by being able to navigate various barriers to breastfeeding and improve self-efficacy. Although WIC offers peer support to participants, many do not take advantage of the offer [21]. WIC would be able to facilitate the transition of mothers to peer support to improve breastfeeding outcomes among participants [21]. Furthermore, interventions that address barriers to breastfeeding related to low-income, unmarried mothers with low educational levels may facilitate behavior change and positive deviance towards higher breastfeeding rates among Black WIC participants.

Strengths and Limitations

This secondary analysis is one of the few studies available in literature that evaluated breastfeeding outcomes among Black women and WIC participants. Additionally, the inclusion criteria allowed all Black women in Hamilton County above 18 years old who gave birth to be included in the data analysis, thus, the total number of samples was 9,116.

The epidemiological data did not specify WIC eligibility among nonparticipants. One of the independent variables included type of insurance used, and mother's use of Medicaid insurance can infer eligibility for WIC due to the autonomic income eligibility defined by the

USDA [39]. However, the epidemiological data collected did not include information of overlapping independent variables, such as WIC participants who also used Medicaid insurance, thus inference from the data is limited.

The data collected by the epidemiological study was based on mothers' self-report during her hospital stay after birth and before discharge, which is typically within a few days. Given the short time-frame, the breastfeeding exclusivity at discharge is not a useful measurement to reflect overall breastfeeding patterns of black mothers after discharge. However, provision of colostrum during the first few days of breastfeeding postpartum prior to transition to mature breastmilk is beneficial to the infants. Thus, infants in the epidemiological data who were exclusively breastfeed likely received benefits from colostrum.

Unlike previous studies that included demographic variables to examine differences between WIC participants and nonparticipants, the epidemiological data was not available for such a comparison. Thus other variables that may be confounding factors for the association between WIC participation and breastfeeding outcome has limited evidence as the data does not allow for comparisons of other variables that may be more or less associated with WIC participation or nonparticipation. However, the findings based on data from this study were consistent with previous studies.

6. Conclusion

Studies included in the systematic review showed mixed results regarding the association between WIC participation and breastfeeding initiation, but there was a general negative association between WIC participation and breastfeeding duration, especially among Black mothers. Other noteworthy factors that may contribute to low breastfeeding outcomes among Black mothers include regional differences, socioeconomic status, marriage status, and educational level. Based on the secondary data analysis, WIC participation is associated with lower breastfeeding outcomes among Black mothers in Hamilton County. Other factors that may mediate the lower breastfeeding outcomes among WIC participants include Medicaid insurance use, marital status and educational level. The COVID-19 pandemic led to decreased breastfeeding at discharge for WIC participants but increased breastfeeding outcomes for nonparticipants. Future research should evaluate specific factors that differ between WIC participants and nonparticipants and how those factors affect breastfeeding outcomes. The WIC program should be able to implement breastfeeding promotion and support to address the factors that specifically affect breastfeeding among WIC participants to improve breastfeeding outcomes and eliminate the disparity in breastfeeding between WIC participants and nonparticipants as well as between Black women and women of other races and ethnicities.

Note: Throughout the paper the terms 'Black' and 'African American' are used interchangeably although many individuals who fit the US Census description of 'Black or African American' may prefer or identify with one term over the other. References to literature use the term favored by the original text, which in some cases is 'Black or African American' in accordance with the Census terminology.

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