ABSTRACT

Title of Dissertation: STRESSFUL LIFE EVENTS WITHIN 12 MONTHS BEFORE DELIVERY AND EXCLUSIVE BREASTFEEDING AT FOUR AND EIGHT WEEKS POSTPARTUM IN THE UNITED STATES

Olaoluwa Fajobi, Doctor of Public Health, December 2019

Dissertation Chair: Yvonne Bronner, ScD
School of Community Health & Policy

Exclusive breastfeeding (EBF) from birth to six months of age is recommended as the optimal method of infant feeding because it is related to decreased morbidity and mortality. In recent years, EBF rates have climbed steadily in the United States; still only 25% of newborns are exclusively breastfed as recommended by the American Academy of Pediatrics. Multiple risk factors are associated with low EBF rates, but there is a need to evaluate new factors. Stressful life events (SLE), a proxy for stress, is one such novel factor. This study sought to assess association between 14 SLE within 12 months before childbirth and EBF at four and eight weeks postpartum among new mothers in the United States who all breastfed at birth. The study design was cross-sectional and utilized data from the Pregnancy Risk Assessment Monitoring System (PRAMS) collected between 2012 and 2015. The study sample was 16,117 mothers. Majority were 25-34 years old (61.6%); Non-Hispanic Whites (61.2%); and had ≥16 years education (46.4%). EBF prevalence was 57.3% at four weeks and 49.2% at eight weeks. Two-thirds (66.7%) reported at least one SLE. The SLE were grouped into four domains: financial, emotional, partner-associated, or traumatic based on a previous principal component analysis. Cumulative SLE measures (total count of SLE experienced and of domains present) were assessed. Adjusted regression models revealed cumulative SLE, but not individual domains were associated with decreased EBF. At four weeks, individuals with one to two SLE had 10% lower odds (aOR=0.90, 95% CI=0.81-0.99) of EBF compared to those with no SLE. Effect modification was observed only in the less than high school educational category, for cumulative SLE, and financial and traumatic domain. At four weeks, financial domain SLE was associated with 29% lower odds (aOR=0.71, 95% CI=0.52-0.97) of EBF while traumatic domain SLE was associated with 43% lower odds (aOR=0.57, 95% CI=0.35-0.92). To improve EBF rates, public health interventions and policy solutions be directed toward improving the plight of mothers who experience financial and traumatic SLE. In addition, there is need to improve educational attainment if we want to further improve EBF rates for all.

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by

Olaoluwa Adetoyese Fajobi

A Dissertation Submitted in Partial Fulfillment
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has been approved

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List of Abbreviations

aOR .... Adjusted Odds Ratio

BMI .... Body Mass Index

CDC .... Centers for Disease Control and Prevention

CI .... Confidence Interval

EBF .... Exclusive Breastfeeding

OR .... Odds Ratio

PRAMS .... Pregnancy Risk Assessment Monitoring System

SLE .... Stressful Life Events

United Nations Children's Fund .... United Nations Children's Fund

USDHHS .... United States Department of Health and Human Services

WHO .... World Health Organization

Chapter 1: Introduction

Background

The World Health Organization (WHO, 2008) defines breastfeeding as feeding a child with breastmilk, through the breast or expressed, while exclusive breastfeeding (EBF) is feeding a child with only human milk (directly from the mother or a wet nurse or expressed) with no water nor other food supplements offered, except for prescribed medications and oral rehydration solution. Over the years, other types of breastfeeding based on the breastmilk content in an infant's diet have been defined. These include predominant (mostly breastmilk, prescribed medications and oral rehydration solution, with other food-based fluids but no solid food offered) and partial (mixed feeding) breastfeeding (Labbok & Krasovec, 1990; WHO, 2008). However, EBF for a specified period is widely regarded as the gold standard of infant nutrition.

Globally, the United Nations Children's Fund (UNICEF) and WHO recommend babies be breastfed exclusively from birth until six months of age and to continue breastfeeding until the end of the second year of life (WHO, 2003). Worldwide, the EBF rate currently stands at 40% for infants below six months of age, with marked differences across countries and regions (UNICEF & WHO, 2017). While breastfeeding protects against mortality and several morbidities (especially in developing regions) during infancy, it is important to note EBF is consistently associated with the best outcomes. Figure 1 presents the relative risk for infant mortality and morbidities by four breastfeeding patterns based on systematic analysis of published papers by the Lancet

Series on maternal and child undernutrition team. Differences in morbidity and mortality pattern shows that EBF is best especially when compared to no breastfeeding.

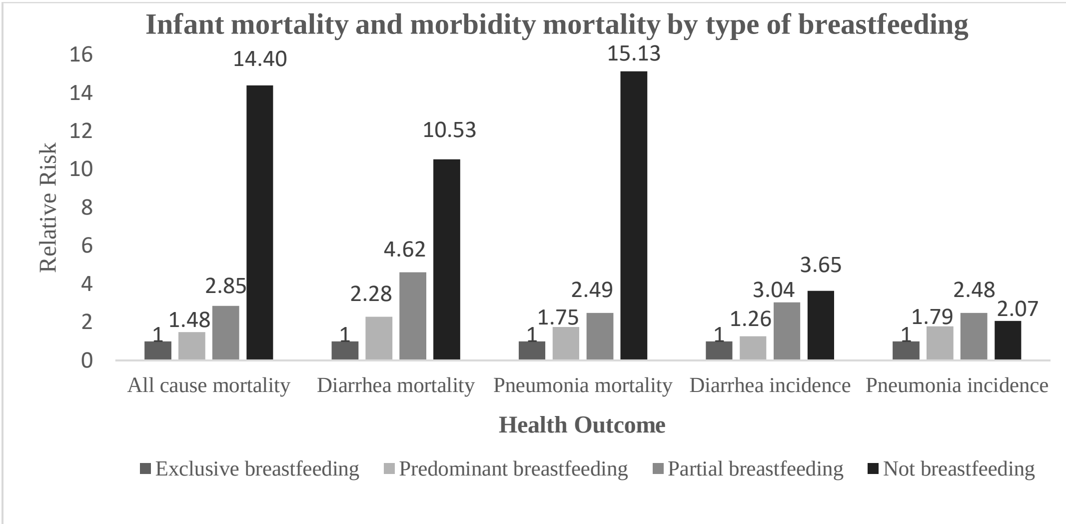

Figure 1. Relative risk of mortality and morbidity by breastfeeding type for infants between birth and five months of age (Black, R.E., Allen, L.H., Bhutta, Z.A., Caulfield, L.E., de Onis, M., Ezzati, M., . . . Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: Global and regional exposures and health consequences. *Lancet*, *371*, 243–260.).

Breastfeeding and Exclusive Breastfeeding Trends in the United States

Although only four out of every 10 infants are exclusively breastfed for six months worldwide, North America (which includes the United States) has the lowest regional prevalence, with only 24% of infants exclusively breastfed for the first half of infancy (UNICEF & WHO, 2017). In the United States, the American Academy of Pediatrics (AAP) recommends new babies be breastfed exclusively from birth until six months of age and continue breastfeeding at least until the end of infancy (American Academy of Pediatrics, 2012). Although breastfeeding rates in the United States have improved over time, they are still below the global level. Figure 2 presents the trends in breastfeeding initiation and EBF at three and six months in the United States.

Despite the popularity of breastfeeding practice at the beginning of the twentieth century, rates declined progressively until the middle of the century, after which it started rising again (Wright, 2001). This re-emergence of breastfeeding has been attributed to a mix of factors including demographic shifts, social movements, and program and policy interventions both nationally and internationally (Wright, 2001). However, in terms of prevalence, EBF lags behind other breastfeeding indicators. Breastfeeding initiation rates in the United States rose from 26.5% in 1970 to 74.2% in 2005 (Grummer-Strawn & Shealy, 2009) and to 82.5% for the 2014 birth cohort (Centers for Disease Control and Prevention, 2017). Unlike other breastfeeding indicators, EBF prevalence was not monitored nationally until the early 2000s. Since it was first monitored, EBF rates have increased over time. Within a decade, it had doubled from 12.1% in 2004 to 24.9% in 2014.

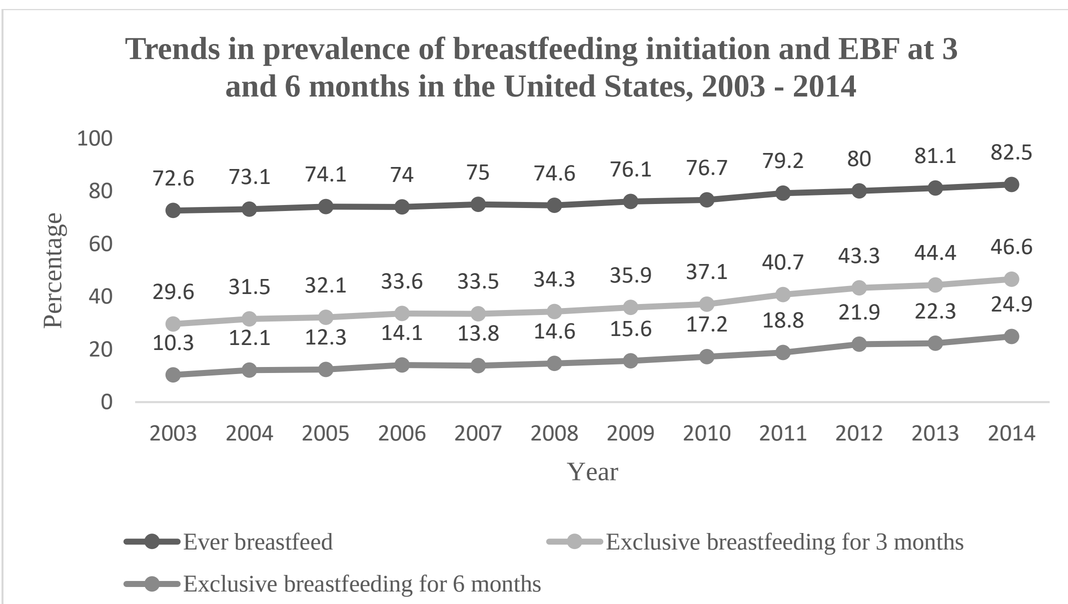

Figure 2. Breastfeeding among United States children born between 2003 and 2014, CDC National Immunization Survey (Centers for Disease Control and Prevention, 2017).

Exclusive Breastfeeding and Healthy People 2020 Goals

One way by which progress in breastfeeding has been monitored is through use of Healthy People goals. Healthy People is an evidence-backed, national strategy for improving population health outcomes over the course of a decade in the United States (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2019a). The most current iteration of this strategy is the Healthy People 2020 goals, with an expected target date of 2020, while plans are underway for the 2030 goals. Health indicators were developed in different topic areas including maternal, infant, and child health (MICH). The overall goal of MICH is to improve the "health and wellbeing of women, infants, children, and families" (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2019a, para. 1). The MICH indicators include five outcome indicators to assess and monitor breastfeeding, with two specifically designed for EBF (MICH-21.4 and MICH-21.5).

The MICH-21.4 indicator refers to the "proportion of infants who are breastfed exclusively through three months," while MICH-21.5 is used to assess the "proportion of infants who are breasted exclusively through six months" (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2019, para. 4). There are an additional nine process indicators also used to monitor breastfeeding progress. The MICH goals baseline (based on year 2006 data) and target values for selected breastfeeding indicators are presented in Figure 3. According to the Breastfeeding Report Card for 2018, the target rates for EBF for three months and six months have been met, currently standing at 46.9% and 24.9%, respectively (CDC, 2018).

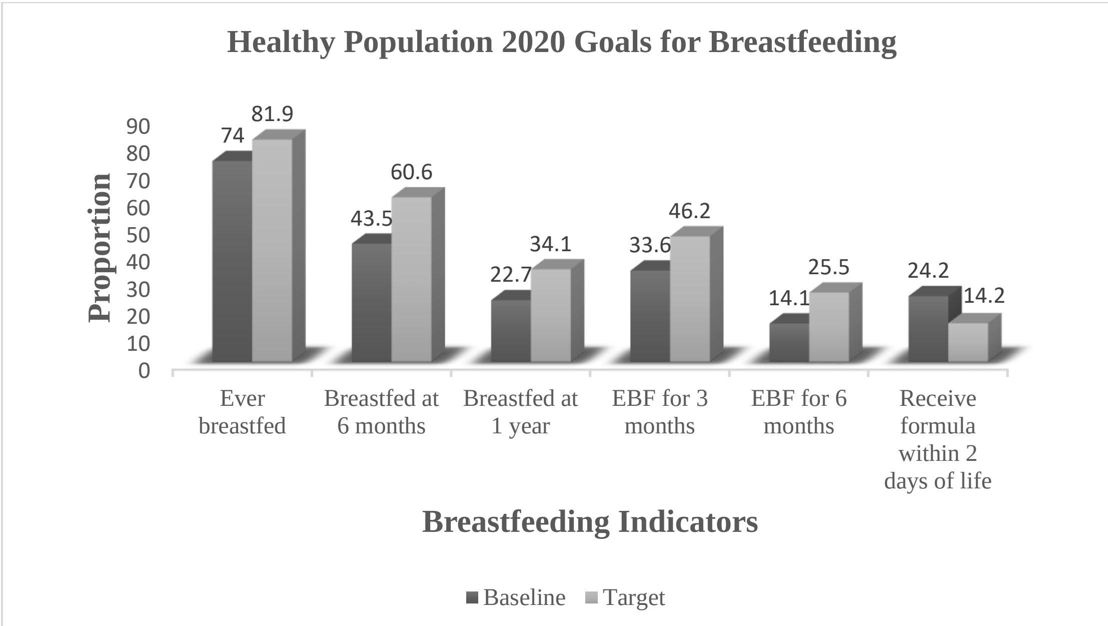

Figure 3. Healthy Population 2020 goals for breastfeeding (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2019a). *Healthy People 2020: Maternal, infant, and child health*.).

Breastfeeding Disparities in the United States

Overall national breastfeeding rates mask notable disparities across the general population. Some of the factors already associated with poor breastfeeding practice includes being of African-American race/ethnic background, younger maternal age, lactation-related challenges such as pain, early return to work, participation in WIC program, and low income level (Anstey, Chen, Elam-Evans, & Perrine, 2017; Centers for Disease Control and Prevention, 2013; Jones, Power, Queenan, & Schulkin, 2015; Santana, Giugliani, Vieira, & Vieira, 2017; Hurley, Black, Papas, & Quigg, 2008; Fein & Roe, 1998; Haider, Jacknowitz, & Schoeni, 2003; Johnston & Esposito, 2007; Mandal, Roe, & Fein, 2010; Ziol-Guest & Hernandez, 2010; Centers for Disease Control and Prevention, 2007).

Breastfeeding, Depression, and Stress

Apart from demographic and socio-economic factors, psychosocial and mental health risk factors of poor breastfeeding have also been documented. One such well-studied example is depression. According to the American Psychiatric Association (2013), depression is a serious health condition which manifests as negative feelings, thoughts, and actions and leads to poor emotional and physical health and productivity outcomes. Prenatal depression describes a depressive episode occurring during pregnancy (Gong, Ni, Shen, Wu, & Jiang, 2015). The prevalence of prenatal depression in the United States was estimated at 17% (Ashley, Harper, Arms-Chavez & LoBello, 2016). Multiple studies identified maternal depression as a predictor of poor breastfeeding outcomes (Figueiredo, Canario, & Field, 2014; Insaf et al, 2011; Kehler, Chaput, & Tough, 2009). Furthermore, evidence suggests depression during pregnancy predicts risk of postpartum depression (Figueiredo, Pacheco, & Costa, 2007; Milgrom et al., 2008). However, several studies have shown a bi-directional relationship between maternal depression and stress (Kinser, Goehler, & Taylor, 2012; Kinser & Lyon, 2014; Lynch, Tamburrino, & Nagel, 1996; Sheline, Gado, & Kraemer, 2003; Warren, 1997; Zayas, Cunningham, McKee & Jankowski, 2002).

Statement of the Problem

While the association between maternal depression and breastfeeding has been extensively studied and remains of continued interest to researchers, relatively little is known about the relationship between preconception and prenatal stress and EBF. Although stress and depression have been shown to be related with each other, they do not characterize the same health condition concept and thus cannot be used interchangeably. Most studies that examined stress and breastfeeding outcomes were conducted in the larger context of a primary focus on depression. Little is known about the independent relationship between preconception/prenatal stress and EBF in the absence of depression. Understanding the relationship between stress preceding child birth and EBF in non-depressed populations could have relevance for improving breastfeeding practice in the United States. Although stress could be measured in a variety of ways, the use of a stressful life events (SLE) tool has been widely utilized as a proxy measure of stress exposure in this study. The SLE approach examines the occurrence of specified life events within a defined period.

In many instances, for analytic purposes life events believed to be measuring the same concept have been grouped into stressor domains (such as traumatic, financial, partner-related, and emotional) using a data-driven process known as principal component analysis. There is evidence to suggest that the relationship between SLE occurring in the prenatal/preconception period and breastfeeding outcomes could differ by domain. This reinforces the need to examine stressor domains instead of relying only on a global assessment of stress exposure. However, assessing the relationship between overall SLE and EBF may also be useful to complement domain-specific perspective for improved understanding of the relationship between stress and EBF. Therefore, examining stress using both a domain-specific as well as a global perspective could offer a more robust understanding of the relationship between prenatal and preconception stress and EBF with application for public health interventions and policy.

Purpose of the Study

The study sought to address this research gap by assessing the relationship between the occurrence of 14 SLE organized into four stressor domains (traumatic, financial, partner-related, and emotional) during the 12 months preceding birth and EBF at four and eight weeks of infancy (two time points that represent monthly milestones along the exclusive breastfeeding continuum in early infancy) among a nearly nationally representative cohort of mothers in the United States. Furthermore, this study operationalized SLE as a total sum of life events as well as an overall burden of SLE domains present (by summing the number of domains in which occurrence of SLE was reported). Therefore, six measures of SLE (four domain types and two cumulative measures) were examined in this study. In addition, the study examined if the relationship between the 14 prenatal SLE and EBF was influenced by levels of selected social determinants of health factors (educational level, income level, and prenatal care utilization). Therefore, the aim of this study was to determine the association between SLE and EBF at four and eight weeks postpartum in the United States, and secondarily assess if the association is moderated by levels of three social determinants of health factors (educational attainment level, federal poverty level, and prenatal health care utilization).

Significance of the Study

Gaining more understanding of the relationship between SLE and EBF could have practice and policy implications. First, findings could be relevant to advocate for and/or enrich policy discussions on potential inclusion of SLE assessment as part of standard preconception and antenatal care practice in the United States. Second, research findings could help ascertain the relative association of different SLE domains on EBF to better understand how these might be addressed in interventions. This could be useful in programs that provide services to individuals and families during prenatal and/or postpartum periods to better identify mothers who start exclusively breastfeeding but are at risk of discontinuing EBF at four or eight weeks. Such programs might include Healthy Start (a federal program implemented across multiple states) and other state/local maternal and child health initiatives.

Lastly, study findings could increase understanding on how SLE exposure within a year before child birth might be addressed in interventions aimed at decreasing EBF disparities that persist in the United States. This is in concordance with one of the research priorities highlighted in the Surgeon General's Call to Action to Support Breastfeeding report, which called for more research to understand and design interventions to decrease breastfeeding disparities in the United States (United States Department of Health and Human Services, 2011).

Summary

Breastfeeding rates in the United States have steadily climbed in the past few decades. However, EBF for six months, which is associated with best outcomes and recommended by leading health agencies, remains low compared to other breastfeeding indicators. Multiple risk factors of poor breastfeeding have been identified while other potential factors such as preconception/prenatal SLE experiences have been relatively understudied. Previous studies that examined relationship on any breastfeeding indicator and any form of stress occurred in the context of depression, an established risk factor for poor breastfeeding. However, the independent relationship between stress and EBF in individuals with no history of depression is relatively unknown. This study sought to address the research gap by determining the relationship between SLE (a proxy for stress) occurring within the 12 months preceding child birth and EBF in early infancy across geographically dispersed states in the United States and to ascertain if the relationship is moderated by levels of social determinants of health factors.

Chapter 2: Literature Review

This chapter presents a review of literature and covers the following topics: (1) benefits of EBF; (2) relationship between demographic/economic factors and breastfeeding; (3) breastfeeding and pre-pregnancy body mass index; (4) breastfeeding and parity; (5) historical perspectives on stress and definitions; (6) stress physiology and pathophysiology; (7); approaches to stress measurement; (8) SLE as a measure of environmental stress exposure; (9) stress and breastfeeding; (10) knowledge gaps; and (11) the theoretical and conceptual frameworks.

Overview of Benefits of Exclusive Breastfeeding

Several studies have shown there are multiple benefits of EBF for infants, mothers, families, and the healthcare system. The benefits include mortality reduction, morbidity prevention, cognitive development, and financial savings.

Mortality reduction. EBF prevents infant child deaths in the United States. Conservative estimates based on only nine causes of mortality in 2014 found 721 infant deaths could have been prevented if 90% of mothers complied with the AAP breastfeeding recommendations (Bartick et al., 2017). Also, findings from a meta-analysis of 18 studies from the United States and a few other countries with a similar level of economic development concluded that any breastfeeding reduced the risk of infant death due to SIDS (OR = 0.55 (95% CI: 0.44, 0.69)) while a greater reduction was observed for exclusively breastfed infants (OR = 0.27 (95% CI: 0.24, 0.31); Hauck, Thompson, Tanabe, Moon, & Vennemann, 2011).

Morbidity prevention. A systematic review and meta-analysis conducted by the Agency for Healthcare Research and Quality (AHRQ) found that exposure to breastfeeding was associated with a decreased risk of several morbidities for babies (Ip et al., 2007). Breastfeeding was found to offer protection against infant morbidities, such as acute otitis media, non-specific gastroenteritis, diarrhea, lower respiratory tract infections, and the risk of obesity that continued into adolescence and adulthood. The estimated protective factor of breastfeeding from these morbidities was strongest for EBF compared to other breastfeeding types.

Cognitive development. Multiple studies conducted in high income countries found being breastfed is associated with improved performance in school subjects (reading, spelling, and mathematics) during childhood and adolescence. Evidence also suggests longer duration of breastfeeding was linked with higher school performance. Although these studies utilized different assessment methods, there was a consistent trend in findings in the United States (Peters, Huang, Vaughn, & Witko, 2013), Canada (Kafouri et al., 2013), Australia (Oddy, Li, Whitehouse, Zubrick, & Malacova, 2011) and Ireland (McCrory & Layte, 2011). Both exposure and longer duration of breastfeeding were beneficial to better educational outcomes in later life.

Financial savings. There is also a financial incentive to exclusively breastfeed. Compliance to breastfeeding recommendations could translate into healthcare cost savings. It was estimated that if 90% of mothers in the United States complied with the American Academy of Pediatrics recommendations, an estimated $17 billion could be saved in healthcare spending annually (Bartick et al., 2017). This estimated value only accounted for direct medical costs and premature deaths. The estimate failed to capture indirect costs such as sick days away from work by caregivers to provide care and the emotional toll on individuals and families for attending to a sick child for an illness that could have been prevented by following EBF recommendations. Families and caregivers also benefit from breastfeeding through direct savings from not having to purchase breastmilk substitutes during the first half of infancy if EBF was practiced.

Relationship between Demographic/Economic Factors and Breastfeeding

National data have shown breastfeeding outcomes in the United States are patterned by levels of demographic and socioeconomic factors. These include race/ethnicity, age, education, and income. Figures 4-7 present the rates by maternal race/ethnicity, age, education, and poverty level for selected breastfeeding outcomes. As shown in Figure 4, EBF at six months lags both breastfeeding initiation and EBF at three months. While the prevalence observed for non-Hispanic White and Hispanic race/ethnic backgrounds are comparable to national levels, Blacks or African-Americans are disproportionately less likely to initiate and exclusively breastfeed at three months and six months of life. The EBF at six months for Whites was almost double the rate observed for African-Americans (27.9% versus 15.0%).

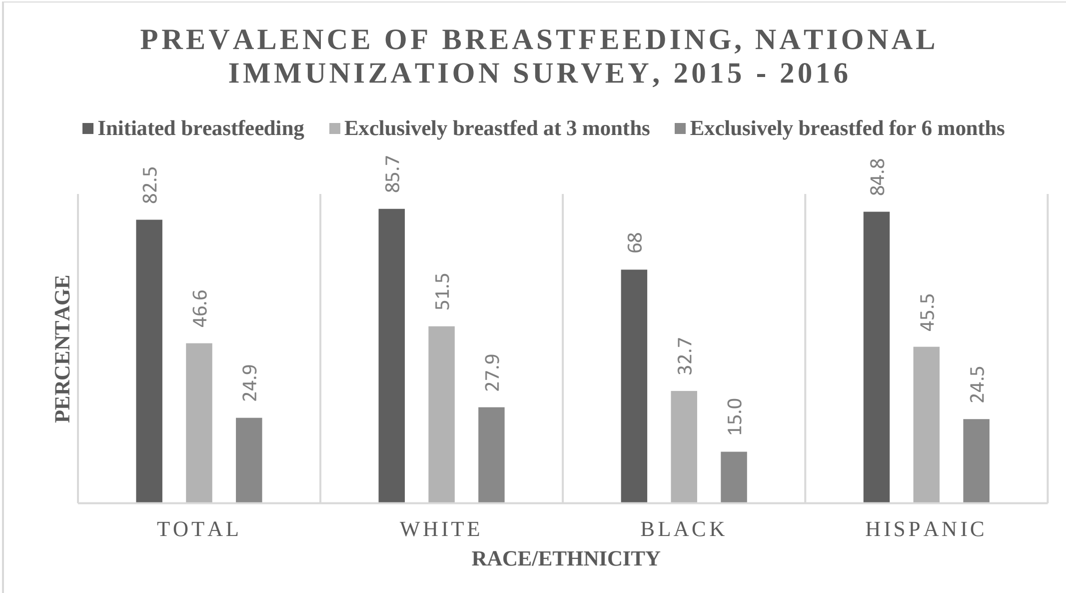

Figure 4. Prevalence of breastfeeding by race/ethnicity, National Immunization Survey, 2015-2016 (Centers for Disease Control and Prevention. (2018). *Breastfeeding among U.S. children born 2009–2014, CDC National Immunization Survey.)*.

There is also a disparity in breastfeeding outcomes by maternal age. As seen in Figure 5, older mothers (defined by age 30 or older) were more likely to initiate and to exclusively breastfeed relative to younger mothers. There was almost a six percentage-point gap in the EBF rate at six months between older and younger women.

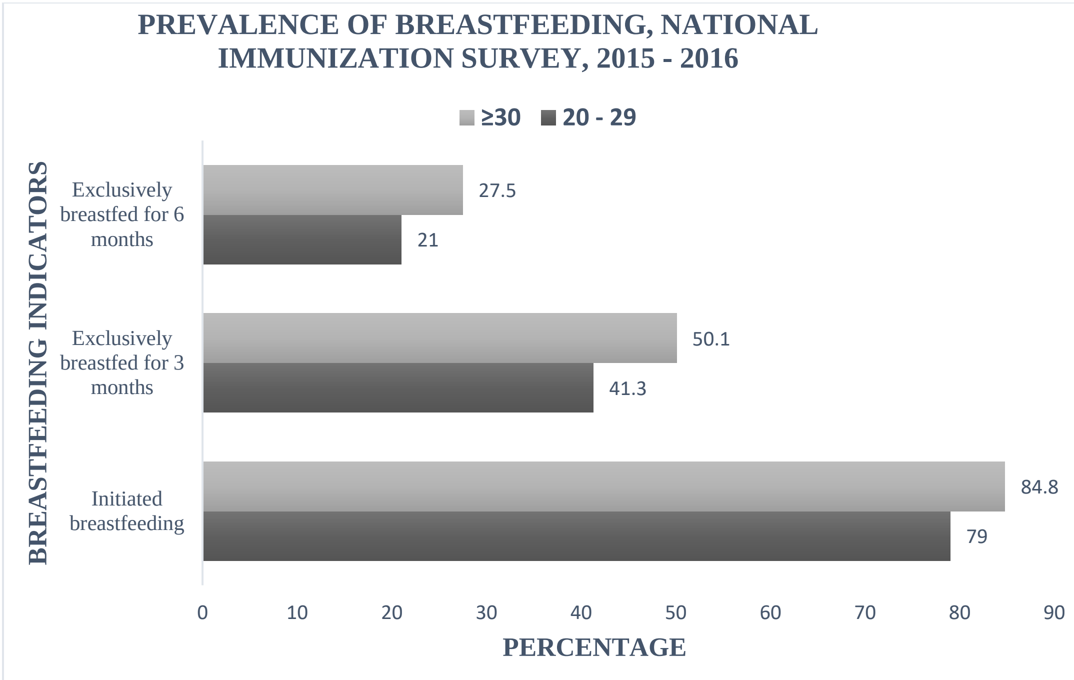

Figure 5. Prevalence of breastfeeding by maternal age groups, National Immunization Survey, 2015-2016 (Centers for Disease Control and Prevention. (2018). *Breastfeeding among U.S. children born 2009–2014, CDC National Immunization Survey*.).

Breastfeeding outcomes also vary with maternal educational attainment. The data presented in Figure 6 shows that those with a college education were more likely to initiate and exclusively breastfeed compared to other educational attainment levels. For EBF at six months, there appeared to be a dose-response gradient with increases observed for each unit increase in maternal educational attainment. There was a 14 percentage-points gap in EBF at six months rate between mothers with less than high school education and those who graduated from college.

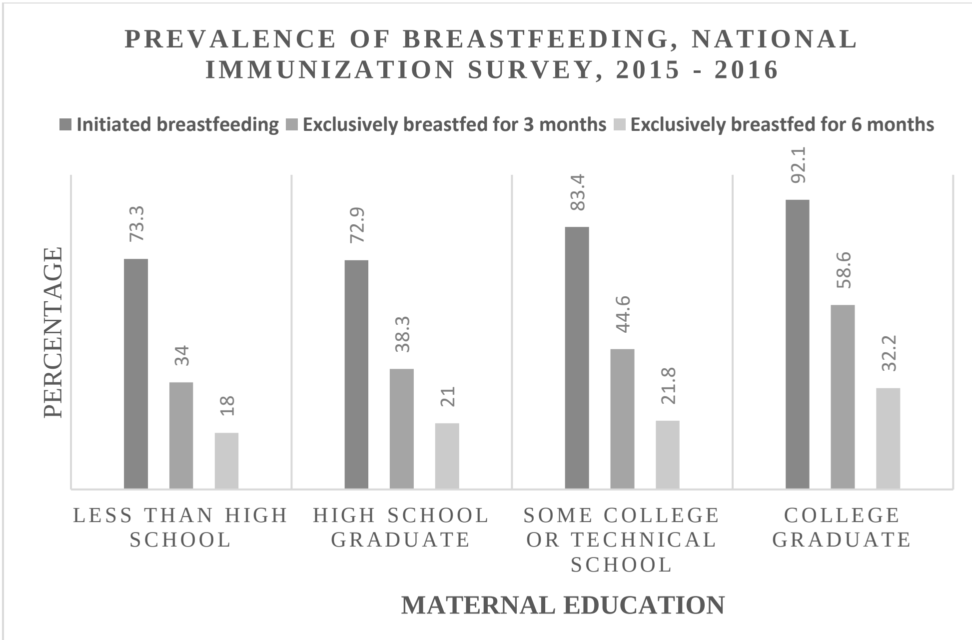

Figure 6. Prevalence of breastfeeding by maternal education, National Immunization Survey 2015-2016 (Centers for Disease Control and Prevention. (2018). *Breastfeeding among U.S. children born 2009–2014, CDC National Immunization Survey*.).

As presented in Figure 7, breastfeeding outcomes are related to affluence. The higher the income above the federal poverty level (a proxy for level of affluence), the greater the likelihood of initiating and exclusively breastfeeding at both three and six months. This largely followed a dose-response gradient, with prevalence of EBF at six months prevalence ranging from 16.4% in the < 100% level to 32.1% in those in the 600% or more federal poverty level category.

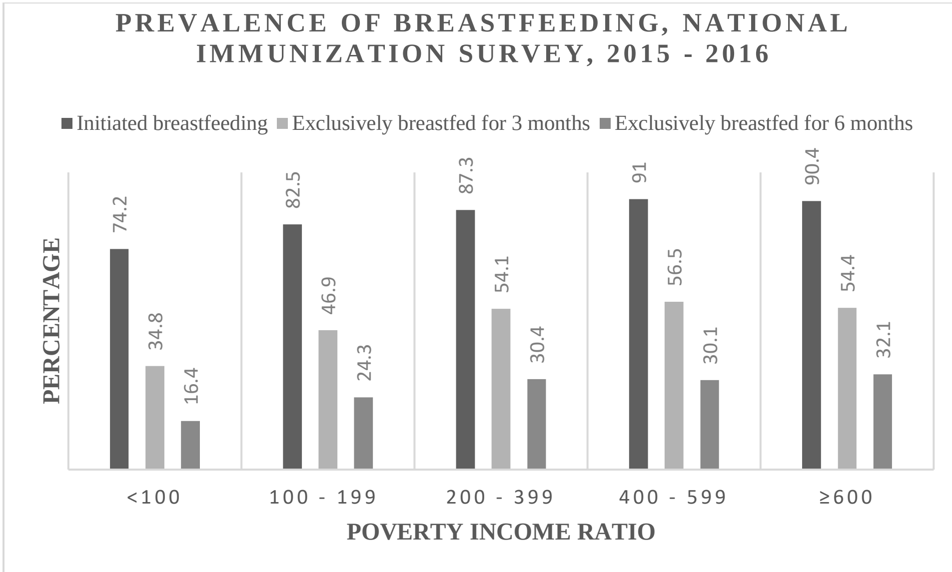

Figure 7. Prevalence of breastfeeding by federal poverty level, National Immunization Survey 2015-2016 (Centers for Disease Control and Prevention. (2018). *Breastfeeding among U.S. children born 2009–2014, CDC National Immunization Survey*.).

Breastfeeding and Pre-pregnancy Body Mass Index

According to 2015-2016 data, 39.8% of U.S. adults are obese with rates slightly higher in females than males (Hales, Carroll, Fryar, & Ogden, 2017). There are also race/ethnic disparities in adult female prevalence, with the lowest rates observed for non-Hispanic Asians (14.8%). The prevalence rate was 38.0%, 50.6%, and 54.8% in non-Hispanic Whites, Hispanics, and non-Hispanic Blacks, respectively (Hales et al., 2017). Entering pregnancy with an overweight or obese status is associated with increased risk of poor obstetric and birth outcomes including gestational diabetes (Torloni et al., 2009), miscarriage, pre-eclampsia, preterm birth, and caesarean delivery (Jarvie & Ramsay, 2010).

Similarly, pre-pregnancy overweight and obesity has also been shown to be related to poor breastfeeding outcomes. Studies have shown a pre-pregnancy obesity status is associated with lower rates of breastfeeding initiation (Modrek et al., 2017) and duration (Averett & Fletcher, 2016). Same trends have been observed for EBF. Findings from the Infant Feeding Practices Study II showed obese mothers had a 29% higher adjusted hazard (HR = 1.29, 95% CI = 1.09-1.53) of earlier cessation of EBF compared to underweight/normal BMI mothers (Hauff, Leonard, & Rasmussen, 2014). Another study among rural White women across New York and Delaware found significantly higher rates of EBF discontinuation in overweight and obese mothers (Hilson, Rasmussen, & Kjolhede, 1997). Overweight and obese women have been shown to have a significantly lower prolactin response to suckling at one week postpartum (Rasmussen & Kjolhede, 2004). Also, delays in lactogenesis II (onset of copious milk secretion) have been found to be higher in obese compared to non-obese individuals (Hilson, Rasmussen & Kjolhede, 2004; Nomsen-Rivers, Chantry, Peerson, Cohen, & Dewey, 2010; Preusting, Brumley, Odibo, Spatz, & Louis, 2017).

In a systematic review, Amir and Donath (2007) documented a variety of anatomical, medical, socio-cultural, and psychological explanations for poor breastfeeding patterns in overweight and obese individuals. Anatomical reasons include difficulties with latching by the baby to the breast (Coates, 1989). Histological changes in adipose tissue as obesity worsened have also been described (Rasmussen, 2007). Medical barriers such as having caesarean section delivery can also interfere with breastfeeding. Having a caesarean section is accompanied with delayed lactogenesis and occurs relatively more frequently in above normal weight mothers compared to normal BMI mothers (Rowe-Murray & Fisher, 2002).

Socio-cultural reasons include embarrassment associated with public feeding (Amir and Donath, 2007), while psychological factors include relatively increased mental health morbidities such as depression (LaCoursiere, Baksh, Bloebaum, & Varnier, 2006). In addition, disparities have been observed by race/ethnicity. Masho, Cha, and Morris (2015) found significant associations between pre-pregnancy BMI and breastfeeding initiation (a necessary condition for exclusivity) in non-Hispanic Whites and African-Americans but not for Hispanics, thus suggesting socio-cultural mechanisms could moderate the relationship between a higher maternal BMI status and breastfeeding in the United States. Another study among Canadian indigenous women reported high levels of breastfeeding despite high levels of overweight and obesity (Vallianatos et al., 2006).

Breastfeeding and Parity

Parity refers to the number of times a woman has ever delivered a live birth. Women who are giving birth for the first time are referred to as primiparas while those who are had previously given birth are known as multiparous mothers. Breastfeeding rates have been demonstrated to differ between primipara and multiparous mothers. Data from the National Immunization Survey for the 2015 birth cohort (CDC, 2018) showed a higher prevalence of EBF for multiparous compared to primipara mothers at (48.2% versus 45.0%) three months and six months postpartum (26.0% versus 23.2%).

Several other studies have reported a similar trend in disparities by parity for breastfeeding initiation and duration (Bourgoin et al., 1997; Dennis, 2002; Grummer-Strawn, Scanlon, & Fein, 2008; Hackman, Schaefer, Beiler, Rose, & Paul, 2015; Haas et al., 2006; Simard et al., 2005). In the study by Hackman et al. (2015), 66% of multiparous mothers compared to 51% of primipara mothers met their breastfeeding goals or were still breastfeeding at six months ($p < 0.001$). In addition, survival ratios for breastfeeding duration were consistently lower at two, four, and six months for primiparas compared to multiparous mothers. First-time mothers usually lack breastfeeding experience prior to having their first child. Multiparous mothers are believed to have self-efficacy from nurturing previous children; these skills could then be applied to a new child (Phillips, Brett, & Mendola, 2011).

Therefore, the breastfeeding experience for the first child could have ramifications for subsequent births, hence raising the potential to shape breastfeeding practice for future births. Being unable to meet breastfeeding goals may affect breastfeeding intention and expectations for future births. The intention to exclusively breastfeed a child or to use breastmilk substitutes and at what time to introduce a feeding choice are part of deliberations usually expected to occur prenatally (Pope & Mazmanian, 2016). Breastfeeding intention is also an important predictor of breastfeeding outcomes such as EBF during the postnatal period (Nelson, Li, Perrine, & Scanlon, 2017). However, decisions about breastfeeding intention and actual breastfeeding during the prenatal period could potentially be influenced by occurrence of SLE before and during pregnancy. This could be particularly important for primipara mothers who are yet to have their first breastfeeding experience compared to multiparous mothers. Findings from a study reported the proportion of mothers who attained their EBF goals was higher for multiparous (38.7%) than for primipara mothers (18.6%) in the United States (Perrine, Scanlon, Li, Odom, Grummer-Strawn, 2012).

Historical Perspectives on Stress and Definitions

The term "stress" originated from the Latin word "stigere" which connotes "to tighten" (Fricchione, Ivkovic, & Yeung, 2016). The Canadian endocrinologist, Hans Selye, was the first to apply the term "stress" to describe a response to a stimulus (later referred to as a "stressor") in living organisms based on findings from animal studies (Selye, 1936). Selye described a concept named general adaptation syndrome (GAS) as the stress response initiated following a threat to normal conditions (Selye, 1936). GAS is comprised of three phases: alarm (perceiving the threat as stressful), resistance (set of coordinated responses to respond to the threat), and exhaustion (process of returning to normalcy). Selye's model initially conceptualized stress as a non-specific response, signaling a common response regardless of the stressor type (Selye, 1956). That understanding has since changed, and the conceptualization of stress has undergone refinements. In recent times, stress has been defined as "experiences that cause feelings of anxiety and frustration because they threaten one's security or push one beyond his/her ability to successfully cope" (McEwen, 2016, p. 56).

Another terminology that has emerged in stress literature over time is "stressor". A stressor is any stimulus present within or outside the body that threatens to disrupt the homeostatic balance (Chrousos, 2009; Fricchione et al., 2016). The current consensus among stress scientists is that the presence or absence of a stressor is no longer sufficient to characterize stress. Stress is believed to involve both the stimulus (stressor) and a cognitive assessment of the seriousness or otherwise of the stressor. The more serious the stressor is perceived to be, the greater the likelihood to trigger responses in both physiological and behavioral domains for an individual (Levine, 2005). Differences in perception to the same stressor can lead to inter-individual differences in response. While some individuals are overwhelmed by the stressor, others are resilient.

Applied to the stress concept, resilience is defined as obtaining a positive result or outcome despite the adversity posed by exposure to a stressor (McEwen, 2016). In resilient individuals, exposure to a stressor results in a "positive adjustment" (Osorio, Probert, Jones, Young, & Robbins, 2017). Therefore, an adaptation to an adverse event in the past serves as a learning experience to prepare a resilient individual for a future exposure to same or similarly related stressors (McEwen, 2016). The quality of the brain architecture is believed to play fundamental roles in shaping the type of adjustment observed in an individual. For instance, adverse early life event exposure is believed to contribute to a poor brain architecture thus limiting the capacity to be resilient and is attended by poor self-esteem and inadequate impulse control (McEwen, 2016; Shonkoff, Boyce, & McEwen, 2009).

Stress Physiology and Pathophysiology

The brain is the primary target of stress and serves as the coordinating center for stress response in the body (Fricchione et al., 2016; McEwen, 2016; Osorio et al., 2017). The specific activities of the brain are at least three-fold, which includes perceiving and deciding how to respond to a stressor, coordinating both physiological and psychological responses, and communicating with multiple body systems such as the immune and cardiovascular systems (McEwen, 2000; McEwen, 2007; Osorio et al., 2017). During stressor exposure, the thalamus sends sensory information to the amygdala in the brain; if this information is interpreted as being threatening in nature, the amygdala then interacts with the paraventricular nucleus located in the hypothalamus (Fricchione et al., 2016). This interaction leads to the secretion of the corticotropin releasing hormone (CRH).

The CRH then acts on the pituitary (also located in the brain) to activate secretion of the adrenocorticotropic hormone (ACTH). The ACTH then travels to the cortex region of the adrenal gland (located just above the kidney) where it acts on the gland to secrete cortisol, the main stress response hormone (Fricchione et al., 2016). The cortisol secreted then moves back to the brain to act on both the hypothalamus and pituitary to initiate physiological modulation of activities as well as a negative feedback to switch off production of cortisol (Fricchione et al., 2016). With repeated episodes or a prolonged stress episode, the elasticity of the negative feedback loop is compromised leading to “allostasis” and “allostatic loading”. Allostasis describes the process by which the body readjusts in a bid to regain homeostatic control following exposure to a “turbulence” provoked by a stressor (McEwen & Gianaros, 2010; Sterling & Eyer, 1988). The process of allostasis entails a reshuffling of priorities in any living organism with the primary goal of neutralizing the stress trigger.

Allostasis, especially when frequently repeated and/or prolonged or in some cases inefficiently processed, imposes a wear and tear on the body, a condition that is referred to as allostatic load. The wear and tear on the body could eventually produce a cascade of undesirable events. Such events could include physiological dysregulation and immunological balance shifts, processes which have been identified as the mechanisms by which stress exposure increases risk of susceptibility to diseases and adoption of behavioral coping strategies (McEwen & Gianaros, 2010; McEwen & Wingfield, 2003). Coping describes the thoughts and activities an individual engages in to manage a stressor deemed by the brain as exceeding available resources (Lazarus & Folkman, 1984; Sperlich & Maina, 2014). In some cases, the coping activity or behavior in response to stress may exacerbate physiological damages via increased allostatic loading.

Approaches to Stress Measurement

Stress measurement could be viewed in terms of exposure to stress as well as the response to stress (Harkness & Monroe, 2016). The former could be likened to the "cause" and the latter to the "effect" (Kopp et al., 2010). Exposure to stress involves a consideration of external conditions producing stress, while the response to stress relates to the internal conditions within an individual as an aftermath of exposure to stress. In stress research, it is important to establish clarity on which aspect of stress is being measured to remove ambiguity and prevent false conclusions. This could also guide the selection of appropriate measurement tools based on the component of stress being assessed in a study.

Traditionally, there are three known approaches to stress measurement documented in literature; these are environmental, psychological and biological (Cohen, Kessler & Gordon, 1997; Kopp et al., 2010). The environmental approach deals with an assessment of life events considered to be potentially stressful. It is deemed to be objective in nature as it relates to direct exposure of an individual to life events (Cohen, Gianaros & Manuck, 2016). The psychological approach is subjective and relies on the perception of an individual to the effect of the stressful event (Kopp et al., 2010). Thus, there could be inter-individual variation even when exposed to the same life events due to differences in coping resources. The biological approach is premised on the notion that exposure to stressful events initiates a cascade of physiological responses (Cohen et al., 2016). Such responses are accompanied by disruption of the homeostatic balance, ultimately leading to changes in physiological components that can then be measured to define stress. Thus, the biological approach relies on measurement of body hormones and physiological function markers such as cortisol, adrenaline, systolic and diastolic blood pressure, and heart rate (Figueroa-Fankhanel, 2014).

Stressful Life Events as a Measure of Environmental Stress Exposure

For several decades, life event tools have been widely used to assess stress exposure beginning with the work of Adolf Meyer in the early 1930s (Cohen et al., 1997). Meyer promoted the use of life charts by physicians during examination of sick individuals as it was believed the stress exposure was not unrelated to the observed deterioration in health status. This spurred research interest in the relationship between environmental stress and physical illnesses. This continued for about two decades and eventually led to the development of the Schedule of Recent Experiences (SRE) tool in the late 1950s, used originally to study health conditions such as tuberculosis (Hawkins, Davies, & Holmes, 1957). A few years later, Holmes and Rahe (1967) revised the SRE to develop the Social Readjustment Rating Scale (SRRS), which arbitrarily assigned values known as life change units (LCU) to each of 43 positive and negative life events. The SRRS became the foundation that shaped most of the existing life event inventories being used by researchers currently.

In the 1970s, the SRRS was used to develop the Life Events Inventory (Cochrane & Robertson, 1973). The Life Events Inventory is a 55-item checklist of stressors, scored on a scale that ranged from 1 to 100. It was developed for use in the general population but was not suitable for use in pregnancy (Newton, Webster, Binu, Maskrey & Phillips, 1979). This shortcoming was addressed and led to the development of the modified Life Events Inventory, a 59-item checklist. Newton et al. (1979) used the modified tool to assess the relationship between psychosocial stress and premature labor. Another iteration of this modified tool with only 33-items was used to determine association between psychological stress and low birth weight (Newton & Hunt, 1984).

Several studies already established a negative relationship between prenatal SLE and multiple maternal and child health outcomes including pregnancy complications (Ahluwalia et al., 2001), gestational diabetes (Hosler et al., 2011), preterm birth (Khashan et al, 2009; Nkansah-Amankra, Luchok, Hussey, Watkins & Liu, 2010), low birth weight (Zhao et al., 2015) and postpartum depression (Latendresse et al, 2015; Liu and Tronick, 2013, Stone et al., 2015). However, the relationship of prenatal SLE to EBF outcomes and the degree to which this relationship could vary by social determinants of health factors in early infancy are relatively understudied.

Stress and Breastfeeding

Stress exposure occurring around pregnancy could exert negative impact on the emotional state and maternal confidence to breastfeed (Dewey, 2001; Lau, 2001). The mechanisms by which stress impacts on lactation is yet to be fully understood but is believed to involve the action of prolactin and oxytocin, two hormones required for breastmilk secretion and ejection respectively (Lau, 2001). Both hormones are also secreted following stress exposure (Altemus, 1995; Neuman, Torner, & Wigger, 2000). Findings from animal studies suggest the lactogenic actions of prolactin and oxytocin could be limited under stressful conditions (Almeida, Yassouridis, & Forgas-Moya, 1994; Grosvenor & Mena, 1967; Lau, 1992). Furthermore, these hormones have also been implicated in the initiation of maternal behavior (Lau, 2001), an indication of the multiple routes by which they could influence breastfeeding. In humans, stress is thought to be capable of suppressing prolactin and oxytocin directly or working through indirect pathways to attenuate maternal behavior (Lau, 2002). In another study, mothers randomized into mental stress (verbal math problems) and noise stress (building construction sound at 70 decibels) groups had significantly lower oxytocin pulses (43% versus 52%) compared to control group, but there were no significant differences in both prolactin and milk yield levels across the three groups (Ueda, Yokoyama, Irahara, & Aono, 1994).

Maternal stress has been shown to be a cause of milk insufficiency which then threatens breastfeeding practice (Hillervik-Lindquist, 1991). Furthermore, a lack of interest in breastfeeding could arise due to emotional disturbances caused by poor coping to stressors (Lau, 2001). In addition, maternal stress may negatively affect the interaction between the mother and the baby. The nature of mother-baby interaction influences milk demand and supply, which in turn could impact on EBF outcomes (Lau, 2001). Evidence also suggests the effect of stress on lactation may differ by type of stressor as well as the duration of the stressor event (Lau, 1992). In a study, milk production was shown to be significantly different based on income levels (a proxy indicator for financial stress). Those who earned an annual income of less than $50,000 were five times more at risk of inadequate milk secretion compared to those who earned at least $50,000 annually (Hill & Aldag, 2005). Decreased milk production has been frequently self-reported during interactions with healthcare providers by mothers who are confronted by SLE (Hill, Aldag, Demirtas, Zinaman, & Chatterton, 2006).

Few available human studies have focused on assessment of stressors during pregnancy and its relationship to breastfeeding outcomes, particularly EBF. A study from Australia found occurrence of SLE in pregnancy was associated with a 34% higher odd of shorter breastfeeding duration after adjusting for several maternal variables (Li et al., 2008). Another study using a convenience sample of only low-income women in the United States found reported stress covering a combined period of pregnancy and early postpartum was related to shorter breastfeeding duration (Dozier, Nelson, & Brownell, 2012). The study by Dozier et al. (2012) focused only on low-income women from a single county in upstate New York, used a relatively small sample size with inadequate power to ascertain true statistically significant associations, and covered life events that occurred both during pregnancy and postpartum. In this study, occurrence of traumatic stress was associated with an almost triple rate of EBF cessation at 13 weeks postpartum, but no significant association was observed for other stress domains at both four and 13 weeks postpartum in adjusted models (Dozier et al., 2012).

Knowledge Gaps

The relationship between preconception/prenatal SLE (a proxy for stress) and EBF is understudied. Several studies that examined the relationship between maternal depression and breastfeeding outcomes adjusted for stress in multivariate models. Furthermore, having depression and stress (two variables already shown to have a bi-directional relationship) included in the same analytic model is common, but conducting new studies in which individuals with diagnosed depression are excluded present a novel opportunity to independently examine the relationship between preconception/prenatal stress and breastfeeding in non-depressed new mothers.

In addition, the relative strength of association between SLE and EBF could potentially differ by stressor domain, hence the need for studies that are examine both overall (cumulative) and specific (individual) domain measures assessing rather than simply relying on a global measurement of stress (used in some studies). Despite the increasing trends of EBF rates in the United States and successes attained relative to the Healthy People 2020 goals, overall rates remain sub-optimal while disparities persist. There is a need to consider studies that focus on ascertaining the relationship between EBF and other least studied additional risk factors besides those already traditionally associated with low breastfeeding rates. Such studies should be conducted using population from across the United States, with potential to assess sub-group differences given the diversity in EBF prevalence in the country.

Other smaller population studies such as Dozier et al. (2012) was based on a convenience sample (thus limiting generalizability) and among a less diverse, predominantly rural population (in a single county in upstate New York) does not reflect the present diversity in the United States. There is a continued need for new studies conducted using nationally-based surveillance data, with participants recruited based on a probabilistic sampling process rather than use of a convenience sample to ensure population inferences can be drawn and attaining a truly diverse population to guarantee representativeness and provide a platform to examine both overall population and sub-groups. This study explores the relationship between 14 prenatal SLE occurring during the 12 months before child birth and EBF outcomes, and to determine if this relationship differs based on levels of key areas of social determinants of health.

Theoretical and Conceptual Framework

Both the Transactional Model of Stress and Coping (TMSC) and Social Determinants of Health framework (SDH) served as the theoretical foundation to guide this study because: (1) as the TMSC schematic representation below indicates, the study participants live in SDH environments where the SLE occur; and (2) their level of appraisal/coping with stressors is measured in this study by the proxy indicator – EBF. The TMSC was first conceptualized through the work of Lazarus and Cohen (1977) and was later refined by Lazarus and Folkman (1984). According to the TMSC, people live in environments where they are exposed to stress. This exposure to stressors (which in this study included 14 SLE) produces two levels of appraisal (primary and secondary). Primary appraisal involves the assessment of the threat (or stressor) while secondary appraisal relates to the assessment of available resources and how to respond towards neutralizing the threat (Glanz, Rimer, & Viswanath, 2008). This is then followed by deploying coping efforts with potential consequences for emotional wellbeing, functional status, and health behaviors (EBF in this study) and outcomes (Glanz et al., 2008). A schematic representation of TMSC is presented in Figure 8.

Figure 8. Transactional Model of Stress and Coping (Guttmann, P. (2016). Illustration of the Transactional Model of Stress and Coping of Richard Lazarus. Retrieved from https://commons.wikimedia.org/wiki/File:Transactional_Model_of_Stress_and_Coping_-_Richard_Lazarus.svg).

The SDH refers to the “conditions in which people are born, grow, live, work and age” (WHO, n.d., para. 1). The conditions in which individuals go through preconception and/or pregnancy could impact on health-promoting behaviors such as EBF practice. The SDH framework places a premium on the physical and social environments in which health behaviors (EBF in this study) and outcomes occur. It deviates from traditional medical models and recognizes resources such as education, income, healthcare, neighborhood quality, and social cohesion as important in shaping observed health patterns. The SDH framework enriches understanding of the resource context (educational attainment status, federal poverty level status, and prenatal care utilization in this study) in which coping strategies are applied to the management of SLE and in relation to the health behavior outcome (EBF practice.) The levels of SDH conditions in which individuals go through preconception and pregnancy is important for decision making on child nurturing activities including infant nutrition choices. It is posited that the available levels of the selected SDH factors (educational attainment status, federal poverty level status, and prenatal care utilization) will moderate the relationship between the 14 SLE and the decision to exclusively breastfeed. Therefore, in addition to the traditional use of education and income measures as confounders, this study will assess the extent to which levels of these SDH factors moderate the relationship between the 14 SLE and the proxy indicator of stress coping (EBF). The schematic presentation of the SDH framework is presented in the Figure 9, and the conceptual model displaying the posited relationship among the study variables is presented in Figure 10.

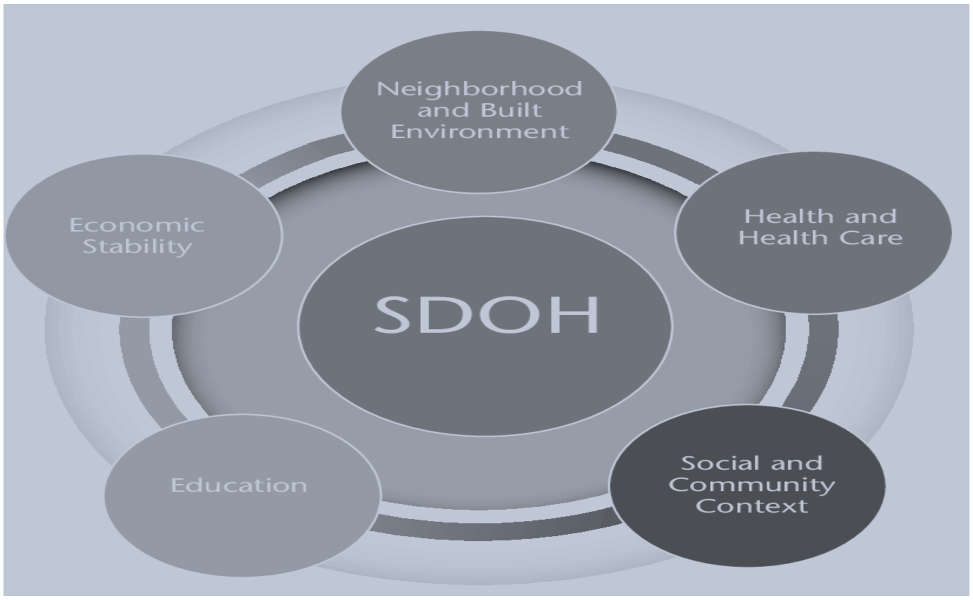

Figure 9. Social Determinants of Health Framework. (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2019b). *Social determinants of health.* Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health).

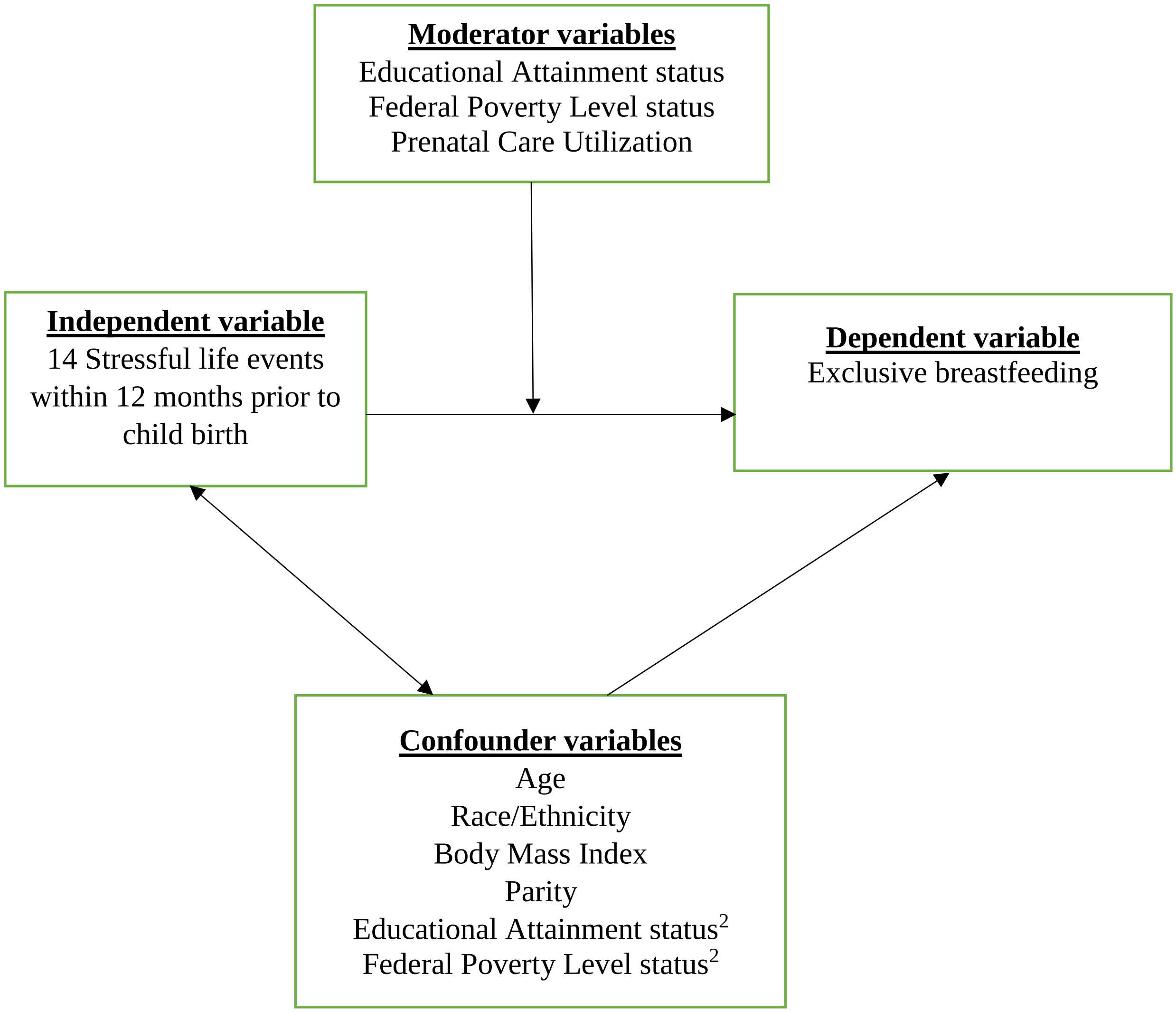

Figure 10. Conceptual Model: The relationship between prenatal stressful life events and exclusive breastfeeding.
[2] Treated as confounder in general analysis and as a moderator in separate analysis

Research Questions

The study utilized data collected in the Pregnancy Risk Assessment Monitoring Survey to assess the following research questions:

- **Research Question 1**: Is there an association between SLE occurring within 12 months before birth and EBF at four weeks among new mothers in the United States?

- **Research Question 2**: Is there an association between SLE occurring within 12 months before birth and EBF at eight weeks among new mothers in the United States?
- **Research Question 3**: Is the association between SLE occurring within 12 months before birth and EBF moderated by social determinants of health factors?

Chapter 3: Methodology

This chapter documents the research methodology approach used in the study. The chapter is divided into sections that include: (1) research hypotheses; (2) study design; (3) data source; (4) description of primary data collection process used to collect PRAMS; (5) data collection instruments; (6) data access; (7) ethical considerations; (8) sample size and power calculations; (8) inclusion and exclusion criteria; and (9) analytical procedure.

This study assessed three research questions and the following hypotheses:

- **Hypothesis$_1$:** Experience of at least one SLE in the financial domain during the past 12 months prior to birth is associated with lower odds of EBF at four weeks postpartum.
- **Hypothesis$_2$:** Experience of at least one SLE in the emotional domain during the past 12 months prior to birth is associated with lower odds of EBF at four weeks postpartum.
- **Hypothesis$_3$:** Experience of at least one SLE in the partner-associated domain during the past 12 months prior to birth is associated with lower odds of EBF at four weeks postpartum.
- **Hypothesis$_4$:** Experience of at least one SLE in the traumatic domain during the past 12 months prior to birth is associated with lower odds of EBF at four weeks postpartum.
- **Hypothesis$_5$:** Higher total SLE count occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.

- **Hypothesis$_6$:** Higher overall SLE burden occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.
- **Hypothesis$_7$:** Experience of at least one SLE in the financial domain during the past 12 months prior to birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_8$:** Experience of at least one SLE in the emotional domain during the past 12 months prior to birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_9$:** Experience of at least one SLE in the partner-associated domain during the past 12 months prior to birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_{10}$:** Experience of at least one SLE in the traumatic domain during the past 12 months prior to birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_{11}$:** Higher total SLE count occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_{12}$:** Higher overall SLE burden occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.
- **Hypothesis$_{13}$:** The association between SLE occurring within 12 months before birth and EBF is moderated by maternal educational attainment.
- **Hypothesis$_{14}$:** The association between SLE occurring within 12 months before birth and EBF is moderated by federal poverty level.

- **Hypothesis15:** The association between SLE occurring within 12 months before birth and EBF is moderated by prenatal care utilization.

Study Design

Secondary data analysis of cross-sectional surveillance data collected annually across several states in the United States. This data was collected by the CDC (working in partnership with state and local stakeholders. For this study, data from a collection of geographically dispersed states was used.

Data Source

The study analyzed data collected as part of the Pregnancy Risk Assessment Monitoring Survey (PRAMS). This is surveillance data of new mothers and babies across several states in the United States and is estimated to cover 83% of all births in the country on an annual basis (CDC, 2018). The focus of the survey is on attitudes and experiences in the preconception, pregnancy, and postpartum periods. The survey was established in 1987 and since then has undergone multiple revisions. Each of the revisions numbered sequentially is referred to as a "phase." The current iteration of the instrument is Phase 8. For this study, the Phase 7 data set which encompassed data collected in 2012, 2013, 2014, and 2015 survey years was used. For Phase 7, the data collected across 36 states and New York City (treated independently apart from New York State) was released by the CDC PRAMS team.

Description of Primary Data Collection Process Used in PRAMS

Annually, each PRAMS state team samples 1,300 to 3,400 new mothers to include in the surveillance data collection. To guarantee adequate representation, there is an oversampling of minority groups and mothers with low birth weight babies (CDC, 2018). Every month, a stratified sample of 100 to 250 mothers was selected from the current birth certificate pool for each state and New York City. The survey provided both telephone-based and mailed-in surveys to new mothers between two and six months postpartum. Individuals selected for participation were sent a pre-letter to inform them about PRAMS and to notify them to be on the lookout for a mailed questionnaire packet. Shortly after, the questionnaire packets were sent with a self-addressed return envelope to facilitate the prompt return of completed questionnaire. Those who did not send the completed questionnaire back were then followed up at two-timed intervals spanning a period of six weeks.

Those who did not eventually respond to mailed packages were then followed up with a phone call two weeks after the last questionnaire was sent (CDC, 2018). The CDC created a tracking platform known as the PRAMS Integrated Data System (PIDS). PIDS provided updated data and reports useful for tracking all aspects of data collection and follow-up activities. Responses obtained from the questionnaire were linked with the birth certificate data for the baby of each selected mother. Appropriate statistical weighting and non-response adjustments were made to ensure the probabilistic assumptions that allowed for generalizing results to the general population of new mothers and babies in the United States were met.

Data Collection Instruments

A standardized questionnaire was developed and used to collect PRAMS data. Questions included in the PRAMS Phase 7 survey were divided into three components:

1) Core questions compiled at the federal level by the CDC team, and included in the survey by all participating states.
2) Standard questions also compiled at the federal level by the CDC team but optional for states to include in their survey questionnaires. Therefore, the inclusion or exclusion of questions in topic domains and/or individual questions in each topic domain varied across states depending on data need of individual states.
3) State developed questions were entirely developed by state teams and were included based on the data need of the state; therefore, variables covered are not available across states.

For the core and standard questions, standardization process for included questions was ensured through the National Center for Health Statistics (NCHS) testing process. The testing process implemented by the NCHS Questionnaire Design Research team involved use of the cognitive interviewing method to ensure each question captured the desired measure. The NCHS team studied different interpretations of individual questions, response errors, and potential for bias among different sub-groups within a diverse national population.

Inclusion Criteria

Participants included in the analysis met the following required criteria: (1) from states that asked questions related to measurement of EBF; (2) had their most recently delivered babies alive at the time of survey administration; (3) non-missing data values for the dependent and independent variables, as well as the confounder and social determinant of health variables. Only nine states and New York City used the variables that defined EBF outcome in the standard questionnaire. Therefore, only participants from the 10 state entities were included in the analytic sample, which were Alabama, Colorado, Georgia, Hawaii, Illinois, Maine, Minnesota, Nebraska, New York State (excluding New York City), and New York City. In addition, based on the skip pattern used in survey administration, only those who initiated breastfeeding in the selected 10 sites could proceed to answer the two questions used to derive duration of EBF. Those who did not initiate breastfeeding were not eligible to answer the two questions.

Exclusion Criteria

Participants were excluded from the analysis if they met one of the following exclusion criteria: (1) diagnosed with depression before pregnancy; (2) with premature babies; (3) with low birth weight babies; (4) with babies that had birth defects.

The AAP developed a different set of recommendations and considerations for breastfeeding premature babies; therefore, mothers with premature babies were excluded. In addition, mothers of low birth weight babies were excluded due to the unique health and nutritional needs of these babies which may have practical implications for EBF compared to healthy term babies. The breastfeeding recommendations used to define EBF in this study applied only to healthy term babies.

Also excluded from the analytic sample were observations who met the inclusion criteria but had missing information for the key study variables.

Advantages of the Data Source

There were a few advantages of using PRAMS data for this study. First, the use of a sample from multiple states presented a potential to assess the research questions and hypotheses in a group of states dispersed geographically as well as provided a unique opportunity to observe any sub-group differences. Findings could have usefulness for generalization both at the national level and for sub-population groups in the United States. Second, for participating states, study participants were drawn from the pool of women with live births using probabilistic-based sampling process, thus the findings are representative for each participating state. Third, PRAMS provides national level surveillance data for maternal and child health indicators on an annual basis, which thus ensures its usefulness for monitoring trends for indicators such as EBF. Similarly, it could be used as a monitoring tool for impact of interventions and policies related to EBF.

Fourth, PRAMS collects data covering multiple stages: preconception, pregnancy, and postpartum, thus raising the potential to obtain a comprehensive profile of a participating individual across multiple life stages instead of a snapshot of a single life stage. This is because of the use of non-concurrent data collection techniques that retrospectively assess events from the past (SLE during the past 12 months). Lastly, PRAMS was collected using a mixed-mode system (Shulman, D'Angelo, Harrison, Smith, & Warner, 2018). This consisted of a self-administered paper survey as well as telephone-based interviewer administered survey for those who did not respond to repeated follow-up to complete the paper survey. This robust approach enhances the overall response rates, especially for certain groups who are less likely to complete a paper survey including adolescents, racial minorities, and those with lowest educational attainment (Shulman et al., 2018).

Limitations of the Data Source

Some of the limitations of the data source included the following: first, data from all participating states were not available. Based on CDC guidelines, only data from states that reached threshold response rates are available for public use access. For the Phase 7 data collection, the threshold was 60% for data collected in 2012, 2013, and 2014, while it was 55% for 2015. This has implications for generalizability of findings to the entire universe of new mothers in the United States for selected survey years. Second, not all states currently participate in PRAMS. Therefore, the non-participation of states with unique population characteristics placed a limit on applying findings from the PRAMS sample to the general population of new mothers in the United States. Third, due to confidentiality concerns, geographical-level information smaller than the state level are excluded from public use access files. Fourth, each state decides on selection of standard and state-developed questions to be included with the core questions in the survey. Thus, the final included questions apart from the core questions are expected to vary among participating states. This could reduce the ability to compare data across states for selected variables of interest.

Independent Variable

The independent variable in this study was SLE. In all a total of 14 SLE were examined in this study. The listing of the individual SLE and the analytical approach used to group the SLE into domains and the way the cumulative SLE measures were determined in this study are presented in this section.

Stressful Life Events. The PRAMS asked new mothers about the occurrence of SLE within 12 months before their most recent child birth. This period potentially allows for examination of events that might have occurred from preconception to child birth. A total of 14 SLE were included in the PRAMS core questionnaire. The 14 included SLE were selected by the CDC from the modified life events inventory (Newton & Hunt, 1984). Although the inventory is made up of 33 life events, the CDC selected only 14 life events to include in PRAMS based on most relevance to pregnancy and birth outcomes.

Participants were asked the following preamble question: “This question is about things that may have happened during the 12 months before your new baby was born. For each item, check No if it did not happen to you or Yes if it did (It may help to look at the calendar when you answer these questions.)” The 14 SLE were: 1) A close family member was very sick and had to go into the hospital; 2) I got separated or divorced from husband or partner; 3) I moved to a new address; 4) I was homeless or had to sleep outside, in a car, or in a shelter; 5) My husband or partner lost his job; 6) I lost my job even though I wanted to go on working; 7) My husband or partner, or I had a cut in work hours or pay; 8) I was apart from my husband or partner due to military deployment or extended work-related travel; 9) I argued with my husband or partner more than usual; 10) My husband or partner said he didn’t want me to be pregnant; 11) I had problems paying the rent, mortgage, or other bills; 12) My husband or partner or I went to jail; 13)

Someone very close to me had a problem with drinking or drugs; 14) Someone very close to me died.

Stressful Life Event Domain. Other studies on SLE that utilized PRAMS data have organized the 14 events into four domains (Ahluwalia, Merritt, Beck, & Rogers, 2001; Burns, Farr, Howards, 2015). This same methodological approach was used in this study. Ahluwalia et al. (2001) used the principal component analysis (PCA) method to determine constructs or domains to group SLE that might be representing identical experiences. The PCA results revealed the SLE loaded on four constructs or domains (emotional, financial, relationship or partner-associated, and traumatic). Loading is an indication of the degree of correlation of individual items with other items in the generated construct. The four domains with the 14 SLE in each domain are presented in Table 1. For this study, the occurrence of at least one SLE in a domain was treated as indicative of a participant experiencing that SLE domain and coded as “Yes.” The occurrence of no event in a domain was treated as that domain not present and was coded as “No.”

Table 1

Organization of Stressful Life Events into Domains

Stressful Life Events domain	Stressful life events in the domain
Emotional	1) Close family member was ill and hospitalized
	2) Someone very close died
Financial	1) Moved to a new address
	2) Lost job though wanted to go on working
	3) Husband/partner lost job
	4) Husband/partner or participant had cut in work hours or pay
	5) Had problems paying rent, mortgage or other bills
Partner-associated	1) Separated/divorced from husband/partner
	2) Argued with husband/partner more than usual
	3) Husband/partner did not want pregnancy
	4) Apart from husband/partner due to work-extended travel
Traumatic	1) Homeless or had to sleep outside, in a car, or shelter
	2) Husband/partner or participant went to jail
	3) Someone very close had a problem with drinking or drugs

Overall stressful life event burden. To assess if the number of SLE domains reported by individuals was associated with EBF, an overall measure of SLE domains was computed. This measure was based on the sum of the number of domains in which individuals reported occurrence of one or more SLE based on an analytic method previously used on PRAMS data by Wilson, Dyer, Latendresse, Wong, and Baksh (2015). A “No” response to SLE in all four domains was given a value of “0.” A “Yes” response to any SLE in only one domain was given a value of “1,” while a “Yes” response in two domains was given a score of “2.” A “Yes” response in three domains was given a score of “3,” and a “Yes” response in four domains was given a score of “4.”

The score of “0” signified no SLE burden, while a score of 4 represented the highest overall SLE burden level, and a score of 1, 2, and 3 represented increasing levels of overall SLE burden. For more meaningful analyses and interpretation, the overall domain burden was categorized into: no burden (for those with a score of “0”), one domain burden (for those who had a score of “1”), and two or more domain burden (for those with a score of “2”, “3” or “4”).

Total stressful life event count. Based on the answers provided to each event, a total stressful life event count was computed corresponding to the number of events where a participant answered “Yes” to the question on if the event occurred in the 12 months preceding child birth. The count score ranged from a value of “0” for individuals who did not experience any of the 14 SLE to a value of “14” for individuals who experienced all 14 events. The count score was then categorized into: no event (for those with a score of “0”), one to two events (for those with a score of “1” or “2”), and three or more events (for those with scores ranging from “3” to “14”).

Dependent Variable

The dependent variables for this study were EBF at four weeks and eight weeks postpartum. The question items used to define EBF in PRAMS were as follows: “How old was your new baby the first time he or she drank liquids other than breast milk (such as formula, water, juice, tea, or cow’s milk)?” and “How old was your new baby the first time he or she ate food (such as baby cereal, baby food, or any other food)?” These two questions were only administered to those who initiated breastfeeding. Those who did not initiate breastfeeding were ineligible to answer the two questions. The length of EBF was determined by the earliest time (in weeks) the child was offered drink or food apart from breastmilk. Those who reported breastfeeding at four and eight weeks and had not offered any liquid other than breastmilk and/or food were treated as EBF at four and eight weeks, respectively.

Other Variables

Other variables were included in the analytical process are: maternal age, race/ethnicity, education, annual household income, pre-pregnancy BMI, parity, and prenatal care utilization. These variables were included as confounders and/or moderators in this study.

Maternal Age. Information on age of participants was included in the birth certificate data that was shared. The age was categorized in the shared dataset as follows: less than 18 years, 18–19 years, 20–24 years, 25–29 years, 30–34 years, 35–39 years, and 40 years or older. During analysis, the seven categories were collapsed into these five categories: less than 20 years, 20–24 years, 25–29 years, 30–34 years, and 35 years or older.

Maternal Race/Ethnicity. A total of 11 race categories were utilized in PRAMS. These were as follows: White, Black, American Indian, Chinese, Japanese, Filipino, Hawaiian, Other Non-White, Alaskan Native, Other Asian, and Mixed Race. In addition, a separate ethnicity question was asked to determine if the participant was Hispanic/Latino or not. For this study, the race and ethnicity variables were combined to generate a new race/ethnicity variable with categories as follows: Hispanic; White, Non-Hispanic; Black or African-American, Non-Hispanic; and Others. This race/ethnicity combination has been used in several studies and publications including those based on CDC datasets.

Maternal Educational Attainment. Maternal educational attainment data was collected in the birth certificate. The years of maternal education were categorized as follows: 0-8 years, 9–11 years, 12 years; 13–15 years, and 16 years or more. For the study, educational attainment was categorized as less than 12 years, 12 years, 13–15 years, and 16 years or more.

Annual Household Income. Data on household income in the past year was obtained using the question: "During the 12 months before your new baby was born, what was your yearly total household income before taxes?" The data was used to compute the federal poverty level (also known as poverty-income ratio), which provided a standardized approach to compare the income for the study sample across different study years in a manner that is adjusted for annual inflation and living conditions that varied by state of residence. The federal poverty level also accounts for household size that varied by participant. Data on the number of dependents on the income was collected using the question: "During the 12 months before your new baby was born, how many people, including yourself, depended on this income?" Both the income and number of dependents data were combined to generate the federal poverty level. In this study, the federal poverty level classification used by the CDC in annual breastfeeding reports was adopted. The categories from lowest (most poor) to highest (most affluent) were as follows: less than 100%, 100%–199%, 200%–399%, 400%–599%, 600% or more.

Pre-pregnancy Body Mass Index (BMI). Participants in PRAMS were asked to self-report their weight and height values prior to their last pregnancy. The reported values were used to derive the pre-pregnancy BMI values in kg/m^2. This was then categorized into BMI groupings based on the WHO cut-off points for BMI. The BMI groupings were as follows: normal weight for BMI values between 18.5 and 24.9, underweight for BMI values less than 18.5, overweight for BMI values between 25.0 and 29.9, and obese for BMI values of 30.0 or more.

Parity. Participants were asked about the number of previous live births with responses recorded in the birth certificate. Parity status was categorized as none for first time mothers (primiparas) and one or more (multiparous mothers).

Prenatal Care Utilization. Prenatal care utilization was assessed using the Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index. The APCNU Index measure combines data on when prenatal care commenced, the number of prenatal care visits, and the gestational age (Kotelchuck, 1994). In this study, prenatal care utilization was used as a proxy measure for health and health care status (one of the components of social determinants of health). The APNCU Index were categorized from most undesired to the most desired level and is displayed in Table 2.

Table 2

Description of the Adequacy of Prenatal Care Utilization Index (Adapted from Kotelchuck, 1994)

APNCU Index Categories	Description of category
Inadequate	Prenatal care begun after the 4th month or less than 50% of recommended visits received
Intermediate	Prenatal care begun by the 4th month and 50%–79% of recommended visits received
Adequate	Prenatal care begun by the 4th month and 80%–109% of recommended visits received
Adequate Plus	Prenatal care begun by the 4th month and 110% or more of recommended visits received

The PRAMS birth certificate data already generated the Kotelchuck Index for the analytic sample using the four categories: Inadequate, Intermediate, Adequate, and Adequate Plus. These categories were used (as pre-computed by the PRAMS analytical team) in this study.

Statistical Analyses

Data were analyzed using STATA Version 13.0 software (Stata Corp, College Station, Texas). Due to the complex study design used for PRAMS, the specified survey weight commands provided by PRAMS was first used to set up the analysis, with use of the “svy” set of commands, before performing statistical analyses. The following steps were performed in sequential order:

Preliminary data inspection. This included checking for missing data. Appropriate statistical commands were used to obtain the count of each variable of interest as well as assess the percentage of missing data. The percentage of missing data in the available dataset after exclusion criteria were applied for study variables were all below 5%. Case-wise deletion was applied to missing data, in which those with missing data for any of the study variables were dropped from data analysis.

Exploratory data analysis. Exploratory data techniques were used to assess the distribution of study variables. This included box plots and scatter plots.

Bivariate analysis. Pearson's chi-square test of independence was used to assess the bivariate relationship between EBF and individual SLE, SLE domains, socio-demographic, economic, pre-pregnancy BMI, and other selected variables. EBF outcomes was dichotomized as Yes (for those who reported breastfeeding) and No (for those who did not breastfeed).

Regression analysis. Both unadjusted (for univariate) and adjusted (for multivariate) logistic regression models were used to test the research hypotheses. The measure of association used was the prevalence odds ratio (a form of odds ratio appropriate for a prevalence study where both exposures and outcomes variables were measured at the same time). Interaction term and stratified analysis were also used to assess effect modification for selected social determinants of health factors.

Sample Size and Power Calculations

Sample size was calculated using STATA Version 13 with the following command: power twoproportions 0.46 0.414, test(chi2) power (0.9).

The following assumptions were implied:

Type 1 error for the proposed study was set at 5% level of significance (or $p<0.05$).

Proportion of EBF for eight weeks for those without SLE was assumed to be 0.46 (use of the 12 weeks EBF proportion value based on previously published CDC data).

For purposes of this calculation, it was hypothesized there was a 10% decrease in proportion of EBF in the presence of SLE, yielding a value of 0.414.

Power was set at 90% (or a Type 2 error value of 0.1).

Therefore, a total sample size of 4,884 (or 2,442 in each group, those with no stressors and those with stressors, respectively) was calculated. A minimum of 4,884 participants was expected to be included in the study. However, the study utilized a total of 16,117 participants, that were available after exclusion criteria were applied and missing data deletion were concluded.

Human Subjects Considerations

For the original data collection, the CDC Institutional Review Board (IRB) provided IRB approval for the data collection. Individual state/non-state entities obtained IRB approval from a federal IRB. Selected participants were required to complete a written informed consent as part of data collection activity. Verbal consent was obtained for interviews conducted by phone. Data handling and analytical procedures used were included in the proposal submitted to the CDC in order to access PRAMS data. The data file was deleted at the end of the dissertation. A written confirmation was submitted to the PRAMS team in accordance with CDC guidelines.

Although this study involved access to only de-identified data with no contact with human subjects, an IRB application was submitted to the Morgan State University IRB in compliance with research guidelines. Based on the existing classification system, this study was classified under the exempt category since it was based on secondary analysis of a dataset that had been previously collected in a manner that was consistent with ethical considerations for primary data collection. Ethical approval was obtained from the Morgan State University IRB prior to data handling and analysis.

Data Access

To request access to the PRAMS data, a proposal was submitted to the CDC in accordance with stipulated guidelines for seeking approval to access the released PRAMS data for the survey years 2012 to 2015. Following the approval process, data from the core questionnaire and birth certificate variables were provided. Also, the proposal requested other specified variables of interest in the standard questionnaire to gain access to the data for these additional variables. Access was also granted to all requested standard questionnaire variables. The data sharing was done using a prepared CD-ROM that was mailed by CDC.

Research Questions and Hypotheses

This study sought to determine the relationship between each identified stressor domain as well as total life event count and overall SLE burden and EBF among new mothers at both four and eight weeks postpartum in the United States. In all, this study examined three research questions and 15 hypotheses utilizing secondary data from the PRAMS surveillance data for years 2012, 2013, 2014, and 2015.

Chapter 4: Results

This chapter presents the results of the statistical analyses performed on the Pregnancy Risk Assessment and Monitoring System collected by the CDC. Only data from four years (2012, 2013, 2014, and 2015) were included in the analysis. Five types of statistical analyses were conducted. First, the study sample was described using frequencies and weighted percentages. Second, Pearson chi-square (X^2) test was used to compare prenatal SLE exposure, socio-demographic and economic, nutritional status, and healthcare utilization during pregnancy with EBF at two postpartum time points (four and eight weeks). Both time points were treated as independent, separate cross-sectional analysis.

Third, multiple logistic regression was performed to determine the relationship between prenatal SLE organized by (a) domains, (b) total count, and (c) overall burden (based on summation of domains present for each individual) and EBF at each of four and eight weeks postpartum, after adjusting for covariates (maternal age, maternal educational attainment, maternal race/ethnicity, parity status, federal poverty level, body mass index, and prenatal care utilization). Fourth, interaction term modeling was used to assess effect modification on the relationship between SLE and selected social determinants of health factors (maternal educational attainment, federal poverty level, and prenatal care utilization). Fifth, stratified analysis was performed for selected categories of maternal educational attainment based on evidence of effect modification from the interaction term modeling.

Exclusions

The released PRAMS dataset for years 2012, 2013, 2014, and 2015 was comprised of a total population of 137,625 from 37 states. Out of this population, a total of 121,508 were excluded from the study due to a variety of reasons. First, states which did not collect data on variables used to derive EBF were excluded. A total of 27 states (n = 106,346) were excluded. Therefore, data from only 10 states (including New York City, treated as a separate state entity from the rest of New York State) with a population of 31,279 were available for final inclusion into the analytic sample. After inspection of missing data, a total of 15,162 observations were excluded from the final analytic sample due to missing data on selected study variables using a listwise deletion process.

The observations excluded were as follows: history of depression (n = 3,167), baby alive (n = 641), premature baby (n = 4,854), low birth weight baby (n = 2,306), baby born with defect (n = 285), thus yielding a SLE (n = 552), maternal race (n = 102), maternal ethnicity (n = 171), maternal educational attainment (n = 109), maternal body mass index (n = 927), parity (n = 176), Kotelchuck Index (n = 346), and federal poverty level (n = 1,526). After these exclusions were made, the final analytic sample was 16,117 new mothers from 10 state entities who initiated breastfeeding. New mothers who did not initiate breastfeeding were automatically excluded due to skip pattern used for the survey questions. The numbers by state are presented in Table 3.

The independent sample *t*-test and Pearson Chi-square analyses were used to compare the socio-economic characteristics of the included sample and the excluded sample due to missing cases. When compared to the included sample, excluded participants were more likely to be younger (*p* = 0.000) and be a primipara mother (*p* = 0.000) but less likely to have a high median annual household income (*p* = 0.000) or a college education (*p* = 0.000).

Table 3

Descriptive Statistics of Study Sample States, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

State	N	%^{A}
Alabama	849	5.27
Colorado	1,736	10.77
Georgia	370	2.30
Hawaii	2,580	16.01
Illinois	2,445	15.17
Maine	947	5.88
Minnesota	1,308	8.12
Nebraska	3,067	19.03
New York State	987	6.12
New York City	1,828	11.34
Total	16,117	100.00

Note: ^{A}Unweighted percentage

Primary Dependent and Independent Variables of Interest

The descriptive characteristics of the study sample are presented in Tables 4 and 5. At four weeks postpartum, 57.3% breastfed exclusively, while at eight weeks postpartum, only 49.2% breastfed exclusively. The prevalence of individual SLE in the 12 months preceding child birth varied from 1.2% for being “homeless or had to sleep outside in a car, or in a shelter” to 17.8% for “argued with husband/partner more than usual” and to 29.9% for “moved to a new address.” For the total SLE count, 33.3% had no event, 43.7% had one to two events, while 23% had three or more events. By SLE domain, the prevalence ranged from 9.8% for traumatic domain to 47.6% for financial domain. For the overall SLE domain burden; 33.3% had no burden, 35.9% had one domain burden, and 30.8% had two or more domain burdens present. The prevalence for double and triple combinations of domains are also presented.

Univariate Analysis of Demographic, Economic, and Stressful Life Event Variables

In the sample population, 61.2% were White, and 32.0% were between 30 and 34 years old. Also, 46.4% had 16 or more years of education, and 42.7% were having their first baby (primiparas). The majority had a normal BMI (53.9%), while 27.2% had a federal poverty level less than 100. Half of the sample population had adequate prenatal care utilization based on use of the Kotelchuck Index (see Table 4).

Table 4

Descriptive Statistics of the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

Variable	**N**	**%[B]**
Demographic and Socio-Economic Factor:		
Age		
Less than 20 years	737	3.30
20 to 24 years	2,809	16.50
25 to 29 years	4,801	29.60
30 to 34 years	4,978	32.00
35 years or older	2,792	18.60
Educational Attainment		
Less than 12 years	1,371	8.60
12 years	3,097	17.80
13 to 15 years	4,550	27.20
16 years or more	7,099	46.40
Race/Ethnicity		
White	8,831	61.20
Hispanic	1,566	13.30
African-American	1,375	10.50
Others	4,345	15.00
Parity		
Primipara	6,940	42.70
Multiparous	9,177	57.30
Federal Poverty Level		
Less than 100	4,635	27.20
100 to 199	3,551	19.90
200 to 399	3,286	19.00
400 to 599	1,505	7.90
600 or more	3,140	26.00

(continued)

Table 4

Descriptive Statistics of the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

Variable	**N**	**%[B]**
Nutritional Status:		
Body Mass Index (kg/m^2)		
Underweight	610	3.90
Normal	8,704	53.90
Overweight	3,871	24.10
Obese	2,932	18.10
Health Care Use:		
Prenatal Care Utilization		
Inadequate	1,580	9.40
Intermediate	2,476	13.70
Adequate	7,978	50.00
Adequate Plus	4,083	26.90
Exclusive breastfeeding:		
Exclusive breastfeeding at 4 weeks		
No	6,485	42.70
Yes	9,632	57.30
Exclusive breastfeeding at 8 weeks		
No	7,882	50.80
Yes	8,235	49.20

Note: [B]Weighted percentage
Percentages should add up to 100 within each category

Table 5

Descriptive Statistics of Stressful Life Events in the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

Variable	**N**	**%[A]**
Stressful Life Events:		
Someone very close died		
No	13,655	84.90
Yes	2,462	15.10
Someone very close had a problem with drinking or drugs		
No	14,695	92.00
Yes	1,422	8.00
Got separated or divorced from husband or partner		
No	15,311	95.00
Yes	806	5.00
Close family member was sick and had to go to hospital		
No	12,645	78.30
Yes	3,472	21.70
Husband/partner or myself went to jail		
No	15,751	98.10
Yes	366	1.90
Husband/partner lost job		
No	14,638	90.40
Yes	1,479	9.60
Moved to a new address		
No	11,046	70.10
Yes	5,071	29.90
Husband/partner or myself had a cut in work hours or pay		
No	13,613	85.10
Yes	2,504	14.90
Husband/partner did not want pregnancy		
No	15,301	95.10
Yes	816	4.90
Lost job even though wanted to go on working		
No	14,868	91.90
Yes	1,249	8.10

(continued)

Table 5

Descriptive Statistics of Stressful Life Events in the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

Variable	**N**	**%[A]**
Had problems paying rent, mortgage, or other bills		
No	13,599	84.80
Yes	2,518	15.20
Argued with husband/partner more than usual		
No	13,203	82.20
Yes	2,914	17.80
Apart from husband/partner due to work extended travel		
No	15,288	95.60
Yes	829	4.40
Homeless or had to sleep outside, in a car, or in a shelter		
No	15,895	98.80
Yes	222	1.20
Total Stressful Life Events Count, Grouped		
No event	5,254	33.30
One to Two events	7,042	43.70
Three or more events	3,821	23.00
Stressful Life Events Domain:		
Financial Stressful Life Event Domain		
No	8,322	52.40
Yes	7,795	47.60
Emotional Stressful Life Event Domain		
No	11,688	72.50
Yes	4,429	27.50
Partner-associated Stressful Life Event Domain		
No	12,012	75.40
Yes	4,105	24.60
Traumatic Stressful Life Event Domain		
No	14,396	90.20
Yes	1,721	9.80

Note: [A]Weighted percentage
(continued)

Table 5

Descriptive Statistics of Stressful Life Events in the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

Variable	**N**	**%**[A]
Overall Stressful Life Event Burden		
No domain	5,254	33.30
One domain present	5,738	35.90
Two or more domains present	5,125	30.80
Stressful Life Events Domain Combinations:		
Double Combinations:		
Financial X Emotional		
No	13,644	85.00
Yes	2,473	15.00
Financial X Partner-associated		
No	13,320	83.30
Yes	2,797	16.70
Financial X Traumatic		
No	14,858	93.10
Yes	1,259	6.90
Emotional X Partner-associated		
No	14,725	91.40
Yes	1,392	8.60
Emotional X Traumatic		
No	15,353	95.60
Yes	764	4.40
Partner-associated X Traumatic		
No	15,190	94.80
Yes	927	5.20
Triple Combinations:		
Financial X Emotional X Traumatic		
No	15,538	96.80
Yes	579	3.20
Financial X Emotional X Partner-associated		
No	15,099	93.80
Yes	1,018	6.20

Note: [A]Weighted percentage
Percentages should add up to 100 within each category

Table 5

Descriptive Statistics of Stressful Life Events in the Study Sample, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

Variable	**N**	**%[A]**
Emotional X Traumatic X Partner-associated		
No	15,687	97.60
Yes	430	2.40
Financial X Traumatic X Partner-associated		
No	15,356	95.80
Yes	761	4.20

Note: [A]Weighted percentage
Percentages should add up to 100 within each category

Bivariate Analysis of Research Variables

Tables 6 and 7 present results of the bivariate relationship between demographic and socio-demographic profile and SLE occurring in the 12 months before child birth and EBF outcome at each of four and eight weeks postpartum. These results showed a statistically significant association between EBF at four weeks and financial SLE domain (p = 0.0000), partner-associated SLE domain (p = 0.0001), traumatic SLE domain (p = 0.0063), but not associated with emotional SLE domain (p = 0.5871). EBF at four weeks was also significantly associated with overall SLE burden (p = 0.0000), total SLE count (p = 0.0000), maternal age (p = 0.0000), educational attainment (p = 0.0000), race/ ethnicity (p = 0.0000), parity (p = 0.0002), federal poverty level (p = 0.0000), pre-pregnancy body mass index (p = 0.0000), but not with prenatal care utilization (p = 0.1968).

Similar associations were observed for EBF at eight weeks. The results demonstrated a statistically significant association for EBF at eight weeks with the following: financial SLE domain (*p* = 0.0000), partner-associated SLE domain (*p* = 0.0001), traumatic SLE domain (*p* = 0.0001), overall SLE burden (*p* = 0.0000), total SLE count (*p* = 0.0000), maternal age (*p* = 0.0000), educational attainment (*p* = 0.0000), race/ethnicity (*p* = 0.0000), parity (*p* = 0.0001), federal poverty level (*p* = 0.0000), pre-pregnancy body mass index (*p* = 0.0000). No significant association was found for emotional SLE domain (*p* = 0.2171) and for prenatal care utilization (*p* = 0.4216).

Table 6

Bivariate Relationship Between Demographic and Socioeconomic Factors with Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

	4 Weeks				**8 Weeks**			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Age								
Less than 20 years	54.70	45.30	15.863	0.0000****	64.10	35.90	25.163	0.0000****
20 to 24 years	48.30	51.70			59.30	40.70		
25 to 29 years	41.50	58.50			50.10	49.90		
30 to 34 years	38.30	61.70			45.20	54.80		
35 years or older	44.90	55.10			51.30	48.70		
Educational Attainment								
Less than 12 years	58.00	42.00	83.642	0.0000****	66.00	34.00	118.198	0.0000****
12 years	52.50	47.50			62.50	37.50		
13 to 15 years	45.40	54.60			55.30	44.70		
16 years or more	34.50	65.50			40.70	59.30		
Race/Ethnicity								
White	35.80	64.20	89.529	0.0000****	43.50	56.50	101.713	0.0000****
Hispanic	53.40	46.60			62.40	37.60		
African-American	55.20	44.80			64.70	35.30		
Others	52.40	47.60			60.30	39.70		
Parity								
Primipara	44.90	55.10	13.525	0.0002***	53.10	46.90	15.667	0.0001***
Multiparous	41.00	59.00			49.00	51.00		

(continued)

Table 6

Bivariate Relationship Between Demographic and Socioeconomic Factors with Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks				**8 Weeks**			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Federal Poverty Level								
Less than 100	53.70	46.30	57.661	0.0000****	63.60	36.40	77.939	0.0000****
100 to 199	43.70	56.30			52.50	47.50		
200 to 399	40.40	59.60			49.00	51.00		
400 to 599	28.30	71.70			36.50	63.50		
600 or more	36.50	63.50			41.60	58.40		
Body Mass Index (kg/m^2)								
Underweight	40.50	59.50	44.380	0.0000****	46.60	53.40	55.087	0.0000****
Normal	38.00	62.00			45.80	54.20		
Overweight	44.70	55.30			52.60	47.40		
Obese	54.40	45.60			63.80	36.20		
Prenatal Care Utilization								
Inadequate	43.30	56.70	1.560	0.1968	51.40	48.60	1.482	0.2171
Intermediate	42.30	57.70			49.80	50.20		
Adequate	41.70	58.30			50.00	50.00		
Adequate Plus	44.40	55.60			52.40	47.60		

Note:
[A]Weighted percentage
Significance: *$p < 0.050$ **$p < 0.010$ ***$p < 0.001$ ****$p < 0.0001$

Table 7

Bivariate Relationship Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

	4 Weeks				8 Weeks			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Stressful Life Events:								
Someone very close died								
No	42.50	57.50	1.123	0.2892	50.40	49.60	2.264	0.1324
Yes	44.00	56.00			52.60	47.40		
Someone very close had a problem with drinking or drugs								
No	42.50	57.50	0.793	0.3733	50.50	49.50	2.095	0.1478
Yes	44.30	55.70			53.40	46.60		
Got separated or divorced from husband or partner								
No	42.10	57.90	18.636	0.0000****	50.10	49.90	29.841	0.0000****
Yes	53.40	46.60			63.90	36.10		
A close family member was sick and had to go to the hospital								
No	43.00	57.00	1.146	0.2843	50.90	49.10	0.478	0.4895
Yes	41.60	58.40			50.10	49.90		
Husband/partner or myself went to jail								
No	42.40	57.60	10.813	0.0010**	50.40	49.60	28.354	0.0000****
Yes	55.80	44.20			71.30	28.70		

(continued)

Table 7

Bivariate Relationship Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks				8 Weeks			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Husband/partner lost job								
No	42.30	57.70	5.858	0.0155*	50.20	49.80	9.333	0.0023**
Yes	46.70	53.30			55.70	44.30		
Moved to a new address								
No	42.10	57.90	2.998	0.0834	50.10	49.90	3.973	0.0463*
Yes	44.10	55.90			52.30	47.70		
Husband/partner or myself had a cut in work hours or pay								
No	41.90	58.10	12.606	0.0004***	49.70	50.30	22.211	0.0000****
Yes	47.10	52.90			56.60	43.40		
Husband/partner did not want pregnancy								
No	42.40	57.60	5.685	0.0171*	50.40	49.60	6.742	0.0094**
Yes	48.30	51.70			56.90	43.10		
Lost job even though wanted to go on working								
No	41.60	58.40	41.671	0.0000****	49.40	50.60	67.910	0.0000****
Yes	54.70	45.30			65.70	34.30		

(continued)

Table 7

Bivariate Relationship Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks				**8 Weeks**			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Had problems paying rent, mortgage, or other bills								
No	41.80	58.20	16.209	0.0001***	49.50	50.50	32.195	0.0000****
Yes	47.80	52.20			57.90	42.10		
Argued with husband/partner more than usual								
No	41.70	58.30	17.424	0.0000****	49.40	50.60	31.002	0.0000****
Yes	47.40	52.60			57.00	43.00		
Apart from husband/partner due to work extended travel								
No	42.90	57.10	4.052	0.0441*	51.00	49.00	6.533	0.0106*
Yes	38.10	61.90			44.80	55.20		
Homeless or had to sleep outside, in a car, or in a shelter								
No	42.60	57.40	3.279	0.0702	50.50	49.50	12.626	0.0004***
Yes	51.80	48.20			68.20	31.80		

(continued)

Table 7

Bivariate Relationship Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks				**8 Weeks**			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Total Stressful Life Events Count, Grouped								
No event	39.10	60.90	18.170	0.0000****	46.60	53.40	24.397	0.0000****
One to Two events	42.80	57.20			50.80	49.20		
Three or more events	47.70	52.30			56.60	43.40		
Financial Stressful Life Event Domain								
No	40.20	59.80	24.471	0.0000****	47.70	52.30	36.330	0.0000****
Yes	45.40	54.60			54.10	45.90		
Emotional Stressful Life Event Domain								
No	42.50	57.50	0.295	0.5871	50.50	49.50	0.646	0.4216
Yes	43.10	56.90			51.40	48.60		
Partner-associated Stressful Life Event Domain								
No	41.50	58.50	15.660	0.0001***	49.20	50.80	27.648	0.0000****
Yes	46.30	53.70			55.60	44.40		

(continued)

Table 7

Bivariate Relationship Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks				8 Weeks			
Variable	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**	**No %[A]**	**Yes %[A]**	**Chi-Square**	**P-value**
Traumatic Stressful Life Event Domain								
No	42.20	57.80	7.471	0.0063**	50.10	49.90	14.820	0.0001***
Yes	47.20	52.80			57.00	43.00		
Overall Stressful Life Event Burden								
No domain	39.10	60.90	14.194	0.0000****	46.60	53.40	20.591	0.0000****
One domain present	43.20	56.80			50.90	49.10		
Two or more domains present	45.90	54.10			55.00	45.00		

Note:
[A]Weighted percentage
Significance: **p* < 0.050 ***p* < 0.010 ****p* < 0.001 *****p* < 0.0001

Univariate Logistic Regression of Research Variables

Table 8 presents the odds ratios (OR) and confidence intervals (CI) for measuring the strength of association between SLE and EBF at both four and eight weeks postpartum when no adjustment was made for other potential covariates.

Exclusive breastfeeding at four weeks. There were significant associations for eight individual SLE and for three SLE domains (except for the emotional domain). Women who reported a financial SLE had 19% less odds (OR = 0.81, 95% CI = 0.74-0.88, p = 0.000) of EBF at four weeks postpartum. Those with a partner-associated SLE had 18% lower odds (OR = 0.82, 95% CI = 0.75-0.91, p = 0.000), and those with traumatic SLE had 18% lower odds (OR = 0.82, 95% CI = 0.71-0.94, p = 0.000). Lower odds of exclusively breastfeeding at four weeks were also observed for each increasing level of overall SLE burden. There was 14% lower odds (OR = 0.84, 95% CI = 0.78-0.94, p = 0.002) in those with one domain compared to those with no SLE burden, and 30% lower odds in those with two or more domains (OR = 0.70, 95% CI = 0.63-0.79, p = 0.000).

Exclusive breastfeeding at eight weeks. Significant associations were observed for 10 individual SLE and for three SLE domains. Having a financial SLE domain was associated with 23% lower odds of exclusively breastfeeding at eight weeks (OR = 0.77, 95% CI = 0.72-0.84, p = 0.000). Partner-associated domain had 23% lower odds (OR = 0.77, 95% CI = 0.70-0.85, p = 0.000), and traumatic domain had 24% lower odds (OR = 0.76, 95% CI = 0.66-0.87, p = 0.000) of exclusively breastfeeding at eight weeks postpartum. No significant association was found for emotional domain. A step-wise gradient was also observed for total SLE count. Compared to those with zero total count, those with one to two events count had 15% lower odds (OR = 0.85, 95% CI = 0.77-0.93, $p = 0.000$), while those with three or more events had 33% lower odds (OR = 0.67, 95% CI = 0.60-0.75, $p = 0.000$). Similar trends were observed for overall SLE burden. Those with SLE in one domain had 16% lower odds (OR = 0.84, 95% CI = 0.76-0.93, $p = 0.001$), while those with two or more domains had 29% lower odds (OR = 0.75, 95% CI = 0.64-0.79, $p = 0.000$).

Table 8

Univariate Logistic Regression Analysis for the Association Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

	4 Weeks		8 Weeks	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Stressful Life Events:				
Someone very person close died	0.94	0.84-1.05	0.92	0.82-1.03
Someone very close had a problem with drinking or drugs	0.93	0.80-1.09	0.89	0.76-1.04
Got separated or divorced from husband or partner	0.63****	0.52-0.78	0.57****	0.46-0.70
A close family member was sick and had to go to the hospital	1.06	0.95-1.17	1.03	0.94-1.14
Husband/partner or myself went to jail	0.58**	0.43-0.80	0.41****	0.29-0.57
Husband/partner lost job	0.84*	0.73-0.97	0.80**	0.69-0.92
Moved to a new address	0.93	0.84-1.01	0.91	0.83-1.00
Husband/partner or myself had a cut in work hours or pay	0.81****	0.72-0.91	0.76****	0.67-0.85
Husband/partner did not want pregnancy	0.79*	0.65-0.96	0.77*	0.63-0.94
Lost job even though wanted to go on working	0.59****	0.50-0.69	0.51****	0.43-0.60
Had problems paying rent, mortgage, or other bills	0.78****	0.70-0.88	0.71****	0.63-0.80
Argued with husband/partner more than usual	0.79****	0.71-0.88	0.74****	0.66-0.82
Apart from husband/partner due to work extended travel	1.22	1.00-1.49	1.28*	1.06-1.56
Homeless or had to sleep outside, in a car, or in a shelter	0.69	0.47-1.02	0.48****	0.31-0.72

(continued)

Table 8

Univariate Logistic Regression Analysis for the Association Between Stressful Life Events in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117; continued)

	4 Weeks		8 Weeks	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Total Stressful Life Events Count, Grouped				
No event (Ref)	–	–	–	–
One to Two events	0.86**	0.78-0.94	0.85****	0.77-0.93
Three or more events	0.70****	0.63-0.79	0.67****	0.60-0.75
Stressful Life Events Domain:				
Financial Stressful Life Event Domain	0.81****	0.74-0.88	0.77****	0.72-0.84
Emotional Stressful Life Event Domain	0.97	0.89-1.07	0.96	0.88-1.06
Partner-associated Stressful Life Event Domain	0.82****	0.75-0.91	0.77****	0.70-0.85
Traumatic Stressful Life Event Domain	0.82**	0.71-0.94	0.76****	0.66-0.87
Overall Stressful Life Event Burden				
No domain (Ref)	–	–	–	–
One domain present	0.84**	0.76-0.93	0.84**	0.76-0.93
Two or more domains present	0.76****	0.68-0.84	0.71****	0.64-0.79

Note:
Covariates not included
Ref. stands for reference category
Significance: *$p < 0.050$ **$p < 0.010$ ***$p < 0.001$ ****$p < 0.0001$

Multiple Logistic Regression of Research Variables

The multiple logistic regression results in Table 9 presents the adjusted odds ratios (aOR) and confidence intervals (CI) for estimating the strength of association between SLE and EBF at four and eight weeks postpartum while adjusting for covariates (age, race/ethnicity, educational attainment, parity, federal poverty level, pre-pregnancy body mass index, and prenatal care utilization). The results showed no association between each of the SLE domain and EBF at four and eight weeks postpartum. However, statistically significant associations were observed with EBF at four weeks and at eight weeks for both total SLE count and overall burden. For total SLE count, having one to two events was associated with 10% lower odds (aOR = 0.90, 95% CI = 0.81-0.99, p = 0.035), and three or more events was associated with 14% lower odds (aOR = 0.86, 95% CI = 0.76-0.97, p = 0.016) at four weeks postpartum compared to those with no event.

For overall SLE burden, those with only one domain had 11% lower odds (aOR = 0.89, 95% CI = 0.80-0.99, p = 0.026) of EBF at four weeks, and those with two or more domains had 12% lower odds (aOR = 0.88, 95% CI = 0.79-0.99, p = 0.030) compared to those with no domain present. For the analysis of EBF at eight weeks postpartum, compared to those with no event count, those with one to two events within 12 months before child birth had 10% less odds (aOR = 0.90, 95% CI = 0.82-0.99, p = 0.036), and those with three or more events had 13% lower odds (aOR = 0.85, 95% CI = 0.77-0.98, p = 0.022). For the overall SLE burden, a significant association was only found among those with two or more domains present with 13% lower odds (aOR = 0.87, 95% CI = 0.78-0.98, p = 0.017) of EBF at eight weeks compared to those with no domain.

Table 9

Multiple Logistic Regression Analysis for the Association Between Stressful Life Events Domain in the 12 Months Before Child Birth and Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N =16,117)

	4 Weeks		**8 Weeks**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stressful Life Event Domain				
No (Ref)	–	–	–	–
Yes	0.92	0.84-1.01	0.92	0.84-1.00
Emotional Stressful Life Event Domain				
No (Ref)	–	–	–	–
Yes	0.99	0.90-1.09	0.98	0.89-1.08
Partner-Associated Stressful Life Event Domain				
No (Ref)	–	–	–	–
Yes	0.95	0.86-1.05	0.92	0.83-1.02
Traumatic Stressful Life Event Domain				
No (Ref)	–	–	–	–
Yes	0.91	0.79-1.06	0.87	0.75-1.02
Total Stressful Life Events Count, Grouped				
No event (Ref)	–	–	–	–
One to Two events	0.90*	0.81-0.99	0.90*	0.82-0.99
Three or more events	0.86*	0.76-0.97	0.87*	0.77-0.98
Overall Stressful Life Event Burden				
No domain (Ref)	–	–	–	–
One domain present	0.89*	0.80-0.99	0.90	0.81-1.00
Two or more domains present	0.88*	0.79-0.99	0.87	0.78-0.98

Note:
Covariates included
Ref. stands for reference category
Significance: *$p < 0.050$ **$p < 0.010$ ***$p < 0.001$ ****$p < 0.0001$

Effect Modification Analysis for Selected Variables

Effect modification testing results for maternal educational attainment results is presented in Table 10. The adjusted odds ratios (aOR) and 95% confidence interval values for the estimation of strength of association of interaction terms are presented. Covariates adjusted for included age, race/ethnicity, body mass index, parity, educational attainment, and federal poverty level. To accrue enough numbers in each cell for effect modification testing and to achieve meaningful interpretation purposes, some categories were collapsed. This process was guided by preliminary analysis to assess the number of levels generated by the interaction term and a consideration for grouping that would result in logical interpretations. The SLE total count and overall domain burden were collapsed. Total count was collapsed into no event, one to two events, and three or more events. Overall domain burden was collapsed into no domain present, one domain present, and two or more domains present.

Significant interaction terms were observed only for the modeled interaction for educational attainment and EBF in the financial, partner-associated, and traumatic domains. Also significant were interaction terms for cumulative exposure (total count and overall domain burden). By domain type, significant interaction terms were mostly in the less than high school education category compared to the 16 years or more reference category. The interaction of financial SLE and less than high school education was associated with 31% lower odds (aOR = 0.69, 95% CI = 0.49-0.96) of EBF compared to 16 years or more category who reported no financial SLE event. For SLE total count, the less than high school category interaction with one to two events was associated with

36% less odds (aOR = 0.64, 95% CI = 0.44-0.95), while three to five events was associated with 49% lower odds (aOR = 0.51, 95% CI = 0.32-0.82) of EBF at four weeks.

At eight weeks postpartum, interaction term values in those with less than high school were 38% lower (aOR = 0.62, 95% CI = 0.42-0.93) for one to two and 53% lower (aOR = 0.47, 95% CI=0.29-0.76) for three or more SLE compared to the 16 years or more category who reported no SLE. As the number of SLE increased, there was a corresponding decrease in EBF prevalence. To further understand the extent of moderation and to guide interpretation of findings, stratified analysis was performed for the educational attainment variable to primarily compare stratum-specific adjusted odds ratios for the four levels of maternal educational attainment. Effect modification results for federal poverty level and prenatal care utilization are presented in the appendices section (see Appendix B). Both the federal poverty level and prenatal care utilization interaction models yielded non-significant values.

Table 10

Effect Modification Analysis for the Interaction Between Stressful Life Event and Educational Attainment in the Relationship with Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N = 16,117)

	4 Weeks		8 Weeks	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stress#Education Interaction				
No; 16 years or more (Ref)	–	–	–	–
Yes; Less than 12 years	0.69*	0.49-0.83	0.64*	0.45-0.91
Yes; 12 years	0.88	0.69-1.12	0.85	0.66-1.09
Yes; 13 to 15 years	0.90	0.73-1.11	0.84	0.68-1.03
Emotional Stress#Education Interaction				
No; 16 years or more (Ref)	–	–	–	–
Yes; Less than 12 years	0.75	0.51-1.12	0.85	0.56-1.28
Yes; 12 years	1.03	0.78-1.34	1.01	0.77-1.33
Yes; 13 to 15 years	1.07	0.85-1.35	0.98	0.78-1.23
Partner-associated Stress#Education Interaction				
No; 16 years or more (Ref)	–	–	–	–
Yes; Less than 12 years	0.80	0.54-1.18	0.70	0.47-1.05
Yes; 12 years	0.78	0.59-1.03	0.73*	0.55-0.96
Yes; 13 to 15 years	0.79	0.62-1.01	0.79	0.62-1.01
Traumatic Stress#Education Interaction				
No; 16 years or more (Ref)	–	–	–	–
Yes; Less than 12 years	0.65	0.38-1.18	0.49*	0.27-0.89
Yes; 12 years	1.21	0.81-1.83	1.36	0.90-2.04
Yes; 13 to 15 years	1.13	0.79-1.65	1.06	0.73-1.52

(continued)

Table 10

Effect Modification Analysis for the Interaction Between Stressful Life Event and Educational Attainment in the Relationship with Exclusive Breastfeeding at Four and Eight Weeks Postpartum, Pregnancy Risk Assessment Monitoring System, 2012-2015 (N = 16,117; continued)

	4 Weeks		**8 Weeks**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Total Stress Count#Education Interaction				
No event; 16 years or more (Ref)	–	–	–	–
One to two events; less than high school	0.64*	0.44-0.95	0.62*	0.42-0.93
One to two events; high school	0.75	0.57-1.01	0.71*	0.53-0.95
One to two events; 13 to 15 years	0.98	0.77-1.25	0.85	0.67-1.08
Three or more events; less than high school	0.51**	0.32-0.82	0.47**	0.29-0.76
Three or more events; high school	0.80	0.58-1.12	0.75	0.54-1.05
Three or more events; 13 to 15 years	0.78	0.59-1.05	0.71*	0.54-0.95
Overall Stress Burden#Education Interaction				
No domain; 16 years or more (Ref)	–	–	–	–
One domain; less than high school	0.57**	0.38-0.85	0.56**	0.37-0.84
One domain; high school	0.72*	0.54-0.97	0.68*	0.51-0.92
One domain; 13 to 15 years	0.91	0.71-1.16	0.80	0.62-1.02
Two or more domains; less than high school	0.64*	0.41-0.98	0.58*	0.37-0.90
Two or more domains; high school	0.85	0.63-1.16	0.79	0.58-1.08
Two or more domains; 13 to 15 years	0.91	0.70-1.18	0.81	0.63-1.05

Note:
Covariates included
Ref. stands for reference category
Significance: *$p < 0.050$ **$p < 0.010$ ***$p < 0.001$ **** $p < 0.00$

Stratified Analysis Comparing Levels of Maternal Educational Attainment

The stratified analysis for maternal educational attainment comparing the four levels of maternal educational attainment are presented in Tables 11 and 12. The adjusted odds ratios and 95% confidence intervals are presented for each stratum. Variables adjusted for were age, race/ethnicity, parity, body mass index, and federal poverty level. The results showed stratum-specific odds ratio estimates that were different between sub-groups. The adjusted stratum-specific odds ratio for the association between financial SLE domain and EBF in the less than high school category was 0.71 (95% CI = 0.52-0.97, $p = 0.033$) but was 1.01 (95% CI = 0.88-1.16, $p > 0.05$) in the 16 years or more category. The corresponding values for high school and 13-15 years were 0.90 (95% CI = 0.73-1.10, $p > 0.05$) and 0.91 (95% CI = 0.77-1.07, $p > 0.05$).

Traumatic domain was associated with 43% lower odds (aOR = 0.57, 95% CI = 0.35-0.92, $p = 0.022$) of EBF at four weeks in the less than high school category. Stratum-specific odds ratios for other educational levels were non-significant and closer to null value for emotional, partner-associated and traumatic domains. For total SLE count, in the less than high school category, having one to two events was associated with 36% lower odds (aOR = 0.64, 95% CI = 0.44-0.92, $p = 0.015$), and having three or more events was associated with 47% lower odds (aOR = 0.53, 95% CI = 0.35-0.80, $p = 0.003$) compared to those with no event. The corresponding odds ratios in the 16 years or more category was 0.99 (95% CI = 0.86-1.15, $p > 0.05$) and 1.06 (95% CI = 0.86-1.29, $p > 0.05$) for one to two events and three to five events, respectively. Similar findings were observed for both domain types (financial and traumatic) and cumulative exposure (total count and overall burden).

Table 11

Stratified Analysis for the Association Between Stressful Life Event and Exclusive Breastfeeding at Four Weeks Postpartum by Educational Attainment Level, Pregnancy Risk Assessment Monitoring System, 2012-2015

	16 years or more		**Less than high school**		**High School**		**13 - 15 years**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.01	0.88-1.16	0.71*	0.52-0.97	0.90	0.73-1.10	0.91	0.77-1.07
Emotional Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.00	0.86-1.16	0.73	0.51-1.06	1.03	0.82-1.29	1.05	0.88-1.26
Partner-associated Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.12	0.95-1.33	0.88	0.62-1.24	0.88	0.71-1.11	0.87	0.73-1.04
Traumatic Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	0.87	0.66-1.15	0.57*	0.35-0.92	1.15	0.85-1.55	0.98	0.76-1.27

(continued)

Table 11

Stratified Analysis for the Association Between Stressful Life Event and Exclusive Breastfeeding at Four Weeks Postpartum by Educational Attainment Level, Pregnancy Risk Assessment Monitoring System, 2012-2015 (continued)

	16 years or more		**Less than high school**		**High School**		**13 - 15 years**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Total Stressful Life Events Count, Grouped								
No event (Ref)	–	–	–	–	–	–	–	–
One to Two events	0.99	0.86-1.15	0.64*	0.44-0.92	0.75*	0.58-0.96	0.97	0.79-1.18
Three or more events	1.06	0.86-1.29	0.53**	0.35-0.80	0.87	0.66-1.14	0.80	0.64-1.00
Overall Stressful Life Event Burden								
No domain (Ref)	–	–	–	–	–	–	–	–
One domain present	1.02	0.88-1.18	0.57**	0.39-0.83	0.73*	0.57-0.95	0.92	0.74-1.13
Two or more domains present	0.99	0.83-1.17	0.62*	0.42-0.92	0.86	0.66-1.11	0.88	0.72-1.09

Note:
Covariates included
Ref. stands for reference category
Significance: **p* < 0.050 ***p* < 0.010 ****p* < 0.001 **** *p* <0.0001

Table 12

Stratified Analysis for the Association Between Stressful Life Event and Exclusive Breastfeeding at Eight Weeks Postpartum by Educational Attainment Level, Pregnancy Risk Assessment Monitoring System, 2012-2015

	16 years or more		**Less than high school**		**High School**		**13 - 15 years**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.02	0.89-1.16	0.67*	0.49-0.94	0.90	0.73-1.12	0.87	0.73-1.02
Emotional Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.01	0.88-1.16	0.81	0.55-1.20	1.03	0.81-1.29	0.97	0.81-1.17
Partner-associated Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	1.10	0.93-1.29	0.75	0.52-1.09	0.84	0.66-1.07	0.87	0.73-1.04
Traumatic Stressful Life Event								
No (Ref)	–	–	–	–	–	–	–	–
Yes	0.85	0.66-1.11	0.40**	0.23-0.68	1.28	0.94-1.75	0.90	0.69-1.16

(continued)

Table 12

Stratified Analysis for the Association Between Stressful Life Event and Exclusive Breastfeeding at Eight Weeks Postpartum by Educational Attainment Level, Pregnancy Risk Assessment Monitoring System, 2012-2015 (continued)

	16 years or more		**Less than high school**		**High School**		**13 - 15 years**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Total Stressful Life Events Count, Grouped								
No event (Ref)	–	–	–	–	–	–	–	–
One to Two events	1.03	0.90-1.18	0.64*	0.44-0.93	0.75*	0.58-0.98	0.88	0.72-1.07
Three or more events	1.08	0.89-1.32	0.48**	0.31-0.75	0.87	0.65-1.16	0.77*	0.72-1.07
Overall Stressful Life Event Burden								
No domain (Ref)	–	–	–	–	–	–	–	–
One domain present	1.06	0.92-1.23	0.59**	0.40-0.87	0.75*	0.57-0.98	0.85	0.69-1.04
Two or more domains present	1.01	0.85-1.19	0.56**	0.37-0.85	0.85	0.65-1.11	0.82	0.67-1.01

Note:
Covariates included
Ref. stands for reference category
Significance: *$p < 0.050$ **$p < 0.010$ ***$p < 0.001$ **** $p < 0.000$

Summary of the Results

The focus of this study was to determine the association between SLE occurring in the 12 months preceding child birth and EBF at four and eight weeks postpartum. By domain types, no significant association with EBF at four or eight weeks postpartum was found in the overall analysis. However, significant associations were found for both total SLE count and overall SLE burden at four and eight weeks postpartum. In addition, this study confirmed other factors previously identified as associated with EBF. These include maternal age, maternal race/ethnicity, educational attainment, federal poverty level (proxy for income), parity status, and body mass index. Lastly, this study found less than high school educational attainment status moderated the association between SLE and EBF but only for financial and traumatic domains as well as for SLE total count and SLE overall burden. No evidence of effect modification was observed for federal poverty level and prenatal care utilization. The summary of findings by research questions and hypotheses are presented in Tables 13 to 15.

Table 13.

Summary of the Results for Research Question 1

Research Hypothesis	Conclusion	Findings
Research Hypothesis 1: Financial SLE domain occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.	Not Supported	Mothers who experienced a financial SLE had a borderline significant 9% lower odd of EBF at four weeks (aOR = 0.91, 95% CI = 0.83-1.00, p = 0.045) when compared to those with no financial SLE
Research Hypothesis 2: Emotional SLE domain occurring within 12 months before birth is not associated with lower odds of EBF at four weeks postpartum.	Not Supported	Mothers who experienced an emotional SLE had a non-significant 1% lower odd of EBF at four weeks (aOR = 0.99, 95% CI = 0.90-1.09, p = 0.839) when compared to those with no emotional SLE
Research Hypothesis 3: Partner-associated SLE domain occurring within 12 months before birth is not associated with lower odds of EBF at four weeks postpartum.	Not Supported	Mothers who experienced a partner-associated SLE had a non-significant 6% lower odd of EBF at four weeks (aOR = 0.94, 95% CI = 0.85-1.04, p = 0.247) when compared to those with no partner-associated SLE
Research Hypothesis 4: Traumatic SLE domain occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.	Not Supported	Mothers who experienced a traumatic SLE had a non-significant 9% lower odd of EBF at four weeks (aOR = 0.91, 95% CI = 0.78-1.06, p = 0.227) when compared to those with no traumatic SLE

(continued)

Table 13.

Summary of the Results for Research Question 1

Research Hypothesis	Conclusion	Findings
Research Hypothesis 5: Higher total SLE count occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.	Supported	Mothers with one to two events were 10% less likely to exclusively breastfeed at four weeks (aOR = 0.90, 95% CI = 0.81-0.99, p = 0.032) when compared to those with no event count. Those with three to five events were 17% less likely to exclusively breastfeed at four weeks (aOR = 0.83, 95% CI = 0.73-0.94, p = 0.004) when compared to those with no event count.
Research Hypothesis 6: Higher overall SLE burden occurring within 12 months before birth is associated with lower odds of EBF at four weeks postpartum.	Supported	Mothers with one domain SLE burden present were 11% less likely to exclusively breastfeed at four weeks (aOR = 0.89, 95% CI = 0.80-0.98, p = 0.023) when compared to those with no burden. Those with two domains present were 12% less likely to exclusively breastfeed at four weeks (aOR = 0.88, 95% CI = 0.78-0.99, p = 0.042) when compared to those with no burden.

Table 14.

Summary of the Results for Research Question 2

Research Hypothesis	Conclusion	Findings
Research Hypothesis 7: Financial SLE domain occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.	Not Supported	Mothers who experienced a financial SLE had a non-significant 8% lower odd of EBF at eight weeks (aOR = 0.92, 95% CI = 0.84-1.00, p = 0.053) when compared to those with no financial SLE
Research Hypothesis 8: Emotional SLE domain occurring within 12 months before birth is not associated with lower odds of EBF at eight weeks postpartum.	Not Supported	Mothers who experienced an emotional SLE had a non-significant 1% lower odd of EBF at eight weeks (aOR = 0.99, 95% CI = 0.90-1.09, p = 0.773) when compared to those with no emotional SLE
Research Hypothesis 9: Partner-associated SLE domain occurring within 12 months before birth is not associated with lower odds of EBF at eight weeks postpartum.	Not Supported	Mothers who experienced a partner-associated SLE had a non-significant 9% lower odds of EBF at eight weeks (aOR = 0.91, 95% CI = 0.83-1.01, p = 0.085) when compared to those with no partner-associated SLE
Research Hypothesis 10: Traumatic SLE domain occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.	Not Supported	Mothers who experienced a traumatic SLE had a non-significant 9% lower odds of EBF at eight weeks (aOR = 0.87, 95% CI = 0.75-1.01, p = 0.071) when compared to those with no traumatic SLE

(continued)

Table 14.

Summary of the Results for Research Question 2

Research Hypothesis	Conclusion	Findings
Research Hypothesis 11: Higher total SLE count occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.	Supported	Mothers with one to two events were 10% less likely to exclusively breastfeed at eight weeks (aOR = 0.90, 95% CI = 0.81-0.99, p = 0.033) when compared to those with no event count. Those with three to five events were 15% less likely to exclusively breastfeed at eight weeks (aOR = 0.85, 95% CI = 0.75-0.97, p = 0.013) when compared to those with no event count.
Research Hypothesis 12: Higher overall SLE burden occurring within 12 months before birth is associated with lower odds of EBF at eight weeks postpartum.	Supported	Mothers with one domain SLE burden present were 10% less likely to exclusively breastfeed at eight weeks (aOR = 0.90, 95% CI = 0.81-1.00, p = 0.046) when compared to those with no burden. Those with two domains present were 12% less likely to exclusively breastfeed at eight weeks (aOR = 0.88, 95% CI = 0.77-0.99, p = 0.033) when compared to those with no burden.

Table 15.

Summary of the Results for Research Question 3

Research Hypothesis	Conclusion	Findings
Research Hypothesis 13: The association between SLE occurring within 12 months before birth and EBF is moderated by maternal educational attainment.	Supported	In the less than high school group, those with financial SLE were 29% less likely to exclusively breastfeed at four weeks (aOR = 0.71, 95% CI = 0.52-0.97, p = 0.033) compared to those with no event. Those with traumatic event had 43% lower odds of EBF (aOR = 0.57, 95% CI = 0.35-0.92, p = 0.022). For SLE total count, those with one to two events had 36% lower odds (aOR = 0.64, 95% CI = 0.44-0.92, p = 0.015) and those with three or more events had 47% lower odds (aOR = 0.53, 95% CI = 0.35-0.80, p = 0.003) compared to those with no event. Same trends were observed at eight weeks postpartum.
Research Hypothesis 14: The association between SLE occurring within 12 months before birth and EBF is moderated by federal poverty level.	Not Supported	There was no evidence of effect modification by federal poverty level. The stratum-specific odds ratios for SLE indicators were similar across collapsed federal poverty level categories.
Research Hypothesis 15: The association between SLE occurring within 12 months before birth and EBF is moderated by prenatal care utilization.	Not Supported	There was no evidence of effect modification by prenatal care utilization. The stratum-specific odds ratios for SLE indicators were similar across collapsed prenatal care utilization categories.

Chapter 5: Discussion

This chapter contextualizes the findings of this study and outlines the contributions to the body of knowledge on the topic area. This chapter also includes a discussion on the significance of the study as well as the implications for public health programs and policy development. Lastly, there are recommendations for additional research.

According to the 2018 Breastfeeding Report Card, less than half (46.9%) of the infants in the United States were exclusively breastfed for three months, while only a quarter (24.9%) of children were exclusively breastfed for six months (CDC, 2018). Utilizing data from nine states and New York City, the prevalence of EBF in this sample was 57.3% at four weeks and 49.2% at eight weeks postpartum, notably higher at each time point than the national trend probably due to the limited diversity of the study sample (highly educated and more affluent). Consequently, the results of this study apply only to the specified sample, not the general population. This study found SLE during the 12 months before child birth was widely prevalent with 67% reporting at least one SLE. Almost half (47.6%) reported having experienced at least one SLE in the financial domain during 12 months before birth.

In several adjusted logistic regression models, this study found evidence of statistically significant associations between SLE and EBF at four weeks and eight weeks postpartum. These findings were consistent with previous findings by Dozier et al. (2012), in which the traumatic domain was associated with a higher likelihood of EBF cessation at 13 weeks postpartum in the adjusted model (aOR = 2.95, 95% CI = 1.04–

8.38). SLE assessed as a cumulative event count or overall domain burden was statistically significant in the adjusted models. This observation for these two measures demonstrated that experiencing a higher number of SLE was negatively associated with EBF outcomes, a known health-promoting behavior. This finding aligns with the assumption underlying the original postulation of Holmes and Rahe (1967) which laid the foundation for research on SLE and health outcomes. That postulation was based on the premise that an increment in stress burden corresponded to a higher level of adjustment resulting in poorer health conditions (Holmes & Rahe, 1967). In this study, as the SLE profile increases, EBF at both four and eight weeks postpartum decreased.

Available studies on SLE focused on breastfeeding initiation (Buck, Gjelsvik, Vivier, Monteiro & Amanullah, 2018), duration (Buck et al., 2018; Li et al., 2008), and cessation (Li et al., 2008), but not exclusivity. The study by Li et al. (2008) among Australian women found 34% higher odds (aOR = 1.34, 95% CI = 1.04–1.71) of shorter breastfeeding among those with SLE at both 18 and 34 weeks of pregnancy. The results were similar to the findings in this study since SLE was related to decreased breastfeeding (Li et al., 2008). This may be because Australia has comparable levels of economic development with the United States. This study identified a potential role for SLE occurring 12 months before child birth in understanding EBF prevalence and patterns in the early postpartum period. The mechanisms through which prenatal SLE could impact on exclusive breastfeeding have not been clearly articulated. One potential explanation of the underlying mechanism as supported by study findings is that as the SLE burden increases, individuals could become overwhelmed. This could undermine breastfeeding self-efficacy (Dozier et al., 2012) and negatively influence breastfeeding. Child feeding decisions, including plans to exclusively breastfeed, are usually made during preconception and/or pregnancy periods before child birth (Arora, McJunkin, Wehrer, & Kuhn, 2000). Therefore, the SLE experience women in the United States are confronted with during the year preceding child birth could influence EBF outcomes.

Interaction models found evidence of effect modification only for maternal educational status but not for federal poverty level or prenatal care utilization. Stratified analysis results for maternal education revealed effect modification occurred at lower educational attainment categories. By domain type, both the financial (aOR = 0.69, 95% CI = 0.49–0.96) and traumatic (aOR = 0.57, 95% CI = 0.35–0.92) domains were significant at four weeks for those with less than high school education. Same trends were observed at eight weeks among those who reported at least one event in the financial (aOR = 0.67, 95% CI = 0.49–0.94) and traumatic (aOR = 0.39, 95% CI = 0.23–0.68) domains. There were no associations found for emotional and partner-associated domains.

By total SLE count and overall domain burden, significant interactions were found at four and eight weeks for both less than high school and high school categories. Among those with less than high school education, having one to two SLE was associated with 36% decreased odds (aOR = 0.64, 95% CI = 0.44–0.92), while those with three or more events had 47% lower odds (aOR = 0.53, 95% CI = 0.35–0.80) of EBF at four weeks. This indicated that irrespective of relationships observed for individual domain types in the overall group, having one or more events in the financial and traumatic domains, as well as experiencing a higher number of SLE was each related to decreased EBF outcome at four and eight weeks of infancy at lower levels of education. Therefore, this study concluded low maternal educational attainment (less than high school) was an effect modifier in the relationship between SLE and EBF. Since this finding was not demonstrated in higher maternal educational attainment categories (high school or higher), it appeared that higher educational attainment buffered the effect of SLE on EBF at four and eight weeks.

The fact that education was shown to be an effect modifier in this study is supported by other studies that have reported lower educational levels increase risk of not exclusively breastfeeding (Jones, Kogan, Singh, Dee, & Grummer-Strawn, 2011; Stough, Khalsa, Nabors, Merianos, & Peugh, 2019). Multiple pathways through which education impacts health have been reported. First, education provides a vehicle for health knowledge and application of this knowledge to choosing healthy behaviors (Barbeau, Krieger, & Soobader, 2004; Braveman, Egerter, & Williams, 2011). Second, higher educational attainment is linked to greater opportunities for higher income compared to lower education levels. This higher earning potential is more likely to be accompanied by being able to support health-promoting behaviors (Braveman et al., 2011; Crissey, 2009).

In this study, those with higher income levels as measured using the federal poverty level had a higher prevalence of EBF compared to individuals on lower income levels. Third, higher education is correlated with perceived higher social status which has independent positive effects on health status (Demakakos, Nazroo, Breeze, & Marmot, 2008), and thus health-promoting behaviors could be impacted. Another social resource that is associated with educational status is social support. Mickelson and Kubzansky (2003) found higher educational attainment was associated with obtaining more emotional support. Receiving or being able to mobilize more emotional support resources could mitigate the degree to which stress impacts on adoption or practice of health-promoting behaviors such as EBF. Taken together, it is probable that these mechanisms may help explain the importance of higher educational attainment on better EBF outcomes in this study.

Strengths of the Study

This study had several strengths. First, the availability of a large sample size reduced the level of imprecision. This large sample size allowed for the comparison of sub-groups in the study due to adequate numbers, and it was also useful to conduct test for effect modification of selected social determinants of health factors. Second the use of a probabilistic sampling process guaranteed equal chances of being selected for participation. Each month, a total of 100–250 new mothers was selected from the birth registry in each participating state using a stratified sampling procedure.

Third, the use of a standardized approach by the CDC across states strengthened internal validity for a multi-site data collection. Fourth, there was a reduced chance of recall bias for the dependent variable (exclusive breastfeeding) due to the survey period coinciding with the expected exclusive breastfeeding period, hence increasing the likelihood of a correct response to the question on length of exclusive breastfeeding. Lastly, minority and high-risk groups were oversampled. This oversampling of certain population groups ensured adequate representation of these groups and facilitated conduct of sub-group analyses.

Limitations of the Study

This study had several limitations. First, participants were asked if any of the SLE happened to them during the 12 months before the baby was born. Due to the time range used covering both preconception and pregnancy periods, it was impossible to ascertain the exact timing each SLE might have occurred. Second, information on the frequency and duration of SLE was not collected. Therefore, it was not possible to determine if these events occurred only once, were repeated, or continued unabated during the 12 months period. Thus, it was not possible to identify differences based on the severity of life events. Third, assessment of SLE is only regarded as a proxy, but not a gold standard measure of stress. One reason for this is because it only represents an assessment of stress exposure where this is individual variation (environmental stress). It should still be noted that SLE tools are popularly used. Fourth, 10 state entities (including New York City) were the only sites to collect data on variables used to derive EBF. Thus, the findings from this study using only 10 state entities could not be generalized to the entire United States population.

Fifth, the degree of nonresponse bias observed could have affected the findings. Although a complex survey design methodology was applied in PRAMS, the analytic method used in this study included a listwise deletion of observations with missing data on any of the key study variables from the final analytic sample. Comparison of the excluded group from the included sample showed significant differences in the demographic and socio-economic characteristics. The final analytic sample was more educated, had higher annual income, and was less obese. Lastly, the cross-sectional design nature of this study prevented the establishment of a cause and effect relationship between the exposure and outcome variables since temporality could not be inferred. However, it should be noted that the exposure variable (SLE) predated the outcome variable (EBF) in PRAMS as participants were asked about events that happened 12 months prior to child birth before breastfeeding occurred; this was also noted by Nkansah-Amankra et al. (2010).

Public Health Significance

Among other recommendations, the Surgeon General's Report on breastfeeding advocated for increased research on breastfeeding disparities (USDHHS, 2011). This call to action encourages identifying previously unknown or poorly understood risk factors of poor EBF outcomes. Findings from this study contribute to the literature on the association between preconception/prenatal SLE occurring 12 months before child birth and EBF outcomes. The results demonstrated evidence of statistically significant associations between cumulative measures of SLE occurring in the 12 months before birth and EBF outcomes after controlling for covariates. This independent association between SLE within 12 months before birth and EBF outcomes at four and eight weeks postpartum should arouse interest of public health practitioners who are in the forefront of improving EBF rates and child health outcomes across the United States. Specifically, it should lead to SLE being considered as an additional risk factor of low EBF rates in this country. In addition, this study showed maternal educational attainment moderated the adjusted associations between prenatal SLE and EBF outcomes, while other examined proxies of social determinants of health (federal poverty level and prenatal care utilization) showed no effect modification. This provided evidence for use in public health interventions focused specifically on improving educational attainment by targeting specific sub-groups who may be relatively more at risk of not exclusively breastfeeding for longer periods due to low educational attainment.

These results could also have other important applications for public health research, practice, and policy aimed at improving both overall and sub-group disparities in EBF rates across the United States. There are useful applications to a variety of stakeholders. For example, healthcare providers could apply this finding to identify communities at greatest risk of having women who fall off the EBF continuum in early postpartum, so they could be targeted to increase educational funding for better schools. State and local agencies could likewise be motivated by these findings to improve the schools in their communities so that these young women could increase their opportunity for increased educational attainment and financial stability, two very strong findings from this study.

Also, public health advocacy groups could use these findings to help policymakers and other groups increase investing in female education. In addition, using the principles of public health 3.0, scientists working at different levels (federal, state, local, and private sector) might apply findings from this study in refining existing breastfeeding surveillance data collection tools to also include monitoring trends in the prevalence of SLE as an additional means of determining if a focus on social determinants of health, such as increased educational attainment, financial stability, and decreased traumatic experience, could be associated with increased EBF.

Public Health Program Implications

Findings from this study can be applied to public health programs focused on the preconception, pregnancy, and postpartum period. In this study, higher total SLE count and higher overall SLE burden assessment at both four and eight weeks postpartum were associated with decreased EBF. In addition, experiencing a financial and a traumatic SLE among those with lowest educational attainment were each related to decreased EBF at four and eight weeks. These findings provided evidence for program managers and healthcare professionals to consider the potential role of SLE occurring within 12 months prior to birth as an independent risk factor for discontinuation of EBF. In addition, there are opportunities for public health program planners to develop intervention designed to improve EBF by focusing on upstream level factors such as higher educational attainment; decreasing homelessness, substance abuse, and incarceration (from the traumatic domain); and increasing affordable housing and job stability (steady number of hours) so that families can pay their bills and rent on time (from the financial domain).

The American College of Obstetricians and Gynecologists (ACOG) recommended psychosocial stressor screening in each trimester of pregnancy towards improving birth outcomes (ACOG, 2006). This recommendation was based on the conclusion that psychosocial stress profile could determine a woman’s capacity to pay attention to personal health, use of prenatal services, and even the health status of her children (ACOG, 2006). The findings in the current study support the premise of the

ACOG recommendation applied to the context of improving EBF outcomes in early infancy. Specifically, this study used a list of only 14 SLE organized into four domains that could potentially be used for a quick routine screening with a summation of total number of SLE and overall domain burden to determine risk for low EBF at points of access to preconception and pregnancy healthcare.

Furthermore, program managers could also use evidence from this study to raise awareness on SLE and its relationship with EBF outcomes. These findings can also be applied in designing interventions that target specific population sub-groups in the United States who are most at risk of early cessation of EBF based on their SLE burden. Chapman and Perez-Escamilla (2012) advocated for the need for culturally-appropriate interventions that specifically promote breastfeeding in groups with historically low rates in the United States. Programs that serve women in predominantly low-resourced settings (such as Healthy Start) during preconception, pregnancy, and postpartum periods could apply study findings in how it identifies, ranks, and prioritizes individuals and families who might benefit from receiving additional breastfeeding education and/or referrals to lactation-promotion services. Women in such resource-limited settings usually rank lower on social determinants of health factors such as educational attainment. This group of women was shown in this study to also be at risk of higher SLE burden and lower rates of continuation of EBF.

Lastly, the finding that maternal education moderated the association between SLE exposure during 12 months prior to child birth and EBF could be useful for long-term, intersectoral programs such as early and continuous education for women. Such programs remain a cornerstone of development efforts in low- and middle-income country investments by the World Bank and its partners (World Bank, 2017). Such program efforts contextualized to the United States could help drive higher female education (at least a vocational training or two-year college degree) for multi-faceted benefits including higher incomes (also shown in this study to be independently associated with higher EBF). Such investments could potentially lead to inter-generational effects. A systematic review concluded that breastfed children have a higher propensity to breastfeed their children later in life (Di Manno, Macdonald & Knight, 2015). In a cohort study in Italy involving three generations, breastfed children are more likely to repeat the experience when they become mothers (Porta et al., 2016). Environmental factors (better health and wellbeing, higher educational achievement) and epigenetic mechanisms have been suggested as independent pathways through which this intergenerational effect is passed along from one generation to the other (Porta et al, 2016).

Public Health Policy Implications

Findings from this study have relevance for public health policy to address disparities. The observation that maternal education moderated the "effect" of SLE exposure in the 12 months prior to child birth on EBF in those with lower education should be of interest to policymakers across multiple sectors including maternal and child health, education, and labor. Long term planning and development efforts to address ways to boost higher education attainment levels for females and also address education disparities across sub-groups, particularly among African-American and Hispanic women, should be aggressively funded.

In the short term, there are opportunities to incorporate study findings into existing policy. The Affordable Care Act (ACA), commonly referred to as "Obamacare," passed into law in 2010 remains the dominant healthcare policy in the United States. The ACA includes a guarantee to provide eight types of free women's preventive health services (USDHHS, Health Resources and Services Administration, 2018), including two services that are relevant for the application of the findings of this study to improve EBF outcomes. These are well-woman visits (provided annually) and breastfeeding support, supplies, and counseling (provided in conjunction with each birth). Well-woman visits include provision of preconception and prenatal care services based on age appropriateness. Breastfeeding support, supplies, and counseling encompasses providing comprehensive lactation support beginning from pregnancy and continuing into the postpartum period and removing cost barriers to access to breastfeeding equipment (USDHHS, Health Resources Services Administration, 2018). Both services were made more available to large segments of the high-risk target sub-groups in states that adopted the Medicaid option, thus making the insurance more accessible and affordable.

However, as shown in this study, focusing on a health service delivery model is arguably insufficient to address the findings in this study. Attention should be directed to managing environmental exposures (SLE) and improving social determinant of health outcomes. New policy interventions should focus on reducing and/or alleviating the impact of SLE exposure at source (particularly for financial and traumatic SLE) and tackling upstream social determinants of health factors (low maternal educational attainment). SLE and maternal education interventions represent a new direction to mobilize and invest monetary resources towards equitably boosting EBF duration universally across the United States.

Increased spending to address SLE such as inability to pay bills, homelessness, and drinking/drug use, and boosting educational attainment beyond high school are examples of specific policy-driven activities to invest in. Long term policy initiatives supportive of higher female educational attainment in the United States could positively benefit EBF outcomes. Recent data revealed less than a third (30.7%) of the U.S. population have a bachelor or higher degree (United States Department of Labor, n.d.) and varies by other factors such as race/ethnicity and income levels. Higher educational attainment is likely to culminate in relatively higher wages and the propensity to also work in settings that allow for more flexibility of schedules and opportunities to practice EBF.

Recommendations for Future Research

The social determinant of health framework was a useful context to identify relationships that could be targeted for future research. Neighborhood/built environment, one of the pillars of the social determinants of health framework, was not captured in this study. This should be explored in future studies. However, there remain other opportunities for additional research. New studies could ascertain the influence of neighborhood-level variables, such as affordable housing, vocational training leading to stable employment, and food security, on the distribution of SLE and examine how such neighborhood indicators are related to EBF outcomes. It is possible that the neighborhood quality by itself could be an extra source of support or discouragement for EBF based on the distribution of facilities, services, level of social order or disorder, quality of interaction between residents, and other neighborhood factors. In addition, sub-group differences based on race/ethnicity within the neighborhood context should be explored to establish cultural differences that could be useful for tailoring appropriate interventions. These suggested studies should also consider potential sub-group differences by demographic, economic, and pre-pregnancy body mass index levels, which have all been shown to be relevant to EBF in the current study.

This study examined exposure to SLE within a period spanning a year before child birth but failed to distinguish between preconception and pregnancy periods due to the survey items used by CDC PRAMS. New studies can assess the relationship in each period instead of combining both. It is already known that pregnancy by itself imposes some strain on the physiological system of women; thus, it would be more meaningful to separate preconception from pregnancy periods to isolate SLE from the additional demands introduced by the state of pregnancy. Also, the focus of this study was on the conditions before birth but did not consider SLE occurring in early postpartum. Life events occurring during postpartum may have a different relationship with EBF compared to those occurring in the 12 months period before birth. New studies should address this research gap.

Furthermore, it may be useful for additional studies to assess the relationship between a combined preconception/prenatal and postpartum life event exposure and compare findings to that from preconception only, prenatal only, and postpartum only life event exposure to determine if the relationship with EBF changes or remains the same. This comparison could have relevance for policy and programs focused on preconception, pregnancy, and postnatal health across the United States. Examples of programs where such research findings could be applied include Home Visiting and Healthy Start programs. Both programs are under the jurisdiction of the Maternal and Child Health Bureau (MCHB) at the Health Resources and Services Administration. Additional program platforms include prenatal counseling visits, Women, Infant, and Children (WIC), and antenatal care visits in clinic settings.

Due to limitation of study design and data collection timing used in PRAMS, it was difficult to establish the studied relationship beyond eight weeks postpartum. New study designs are warranted that allow longitudinal design with follow-up of mothers for up to six months, in line with EBF recommendations, to determine the nature of the association across the expected period for EBF. This could also have applications for interventions unique to each time period along the EBF continuum. Also, additional studies could broaden the scope of SLE beyond the 14 items used in PRAMS. The original tool developed by Newton and Hunt (1984) contained additional life events that could be studied. An additional contributor to the stress burden of minority race/ethnic groups is discrimination (Thoits, 2010).

This extra source of stress was not assessed in this study, thus its contribution to total stress experience in race/ethnic minorities (African-Americans, Hispanics, immigrants) and influence on EBF was unmeasured. Future studies could examine this additional source of stress alongside SLE and relationship with EBF outcomes. Furthermore, although this study examined potential effect modification for selected social determinant of health factors, there remains the need to determine if there are additional protective factors that could mitigate the "effect" of SLE exposure on EBF. One such candidate factor that merits an examination is social support. Previous studies indicate social support can potentially act as a defense to reduce the impact of stress (Cardwell, 2013; Glanz et al, 2008; Thoits, 2010). Another study showed availability of social support and networks was positively associated with better mental functioning even in the presence of high levels of home and work-related stressors (Achat et al, 1998). Lastly, studies with mixed-methods design and/or qualitative research are warranted to gain further insight into the "why" and "how" SLE exposure could independently reduce the likelihood of EBF at specified time points in the postpartum period.

Beyond traditional research needs, there are also opportunities for translational research to help develop easy to use but highly sensitive and specific, relatively shorter SLE assessment tools that could be used in preconception and prenatal care settings to identify at-risk individuals. Such tools should be quick to deploy and require little expertise so that even low skilled healthcare providers at the clinic or community level can use it to determine a SLE score that is predictive of EBF practice and has a meaningful application for referrals and targeting for additional support services. Such referral services could include access to programs that address SLE, other programs that address social determinants of health resources, relatively more contacts with lactation consultancy services, and breastfeeding peer support.

With additional SLE/EBF research, new revisions to the ACA could focus on funneling additional resources to mandate healthcare providers to screen for specific SLE during preconception and prenatal contacts. Based on screening, at-risk individuals could benefit from referral to additional contacts with lactation consultancy services and accessing supplies in the early postpartum period. Other policy solutions that are part of the EBF debate include paid and unpaid maternity leave and should be revisited as part of efforts to address the impact of SLE on EBF. The United States remains the only developed nation among economically developed countries with no nationally guaranteed paid maternity leave (Organisation for Economic Co-operation and Development, 2016). However, there are opportunities for limited unpaid leave in the United States through the Family Medical Leave Act (FMLA) although it is not available to every woman, especially those who could benefit the most from it.

Conclusion

To improve EBF rates, findings from this study suggest that public health interventions and policy solutions be directed toward improving the plight of mothers who experience financial and traumatic SLE. These domains are linked to the social determinants of health, the first construct in the Transactional Model of Stress and Coping used to guide this research, as well as an area of research that is under explored relative to EBF. In addition, maternal educational attainment significantly modified the effect of SLE on EBF indicating the need to improve educational attainment if we want to further improve EBF rates for all. This is especially important since the babies that most need EBF to protect them from morbidity and mortality are born to these mothers with low educational attainment and who also live where the social determinants of health are worse.

Dissemination of Findings

The study findings will be disseminated to the scientific community and the public in a variety of ways. First, findings will be shared with the CDC as required by the data sharing agreement for PRAMS datasets. In addition, one of the observations noted with the dataset was the non-inclusion of questions used to derive EBF in the core questionnaire, but rather it was included in the standard questionnaire. This made the use of these questions optional for states. A recommendation to include these questions in the core questionnaire so that all participating states can include it in PRAMS data collection would be shared with the CDC PRAMS team for consideration in future surveys. Second, abstracts for oral presentation will be submitted to the Breastfeeding as well as Maternal and Child Health sections of the annual American Public Health Association meeting. Other avenues include the American Society for Nutrition annual meeting and the National Breastfeeding Conference.

Third, manuscripts will be prepared and submitted to leading scientific journals that are focused on maternal and child health topics. Targeted journals will include the American Journal of Public Health, Breastfeeding Medicine, International Journal of Breastfeeding, Journal of Nutrition, and American Journal of Clinical Nutrition as well as the Maternal Child Health Journal. Approval will be sought from the CDC as stipulated by the data sharing agreement before submitting abstracts or manuscripts. Lastly, additional opportunities to present to practice professionals and other stakeholders (including program initiatives such as Healthy Start, community-based organizations, breastfeeding coalitions at the national and state levels, and policymakers) at formal and informal forums will be explored.

References

Achat, H., Kawachi, I., Levine, S., Berkey, C., Coakley, E., & Colditz, G. (1998). Social networks, stress and health-related quality of life. *Quality of Life Research*, *7*(8), 735–750.

Ahluwalia, I.B., Merritt, R., Beck, L.F., & Rogers, M. (2001). Multiple lifestyle and psychosocial risks and delivery of small for gestational age infants. *Obstetrics & Gynecology, 97*(5 Part 1), 649–656.

Almeida, O.F., Yassouridis, A., & Forgas-Moya, I. (1994). Reduced availability of milk after central injection of corticotroping-releasing hormone in lactating rats. *Neuroendocrinology, 59*(1), 72–77.

Altemus, M. (1995). Neuropeptides in anxiety disorders: effects of lactation. *Annals of the New York Academy of Sciences*, *771*, 697–707.

American Academy of Pediatrics. (2012). Breastfeeding and the use of human milk. *Pediatrics, 129*, e827 – e841.

American College of Obstetricians and Gynecologists. (2006). ACOG Committee Opinion No. 343: Psychosocial risk factors: Perinatal screening and intervention. *Obstetrics and Gynecology, 108*(2), 469–477.

American Psychiatric Association (2017). *What is depression?* Retrieved from https://www.psychiatry.org/patients-families/depression/what-is-depression

Amir, L.H., & Donath, S. (2007). A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *BMC Pregnancy and Childbirth*, *7*, 9.

Anstey, E.H., Chen, J., Elam-Evans, L.D., & Perrine, C.G. (2017). Racial and geographic differences in breastfeeding. *MMWR Morbidity and Mortality Weekly Report, 66*(27), 723–727.

Arora, S., McJunkin, C., Wehrer, J., & Kuhn, P. (2000). Major factors influencing breastfeeding rates: Mother's perception of father's attitude and milk supply. *Pediatrics, 106*(5), e67.

Ashley, J.M., Harper, B.D., Arms-Chavez, C.J., & LoBello, S.G. (2016). Estimated prevalence of antenatal depression in the US population. *Archives of Women's Mental Health, 19*(2), 395–400.

Averett, S.L., & Fletcher, E.K. (2016). Prepregnancy obesity and birth outcomes. *Maternal and Child Health Journal, 20*(3), 655–664.

Barbeau, E., Krieger, N., & Soobader, M.J. (2004). Working class matters: Socioeconomic disadvantage, race/ethnicity, gender, and smoking in NHIS 2000. *American Journal of Public Health, 94,* 269–278.

Bartick, M.C., Schwarz, E.B., Green, B.D., Jegier, B.J., Reinhold, A.G., Colaizy, T.T., . . . Stuebe, A.M. (2017). Suboptimal breastfeeding in the United States: Maternal and pediatric health outcomes and costs. *Maternal & Child Nutrition, 13*, e12366.

Black, R.E., Allen, L.H., Bhutta, Z.A., Caulfield, L.E., de Onis, M., Ezzati, M., . . . Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: Global and regional exposures and health consequences. *Lancet, 371*, 243–260.

Bourgoin, G.L., Lahaie, N.R., Rheaume, B.A., Berger, M.G., Dovigi, C.V., Picard, L.M., . . . Sahai, V.F. (1997). Factors influencing the duration of breastfeeding in the Sudbury region. *Canadian Journal of Public Health, 88*(4), 238–241.

Braveman, P., Egerter, S., & Williams, D.R. (2010). The social determinants of health: Coming of age. *Annual Review of Public Health, 32,* 381–398.

Buck, C.O., Gjelsvic, A., Vivier, P.M., Monteiro, K., & Amanullah, S. (2018). Prenatal exposure to stressful life events and infant breastfeeding. *Breastfeeding Medicine, 13*(6), 426–432.

Burns, E.R., Farr, S.L., & Howards, P.P. (2015). Stressful life events experienced by women in the year before their infants' births – United States, 2000–2010. *Morbidity and Mortality Weekly Report*, *64*(9), 247–251.

Cardwell, M.S. (2013). Stress: Pregnancy considerations. *Obstetrical and Gynecological Survey, 68*(2), 119–129.

Centers for Disease Control and Prevention. (2007). Breastfeeding trends and updated national health objectives for exclusive breastfeeding - United States, birth years 2000-2004. *Morbidity and Mortality Weekly Report, 56*(30), 760–763.

Centers for Disease Control and Prevention. (2013). Progress in increasing breastfeeding and reducing racial/ethnic differences – United States, 2000–2008 births. *Morbidity and Mortality Weekly Report*, *62*(5), 77–80.

Centers for Disease Control and Prevention. (2017). *Breastfeeding among U.S. children born 2003 – 2014, CDC National Immunization Survey*. Retrieved from http://medbox.iiab.me/modules/en-cdc/www.cdc.gov/breastfeeding/data/NIS_data.1

Centers for Disease Control and Prevention. (2018). *Breastfeeding among U.S. children born 2009 – 2014, CDC National Immunization Survey*. Retrieved from https://www.cdc.gov/breastfeeding/data/nis_data/results.html

Centers for Disease Control and Prevention. (2019). *What is PRAMS?* Retrieved from https://www.cdc.gov/prams/index.htm

Chapman, D.J., & Perez-Escamilla, R. (2012). Breastfeeding among minority women: Moving from risk factors to interventions. *Advances in Nutrition, 3*(1), 95–104.

Chrousos, G.P. (2009). Stress and disorders of the stress system. *Nature Review Endocrinology, 5*, 374–381.

Coates, M.M. (1989). Assisting the newborn to latch on to the very large breast: HELP! *Journal of Human Lactation, 5*(3), 131–132.

Cochrane, R., & Robertson, A. (1973). The Life Events Inventory: A measure of the relative severity of psycho-social stressors. *Journal of Psychosomatic Research, 17*(2), 135–140.

Cohen, S., Gianaros, P.J., & Manuck, S.B. (2016). A stage model of stress and disease. *Perspectives on Psychological Science, 11*(4), 456–463.

Cohen, S., Kessler, R.C., & Gordon, L.U. (1997). *Measuring stress.* New York, NY: Oxford University Press.

Crissey, S.R. (2009). *Educational attainment in the United States: 2007.* (P20-560). Washington, DC: U.S. Department of Commerce, Economics and Statistics Administration. Retrieved from https://files.eric.ed.gov/fulltext/ED505040.pdf

Demakakos, P., Nazroo, J., Breeze, E., & Marmot, M. (2008). Socioeconomic status and health: The role of subjective social status. *Social Science & Medicine, 67,* 330–340.

Dennis, C.L. (2002). Breastfeeding initiation and duration: A 1990–2000 literature review. *Journal of Obstetric, Gynecologic, & Neonatal Nursing, 31*, 12–32.

Dewey, K.G. (2001). Maternal and fetal stress are associated with impaired lactogenesis in humans. *Journal of Nutrition, 131*(11), 3012S–3015S.

Di Manno, L., Macdonald, J.A., Knight, T. (2015). The intergenerational continuity of breastfeeding intention, initiation, and duration: A systematic review. *Birth, 42*(1), 5–15.

Dozier, A.M., Nelson, A., & Brownell, E. (2012). The relationship between life stress and breastfeeding outcomes among low-income mothers. *Advances in Preventive Medicine, 2012*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3546433/pdf/APM2012-902487.pdf

Fein, S.B., & Roe, B. (1998). The effect of work status on initiation and duration of breastfeeding. *American Journal of Public Health, 88,* 1042–1046.

Figueiredo, B., Canario, C., & Field T. (2014). Breastfeeding is negatively affected by prenatal depression and reduces postpartum depression. *Psychological Medicine, 44*(5), 927–936.

Figueiredo, B., Pacheco, A., & Costa, R. (2007). Depression during pregnancy and the postpartum period in adolescent and adult Portuguese mothers. *Archives of Women's Health, 10*, 103–109.

Figueroa-Fankhanel, F. (2014). Measurement of stress. *The Psychiatric Clinics of North America, 37*(4), 455–487.

Fricchione, G.L., Ivkovic, A., & Yeung, A.S. (2016). *The science of stress: Living under pressure.* Chicago, IL: The University of Chicago Press.

Glanz, K., Rimer, B.K., & Viswanath, K. (2008). *Health behavior and health education.* San Francisco, CA: Jossey-Bass.

Gong, H., Ni, C., Shen, X., Wu, T., & Jiang, C. (2015). Yoga for prenatal depression: A systematic review and meta-analysis. *BMC Psychiatry, 15,* 14.

Grosvenor, C.E., & Mena, F. (1967). Effect of auditory, olfactory and optic stimuli upon milk release and suckling-induced release of prolactin in lactating rats. *Endocrinology, 80,* 840–848.

Grummer-Strawn, L.M., Scanlon, K.S., & Fein, S.B. (2008). Infant feeding and feeding transitions during the first year of life. *Pediatrics, 122,* S36–S42.

Grummer-Strawn, L.M., & Shealy, K.R. (2009). Progress in protecting, promoting, and supporting breastfeeding: 1984–2009. *Breastfeeding Medicine, Suppl 1,* S31–S39.

Guttmann, P. (2016). *Illustration of the Transactional Model of Stress and Coping of Richard Lazarus.* Retrieved from https://commons.wikimedia.org/wiki/File:Transactional_Model_of_Stress_and_Coping_-_Richard_Lazarus.svg

Haas, D.M., Howard, C.S., Christopher, M., Rowan, K., Broga, M.C., & Corey, T. (2006). Assessment of breastfeeding practices and reasons for success in a military community hospital. *Journal of Human Lactation, 22*(4), 439–445.

Hackman, N.M., Schaefer, E.W., Beiler, J.S., Rose, C.M., & Paul, I.M. (2015). Breastfeeding outcome comparison by parity. *Breastfeeding Medicine, 10*(3), 156–162.

Haider, S.J., Jacknowitz, A., & Schoeni, R.F. (2003). Welfare work requirements and child well-being: Evidence from the effects on breastfeeding. *Demography, 40*(3), 479–497.

Hales, C.M., Carroll, M.D., Fryar, C.D., & Ogden, C.L. (2017). Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief, 288*, 1–8.

Harkness, K.L., & Monroe, S.M. (2016). The assessment and measurement of adult life stress: Basic premises, operational principles, and design requirements. *Journal of Abnormal Psychology, 125*(5), 727–745.

Hauck, F.R., Thompson, J.M., Tanabe, K.O., Moon, R.Y., & Vennemann, M.M. (2011). Breastfeeding and reduced risk of sudden infant death syndrome: A meta-analysis. *Pediatrics, 128*, 103–110.

Hauff, L.E., Leonard, S.A., & Rasmussen, K.M. (2014). Associations of maternal obesity and psychosocial factors with breastfeeding intention, initiation, and duration. *American Journal of Clinical Nutrition, 99,* 524–534.

Hawkins, N.G., Davies, R., & Holmes, T.H. (1957). Evidence of psychosocial factors in the development of pulmonary tuberculosis. *American Review of Tuberculosis and Pulmonary Diseases, 75,* 768–780.

Hill, P.D., & Aldag, J.C. (2005). Milk volume on day 4 and income predictive of lactation adequacy at 6 weeks of mothers of non-nursing preterm infants. *Journal of Perinatal Neonatal Nursing, 19*(3), 273–282.

Hill, P.D., Aldag, J.C., Demirtas, H., Zinaman, M., & Chatterton, R.T. (2006). Mood states and milk output in lactating mothers of preterm and term infants. *Journal of Human Lactation, 22*(3), 305–314.

Hillervik-Lindquist, C. (1991). Studies on perceived breast milk insufficiency: A prospective study in a group of Swedish women. *Acta Paediatrica Scandinavica Supplement, 376,* 1–27.

Hilson, J.A., Rasmussen, K.M., & Kjolhede, C.L. (1997). Maternal obesity and breast-feeding success in a rural population of white women. *American Journal of Clinical Nutrition, 66,* 1371–1378.

Hilson, J.A., Rasmussen, K.M., & Kjolhede, C.L. (2004). High prepregnant body mass index is associated with poor lactation outcomes among white, rural women independent of psychosocial and demographic correlates. *Journal of Human Lactation, 20,* 18–29.

Holmes, T.H., & Rahe, T.H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research*, *11*(2), 213–218.

Hosler, A.S., Nayak, S.G., & Radigan, A.M. (2011). Stressful events, smoking exposure and other maternal risk factors associated with gestational diabetes mellitus. *Paediatric and Perinatal Epidemiology*, *25*(6), 566–574.

Hurley, K.M., Black, M.M., Papas, M.A., & Quigg, A.M. (2008). Variation in breastfeeding behaviours, perceptions and experiences by race/ethnicity among a low-income statewide sample of Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participants in the United States. *Maternal Child Nutrition*, *4(*2), 95–105.

Insaf, T., Fortner, R.T., Pekow, P., Dole, N., Markenson, G., & Chasan-Taber, L. (2011). Prenatal stress, anxiety, and depressive symptoms as predictors of intention to breastfeed among Hispanic women. *Journal of Women's Health, 20*, 1183–1192.

Ip, S., Chung, M., Raman, G., Chew, P., Magula, N., DeVine, D., . . . Lau, J. (2007). Breastfeeding and maternal and infant health outcomes in developed countries. *Evidence Report/Technology Assessment*, *153*, 1–186.

Jarvie, E., & Ramsay, J.E. (2010). Obstetric management of obesity in pregnancy. *Seminars in Fetal & Neonatal Medicine*, *15*(2), 83–88.

Johnston, M.L., & Esposito, N. (2007). Barriers and facilitators for breastfeeding among working women in the United States. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, *36,* 9–20.

Jones, J.R., Kogan, M.D., Singh, G.K., Dee, D.L., & Grummer-Strawn, L.M. (2011). Factors associated with exclusive breastfeeding in the United States. *Pediatrics, 128*(6), 1117–1125.

Jones, K.M., Power, M.L., Queenan, J.T., & Schulkin, J. (2015). Racial and ethnic disparities in breastfeeding. *Breastfeeding Medicine, 10*(4), 186–196.

Kafouri, S., Kramer, M., Leonard, G., Perron, M., Pike, B., Richer, L., . . . Paus, T. (2013). Breastfeeding and brain structure in adolescence. *International Journal of Epidemiology*, *42*, 150–159.

Kehler, H.L., Chaput, K.H., & Tough, S.C. (2009). Risk factors for cessation of breastfeeding prior to six months postpartum among a community sample of women in Calgary, Alberta. *Canadian Journal of Public Health*, *100*(5), 376–380.

Khashan, A.S., McNamee, R., Abel, K.M., Mortensen, P.B., Kenny, C., Pedersen, M.G., . . . Baker, P.N. (2009). Rates of preterm birth following antenatal exposure to severe life events: A population-based cohort study. *Human Reproduction, 24*(2), 429–437.

Kinser, P.A., Goehler, L.E., & Taylor, A.G. (2012). How might yoga help depression? A neurobiological perspective. *Explore (NY), 8*, 118–126.

Kinser, P.A., & Lyon, D.E. (2014). A conceptual framework of stress vulnerability, depression, and health outcomes in women: Potential uses in research on complementary therapies for depression. *Brain and Behavior, 4*(5), 665 – 674.

Kopp, M.S., Thege, B.K., Balog, P., Stauder, A., Salavecz, G., Rosza, S., . . . Adam, S. (2010). Measures of stress in epidemiological research. *Journal of Psychosomatic Research, 69,* 211–225.

Kotelchuck, M. (1994). An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization Index. *American Journal of Public Health, 84,* 1414–1420.

Labbok, M., & Krasovec, K. (1990). Towards consistency in breastfeeding definitions. *Studies in Family Planning, 21*(4), 226–230.

LaCoursiere, D.Y., Baksh, L., Bloebaum, L., & Varnier, M.W. (2006). Maternal body mass index and self-reported postpartum depressive symptoms. *Maternal and Child Health Journal, 10*(4), 385–390.

Latendresse, G., Wong, B., Dyer, J., Wilson, B., Baksh, L., & Hogue, C. (2015). Duration of maternal stress and depression: Predictors of newborn admission to neonatal intensive care unit and postpartum depression. *Nursing Research, 64,* 331–341.

Lau, C (1992). Effects of various stressors on milk release in the rat. *Physiology & Behavior, 51*(17), 1157–1163.

Lau, C. (2001). Effects of stress on lactation. *Pediatrics Clinics of North America, 48*(1), 221–234.

Lau, C. (2002). The effect of stress on lactation – its significance for the preterm infant. *Advances in Experimental Medicine and Biology, 503,* 91–97.

Lazarus, R.S., & Cohen, J.B. (1977). Environmental stress. In I. Altman, & J.F. Wohlwill (Eds), *Human behavior and environment.* New York, NY: Plenum.

Lazarus, R.S., & Folkman, S. (1984). *Stress, appraisal, and coping.* New York, NY: Springer Publishing.

Levine, S. (2005). Developmental determinants of sensitivity and resistance to stress. *Psychoneuroendocrinology, 30*(10), 939–946.

Li, J., Kendall, G.E., Henderson, S., Downie, J., Landsborough, L., & Oddy, W.H. (2008). Maternal psychosocial well-being in pregnancy and breastfeeding duration. *Acta Paediatrica, 97*(2), 221–225.

Liu, C.H., & Tronick, E. (2013). Re-conceptualizing prenatal life stressors in predicting post-partum depression: Cumulative-, specific-, and domain-specific approaches to calculating risk. *Paediatr Perinatal Epidemiology, 27,* 481–490.

Lynch, D., Tamburrino, M., & Nagel, R. (1996). Depressive symptoms: Associations with health perceptions and health behaviors. *Depression, 4,* 68–72.

Mandal, B., Roe, B.E., & Fein, S.B. (2010). The differential effects of full-time and part-time work status on breastfeeding. *Health Policy, 97,* 79–86.

Masho, S.W., Cha, S., & Morris, M.R. (2015). Prepregnancy obesity and breastfeeding noninitiation in the United States: An examination of racial and ethnic differences. *Breastfeeding Medicine, 10*(5), 253–262.

McCrory, C., & Layte, R. (2011). The effect of breastfeeding on children's educational test scores at nine years of age: Results of an Irish cohort study. *Social Science Medicine, 72*(9), 1515–1521.

McEwen, B.S. (2000). The neurobiology of stress: From serendipity to clinical relevance. *Brain Research, 886*, 172–189.

McEwen, B.S. (2007). Physiology and neurobiology of stress and adaptation: Central role of the brain. *Physiological Reviews, 87*, 873–904.

McEwen, B.S. (2016). In pursuit of resilience: Stress, epigenetics, and brain plasticity. *Annals of the New York Academy of Sciences, 1373*(1), 56–64.

McEwen, B.S., & Gianaros, P.J. (2010). Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. *Annals of the New York Academy of Sciences, 1186,* 190–222.

McEwen, B.S., & Wingfield, J.C. (2003). The concept of allostasis in biology and biomedicine. *Hormones and Behavior, 43*, 2–15.

Mickelson, K.D., & Kubzansky, L.D. (2003). Social distribution of social support: The mediating role of life events. *American Journal of Community Psychology, 32*, 265–281.

Milgrom, J., Gemmill, A.W., Bilszta, J. L., Hayes, B., Barnett, B., Brooks, J., . . . Buist, A. (2008). Antenatal risk factors for postnatal depression: A large prospective study. *Journal of Affective Disorders*, *108*(1–2), 147–157.

Modrek, S., Basu, S., Harding, M., White, J., Bartick, M., Rodriguez, E., . . . Rosenberg, K. (2017). Does breastfeeding duration decrease child obesity? An instrumental variables analysis. *Pediatric Obesity, 12*(4), 304–311.

Nelson, J.M., Li, R., Perrine, C.G., & Scanlon, K.S. (2017). Changes in mothers' intended duration of breastfeeding from the prenatal to neonatal periods. *Birth*, epub ahead of print.

Neuman, I.D., Torner, L., & Wigger, A. (2000). Brain oxytocin: Differential inhibition of neuroendocrine stress responses and anxiety-related behaviour in virgin, pregnant and lactating rats. *Neuroscience, 95*(2), 567 – 575.

Newton, R.W., & Hunt, L.P. (1984). Psychosocial stress in pregnancy and its relation to low birth weight. *British Medical Journal, 288,* 1191–1194.

Newton, R.W., Webster, P.A., Binu, P.S., Maskrey, N., & Phillips, A.B. (1979). Psychosocial stress in pregnancy and its relation to the onset of premature labour. *British Medical Journal, 2*(6187), 411–413.

Nkansah, S., Luchok, K.J., Hussey, J.R., Watkins, K., & Liu, X. (2010). Effects of maternal stress on low birth weight and preterm birth outcomes across neighborhoods of South Carolina. *Maternal and Child Health, 14*(2), 215–226.

Nomsen-Rivers, L.A., Chantry, C.J., Peerson, J.M., Cohen, R.J., & Dewey, K.G. (2010). Delayed onset of lactogenesis among first-time mothers is related to maternal obesity and factors associated with ineffective breastfeeding. *American Journal of Clinical Nutrition, 92,* 574–584.

Oddy, W.H., Li, J., Whitehouse, A.J., Zubrick, S.R., & Malacova, E. (2011). Breastfeeding duration and academic achievement at 10 years. *Pediatrics, 127*(1), e137–e145.

Organisation for Economic Co-operation and Development (2016). *Parental leave: Where are the fathers?* Policy Brief. Retrieved from https://www.oecd.org/policy-briefs/parental-leave-where-are-the-fathers.pdf

Osorio, C., Probert, T., Jones, E., Young, A.H., & Robbins, I. (2017). Adapting to stress: Understanding the neurobiology of resilience. *Behavioral Medicine, 43*(4), 307–322.

Perrine, C.G., Scanlon, K.S., Li, R., Odom, E., & Grummer-Strawn, L.M. (2012). Baby-friendly hospital practices and meeting exclusive breastfeeding intention. *Pediatrics, 130*(1) 54–60.

Peters, K.E., Huang, J., Vaughn, M.G., & Witko, C. (2013). Does breastfeeding contribute to the racial gap in reading and math test scores? *Annals of Epidemiology*, *23*(10), 646–651.

Phillips, G., Brett, K., & Mendola, P. (2011). Previous breastfeeding practices and duration of exclusive breastfeeding in the United States. *Maternal Child Health Journal*, *15,* 1210–1216.

Pope, C.J., & Mazmanian, D. (2016). Breastfeeding and postpartum depression: An overview and methodological recommendations for future research. *Depression Research and Treatment, 2016,* 4765310.

Porta, F., Mussa, A., Baldassarre, G., Perduca, V., Farina, D., Spada, M., . . . Ponzone, A. (2016). Genealogy of breastfeeding. *European Journal of Pediatrics, 175*(1), 105–112.

Preusting, I., Brumley, J., Odibo, L., Spatz, D.L., &Louis, J.M. (2017). Obesity as a predictor of delayed lactogenesis II. *Journal of Human Lactation*, *33*(4), 684–691.

Rasmussen, K.H. (2007). Association of maternal obesity before conception with poor lactation performance. *Annual Review of Nutrition, 27,* 103–121.

Rasmussen, K.M., & Kjolhede, C.L. (2004). Prepregnant overweight and obesity diminish the prolactin response to suckling in the first week postpartum. *Pediatrics, 113*(5), e465–e471.

Rowe-Murray, H.J., & Fisher, J.R.W. (2002). Baby friendly hospital practices: Caesarean section is a persistent barrier to early initiation of breastfeeding. *Birth, 29*(2), 124–131.

Santana, G.S., Giugliani, E.R.J., Vieira, T.O., & Vieira, G.O. (2017). Factors associated with breastfeeding maintenance for 12 months or more: A systematic review. *Jornal de Pediatria,* epub ahead of print.

Selye, H. (1936). A syndrome produced by diverse nocuous agents. *Nature, 138*, 32.

Selye, H. (1956). What is stress? *Metabolism*, *5*(5), 25–30.

Sheline, Y.I., Gado, M.H., & Kraemer, H.C. (2003). Untreated depression and hippocampal volume loss. *American Journal of Psychiatry, 160,* 1516–1518.

Shonkoff, J.P., Boyce, W.T., & McEwen, B.S. (2009). Neuroscience, molecular biology, and the childhood roots of health disparities. *Journal of the American Medical Association, 301,* 2252–2259.

Shulman, H.B., D'Angelo, D.V., Harrison, L., Smith, R.A., & Warner, L. (2018). The Pregnancy Risk Assessment Monitoring System (PRAMS): Overview of design and methodology. *American Journal of Public Health, 108*(10), 1305–1313.

Simard, I., O'Brien, H.T., Beaudoin, A., Turcotte, D., Damant, D., Ferland, S., . . . Champoux, L. (2005). Factors influencing the initiation and duration of breastfeeding among low-income women followed by the Canada prenatal nutrition program in 4 regions of Quebec. *Journal of Human Lactation, 21*(3), 327–337.

Sperlich, S., & Maina, M.N. (2014). Are single mothers' higher smoking rates mediated by dysfunctional coping styles? *BMC Women's Health, 14*, 24.

Sterling, P., & Eyer, J. (1998). Allostasis: A new paradigm to explain arousal pathology. In S. Fisher, & J. Reason (Eds.), *Handbook of life stress, cognition and health.* New York, NY: John Wiley & Sons.

Stone, S.L., Diop, H, Declercq, E., Cabral, H.J., Fox, M.P., & Wise, L.A. (2015). Stressful events during pregnancy and postpartum depression. *Journal of Women's Health, 24*(5), 384–393.

Stough, C.O., Khalsa, A.S., Nabors, L.A., Merianos, A.L., & Peugh, J. (2019). Predictors of exclusive breastfeeding for 6 months in a national sample of US Children. *American Journal of Health Promotion, 33*(1), 48–56.

Thoits, P.A. (2010). Stress and health: Major findings and policy implications. *Journal of Health and Social Behavior, 51 Suppl,* S41–S53.

Torloni, M.R., Betran, A.P., Horta, B.L., Nakamura, M.U., Atallah, A.N., Moron, A.F., . . . Valente, O. (2009). Prepregnancy BMI and the risk of gestational diabetes: A systematic review of the literature with meta-analysis. *Obesity Reviews, 10*(2), 194–203.

Ueda, T., Yokohama, Y., Irahara, M., & Aono, T. (1994). Influence of psychological stress on suckling-induced pulsatile oxytocin release. *Obstetrics and Gynecology, 84*(2), 259–262.

United Nations Children's Fund and World Health Organization. (2017). *Global breastfeeding scorecard, 2017, tracking breastfeeding policies and programmes.* Geneva: Author.

U.S. Department of Health and Human Services. (2011). *The Surgeon General's call to action to support breastfeeding*. Washington, DC: Author.

U.S. Department of Health and Human Services, Health Resources Services Administration. (2018). *Women's preventive services guidelines*. Retrieved from https://www.hrsa.gov/womens-guidelines/index.html

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2019a). *Healthy People 2020: Maternal, infant, and child health.* Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2019b). *Social determinants of health*. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health

U.S. Department of Labor (2012). *Fact sheet #28: The Family and Medical Leave Act.* Retrieved from https://www.dol.gov/whd/regs/compliance/whdfs28.pdf.

U.S. Department of Labor. (n.d.). *Overtime pay.* Retrieved on February 25, 2019 from https://www.dol.gov/whd/overtime_pay.htm

Vallianatos, H., Brennand, E.A., Raine, K., Stephen, Q., Petawanabo, B., Dannenbaum, D., . . . Willows, N.D. (2006). Beliefs and practices of first nation women about weight gain during pregnancy and lactation: Implications for women's health. *The Canadian Journal of Nursing Research, 38*(1), 102–119.

Warren, B.J. (1997). Depression, stressful life events, social support, and self-esteem in middle class African American women. *Archives of Psychiatric Nursing, 11*(3), 107–117.

Wilson, B.L., Dyer, J.M., Latendresse, G., Wong, B., & Baksh, L. (2015). Exploring the psychosocial predictors of gestational diabetes and birth weight. *Journal of Obstetric, Gynecologic & Neonatal Nursing, 44*(6), 760–771.

World Bank (2017). *Girls' education.* Retrieved from https://www.worldbank.org/en/topic/girlseducation.

World Health Organization. (2003). *Global strategy for infant and young child feeding*. Geneva: Author.

World Health Organization. (2008). *Indicators for assessing infant and young child feeding practices.* Washington, DC: Author.

World Health Organization. (n.d.). *About social determinants of health*. (n.d.). Retrieved from https://www.who.int/social_determinants/sdh_definition/en/

Wright, A.L. (2001). The rise of breastfeeding in the United States. *Pediatric Clinics of North America, 48*(1), 1–12.

Zayas, L.H., Cunningham, M., McKee, M.D., & Jankowski, K.R. (2002). Depression and negative life events among pregnant African-American and Hispanic women. *Women's Health Issues, 12*(1), 16–22.

Zhao, Y., Kershaw, T., Ettinger, A.S., Higgins, C., Lu, M.C., & Cho, S.M. (2015). Association between life event stressors and low birth weight in African American and White populations: Findings from the 2007 and 2010 Los Angeles Mommy and Baby (LAMB) surveys. *Maternal and Child Health*, *19*(10), 2195–2205.

Ziol-Guest, K.M., & Hernandez, D.C. (2010). First- and second-trimester WIC participation is associated with lower rates of breastfeeding and early introduction of cow's milk during infancy. *Journal of the Academy of Nutrition and Dietetics, 110*(5), 702–709.

Appendices

Appendix A

PRAMS Acknowledgment

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Appendix B

Table B1. Effect Modification Analysis for Federal Poverty Level in the Relationship Between Stressful Life Event and Exclusive Breastfeeding

	4 Weeks		8 Weeks	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stress#Poverty Level Interaction				
No; Higher FPL (Ref)	–	–	–	–
Yes; Lower FPL (<200)	1.02	0.86-1.22	1.06	0.89-1.26
Emotional Stress#Poverty Level Interaction				
No; Higher FPL (Ref)	–	–	–	–
Yes; Lower FPL (<200)	1.01	0.84-1.23	0.96	0.79-1.17
Partner-associated Stress#Poverty Level Interaction				
No; Higher FPL (Ref)	–	–	–	–
Yes; Lower FPL (<200)	0.96	0.78-1.18	0.98	0.80-1.19
Traumatic Stress#Poverty Level Interaction				
No; Higher FPL (Ref)	–	–	–	–
Yes; Lower FPL (<200)	0.94	0.69-1.28	0.88	0.65-1.20
Total Stress Count#Poverty Level Interaction				
No event; Higher FPL (Ref)	–	–	–	–
One to two events; Lower FPL (<200)	0.94	0.77-1.16	0.92	0.75-1.12
Three or more events; Lower FPL (<200)	0.96	0.75-1.23	0.96	0.75-1.23
Overall Stress Burden#Poverty Level Interaction				
No domain; Higher FPL (Ref)	–	–	–	–
One domain; Lower FPL (<200)	0.89	0.72-1.10	0.89	0.72-1.10
Two or more domains; Lower FPL (<200)	1.01	0.81-1.26	0.97	0.77-1.21

Table B2. Effect Modification Analysis for Prenatal Care Utilization in the Relationship Between Stressful Life Event and Exclusive Breastfeeding

	4 Weeks		**8 Weeks**	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Financial Stress#Prenatal Care Interaction				
No; Adequate/Adequate Plus (Ref)	–	–	–	–
Yes; Inadequate/Intermediate	1.06	0.87-1.31	1.14	0.93-1.40
Emotional Stress#Poverty Level Interaction				
No; Adequate/Adequate Plus (Ref)	–	–	–	–
Yes; Inadequate/Intermediate	0.83	0.65-1.04	0.87	0.69-1.10
Partner-associated Stress#Poverty Level Interaction				
No; Adequate/Adequate Plus (Ref)	–	–	–	–
Yes; Inadequate/Intermediate	1.21	0.96-1.52	1.18	0.94-1.49
Traumatic Stress#Poverty Level Interaction				
No; Adequate/Adequate Plus (Ref)	–	–	–	–
Yes; Inadequate/Intermediate	0.92	0.65-1.29	1.09	0.77-1.54
Total Stress Count#Poverty Level Interaction				
No event; Adequate/Adequate Plus (Ref)	–	–	–	–
One to two events; Inadequate/Intermediate	0.98	0.77-1.25	0.94	0.74-1.20
Three or more events; Inadequate/Intermediate	1.03	0.78-1.35	1.12	0.85-1.47
Overall Stress Burden#Poverty Level Interaction				
No domain; Adequate/Adequate Plus (Ref)	–	–	–	–
One domain; Inadequate/Intermediate	0.99	0.77-1.27	0.95	0.74-1.22
Two or more domains; Inadequate/Intermediate	1.01	0.78-1.30	1.07	0.82-1.38