ASSESSING THE IMPACT OF THE SPECIAL SUPPLEMENTAL NUTRITION PROGRAM FOR WOMEN, INFANTS AND CHILDREN (WIC) FOOD PACKAGE REVISION ON POSTPARTUM WOMEN

A Dissertation

by

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ABSTRACT

The postpartum period plays an important part in ensuring ideal maternal and child health. The main purpose of this study was to identify whether postpartum women participating in WIC are benefitting from the WIC Food Package (WIC-FP) revision. Three studies, a scoping review and two quantitative studies, were used to examine the impact of the WIC-FP revision on food consumption behaviors in postpartum WIC participants.

The first study, a scoping review, systemically reviewed existing literature on the impact of the WIC food package revision on rural postpartum WIC participants. Five articles were included in the review. Findings revealed that after the WIC-FP revision, there was an increase in fruit, vegetable, whole grain and low fat dairy consumption, as well as a decrease in whole milk consumption.

The second study assessed the impact of the WIC-FP revision on food consumption behaviors in rural postpartum WIC participants. Analyses included descriptive statistics, and a series of logistic regressions and multinomial logit models on 16,821 postpartum women participating in WIC before and after the WIC-FP revision. Findings revealed an increase in the likelihood of meeting the recommended daily amounts for fruit consumption after the WIC-FP revision compared to before. Furthermore, there was also an increased likelihood of consuming reduced fat or low fat/fat-free milk and a decreased likelihood of consuming whole milk after the revision compared to before.

The third study assessed the impact of the WIC-FP revision on food consumption behaviors in postpartum WIC participants residing in Texas. Descriptive statistics, and a series of logistic regressions and multinomial logit models were performed on 3,277 postpartum WIC participants residing in Texas before and after the WIC-FP revision. After the WIC-FP revision, there was an increase in the likelihood of meeting the daily recommended amounts for fruit consumption compared to before. Additionally, after the WIC-FP revision, participants were also more likely to consume reduced fat or low fat/fat free milk and less likely to consume whole milk compared to before.

Findings from this study will guide in the formulation of state and national policies and the design of targeted interventions to improve food consumption behaviors in postpartum WIC participants.

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Contributors

This work was supervised by a dissertation committee consisting of Dr. Lisako McKyer (committee chair) of the Department of Health Promotion and Community Health Sciences, Dr. Ariun Ishdorj of the Departments of Agricultural Economics, Dr. James Burdine of the Department of Health Promotion and Community Health Sciences and Dr. Ledric Sherman of the Department of Health and Kinesiology.

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NOMENCLATURE

USDA	United States Department of Agriculture
WIC	Special Supplemental Nutrition Program for Women, Infants and Children
WIC-FP	Special Supplemental Nutrition Program for Women, Infants and Children Food Package
DGA	Dietary Guidelines for Americans
AAP	American Academy of Pediatrics
NATFAN	National Food and Nutrition

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1. INTRODUCTION

Nutrition is vital in promoting maternal and infant health. However, the period after a woman gives birth, usually referred to as the postpartum period, should not be overlooked as this period is vital for developing healthy eating habits (Falciglia et al., 2014). Additionally, during this period, adequate nutrition is needed for replenishing nutrient stores, lactation and returning to original prepregnancy weight (Institute of Medicine and National Academy of Sciences, 1992). Postpartum weight retention is also a contributor to the risk of obesity (Endres et al., 2015). With the increased concern of the obesity epidemic, adequate nutrition in postpartum women is paramount.

According to the Centers for Disease Control and Prevention (CDC), the prevalence for obesity is approximately 40% among women (Ogden et al., 2017) putting them at higher risk for hypertension, diabetes, coronary heart diseases and multiple cancers (Chescheir, 2011). Moreover, obesity among adults is higher in low-income groups (Ogden et al., 2017). Poverty is a notable factor that may affect the health of rural postpartum women. Approximately 28% of those living in rural counties live in persistent poverty (Economic Research Service, 2004). Subsequently, low-income, postpartum women exhibit poor diet quality and are at risk of various dietary inadequacies (Shah et al., 2010) and face additional barriers such as poor finances, lack of transportation and the perceived high cost of healthy food (Shah et al., 2010).

Geographically, the "Southern obesity belt," which encompasses, Alabama, Arkansas, Indiana, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Oklahoma, South Carolina, Texas, and West Virginia has the highest prevalence of obesity (CDC, 2018). Specifically, in Texas, 34.6% of women are obese (Texas Health and Human Services, 2016). Texas has a racially and ethnically diverse population, is one of the most urban states in the U.S., and has a large rural population. Furthermore, about 10% of the population live in the border region (Ishdorj & Capps, 2017). The border region, which is predominantly rural and Hispanic suffers from persistent poverty (Slack et al., 2009). The high obesity and poverty rates in rural and border regions leave that population at a risk for poor nutritional health and overweight/obesity. Therefore, additional support is needed to improve healthy eating behaviors and health outcomes in low-income postpartum women.

Accordingly, the United States Department of Agriculture (USDA) developed the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) to help safeguard the health of women at nutritional risk such as low income postpartum women. WIC provides healthy foods and services such as nutrition education and counseling, breastfeeding support and medical referrals to low income pregnant, postpartum, breastfeeding women, infants, and children up to age five (United States Department of Agriculture, 2018b). In 2009, the USDA made a new food package rule that made significant changes to previous benefits in order to meet the nutrition recommendations of the Dietary Guidelines for Americans (DGA) and the American Academy of Pediatrics (AAP). The revision increased provision of fruits and vegetables,

whole grain, low-fat dairy and reduced juice allowances while providing support for breastfeeding (United States Department of Agriculture, 2018a).

Previous research shows that after the WIC-FP revision, there was an increase in reduced fat milk consumption and a decrease in whole milk consumption (Ishdorj & Capps, 2017; A. S. Kong et al., 2010; Meiqari et al., 2015; S. Whaley et al., 2000) and an increase in fruit (Odoms-Young et al., 2014a) and vegetable consumption (S. Whaley et al., 2000) . This prior research was conducted to ascertain the effects of the 2009 WIC-FP revision on infants and children, pregnant women, or the WIC population as a whole, but there is little to none that has specifically looked at the effects of the revision on postpartum women participating in WIC. As a result, we cannot determine whether the revision benefits postpartum WIC participants.

Conceptual model

The proposed conceptual model guiding this dissertation draws from components of the Social-Ecological model of health behavior (McLeroy et al., 1988) and the Model of Community Nutrition Environments (Glanz et al., 2005). The model in Figure 1 depicts how policy, environmental and individual factors influence eating patterns.

The environment level consists of geographical location, whether the participant resides in rural, non-rural areas, border or non-border regions, as well as the community nutrition environment, which includes access to food source such as the home, grocery stores, fast food store, etc. (Glanz et al., 2005). This community nutrition level has associations related to socioeconomics, race and ethnic health patterns in the individual level (Glanz et al., 2005). Additionally, neighborhood characteristics have also been

linked to individual consumption behaviors. The environment has two pathways of influence on eating patterns, which can also be mediated or moderated by individual factors (Glanz et al., 2005).

The policy level includes government policies such as the 2009 WIC-FP revision that may have a dramatic effect on the population. Policies can indirectly restrict behavior or provide behavioral incentives, in this case, policy influences both the environment and eating patterns.

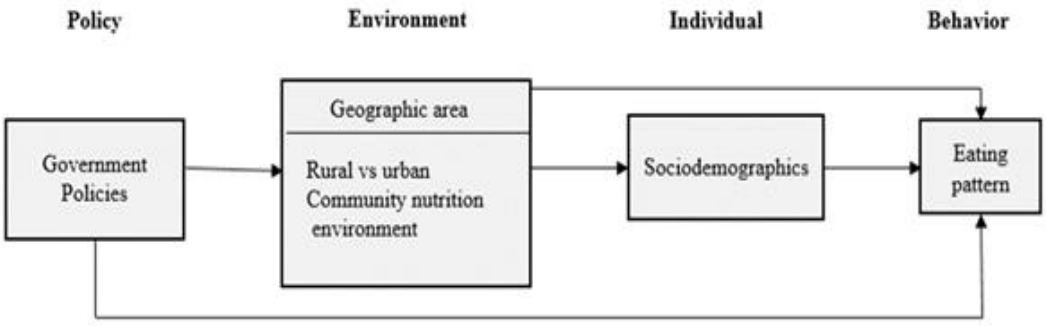

Figure 1: Proposed Conceptual Model
Adapted from Glanz et al. (2005)

The purpose of this dissertation is to identify whether postpartum women participating in WIC are benefitting from the WIC FP revision. The overall objective of this study is to examine the effects of the WIC-FP revision on food consumption behaviors in postpartum women participating in WIC.

The dissertation is organized in a journal article format with five sections. Sections 2 to 4 are independent manuscripts ready to be submitted for publication in

peer-reviewed journals. Appendices are included at the end. The following are brief descriptions of each section of this dissertation:

- **Section 1:** Introduction. Overview and significance of this dissertation
- **Section 2**: Journal article 1. A scoping review of existing literature to identify the impact of the WIC-FP revision on postpartum women.
- **Section 3**: Journal article 2. Descriptive and inferential statistics on the impact of the WIC-FP revision on food consumption behaviors in postpartum WIC participants.
- **Section 4**: Journal article 3. Descriptive and inferential statistics on the impact of the WIC-FP revision on food consumption behaviors in postpartum WIC participants in Texas.
- **Section 5**: Summary and Conclusion. Discussion of the overall findings, and recommendations for future practice.

2. IMPACT OF THE WIC FOOD PACKAGE REVISION ON RURAL POSTPARTUM WIC PARTICIPANTS: A SCOPING REVIEW

Introduction

The postpartum period plays an important part in ensuring ideal maternal and child health. This period is categorized as the time after delivery or pregnancy termination up to 6 months (Washington State WIC Nutrition Program, 2017). Furthermore, this period is also vital for maintaining a healthy weight, developing healthy eating habits, and providing healthy modeling for children ((Falciglia et al., 2014; Institute of Medicine (US) Committee on Nutritional Status during Pregnancy and Lactation, 1992). During the transition from pregnancy to postpartum, unhealthy eating practices may lead to a less healthy diet and an overall lower quality of life. Given the emphasis of healthy eating during the postpartum period, healthy eating is not always evident. George and colleagues (George et al., 2005) noted a decline in vegetable and fruit consumption, but an increase in energy from fat and sugar consumption in postpartum women. It is apparent that postpartum women need adequate nutrition, but this is sometimes difficult to accomplish in low-income impoverished areas.

In the United States (U.S), poverty is one of the notable factors affecting the health of postpartum women. Poverty rates are highest in remote rural areas and are usually characterized by food deserts where access to food is limited (Weber et al., 2005). Similar to postpartum women, low-income postpartum women in particular also had a low intake of fruit and vegetables, whole grains, and oils but higher intake of sodium, saturated fats, and discretionary calories (Shah et al., 2010). Rural areas have

high poverty rates that may affect food consumption in low-income postpartum women. Specifically, rural postpartum women may face the added burden of eating healthy and providing healthy food for their family.

In the US, 19.3% of the population (about 60 million people) live in rural areas (US. Census Bureau, 2016). People living in rural areas experience various nutrition-related health disparities such as heart disease, diabetes and obesity, where obesity rates are highest in women (Befort et al., 2012; Cossman et al., 2010). Inevitably, low-income rural postpartum women have the added risk of poor diet quality compared to urban postpartum women (Martin et al., 2017). Therefore, ensuring that rural postpartum women receive adequate nutrition to recover from pregnancy and childbirth is a need.

The United States Department of Agriculture's (USDA) Special Nutrition Program for Women, Infants, and Children (WIC) program may be vital in targeting low-income rural women who may face nutritional risk. WIC is the third largest food and nutrition assistance program and was formulated to safeguard the health of low-income mothers and children, serving an estimated 8 million people in the United States (United States Department of Agriculture, 2018d). Specifically, WIC was developed to provide supplemental nutritious food, nutrition education, and referrals to other health, welfare, and social services for pregnant, breastfeeding, postpartum women and infants and children below the age of five years (United States Department of Agriculture, 2015). To qualify for WIC, applicants must have an income that is less than 185 percent of the federal poverty income guidelines (United States Department of Agriculture, 2018d). In most states, WIC participants receive a check or voucher to purchase WIC

foods such as cereal, fruit, vegetables, juice, dairy, and baby food (United States Department of Agriculture, 2018c). While the WIC food package has been essential in providing supplementary food to WIC participants, prior reviews indicated that the food package policy needed revision to better meet the nutritional needs of WIC participants.

In 2005, changes to the WIC program were adopted as an interim rule and was mandatory in 2009, while the final rule was published in March 2014. Changes to the WIC program were made to better align with Dietary Guidelines for Americans (DGA) (Department of Health Human Services, 2016) and the American Academy of Pediatrics' infant and child feeding regulations (American Academy of Pediatrics, 2018). For example, the revision makes provisions for cash value vouchers for fruits and vegetables which were previously not part of the WIC program, the addition of whole grains, restriction of the fat content of dairy and reduced juice allowances (United States Department of Agriculture, 2018e). Since the WIC food package policy revision may bring WIC participants closer to meeting the 2015 DGA, the effects of this revision should be assessed.

Currently, the effects of the WIC food policy revision on postpartum rural WIC participants is unknown. Emphasis should be placed on rural postpartum women because this group faces a multitude of additional barriers in accessing health and nutrition compared to their urban counterparts (Shah et al., 2010) . Additionally, there has previously been no reviews that specifically focus on rural postpartum WIC participants. However, a prior review focused on the WIC policy revision, and the overall influence

of policy revision on all WIC participants. The study noted an increase in fruit and vegetable consumption, and whole grains after the revision (Schultz et al., 2015).

The lack of research literature synthesizing the evidence specific to rural postpartum women necessitates the need for a review on this particular sub-population of WIC participants given their unique situation and needs. This current review fills the gap by specifically examining how the policy affects rural postpartum WIC participants with the objective of assessing the impact of the 2009 WIC policy change on postpartum rural WIC participants' food consumption patterns.

The review examines the following research questions:

1. What is the status of the extant research literature on the impact of the WIC FP revision on postpartum women?
2. What changes in food consumption patterns were evident in postpartum women participating in WIC after the WIC FP revision?

Examining existing literature will provide a well-documented scoping review conducted systemically of the impact of the 2009 WIC FP revision on rural postpartum women participating in WIC in the U.S. Furthermore, information from this study may act as a basis for the formulation of state and nationwide policies that will aid in the narrowing of disparity gaps and ensure that all WIC participants are benefitting from the program.

Methods

Literature Search and Selection Methods

For this review, guidelines from Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement (PRISMA) (Moher et al., 2009) were used. The author under the guidance of the library specialist in systematic reviews selected search terms and appropriate databases for relevant articles between January and March 2018. Electronic databases searched included MEDLINE, CINAHL, and Agricola using the following keywords and Boolean operators: food package, 2009 revision or change, food packaging, food assistance, WIC and Special Supplemental Nutrition Program for Women, Infants, and Children (Appendix A).

Inclusion/Exclusion Criteria

To meet the inclusion criteria for this review, articles had to be the following: a) peer-reviewed articles; b) published in English; c) collected in the United States; d) include WIC population; e) had to include women/mothers; and f) be articles published after 2009. The exclusion criteria consisted of the following: a) articles not published in English; b) studies with data collected from outside the US; c) non-peer reviewed; d) not focused on the WIC policy change; and e) no food consumption measured.

Data Extraction

Rayyan, a web-based application (Ouzzani et al., 2016), was used to expedite the initial screening of articles. The reference list of each article was reviewed (i.e. purling) to identify any additional articles for the current review. Subsequently, full texts of

abstracts meeting the inclusion criteria were reviewed and selected. Data from the selected studies were coded using Google Forms.

Methodological Quality Assessment

For this review, a methodological quality scale (MSQ) was tailored from a previously established instrument (Diep et al., 2015; Lu et al., 2014; Sosa, 2012). Each article was assessed on a 10-item scale measuring, theoretical framework, study design, sample size, participants, postpartum inclusion, measures, validity, reliability, data analysis, and rural participation (Table 1). The possible score ranged from 7- 24, with the highest score signifying higher methodological rigor. A second reviewer independently reviewed all the articles, which exceeded the recommended 20-30% recommended by (Schlosser, 2007) for establishing 80%-100% inter-rater reliability.

Table 1: Criteria for Assessing Studies' Methodological Quality

Methodological Criterion	Description	Score
Theoretical Framework	Presented explicit theoretical framework	2
	Presented implicit theoretical framework	1
	Did not present a theoretical framework	0
Study Design	Longitudinal	3
	Natural experiment	2
	Cross-sectional	1
Sample size	Large (>300)	3
	Medium (>100 and <300)	2
	Small (<100)	1
Participant	Mother-child dyad	2
	No dyad	1
Postpartum	Postpartum	2
	Not stated	1
Measures	Reported both self-report and objective/observed measures of diet	3
	Reported only objective/observed measures of diet	2
	Reported only self-reported measures of diet	1
Validity	Validity coefficients reported	1
	Did not report any validity coefficients	0
Reliability	Reliability coefficients reported	1
	Did not report any reliability coefficient	0
Data Analysis	Advanced statistics (Mixed models, SEM, HLM)	5
	Regression/ Analysis of covariance	4
	Bivariate statistics (e.g. ANOVA, Pearson r, t test	3
	Qualitative (content analysis)	2
	Descriptive only (e.g. frequency)	1
Rural participation	Included rural participants	2
	Did not include rural participants	1

Results

Study Selection

A total of 174 studies were retrieved using the keyword search. After the elimination of duplicates, 115 articles were reviewed. When inclusion and exclusion criteria were applied, five articles were included for the final review. The majority of articles were excluded because they did not focus on food consumption or the WIC

policy change. A flowchart as recommended by (Moher et al., 2009) describes the screening process in detail (Figure 2).

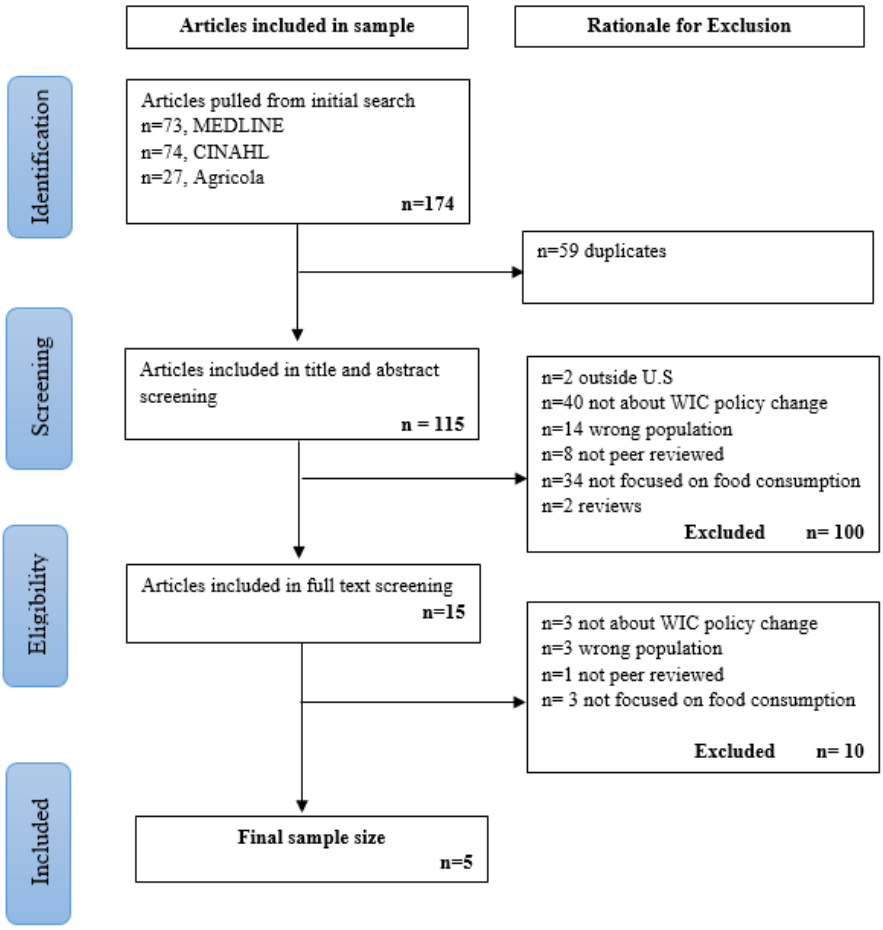

Figure 2: Literature Search Screening Process for Retrieving Articles

Study Characteristics

The overall purpose of each chosen study in the search was to identify how the WIC food policy revision affected food consumption patterns in rural postpartum WIC

participants. The final review included articles published between 2012 and 2015. Two of the articles were published in a health behavior journal; the other three were published in a public health, preventative medicine, and healthcare and nutrition journal respectively. General study characteristics including title, author, year, research design, state, sample size, the inclusion of rural population, focus on rural population, type of WIC participant, linked surveys, measures, postpartum specific outcomes, results and MQS scores are presented in Table 2.

A majority (n=4) of the articles included children under five (Kong et al., 2014; Meiqari et al., 2015; Odoms-Young et al., 2014; Whaley et al., 2012) and two had both children and infants (Meiqari et al., 2015; Whaley et al., 2012). Among the five articles, two were conducted in Illinois (Kong et al., 2014; Odoms-Young et al., 2014), one in Georgia (Meiqari et al., 2015), one in California (Whaley et al., 2012), and one in Maryland (Black et al., 2009).

Postpartum Specific Outcome

Several of the studies included mother-infant/child dyads (Kong et al., 2014; Odoms-Young et al., 2014; Whaley et al., 2012). However, only postpartum outcomes were of focus in this review. All five studies included diet intake (Black et al., 2009; Kong et al., 2014; Meiqari et al., 2015; Odoms-Young et al., 2014; Whaley et al., 2012), which usually included the consumption of dairy, fruits, vegetables, whole grains, legumes, peanut butter or canned fish. Two of the studies included acculturation (Kong et al., 2014; Odoms-Young et al., 2014), one included diet quality (Kong et al., 2014), and one included food security and home food availability (Odoms-Young et al., 2014).

Study Findings

Results about women were extracted and outlined as the focal population. After the WIC policy revision, there was an increase in fruit and vegetables consumption (Black et al., 2009; Whaley et al., 2012), low fat dairy consumption (Whaley et al., 2012), whole grain (Black et al., 2009; Kong et al., 2014; Whaley et al., 2012), and a decrease in saturated fat (Kong et al., 2014) and whole milk consumption (Whaley et al., 2012). According to (Black et al., 2009), participants preferred fresh food for taste but endorsed canned and frozen food for convenience and cost. Furthermore, participants preferred consuming whole milk over low-fat milk.

When comparing racial groups, Hispanics had low acculturation (Kong et al., 2014). After the WIC food package revision, there was an increased consumption of fruits (Odoms-Young et al., 2014). According to (Odoms-Young et al., 2014), there was also an increase in home availability of low-fat dairy and whole grains. African American participants had an increase in energy intake and an increase in fruit and juice availability. Overall, there was an increase in whole grain and low-fat milk consumption in both Hispanics and African Americans.

Table 2: Characteristics of Studies Identified in the Review

Lead author, Year	Research Design	Location	Sample size	Rural population	Rural focus	Participants	Measures	Linked	Postpartum specific outcome	Results	MQS score
Kong et al., 2014	Quantitative: cross-sectional	Illinois	pre=275 post=222	Not stated	No	Children, mothers	Survey/Questionnaires, anthropometric measures	Mother-child dyad	Dietary intake, Acculturation; Diet quality	Non-significant changes in overall diet quality; lower trend in saturated fat and high fiber intake; low acculturation for Hispanic mothers	15
Meiqari et al., 2015)	Quantitative: cross-sectional	Georgia	pre n=77 post n=57	Not stated	No	Postpartum, infants, children	Survey/Questionnaires	Mother-child dyad	Consumption of low-fat milk for mothers	Non-significant increase odds for consuming low-fat milk;	13
Whaley et al., 2012	Quantitative: cross-sectional	California	pre=3004 post=2996	Not stated	No	Pregnant, postpartum, children, infants, children	Survey/Questionnaires	Mother-child dyad	Fruit, vegetables, whole grain, low-fat milk	Increase in whole grain, fruit and vegetable and low-fat milk; decrease in whole milk	14
Black et al., 2009	Qualitative: Cross-sectional	Maryland	n=223	Yes	No	Postpartum, pregnant	Interviews, focus groups, grocery inventory	None	Fruit and vegetable, Whole grain, Milk and Milk alternatives, legumes and peanut butter, canned fish	All participants consumed fruits and vegetables; preferred fresh for taste, but canned and frozen for convenience and cost. Consumption of whole milk and not reduced-fat milk. Non-Hispanic participants preferred peanut butter to beans.	11
Odoms-Young et al., 2014	Quantitative: Natural experiment	Illinois	n=273	Not stated	No	Pregnant, postpartum, children	Survey/Questionnaires	Mother-child dyad	Acculturation; Food security; Dietary intake; Home food availability	Increase in fruit consumption and low-fat dairy intake in Hispanic mothers. Increase in home availability of low-fat dairy and whole grains; increase in energy intake in African Americans; decrease in whole milk in African American mothers; Increase in fruit and juice availability in African American mothers; increase in whole grain and low/nonfat milk in Hispanic and African American mothers.	13

Methodological Quality of Reviewed Articles

The methodological quality of the reviewed articles had scores ranging from 11-15.

Theoretical Framework

None of the studies aligned a theoretical framework to their study.

Study Design

The majority of the studies were quantitative studies (Kong et al., 2014; Odoms-Young et al., 2014; Whaley et al., 2012), with only one qualitative study included (Black et al., 2009). Of the five studies, four were cross-sectional (Black et al., 2009; Kong et al., 2014; Meiqari et al., 2015; Whaley et al., 2012), and one was a natural experiment (Odoms-Young et al., 2014).

Sample size

Sample size ranged from 57 to 3004 participants and was usually presented as pre and post sample sizes. Two studies had a large sample size (Kong et al., 2014; Whaley et al., 2012), and three were medium sized (Black et al., 2009; Meiqari et al., 2015; Odoms-Young et al., 2014).

Participants

Regarding participant dyads, most (n=4, 80%) included mother-child/infant dyads (Kong et al., 2014; Meiqari et al., 2015; Odoms-Young et al., 2014; Whaley et al., 2012), while one had only mothers (Black et al., 2009) .

Postpartum

Of the five articles, four included postpartum women (Black et al., 2009; Meiqari et al., 2015; Odoms-Young et al., 2014; Whaley et al., 2012), and one did not state if postpartum women were included; however, caregivers/mothers were included (Kong et al., 2014).

Measures

All the quantitative studies used surveys/questionnaires, which usually included 24-hour recalls (Meiqari et al., 2015; Odoms-Young et al., 2014; Whaley et al., 2012) or anthropometric measures (Kong et al., 2014). The qualitative study included interviews, focus groups, and a store inventory (Meiqari et al., 2015). Additionally, majority of the measures were self-reported but one used a combination of self-reported and objective measures (Kong et al., 2014).

Reliability and Validity

None of the studies reported the reliability and validity coefficients of their data.

Data Analysis

For the data analysis, three (60%) utilized regressions (Kong et al., 2014; Meiqari et al., 2015; Whaley et al., 2012), one bivariate analysis (Odoms-Young et al., 2014) and one focused on qualitative analysis (Black et al., 2009).

Rural participation

A majority (n=4, 80%) of the studies did not state if a rural population was included, but it could be deduced in one of the studies that a rural population was included because the results section revealed a more detailed analysis that showed an inclusion of rural participants (Black et al., 2009) (Table 3).

Table 3: Distribution of MQS Characteristic across Reviewed Studies

Methodological Criterion	Description	Score	N of studies	Percentage (%)
Theoretical Framework	Presented explicit theoretical framework	2	0	0
	Presented implicit theoretical framework	1	0	0
	Did not present a theoretical framework	0	5	100
Study Design	Longitudinal	3	0	0
	Natural experiment	2	1	20
	Cross-sectional	1	4	80
Sample size	Large (>300)	3	2	20
	Medium (>100 and <300)	2	3	60
	Small (<100)	1	0	20
Participant	Mother-child dyad	2	4	80
	No dyad	1	1	20
Postpartum	Postpartum	2	4	80
	Not stated	1	1	20
Measures	Reported both self-report and objective/observed measures of diet	3	1	20
	Reported only objective/observed measures of diet	2	0	0
	Reported only self-reported measures of diet	1	4	80
Validity	Validity coefficients reported	1	0	0
	Did not report any validity coefficients	0	5	100
Reliability	Reliability coefficients reported	1	0	0
	Did not report any reliability coefficient	0	5	100

Table 3: Continued

Methodological Criterion	Description	Score	N of studies	Percentage (%)
Data Analysis	Advanced statistics (Mixed models)	5	0	0
	Regression/ Analysis of covariance	4	3	60
	Bivariate statistics (e.g. ANOVA, Pearson r, t test	3	1	20
	Qualitative (content analysis)	2	1	20
	Descriptive only (e.g. frequency)	1	0	0
Rural participation	Included rural participants	2	1	20
	Did not include rural participants	1	4	80

Discussion

The overall goal of this review was to evaluate the existing research literature specific to the impact of the 2009 WIC policy change on rural postpartum WIC participants' food consumption patterns. As previously stated, only a limited number of articles included postpartum WIC participants. Consequently, little is known about postpartum women despite the abundance of studies focusing on breastfeeding and infant feeding practices. Postpartum women should not be overlooked, as the postpartum period is a time for a balanced diet as nutritional needs are reevaluated (World Health Organization, 2010). More evidence is needed to establish the impact of the WIC food package policy change on rural postpartum women.

The 2009 WIC food package policy revision demonstrated a positive trend towards improved dietary intake. There was generally an increase in fruits and vegetables, whole grains, low-fat dairy, and reduction in full-fat dairy in the research; however, these changes were seen to be minimal. Even though food consumption changes could be seen as minimal, improvements after the policy change move participants closer to meeting the DGA (US Department of Health and Human Services, 2017). Meeting the DGA should always be paramount with respect to nutrition and a healthy diet.

The studies in the review had low methodological quality showing a need for improvement. There was no theory utilization reported in any of the studies possibly indicating that they were not theory-driven. Theories are important as they provide a framework to identify determinants of health behavior, acting as a basis for successful design and implementation of health interventions (Fishbein & Cappella, 2006). Additionally, validity and reliability coefficients were not reported, which makes it difficult to measure psychometric properties and ensure the quality of their data (Streiner & Kottner, 2014; Vacha-Haase et al., 1999). Reliability and validity should be emphasized by journals to ensure awareness of the implication of omitting reliability and validity scores. The majority of the studies analyzed data using regressions. Though complex models may help diversify results, models should be a good fit for the research question, such as multivariate analysis for complex models of reality (Thompson, 2006). Nutrition studies should diversify statistical analyses so different perspectives can be reported as this provides stronger evidence for public health practice. For example, the use of higher level statistics more qualitative studies in WIC participants will identify mechanisms for dietary change (Diep et al., 2015).

None of the studies focused on rural WIC postpartum participants, but one included rural WIC participants of any status (pregnant, postpartum, etc.). It is vital that rural WIC participants are included in research as this population faces various barriers to healthy eating including lack of access, and lack of finances (Govender et al., 2016). Furthermore, the US currently has several health disparities between rural and urban women. Rural women experience general health and behavior conditions at a higher rate than urban women (American College of Obstetricians and Gynecologists, 2014). These methodological aspects in the review need to be addressed to strengthen research practices.

Future Directions

Additional research is needed to identify demographic factors and rural and urban differences that may affect food consumption behaviors in postpartum WIC participants. Identifying factors influencing food consumption pattern in postpartum WIC participants will facilitate the design of interventions that are tailored and targeted for increased healthy food consumption. Furthermore, the rural population needs to be included in studies to identify differences in food consumption patterns and barriers to access to food or consumption of food.

Limitations of the Review

The search terms and inclusion/exclusion criteria used in this review may be inadequate to capture all relevant articles with postpartum women and the 2009 WIC policy revision. However, this is highly unlikely because a librarian trained in systematic reviews, information science and public health field facilitated the search. More research is

still needed to provide evidence of the impact of the 2009 WIC food package revision, specifically on postpartum women in rural areas.

Implications for Practice

Findings from this review can help policy makers, practitioners, and researchers identify the impact of the 2009 WIC food package policy change on postpartum participants. Subsequently, findings can aid in the re-modification of the WIC food package to close the gap and provide further improvements that target rural postpartum participants. Findings can also strengthen educational training provided to WIC personnel and health educators to encourage WIC participants to increase the consumption of healthy food.

3. IMPACT OF THE WIC FOOD PACKAGE REVISION ON RURAL POSTPARTUM WIC PARTICIPANTS IN THE U.S.

Introduction

Healthy diet and nutrition are important in preventing chronic diseases and are essential factors in the promoting and maintaining good health throughout the entire life course (WHO & FAO Expert Consultation, 2003). The postpartum period, usually defined as the time span up to six months after delivery, is a vital period where women require good nutrition for themselves and their offspring (Abu-Saad & Fraser, 2010). During the postpartum period, unhealthy diets may occur due to new competing demands of infant care, the need for social support, fatigue, depression, and weight-related concerns (Institute of Medicine (US) Committee on Nutritional Status During Pregnancy and Lactation, 1992). Therefore during the postpartum period, women require increased attention on replenishing nutrient stores and achieving adequate nutrient intake during lactation (Shah et al., 2010). The overall promotion of health should be of emphasis for postpartum women, however, this may not always be possible for low-income women living in rural areas.

In the U.S., most rural areas face high rates of poverty. The highest poverty rates are reported in completely rural counties where 16.8% of the population are categorized as poor. The degree of rurality and persistent poverty are also linked; approximately 28% of those living in rural counties live in persistent poverty (Economic Research Service, 2004). Subsequently, low-income, postpartum women exhibit poor diet quality and are at risk of various dietary inadequacies (Shah et al., 2010). With the additional barriers facing rural low-income postpartum women, such as poor finances, lack of transportation and the

perceived high cost of healthy food (Shah et al., 2010), additional support is needed to improve their health outcomes.

Federal programs such as the United States Department of Agriculture's (USDA) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is essential in providing the additional support needed by rural, low-income women. WIC provides supplemental food, nutrition education, and health referrals to low-income, pregnant, breastfeeding or postpartum women, as well as infants and children up to the age five who are at nutritional risk (United States Department of Agriculture, 2018f). To qualify for WIC benefits, the participants' income must be less than 185 %of the federal poverty income guidelines (United States Department of Agriculture, 2018d). In 2009, to better align with Dietary Guidelines for Americans (DGA) and improve the balance of food, a revision was made to food packages by increasing the dollar amount for the cash value vouchers for the purchase of fruits and vegetables, adding fish and whole grain, and reducing the amount of juice, milk, legumes and peanut butter given to participants (National Academies of Sciences, Engineering, and Medicine, 2016).

The DGA provides food-based recommendations to promote health, prevent disease, and meet the nutritional needs of Americans. Specifically, the current DGA for women recommends two cups of fruit and two and a half cups of vegetables, three cups of fat-free or low-fat milk, and three or more ounces of whole grain products per day (United States Department of Agriculture, 2008).

A prior study focusing on WIC participants reported an increase in whole grain, low-fat milk, fruit and vegetable consumption, as well as a decrease in whole milk consumption after the 2009 WIC package revision (Whaley et al., 2012). Previous research

has been conducted to ascertain the effects of the 2009 WIC Food Package (WIC-FP) revision on infants and pregnant women, but there is little to none that has specifically examined the effects of the revision on postpartum WIC participants in rural areas. As a result, we cannot determine whether the revision benefits rural WIC participants. Additionally, data has been published from regions and states, but none show the wide national representation that this study will accomplish. The objective of the study is to assess the impact of the WIC-FP revision on rural postpartum WIC participants.

The study will examine the following research questions:

1. What are the changes in food consumption behaviors in rural postpartum WIC participants since the WIC food package revision?
2. What are the disparities in food consumption behaviors in postpartum WIC participants residing in rural and urban areas?
3. What demographic factors influence rural postpartum WIC participants' food consumption behaviors?

Methods

Data Source

This cross-sectional study utilized secondary data from the National Food and Nutrition (NATFAN) survey. NATFAN is a survey that was administered in multiple states to assess changes in food and nutrition behaviors before and after the WIC-FP revision; ideally, NATFAN primarily focused on WIC participants. Surveys were administered to participants from 40 states and 11 Indian Tribal Organization (ITOs) in WIC clinics in 2009 before the WIC food package revision. Six months after the food package revision, the surveys were re-administered in late 2010 and early 2011. All study protocols were approved by Texas A & M University's Institutional Review Board.

Study Sample

The NATFAN survey was administered to women who were pregnant, postpartum and caregivers of infants less than one year of age or children less than five years of age who received WIC benefits. For the purpose of this study, only postpartum women were included, these were participants who responded "yes" to having a baby within the last six months. Additionally, only participants from states that were surveyed before and after the WIC food package revision were included. The final sample size was 16,821 postpartum women in the U.S., with 9,121 (54.2%) before the revision and 7,700 (45.8%) after the revision.

Instruments and Measures

The NATFAN survey included three surveys: questions for women (31 items), infants (36 items), and children (32 items). The dataset contained variables on infant feeding practices, breastfeeding, postpartum food consumption, and detailed demographics. In this study, the women survey was utilized and contained fruit and vegetable consumption and variety, frequency of the consumption of whole and refined grains, frequency, consumption, and preference of type of milk consumed, and frequency of fruit juice and beverages (sugar-sweetened and artificially-sweetened) consumption. For the purpose of this study, only fruit, vegetable and milk consumption was the focal point. The NATFAN survey was developed, tested and reviewed for content validity by experts in the field (McKyer et al., 2011).

Measures

Fruit and Vegetable Consumption

Participants were asked how often they consumed fruit and vegetables. Responses were never or less than once per week, 1-3 times were per week, 4-6 times per week, 1 time per day, 2 times per day, 3 times per day and 4 or more times per day. For purposeful analysis of the data, a dummy variable was created and recoded to “meet recommendation” or “does not meet the recommendation." Recommendations were guidelines/benchmarks that were developed for NATFAN as a reference point for interpreting whether food consumption patterns aligned with the DGA. Women are recommended to consume 1.5 to 2 cups of fruits per day (2 or more times/day for NATFAN benchmark), 2-2.5cups of

vegetables per day (3 or more times per day for NATFAN benchmark) and 3 cups of milk per day (3 cups per day for NATFAN benchmark). See figure 2.

Key Food Item	Daily Recommended Amounts	NATFAN Benchmark	Comments/Assumptions*
Milk	Women - 3 cups/day Child (2- 4y) - 2-2½ cups/day Child (1y)[a] - 2 cups/day	3 cups/day for women 2-2 1/2 cups/day 2 cups/day or 2-3 breast feedings	NATFAN surveys obtained amounts and frequencies reported for this item.
Fruits	Women- 1½ - 2 cups/day Child (2- 4y) - 1-1½ cups/day Child (1y) a - 1 cup/day	2 or more times/day 2 or more times/day 2 or more times/day	*adult serving size = 1 cup *child (2-4y): serving size= ½ cup *child (1 y): serving size= ¼ cup[a]
Vegetables	Women - 2-2 ½ cups/day Child (2-4y) – 1-1 ½ cups /day Child (1y) a – 1 cup/day	3 or more times/day 2 or more times/day 3 or more times/day	*adult serving size = 1 cup *child (2-4y): serving size= ½ cup *child (1 y): serving size= ¼ cup
Whole grains	Women - 3 oz. eq./day Child (2- 4y) - 1 ½ - 2 ½ oz. eq./day Child (1y) a - 1 ½ oz. eq./day	2 or more times/day 1 or more times/day 1 or more times/day	[b] based on 1 slice of whole wheat bread, or ½ cup of cooked brown rice being equal to 1oz. equivalent of whole grain.
Juice	Make most of your choices whole or cut-up fruit rather than juice, for the benefits dietary fiber provides	Eliminate intake or 100% fruit or vegetable juice 1 time per day or less	Eliminate intake or limit intake of fruit juice to 4-6 fl. oz./day for children ages 1-6 years old and 6-11 fl. oz./day for women (*Time for a Change*, pg. 78, Table 3-1)

[a] Since there are few portion size recommendations for one year old children, daily recommendations were constructed from multiple sources including USDA's website http://www.fns.usda.gov/cnd/care/programbasics/meals/meal_patterns.htm, and guidebook, *Infant Nutrition and Feeding, A Guide for Use in the WIC and CSF Programs*, AAP's *Pediatric Nutrition Handbook, 6th Edition* and IOM's *WIC Food Packages, Time for a Change.*

[b] Women would have to eat 2 slices of bread or ½ cup cooked brown rice 1.5 times/day to meet recommendation; children would have to eat 1 slice of bread or ¼ cup of brown rice 1.5 times/day to meet the recommendation. (http://www.choosemyplate.gov/food-groups/grains-counts.html)

Figure 3: NATFAN Benchmarks for Women and Children Food Groups Interest
Reprinted from Institute for Obesity Research and Program Evaluation (2014)

Milk Consumption

Women are recommended to drink at least 3 cups of milk per day (3 cups/day NATFAN benchmark (Figure 3)). For milk consumption, women were asked how many cups of milk they drank in a day. Responses ranged from less than a cup, 1 cup, 2 cups, 3 cups, or 4 cups or more. Based on dietary recommendations, a dummy variable was

created to reflect whether participants met or did not meet the recommendation. Participants who drank 3 cups or more met the recommendations.

Milk Type

Women are recommended to consume low fat or fat-free milk. Participants were asked about the kind of milk they usually drank. The options were, whole milk, 2 %, 1%, ½%, skim milk or does not drink milk. For easy interpretation of data, responses were recoded to whole milk, reduced fat and low-fat/fat-free milk.

Covariates

Age. Participants were asked to report their current age. This variable was left as a continuous variable.

Education. Participant's highest education ranged from 1st to 6th grade through to Bachelor's degree or higher. This variable was recoded as "less than high school," "high school or GED," "some college or associate degree" and "college graduate or higher" to align with commonly used scales.

Race. The race variable in the NATFAN survey varied from White, Black, Native American, Pacific Islander Asian, and others; plus an ethnicity option (Hispanic or non-Hispanic) for each race. These categories were recoded into White, Black, Hispanic and others

Rurality. Since participants reported zip codes, rurality was categorized based on the USDA's 2013 Rural-Urban Continuum Codes (RUCC), generally utilized by the USDA for various programs. The USDA RUCC, a county-based measure is commonly

used to classify rural and non-rural areas (United States Department of Agriculture, 2016). A dummy variable of "yes" or "no" was used to measure rural areas.

Post revision. A dummy variable for pre (0) and post (1) revision was created to measure the change in food consumption after the WIC-FP revision.

Data Analysis

Data for this study was analyzed using STATA 15 statistical package (StataCorp, College Station, TX). Descriptive statistics and analysis of proportions were used to identify changes in fruit, vegetable and milk consumption in postpartum WIC participants. A series of logistic regressions were used to assess whether postpartum WIC participants met the recommendations of fruit, vegetable and milk consumption after the WIC-FP revision. For milk type consumption, a series of multinomial logit regressions were used to compare the likelihood of consuming certain milk types after the WIC-FP revision compared to before. All statistical tests assumed significance at $p<0.05$.

Multiple imputation (MI) using chained equations was used to deal with missing data. MI will allow for an imputation model including the analysis variables and additional observed variables not included in the model but associated with the variables with missing data (Lee, 2013). Imputations were repeated 20 times to capture the uncertainty in missing values. MI will offer gains by reducing bias and improving precision in data analysis (Lee, 2013).

Results

Sample Description

The pre and post samples were sociodemographically similar. The descriptive sample characteristics of 16,821 postpartum women categorized by rural and urban areas, before and after the WIC FP revision are presented in Table 4. A majority of the women had a high school diploma or a GED, were white (62.9%), and had an average age of 24 years. In rural areas, a higher number of participants had a high school diploma or GED (approximately 36%), were white and had an average age of 24 years. In non-rural areas, a majority of the participants had some college degree (32.3% before and 32.1% after the WIC food package revision) and had an average age of 24 years before WIC food package revision and 25 years after.

Table 4: Demographic Characteristics, Postpartum WIC Participants by Rurality (%/mean)
n=16,821

Demographic characteristics	**Total**		**Rural**		**Non-rural**	
	Before	**After**	**Before**	**After**	**Before**	**After**
Education						
Less than high school	28.5	30.9	22.1	25.7	26.9	28.3
High school or GED	31.9	32.8	35.6	35.5	31.7	33.4
Some college or AA degree	32.1	30.2	33.8	32.3	33.5	32.1
College Graduate or above	7.6	6.0	8.5	6.5	8.0	6.2
Race						
White	44.4	38.9	62.6	59.3	41.5	35.1
Black	13.2	17.1	5.1	6.0	15.7	20.1
Hispanic	32.9	34.2	21.1	23.0	33.8	35.4
Others	9.5	9.8	11.2	11.7	9.0	9.4
Age	24.1	25.3	22.6	24.0	24.3	25.4

Fruit Consumption

Rural and non-rural differences in fruit consumption before and after the WIC food package revision are shown in Table 5. In both rural and urban areas, there was a significant increase in the proportion of participants who consumed fruits two or more times a day after the WIC-FP revision (9.1% and 4.9% respectively). In rural and non-rural areas, the top five fruits most frequently eaten were apples, bananas, grapes, strawberries, and oranges before and after the WIC-FP revision. Furthermore, urban WIC postpartum participants consumed a wider variety of fruits after the revision compared to their rural counterparts.

Table 5: Postpartum WIC Participant's Consumption of Fruits before and after the WIC Food Package Revision
n=16,821

	Rural		Non-rural		Rural/Urban Differences		Pre/Post Difference	
	Pre	**Post**	**Pre**	**Post**	**Rural**	**Non-rural**	**Pre**	**Post**
Never/< once/week	4.2%	2.8%	3.8%	2.9%	-1.4%*	-0.9%*	-0.4%	+0.1%
1-3 times	26.6%	20.8%	24.1%	20.6%	-5.8%*	-3.5%*	-2.3%*	-0.2%
4-6 times	21.5%	19.9%	19.2%	18.7%	-1.6%	-0.5%	-2.3%*	-1.2%
1 time/day	18.1%	17.8%	17.7%	17.7%	-0.3%	0%	-0.4%	-0.1%
2 or more times/day	29.6%	38.7%	35.2%	40.1%	+9.1%*	+4.9%*	+5.6%*	+1.4%

*Significant at the 0.05 level

A series of logistic regression analyses were performed to examine whether rural and urban postpartum women meet the daily dietary amounts of fruit consumption (two or more servings per day). The results from Table 6 show that, post revision, both rural and urban postpartum WIC participants were more likely to meet the dietary recommendation

of daily fruit consumption (OR=1.56, OR=1.24 respectively). Among rural postpartum women, Blacks, Hispanics, and other races were more likely to meet the fruit consumption recommendations compared to Whites. In rural areas, breastfeeding postpartum women were also more likely (OR=1.48) to meet the daily fruit consumption recommendation compared to those who were not breastfeeding.

Table 6: Logistic Regression for Fruit Consumption in Postpartum WIC Participants, Rural Vs Urban
n=16,821

	Rural n= 3,720		Non-rural n= 13,101	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	0.85	(0.70, 1.03)	0.85*	(0.77, 0.94)
Some college	0.92	(0.76, 1.13)	0.83*	(0.75, 0.92)
College or Graduate	1.20	(0.88, 1.63)	1.03	(0.88, 1.21)
Race[b]				
Black	1.75*	(1.28,3.39)	1.39*	(1.24, 1.55)
Hispanic	1.46*	(1.20, 1.78)	1.21*	(1.10, 1.33)
Others	1.44*	(1.14, 1.81)	1.37*	(1.11, 1.56)
Age	1.00	(0.98, 1.01)	1.00*	(1.00, 1.01)
Breastfeeding[c]				
Yes	1.48*	(1.24, 1.76)	1.37*	(1.38, 1.63)
Region[d]				
Mid-Atlantic	1.06	(1.12, 1.56)	1.28*	(1.14, 1.64)
Southeast	0.91	(0.86, 1.21)	1.04	(0.86, 1.25)
Midwest	0.95	(0.91, 1.36)	1.15	(0.92, 1.43)
Southwest	0.97	(1.08, 1.48)	1.34*	(1.12, 1.59)
Mountain Plains	0.99	(0.92, 1.26)	1.08	(0.90, 1.29)
Western	1.11	(1.12, 1.54)	1.36*	(1.14, 1.63)
Policy change[e]				
Post-revision	1.56*	(1.21, 1.39)	1.24*	(1.15, 1.33)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = north eastern
e reference = pre-revision
* Significant at p<0.05

Vegetable Consumption

Rural and non-rural differences in vegetable consumption in postpartum women were assessed before and after the WIC food package revision. In non-rural areas, there was a significant increase in consuming vegetables three or more times per day (2.0 %), but no significant change in rural areas (see Table 7). The top five vegetables most frequently consumed before and after the food package revision in rural and urban areas were corn, potato, lettuce, carrots, and green beans. Postpartum WIC participants in urban areas had more variety in vegetable consumption compared to those in rural areas.

Table 7: Postpartum WIC Participant's Consumption of Vegetables before and after the WIC Food Package Revision
n=16,821

	Rural		**Non-rural**		**Pre/Post Difference**		**Rural/Urban Differences**	
	Pre	**Post**	**Pre**	**Post**	**Rural**	**Non-rural**	**Pre**	**Post**
Never/< once/week	4.0%	3.9%	4.1%	4.1%	-0.10%	0.00%	+0.10%	+0.20%
1-3 times	21.5%	21.2%	22.6%	22.0%	-0.30%	-0.60%	+1.10%	+0.80%
4-6 times	23.9%	21.1%	20.1%	19.0%	-2.80%*	-1.10%	-3.80%*	-2.10%
1 to 2 times/day	37.5%	38.6%	39.4%	39.1%	-1.10%	+0.30%	+1.90%	+0.50%
3 or more times/day	13.1%	15.2%	13.8%	15.8%	+2.10%	+2.00%*	+0.70%	+0.60%

*Significant at 0.05

Results from the logistic regression for vegetable consumption in rural and urban postpartum WIC participants are presented in Table 8. The use of logistic regression allows us to estimate who met the vegetable recommendation of three or more servings per day. Rural postpartum WIC participants did not meet the recommended daily amounts of vegetable consumption. However, their non-rural counterparts were more likely to meet

the recommended daily vegetable consumption amounts after the WIC-FP revision (OR=1.16).

In rural and non-rural areas, breastfeeding postpartum women were more likely to meet the recommended allowance for vegetable consumption compared to non-breastfeeding postpartum women, and all other races were more likely than white participants to meet the recommended daily allowance for vegetable consumption.

Table 8: Logistic Regression for Vegetable Consumption in Postpartum WIC Participants, Rural Vs Urban
n=16,821

	Rural n= 3,720		Non-rural n= 13,101	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	1.08	(0.83, 1.41)	1.04	(0.91, 1.19)
Some college	1.16	(0.88, 1.53)	0.94	(0.82, 1.08)
College or Graduate	1.18	(0.78, 1.78)	0.97	(0.78, 1.21)
Race[b]				
Black	1.27	(0.83, 1.94)	1.44*	(1.24, 1.66)
Hispanic	1.10	(0.84, 1.43)	0.92	(0.81, 1.06)
Others	1.51*	(1.12, .03)	1.23*	(1.04, 1.48)
Age	1.01	(0.99, 1.03)	1.02*	(1.01, 1.02)
Breastfeeding[c]				
Yes	1.28*	(1.01, 1.61)	1.16*	(1.04, 1.30)
Region[d]				
Mid-Atlantic	0.93	(0.55, 1.58)	1.18	(0.92, 1.53)
Southeast	0.59*	(0.36, 0.95)	1.28	(0.98, 1.66)
Midwest	0.68	(0.29, 1.57)	1.09	(0.80, 1.49)
Southwest	0.71	(0.46, 1.11)	1.36*	(1.06, 1.73)
Mountain Plains	0.67	(0.44, 1.04)	1.17	(0.91, 1.51)
Western	0.82	(0.53, 1.27)	1.43*	(1.11, 1.84)
Policy change[e]				
Post-revision	1.20	(0.99, 1.46)	1.16*	(1.05, 1.28)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = north eastern
e reference = pre-revision
* Significant at p<0.05

Milk Consumption

Rural and non-rural differences in milk consumption reported in cups before and after the WIC-FP revision are shown in Table 9. There was a significant decrease (1.60%) in postpartum women consuming three or more cups of milk per day in non-rural areas but not for rural areas.

Table 9: Postpartum WIC Participant's Consumption of Milk before and after the WIC Food Package Revision
n=16,821

	Rural		**Non-rural**		**Pre/Post Difference**		**Rural/Urban Differences**	
	Pre	**Post**	**Pre**	**Post**	**Rural**	**Non-rural**	**Pre**	**Post**
I do not drink milk	4.8%	4.5%	5.0%	4.7%	-0.30%	-0.30%	+0.20%	+0.20%
Less than 1 C	13.1%	14.6%	12.2%	13.7%	+1.50%	+1.50%*	-0.90%	-0.90%
1 -2 C	59.2%	56.6%	57.0%	57.4%	-2.60%	+0.40%	-2.20%	+0.80%
3 or more C	22.9%	24.3%	25.8%	24.2%	+1.40%	-1.60%*	+2.90%*	-0.10%

A series of logistic regression were performed to determine the likelihood of postpartum women meeting the recommended daily amounts of consuming three or more cups of milk a day (see Table 10). There was no significant change in rural postpartum women meeting the recommended daily milk consumption amounts after the WIC-FP revision. However, breastfeeding postpartum women were more likely than non-breastfeeding women to meet the recommended daily milk amounts. After the WIC-FP revision, non-rural postpartum WIC participants were less likely to meet the recommended daily amounts for milk (OR=0.91).

Table 10: Logistic Regression for Milk Consumption in Postpartum WIC Participants, Rural Vs Urban
n=16,821

	Rural n= 3,720		Non-rural n= 13,101	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	0.90	(0.73, 1.12)	0.80*	(0.71, 0.89)
Some college	0.84	(0.67, 1.05)	0.70*	(0.62, 0.78)
College or Graduate	0.67*	(0.47, 0.95)	0.56*	(0.46, 0.68)
Race[b]				
Black	0.99	(0.69, 1.43)	0.71*	(0.62, 0.81)
Hispanic	0.82	(0.66, 1.03)	0.90	(0.81, 1.00)
Others	0.85	(0.65, 1.10)	0.85*	(0.73, 0.99)
Age	1.00	(0.99, 1.02)	1.02	(1.01, 1.02)
Breastfeeding[c]				
Yes	1.71*	(1.42, 2.07)	1.61*	(1.48, 1.77)
Region[d]				
Mid-Atlantic	1.00	(0.64, 1.57)	1.10	(0.89, 1.34)
Southeast	0.76	(0.51, 1.13)	0.96	(0.78, 1.18)
Midwest	1.44	(0.77, 2.71)	1.21	(0.97, 1.54)
Southwest	0.62	(0.42, 0.91)	0.85	(0.70, 1.03)
Mountain Plains	0.91	(0.63, 1.31)	1.11	(0.91, 1.35)
Western	0.92	(0.63, 1.33)	1.00	(0.83, 1.2)
Policy change[e]				
Post-revision	1.12	(0.96, 1.32)	0.91*	(0.84, 0.99)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = north eastern
e reference = pre-revision
* Significant at p<0.05

Milk Type Consumption

Rural and non-rural differences in the type of milk consumed by postpartum women are reported in Table 11. There was a significant decrease in rural and non-rural postpartum WIC participants' consumption of whole milk (11.80% and 14.10%) and an increase in reduced-fat milk (10.80% and 11.30% respectively). Additionally, there was a significant increase in consumption of low fat/fat-free milk in non-rural postpartum women (2.40%).

Table 11: Postpartum WIC Participant's Consumption of Milk by Type, before and after the WIC Food Package Revision
n=16,821

	Rural		**Non-rural**		**Pre/Post Difference**		**Rural/Urban Differences**	
	Pre	**Post**	**Pre**	**Post**	**Rural**	**Non-rural**	**Pre**	**Post**
Do not drink milk	4.3%	4.0%	4.7%	5.1%	-0.30%	+0.40%	+0.40%	+1.10%*
Whole milk	28.8%	17.0%	32.3%	18.2%	-11.80%*	-14.10%*	+3.50%*	+1.20%
Reduced fat milk	48.5%	59.3%	44.7%	56.0%	+10.80%*	+11.30%*	-3.80%*	-3.30%*
Low/ fat-free milk	18.4%	19.7%	18.3%	20.7%	+1.30%	+2.40%**	-0.10%	+1.00%

*Significant at 0.05 level

Marginal effects of the multinomial logistic regression were used to determine the likelihood of choosing whole, reduced fat or low-fat/fat free milk (see Table 12). In rural postpartum WIC participants, the probability of consuming whole milk decreased by 13.6% while the probability of consuming reduced fat milk and low fat milk increased by 8.5% and 1.3% respectively after the WIC-FP revision compared to before. Similar results were seen in non-rural areas postpartum WIC participants where the probability of

consuming whole fat milk decreased by 15.9%, but the probability for consuming reduced fat and low fat milk increased by 10.9% and 4.6% respectively after the revision compared to before. In rural areas, postpartum WIC participants who were Black were 17.2% more likely to consume whole milk, and less likely to consume reduced fat and low-fat milk (10.1% and 9.0% respectively). However, in rural areas, breastfeeding mothers were 3.5% less likely to consume whole milk, 0.6% less likely to consume reduced fat milk and 4.4% less likely to consume low fat milk compared to those who were not breastfeeding.

Table 12: Marginal Effects (ME) of Multinomial Regression for Milk Type in Postpartum WIC Participants, Rural Vs Urban
n=16,821

	Rural n= 3,720			Non-rural n= 13,101		
	Whole	Reduced fat	Low Fat/Fat free	Whole	Reduced fat	Low Fat/Fat free
	ME	**ME**	**ME**	**ME**	**ME**	**ME**
Education[a]						
High school or GED	-0.017	-0.006*	0.020	-0.050*	0.026*	0.025*
Some college	-0.110*	-0.009*	0.121*	-0.109*	-0.014	0.107*
College or Graduate	-0.192*	-0.071*	0.259*	-0.170*	-0.080*	0.241*
Race[b]						
Black	0.172*	-0.101*	-0.090*	0.145*	-0.012	-0.162*
Hispanic	0.017	0.022	-0.323	0.034*	0.051*	-0.078*
Others	0.006*	0.079	-0.085*	0.030*	0.033*	-0.063
Age	-0.002	-0.0004*	0.001	-0.002*	0.001	-0.001
Breastfeeding[c]						
Yes	-0.035*	-0.006*	-0.044*	-0.039*	0.005	-0.046*
Region[d]						
Mid-Atlantic	0.0004	0.282*	-0.244*	-0.035	0.160*	-0.121*
Southeast	0.073	0.241*	-0.283*	-0.034	0.149*	-0.104*
Midwest	-0.080	0.289*	-0.149*	-0.181*	0.238*	-0.043*
Southwest	0.115*	0.178*	-0.290*	-0.028	0.206*	-0.174*
Mountain Plains	-0.074*	0.265*	-0.167*	-0.169*	0.252*	-0.073*
Western	-0.027	0.145*	-0.097*	-0.183*	0.202*	-0.013
Policy change[e]						
Post-revision	-0.136*	0.085*	0.013*	-0.159*	0.109*	0.046*

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = north eastern
e reference = pre-revision
* Significant at p<0.05

Discussion

Consuming the recommended daily amounts of food is vital in providing a healthy balanced diet and preventing chronic diseases (WHO & Consultation, 2003). Results from this study showed that only a small proportion of postpartum WIC participants met the recommended daily servings of fruit, vegetable, and milk; results similar to previous research in US adults (Blanck et al., 2008). After the WIC food package revision, there was a minute move by rural postpartum WIC participants towards meeting the daily recommended intakes for fruit consumption. Non-rural postpartum WIC participants were more likely to meet the recommended daily amounts of fruit and vegetable consumption and less likely to meet that of milk consumption after the revision.

In this study, rural participants were significantly more likely to meet the daily fruit recommendation after the WIC food package revision compared to before, which is similar to previous studies (Whaley et al., 2000). However, the WIC-FP revision did not catalyze a significant change in the likelihood of meeting the daily recommended amounts for vegetables after the revision compared to before the revision. Previous studies confirm that, similar to WIC participants, those living in poverty are more likely to consume even less of the recommended amount of vegetables (Havas et al., 2003; MacLellan et al., 2004).

In rural areas, the community environment influences affects access and food sources and ultimately individual eating patterns (Glanz et al., 2005). Specifically, although rural communities are known for the production of fruits and vegetables, they may encounter food deserts (Liese et al., 2007) where there is limited access to grocery stores and higher prices than non-rural residents (Larson et al., 2009; Morton & Blanchard,

2007). Additionally, since WIC participants have the option of purchasing either fruits or vegetables, or a combination of both, participants favored purchasing more fruits. Redemption data indicated that 67% of the voucher went to fruits and 33% to vegetables (National Academies of Sciences, Engineering, and Medicine, 2017).

The WIC-FP revision reduced the amount of milk given to participants and limited the choice of milk by restricting the participant to low-fat or fat free/fat free milk, which then influenced the type of milk rural postpartum WIC participants consumed. These participants were less likely to consume whole milk compared to reduced or low-fat milk. Consuming less whole milk and more low-fat milk is a positive shift as the DGA recommends consuming fat-free or low-fat dairy (United States Department of Agriculture, 2008). Since the WIC-FP revision, studies have found an increase in the availability of low fat milk in stores (Andreyeva et al., 2012), an increased consumption of low fat milk, and a decreased consumption of whole milk (Whaley et al., 2000). In rural areas, there was no change in the amount of milk consumed by postpartum WIC participants and in non-rural areas postpartum WIC participants were less likely to meet the daily recommended amounts of milk consumption. In rural areas, no demographic factors were significantly associated with meeting the recommended daily amounts for milk consumption.

For fruit and vegetable consumption, results reveal several differences in food consumption patterns by demographic characteristics such as education, race, region, and breastfeeding status. Previous studies regarding race and ethnicity are mixed. In some studies, white participants consumed more fruits and vegetables compared to other races, and in others, the converse was evident (Deshmukh-Taskar et al., 2007; Odoms-Young et al., 2014; United States Department of Agriculture, 2008). The reason for the differences

are not clear, but further studies are needed to understand these differences to help tailor health promotion interventions to the needs of postpartum WIC participants.

In rural areas, breastfeeding had a positive influence on participant's consumption of fruit, vegetable, and milk. During this period, women have a heightened awareness of the importance of healthy eating as they are catering to their nutritional needs and that of the infant (World Health Organization, 2001).

Future Directions

Further research is needed to identify why different races are more likely to consume more fruits and vegetables compared to Whites in rural areas. Additional insight is needed to identify other underlining factors that affect food consumption behavior and cause rural WIC postpartum participants to lag behind in meeting the recommended daily amounts of food consumption. More research is needed to identify the association between fruit juice or sugar-sweetened beverage consumption and fruit, vegetable and milk consumption. Additionally, a microanalysis is needed to identify if living in border regions compounded by residing in rural areas affect food consumption behaviors in postpartum WIC participants.

Limitations

The NATFAN data was collected six months after the food package revision. Therefore, results may not be conclusive in establishing the long-term effect of the policy on rural postpartum WIC participants. NATFAN was cross-sectional and only captured a portion of participants. However, NATFAN was nationally administered providing a wide snapshot of WIC participants that are demographically similar to the WIC population

nationwide. Additionally, this study lacked several variables that that may all influence food consumption patterns in rural postpartum WIC participants such as their current health status, alcohol and smoking habits, and illegal drug use.

Implications for Practice

The findings from this study underscore the importance of designing targeted interventions for rural postpartum WIC participants. Nutrition education and health promotion program should focus on strategies to increase the consumption of healthy food in rural population. Policies should also focus on addressing the issues of accessibility and availability of food in rural areas.

4. IMPACT OF THE WIC FOOD PACKAGE REVISION ON POSTPARTUM WIC PARTICIPANTS IN TEXAS

Introduction

The postpartum period, referring to the 6 months after childbirth, is a critical period where nutrition plays a major role in improving the health of mother and infant. However, during this period, postpartum women are prone to exhibit poor diet quality, which can also lead to several chronic diseases, such as diabetes and the onset of obesity (Pedroza-Tobías et al., 2016).

Obesity may lead to the development of other diseases in postpartum women such as, cardiovascular diseases and some cancers (Moussa et al., 2016). Moreover, obese postpartum women are more likely to have more hospitalization stays, higher risk of depression and anxiety symptoms, increased infectious morbidity, and increased deep venous thrombosis (Moussa et al., 2016). In the U.S, the prevalence rate for obesity among women is about 40%. However, higher rates of obesity are seen in low-income groups compared to higher income groups, and in non-Hispanic black and Hispanic adults compared to non-Hispanic white and Asian adults (Hales et al., 2017). According to the Behavioral Risk Factor Surveillance System (BRFSS), in 2015 the South also had the highest prevalence of adult self-reported obesity, ranging between 30% and 35% by state (Centers for Disease Control and Prevention, 2018). Evidently, there is a geographical concentration of high obesity rates seen in the south.

The "Southern Obesity Belt," encompassing approximately 12 states (Alabama, Arkansas, Indiana, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Oklahoma, South Carolina, Texas, and West Virginia) in the South and Southeastern U.S., has the

highest rates of diabetes and obesity (Beltrán-Sánchez et al., 2013). Specifically, in Texas, 34.6% of women are categorized as obese (Texas Health and Human Services, 2016). Also, in Texas, about 10% of the Texas population resides along the U.S-Mexico border (Ishdorj & Capps, 2017). The Texas-Mexico border region, which comprises of rural and urban areas, is one of the regions that experiences persistent poverty (Miller & Weber, 2014). This region is predominantly Hispanic and faces the added disadvantage of food insecurity, obesity, and poor nutritional status (Ishdorj & Capps, 2017; United States-Mexico Border Health Commission, 2010). Fortunately, diet is a risk factor that can be altered to prevent obesity, improve health and reduce the risk of diseases (Pedroza-Tobías et al., 2016). Several federal programs have been developed to encourage healthy eating and promote health.

The United States Department of Agriculture's (USDA) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was formulated to provide a package of supplemental food, nutrition education, counseling and healthcare referrals for low-income pregnant, breastfeeding and postpartum women, infants and children up to age five (United States Department of Agriculture, 2018f). In 2014, WIC served an estimated 8 million low income women, infants and children (United States Department of Agriculture, 2017). With these substantial numbers, it is imperative that all WIC participants benefit from the program. In 2009, the mandatory rule was enforced for cash value vouchers (CVVs) for fruits and vegetables, the addition of whole grain, reduction in amount of milk, restriction of the fat content of milk and a reduction in juice allowance, which was not previously included in packages. The revision to the WIC food package (WIC-FP) is a positive move towards achieving Healthy People 2020 objectives and meeting the Dietary

Guidelines for Americans (DGA) (United States Department of Agriculture, 2008). The WIC-FP revision provides an opportunity for WIC participants to meet the current DGA. In meeting the DGA, the WIC food package provides about 71% of the recommended amount for milk consumption and less than 50% of fruit and vegetables for women (National Academies of Sciences, Engineering, and Medicine, 2017).

Previous studies have reported the impact of the WIC-FP revision on Texas children's milk and beverage consumption. Their study reported a significant decrease in whole milk consumption and increase in lower fat milk consumption after the WIC-FP revision (Ishdorj & Capps Jr, 2015; Ishdorj & Capps, 2017). However, to date, no study has reported the impact of the WIC-FP revision on postpartum WIC participants residing in Texas.

Due to the extreme poverty and poor health status of women in the Texas US-Mexico border region and the added disadvantage of Texas inclusion in the "Southern Obesity Belt," it is important to examine the impact of the WIC-FP revision on postpartum WIC participants residing in the Texas.

This study will answer the following research questions:

1. What are the changes in food consumption behaviors in postpartum women living in Texas after the WIC FP revision?
2. What are the disparities in postpartum food consumption behaviors in postpartum WIC participants living in the Texas-Mexico border region compared to non-border region?
3. Which demographic factors influence postpartum food consumption behaviors in WIC participants living in Texas?

Methods

Data Source

This study utilized cross-sectional secondary data from the National Food and Nutrition (NATFAN) survey, which was administered in WIC clinics across multiple states to assess changes in food and nutrition behaviors before and after the new WIC (WIC-FP) revision. Surveys were administered to participants from 40 states and 11 Indian Tribal Organization (ITOs) in WIC clinics in 2009, before the WIC food package revision and in 2010/2011, six months after the food package revision. The survey was administered to pregnant, post-partum women, or caregivers with children under five years. Texas A & M University's Institutional Review Board approved all study protocols for his study. Based on the focus of this study, only postpartum participants in Texas were included for analyses. For the purpose of this study, postpartum women were defined as participants who responded "yes" to having a baby within the last six months. The final sample size was 3,277 postpartum WIC participants living in Texas, with 1,770 (55.5%) before the revision and 1,507 (46.5%) after the revision.

Measures

The NATFAN survey was designed to include three surveys: questions for women, questions for infants, and questions for children. Data were collected from participants on infant feeding practices, breastfeeding practices, pregnancy and postpartum food consumption, and demographics. For this study, only the women's survey was utilized. Furthermore, the focal point of this study was fruit, vegetable and milk consumption. The

NATFAN survey was developed, tested and reviewed for content validity by experts in the field (McKyer et al., 2011).

Recommended guidelines/benchmarks were developed for NATFAN as a reference point for interpreting whether food consumption patterns aligned with the DGA. Women are recommended to consume 1.5 to 2 cups of fruits per day (2 or more times/day for NATFAN benchmark), 2-2.5cups of vegetables per day (3 or more times per day for NATFAN benchmark) and 3 cups of milk per day (3 cups per day for NATFAN benchmark). Therefore, variables were recoded to identify whether participants met the recommended daily amounts (see Figure 4).

Key Food Item	Daily Recommended Amounts	NATFAN Benchmark	Comments/Assumptions*
Milk	Women - 3 cups/day Child (2- 4y) - 2-2½ cups/day Child (1y)[a] - 2 cups/day	3 cups/day for women 2-2 1/2 cups/day 2 cups/day or 2-3 breast feedings	NATFAN surveys obtained amounts and frequencies reported for this item.
Fruits	Women- 1½ - 2 cups/day Child (2- 4y) - 1-1½ cups/day Child (1y) a - 1 cup/day	2 or more times/day 2 or more times/day 2 or more times/day	*adult serving size = 1 cup *child (2-4y): serving size= ½ cup *child (1 y): serving size= ¼ cup[a]
Vegetables	Women - 2-2 ½ cups/day Child (2-4y) – 1-1 ½ cups /day Child (1y) a – 1 cup/day	3 or more times/day 2 or more times/day 3 or more times/day	*adult serving size = 1 cup *child (2-4y): serving size= ½ cup *child (1 y): serving size= ¼ cup
Whole grains	Women - 3 oz. eq./day Child (2- 4y) - 1 ½ - 2 ½ oz. eq./day Child (1y) a - 1 ½ oz. eq./day	2 or more times/day 1 or more times/day 1 or more times/day	[b] based on 1 slice of whole wheat bread, or ½ cup of cooked brown rice being equal to 1oz. equivalent of whole grain.
Juice	Make most of your choices whole or cut-up fruit rather than juice, for the benefits dietary fiber provides	Eliminate intake or 100% fruit or vegetable juice 1 time per day or less	Eliminate intake or limit intake of fruit juice to 4-6 fl. oz./day for children ages 1-6 years old and 6-11 fl. oz./day for women (*Time for a Change,* pg. 78, Table 3-1)

[a] Since there are few portion size recommendations for one year old children, daily recommendations were constructed from multiple sources including USDA's website http://www.fns.usda.gov/cnd/care/programbasics/meals/meal_patterns.htm, and guidebook, *Infant Nutrition and Feeding, A Guide for Use in the WIC and CSF Programs*, AAP's *Pediatric Nutrition Handbook, 6th Edition* and IOM's *WIC Food Packages, Time for a Change.*

[b] Women would have to eat 2 slices of bread or ½ cup cooked brown rice 1.5 times/day to meet recommendation; children would have to eat 1 slice of bread or ¼ cup of brown rice 1.5 times/day to meet the recommendation. (http://www.choosemyplate.gov/food-groups/grains-counts.html)

Figure 4: NATFAN Benchmarks

Reprinted from Institute for Obesity Research and Program Evaluation (2014)

Dependent Variables

The dependent variables were fruit, vegetable, milk and milk type consumption. For fruit and vegetable consumption, participants were asked how often they consumed fruit and vegetables. Responses were never or less than once per week, 1-3 times per week, 4-6 times per week, 1 time per day, 2 times per day, 3 times per day and 4 or more times per day. These responses were recoded to “meet recommendation” or “does not meet the recommendation" based on the NATFAN benchmarks and the DGA.

For milk consumption, women are recommended to drink at least 3 cups of milk per day (3 cups/day NATFAN benchmark (Figure 2)). Women were asked how many cups of milk they consumed in a day. Responses ranged from less than a cup to 4 cups or more. Based on the DGA, a dummy variable was created to reflect if participants meet or do not meet the recommendation. Those who consumed 3 or more cups of milk met the recommendation.

For milk type consumption, women are recommended to consume low fat or fat-free milk. Participants were asked about the type of milk they usually consumed. The options were whole milk, 2%, 1%, ½% skim milk or does not drink milk. For easy interpretation of data, responses were recoded to whole milk, reduced fat and low-fat milk/fat-free milk.

Independent Variables

Participants were asked to report their current age, which was left as a continuous variable. Women’s highest education ranged from 1st to 6th grade through Bachelor’s degree or higher. This variable was recoded as, “less than high school," “high school or

GED," “some college or associate degree” and “college graduate or higher" to align with commonly used scales.

The race/ethnicity variable in the NATFAN survey was listed as, White, Black, Native American, Pacific Islander, Asian, and others with options to specify if participant was Hispanic or non-Hispanic. These categories were recoded into White, Black, Hispanic and others.

Since participants reported zip codes, rurality was categorized based on the USDA’s 2013 Rural-Urban Continuum Codes (RUCC), frequently utilized by the USDA for various federal programs (United States Department of Agriculture, 2016). The USDA RUCC, a county-based measure is commonly used to classify rural and non-rural areas (United States Department of Agriculture, 2016). This approach is preferred as it captures more rural/non-rural variations (Su et al., 2013). A dummy variable of “yes” or “no” was used to measure if participants resided in a rural area.

Additionally, as the present study focused on the Texas-Mexico border region, zip codes were used to identify participants living in border and non-border regions. This was determined by using categorizations defined by the Texas Department of State Health Services, Office of Border Health (Texas Department of Health and Human Service, 2018). A dummy variable of “yes” or “no” was used to measure if participants resided in a border region.

To measure the change in food consumption behavior after the WIC food package revision, a dummy variable for pre - 0 and post -1 revision was created.

Statistical Analysis

Demographics were examined to compare border and non-border postpartum WIC participants in order to identify disparities. Then, descriptive statistics and an analysis of proportions were used to identify changes in fruit, vegetable and milk consumption in postpartum WIC participants in the border and non-border region. A series of logistic regressions were used to assess whether postpartum women met the recommendations of fruit, vegetable and milk consumption before and after the WIC food package revision. Finally, for milk type consumption, a series of multinomial logit regressions were used to compare the likelihood of consuming certain milk types after the WIC-FP revision in border and non-border regions. To address missing data, multiple imputation (MI) using chained equations was used in order to reduce bias and improve precision of the analysis (Lee & Simpson, 2014). Imputations were repeated 20 times to capture the uncertainty in missing values. All estimations were obtained using STATA 15 statistical package (StataCorp, College Station, TX) and for statistical significance, alpha was set at .05.

Results

Sample Description

The pre and post samples were sociodemographically similar; Table 13 shows the sample characteristics of 3,227 postpartum WIC participants living in Texas by border and non-border regions. Approximately 40% of the participants had less than a high school diploma. In the total sample, majority of the participants were Hispanic (61.9% before and 63.5% after the revision) and had an average age of 25 years. In the border region, majority of the participants were Hispanic (89.1% before and 91.5% after the revision). Similarly,

majority of the participants in the non-border region were also Hispanic (about 53% before and after the revision).

Table 13: Demographic Characteristics, Postpartum WIC Participants in Texas n=3,277

Demographic characteristics	Total		Border		Non border	
	Before	After	Before	After	Before	After
Education						
Less than high school	39.6	39.6	36.4	32.5	36.2	36.7
High school or GED	34.0	31.5	32.8	30.8	36.3	33.6
Some college or AA degree	23.5	25.7	26.6	31.7	24.9	26.8
College Graduate or above	2.9	3.2	4.2	5.0	2.8	2.9
Race						
White	18.1	18.2	3.9	2.6	22.5	23.4
Black	12.5	12.2	0	0.6	16.3	16.3
Hispanic	61.9	63.5	89.1	91.5	53.2	53.8
Others	7.5	6.0	7.1	5.2	8.0	6.5
Age	24.9	25.1	25.3	24.9	24.5	24.8

Fruit Consumption

In the border and non-border regions of Texas, there was a significant increase in the proportion of WIC postpartum participants who consumed fruits two or more times a day after the WIC-FP revision (11.5% and 4.7% respectively). However, there was no significant difference in the consumption of fruits between border and non-border postpartum WIC participants (see Table 14).

Table 14: Postpartum WIC Participant's Consumption of Fruits in Texas, before and after the WIC Food Package Revision
N=3,277

	Border		Non-Border		Pre/Post Difference		Border/Non-border Differences	
	Pre	**Post**	**Pre**	**Post**	**Border**	**Non-Border**	**Pre**	**Post**
Never/< once/week	4.3%	1.6%	4.9%	2.6%	-2.7%*	-2.3%*	0.6%	1.0%
1-3 times	26.4%	17.2%	23. 1%	19.5%	-9.2%*	-3.6%*	-3.3%	2.3%
4-6 times	19.8%	15.3%	17.0%	18.6%	-4.5%	1.6%	-2.8%	3.3%
1 time/day	15.4%	20.3%	17.4%	17.0%	4.9%	-0.4%	2.0%	3.3%
2 or more times/day	34.1%	45.6%	37.6%	42.3%	11.5%*	4.7%*	3.5%	-3.3%

* Significant at the 0.05 level

Logistic regression analyses were performed to determine the likelihood of WIC postpartum WIC participants in Texas meeting the recommended daily amount of fruit consumption (see Table 15). After the WIC-FP revision, postpartum WIC participants in the border and non-border regions were more likely to meet the recommended daily amount for fruit consumption compared to before the revision (OR= 1.32 and OR=1.23 respectively). Among border region WIC participants, those residing in rural areas were more likely to meet the recommended daily amount of fruit consumption compared to non-rural areas.

Table 15: Logistic Regression for Fruit Consumption in Postpartum WIC Participants, Border vs. Non-border
n=3,277

	Border n= 671		Non-border n= 2,606	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	0.80	(0.53, 1.19)	0.91	(0.75, 1.11)
Some college	0.77	(0.51, 1.17)	0.80	(0.64, 1.00)
College or Graduate	0.44	(0.18, 1.07)	0.76	(0.45, 1.29)
Race/Ethnicity[b]				
Black	1.74	(0.92, 32.81)	1.92*	(1.46, 2.53)
Hispanic	1.15	(0.43, 3.09)	1.58*	(1.27, 1.97)
Others	1.75	(0.55, 554)	1.88*	(1.32, 2.67)
Age	1.03	(1.00, 1.05)	1.46*	(1.01, 1.03)
Breastfeeding[c]				
Yes	1.34	(0.93, 1.92)	1.01*	(1.04, 1.30)
Region[d]				
Rural	1.50*	(1.01, 2.24)	0.82	(0.68, 1.02)
Policy change[e]				
Post-revision	1.76*	(1.28, 2.44)	1.23*	(1.05, 1.45)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = non-rural
e reference = pre-revision
* Significant at p<0.05

Vegetable Consumption

Border and non-border differences in vegetable consumption were assessed before and after the WIC-FP revision. In the border and non-border regions, there was no significant change in the proportion of postpartum WIC participants who consumed vegetables three or more times per day after the WIC-FP revision (see Table 16).

Table 16: Postpartum WIC Participant's Consumption of Vegetables in Texas, before and after the WIC Food Package Revision
n=3,277

	Border		Non-Border		Pre/Post Difference		Border/Non-border Differences	
	Pre	**Post**	**Pre**	**Post**	**Border**	**Non-Border**	**Pre**	**Post**
Never/< once/week	7.7	4.4	5.2	5.0	-3.3	0.2	-2.5	0.6
1-3 times	27.4	23.1	25.8	22.7	-4.3*	-3.1	-1.6	-0.4
4-6 times	19.1	16.7	19.6	20.7	-2.4	1.1	0.5	4.0
1 to 2 times/day	32.1	41.7	34.6	35.9	9.6*	1.3	2.5	-5.8
3 or more times/day	13.7	14.1	14.8	15.7	0.4	0.9	1.1	1.6

*Significant at the 0.05 level

A series of logistic regressions were used to measure whether postpartum WIC participants in Texas met the recommended daily amounts for vegetable consumption (see Table 17). In the border and non-border regions, there was no significant change in the likelihood of postpartum WIC participants meeting the recommended daily amounts for vegetable consumption after the WIC-FP revision.

Table 17: Logistic Regression for Vegetable Consumption in Postpartum WIC Participants, Border vs. Non-border
n=3,277

	Border n= 671		Non-border n= 2,606	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	1.41	(0.81, 2.45)	0.97	(0.75, 1.11)
Some college	0.88	(0.46, 1.67)	0.79	(0.64, 1.00)
College or Graduate	0.66	(0.15, 2.81)	1.18	(0.45, 1.29)
Race/Ethnicity[b]				
Black	7.01	(0.33, 149.30)	1.49*	(1.46, 2.53)
Hispanic	0.91	(0.24, 3.35)	0.94	(1.27, 1.97)
Others	1.08	(0.23, 5.04)	1.01	(1.32, 2.67)
Age	0.99	(0.96, 1.03)	1.02*	(1.01, 1.03)
Breastfeeding[c]				
Yes	1.56	(0.96, 2.53)	0.99	(1.04, 1.30)
Region[d]				
Rural	1.43	(0.84, 2.43)	0.97	(0.68, 1.02)
Policy change[e]				
Post-revision	1.07	(0.68, 1.67)	1.07	(1.05, 1.45)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = non-rural
e reference = pre-revision
* Significant at p<0.05

Milk Consumption

Border and non-border differences, before and after the WIC-FP revision for milk consumption in postpartum WIC participants residing in Texas were assessed. In the non-border region, there was a significant increase (3.9%) in the proportion of WIC participants who consumed less than 1 cup of milk per day. But, in both the border and non-border

regions, there was no significant change in those who consumed the recommended daily amounts of 3 or more cups a day (see Table 18).

Table 18: Postpartum WIC Participant's Consumption of Milk in Texas, before and after the WIC Food Package Revision
n=3,277

	Border		**Non-Border**		**Pre/Post Difference**		**Border/Non-border Differences**	
	Pre	**Post**	**Pre**	**Post**	**Border**	**Non-Border**	**Pre**	**Post**
I do not drink milk	2.0	5.2	6.4	7.9	3.2*	1.5	4.4*	2.7
Less than 1 C	12.0	13.7	13.1	17.0	1.7	3.9*	1.1	3.3
1 -2 C	65.9	65.3	57.4	54.9	-0.6	-2.5	-8.5*	-10.4*
3 or more C	20.1	15.8	23.1	20.2	-4.3	-2.9	3.0	4.4

*Significant at the 0.05 level

Logistic regression analyses were performed to determine whether postpartum WIC participants residing in Texas in border and non-border regions were meeting the daily recommended amounts for milk consumption (see Table 19). For border region participants, there was no significant change in meeting the recommended milk consumption amounts after the WIC-FP revision compared to before. Furthermore, the only association noted was the likelihood of breastfeeding WIC participants meeting the recommended milk amounts (OR=2.27) compared to those who did not breastfeed. In the non-border region, there was also no significant change in meeting the recommended daily milk amounts compared to before the WIC-FP revision. However, Black, Hispanic and other races where less likely to meet the recommended daily milk amounts compared to white participants (OR=0.53, OR=0.60, OR=0.61 respectively). An increase in age was associated with the increased likelihood of meeting the recommended daily milk amounts

(OR=1.01), while rural participants in the non-border region were less likely to meet recommended daily milk amounts compared to those in non-rural areas, and those who were breastfeeding were more likely to meet the recommended milk amounts (OR=2.25) compared to those were not breastfeeding.

Table 19: Logistic Regression for Milk Consumption in Postpartum WIC Participants, Border vs. Non-border
n=3,274

	Border n= 668		Non-border n= 2,606	
	Odds Ratio (OR)	**Confidence Intervals (CI)**	**Odds Ratio (OR)**	**Confidence Intervals (CI)**
Education[a]				
High school or GED	0.79	(0.47, 1.31)	0.81	(0.64, 1.03)
Some college	0.84	(0.50, 1.41)	0.79	(0.61, 1.04)
College or Graduate	0.30	(0.07, 1.27)	1.19	(0.67, 2.09)
Race/Ethnicity[b]				
Black	-	-	0.53*	(0.38, 0.74)
Hispanic	0.44	(0.15, 1.29)	0.60*	(0.47, 0.77)
Others	0.78	(0.21, 2.82)	0.61*	(0.40, 0.94)
Age	1.03	(1.00 1.06)	1.01*	(0.99, 1.03)
Breastfeeding[c]				
Yes	2.27*	(1.48, 3.47)	2.25*	(1.81, 2.81)
Region[d]				
Rural	0.67	(0.38, 1.18)	0.73*	(0.56, 0.94)
Policy change[e]				
Post-revision	0.82	(0.55, 1.24)	0.82	(0.68, 1.00)

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = non-rural
e reference = pre-revision
* Significant at p<0.05

Milk Type Consumption

Border and non-border differences in the type of milk consumed by postpartum WIC participants in Texas were assessed before and after the WIC-FP revision. In both the border and non-border regions, there was a decrease in the proportion of participants who consumed whole milk (37.5% and 32.3% respectively), and an increase in reduced fat milk (30.4% and 27.8% respectively) and low fat/fat free milk (4.2% and 3.6% respectively) after the WIC-FP revision (see Table 20).

Table 20: Postpartum WIC Participant's Consumption of Milk Types in Texas, before and after the WIC Food Package Revision
n=3,277

	Border		Non-Border		Pre/Post Difference		Border/Non-border Differences	
	Pre	**Post**	**Pre**	**Post**	**Border**	**Non-Border**	**Pre**	**Post**
Do not drink milk	2.1	5.0	5.0	5.9	2.9*	0.9	2.9*	0.9
Whole milk	49.0	11.5	53.6	21.3	-37.5*	-32.3*	4.6	9.8*
Reduced fat milk	42.8	73.2	35.9	63.7	30.4*	27.8*	-6.9*	-9.5*
Low/fat free milk	6.1	10.3	5.5	9.1	4.2*	3.6*	-0.6	-1.2

*Significant at the 0.05 level

A multinomial logit model was used to assess the likelihood of participants choosing to consume whole fat, reduced fat or low fat/fat free milk. After the revision, in the border region, the probability of participants consuming whole milk decreased by 37.6% and increased by 30.8% for reduced fat milk. In non-border postpartum WIC participants, after the WIC-FP revision, the probability of consuming whole fat milk decreased by 8.5%, reduced fat milk increased by 27.5% and low fat/fat free milk increased by 3.5%. In the non-border region, postpartum WIC participants who were black were 12.8% more likely to consume whole milk, but 13.4% less likely to consume reduced

fat milk and 4.9% less likely to consume low fat/fat free milk compared to White participants. However, in the border region, Hispanic participants were 8.3% more likely to consume low fat/fat free milk compared to White participants while Black participants were 41.9% less likely to consume whole milk compared to White participants. Breastfeeding postpartum WIC participants in the non-border region of Texas were 8.5% less likely to consume whole milk but more likely to consume reduced fat of low fat/fat free milk (7.3% and 3.4% respectively) compared to those who did not breastfeed. Furthermore, postpartum WIC participants living in rural areas were 4.6% more likely to consume whole milk and 2.6% less likely to consume low fat/fat free milk, compared to those living in non-rural areas. In the non-border region, participants with some college degree or graduate degree were less likely to consume whole milk and more likely to consume low fat/fat free milk compared to those with less than a high school diploma (see Table 21).

Table 21: Marginal Effects (ME) of Multinomial Regression for Milk Type in Postpartum WIC Participants, Border Vs Non-border
n=3,277

	Border n= 671			**Non-border n= 2,606**		
	Whole	Reduced fat	Low Fat/Fat free	Whole	Reduced fat	Low Fat/Fat free
	ME	**ME**	**ME**	**ME**	**ME**	**ME**
Education[a]						
High school or GED	-0.051	0.062	-0.030	-0.028	0.025	-0.005
Some college	-0.064	0.035	0.024	-0.080*	0.024	0.039*
College or Graduate	-0.018	-0.084	0.080	-0.150*	0.073	0.091*
Race/Ethnicity[b]						
Black	-0.419*	-0.015	-0.003	0.128*	-0.134*	-0.049*
Hispanic	-0.145	0.029	0.083*	-0.034	0.038	-0.020
Others	-0.110	0.024	0.063	-0.008	0.009	-0.14
Age	-0.005	0.005	0.001	-0.006*	0.006	0.002
Breastfeeding[c]						
Yes	-0.013	0.017	0.007	-0.085*	0.073*	0.034*
Region[d]						
Rural	0.032	-0.074	0.006	0.046*	-0.026	-0.026*
Policy change[e]						
Post-revision	-0.376*	0.308*	0.040	-0.318*	0.275*	0.033*

a reference = less than high school
b reference = white
c reference = not breastfeeding
d reference = non-rural
e reference = pre-revision
* Significant at p<0.05

Discussion

Meeting the DGA is vital for good nutrition and health in postpartum women. This is especially vital for postpartum WIC participants residing in the Texas-Mexico border region because this region is known for poverty and poor health outcomes (Miller & Weber, 2014) . The WIC program provides participants with the means to access a variety of foods that may move them towards meeting the DGA and address the problem of overweight/obesity, thereby reducing diet related health disparities. It is therefore, important to assess the impact of the WIC-FP revision on postpartum women in Texas.

Findings from this study reveal that postpartum WIC participants in Texas are still lagging behind in meeting the recommended daily amounts of fruits, vegetables and milk consumption, similar to previous studies in the U.S population (Bowman, 2017). After the WIC-FP revision, postpartum WIC participants in the border and non-border region of Texas were more likely to meet the recommended daily amounts of fruit consumption, were more likely to consume whole milk, and less likely to consume reduced fat milk and low fat/fat free milk. There was no significant change in any of the participants meeting the recommended daily amounts of vegetable and milk consumption. Despite the insignificant change in the consumption of certain foods, findings of this study show that the revision had a positive impact on food consumption behaviors, and moved participants towards meeting the DGA, in accordance with past research (Schultz et al., 2015).

An increase in the likelihood of meeting the recommended amounts for fruit consumption but not vegetable consumption in postpartum women is supported by a previous study (Whaley et al., 2000). The CVVs give WIC participants the option of

purchasing fruits or vegetables, or a combination of both, but redemption data indicated that participants usually purchased more fruits compared to vegetables (National Academies of Sciences, Engineering, and Medicine, 2017; Texas Department of State Health Services, 2018). In this study, all other races were more likely to meet the recommended daily amounts of fruit consumption compared to White participants. There are currently mixed results concerning the racial/ethnic disproportionality of fruit consumption. Some studies reported that Black participants were more likely to redeem and consume less fruits, while in others, the opposite was true (Deshmukh-Taskar et al., 2007; Gleason & Pooler, 2011; Odoms-Young et al., 2014). However, in this study, the low proportion of Black participants may play a factor in model estimation, resulting in a larger likelihood compared to the other races. A prior study suggests the notion of non-use of CVVs, where vendors misinterpret the redemption rules and do not allow participants to go over the limit and compensate with their own funds. This usually leads to participants resorting to leaving the food they wanted to purchase behind (Gleason & Pooler, 2011).

Both border and non-border postpartum WIC participants did not meet the recommended daily amounts of milk consumption after the WIC-FP revision. This could be a result of revisions in the new WIC-FP, where the amount of milk offered was reduced compared to before. In the non-border region, participants who were Black, Hispanic and other races were less likely to meet the recommended daily amounts of milk compared White participants. This may possibly be because lactose maldigestion, associated with certain ethnic and racial groups such as Asians, African Americans, Hispanics, and American Indians (Jackson & Savaiano, 2001) may lead to avoidance of milk or consumption of non-dairy alternatives.

After the WIC-FP revision, there was a decrease in the probability of postpartum WIC participants' consumption of whole milk but an increase in the consumption of reduced fat or low-fat/fat free milk in both the border and non-border regions. In the non-border region, the probability of consuming whole milk was higher for Black participants compared to White participants but lower for reduced and low fat/fat free milk, this finding is similar to a previous conducted in infants in Texas participating in WIC (Ishdorj & Capps, 2017). Additionally, participants residing in non-border rural areas were more likely to consume whole fat milk and less likely to consume low fat/fat free milk compared to those in non-rural areas. Similarly, other studies reported a decrease in whole milk consumption and an increase in low fat milk consumption in WIC participants after the revision (Kong et al., 2014; Odoms-Young et al., 2014; Whaley et al., 2000). Results correspond with the rule in the revision that removes whole milk from the postpartum women packages and replaces it with low-fat or fat free milk. Offering low fat/fat free milk as a default makes it easier for WIC participants to adopt the change (Kong et al., 2014). However, despite this rule, participants are still consuming whole milk, therefore, we can only speculate that these may be non-WIC purchases or consumption from other members of the household who may receive whole milk in their WIC-FP.

There were no major disparities in meeting the recommended daily amounts of fruit, vegetables and milk consumption between border and non-border regions in spite of the various barriers faced by participants in the border regions such as access and availability to healthy food. However, participants residing in rural, non-border areas seem to face challenges in healthy eating. Rural residents usually face high poverty rates and are less likely to meet recommended daily amounts for food consumption (MacLellan et al., 2004).

Additionally, rural participants face the added burden of limited access to affordable healthy food compared to non-rural residents, which may contribute to the greater occurrence of overweight/obesity (Reed et al., 2016). The most common barriers faced by those residing in rural areas are the lack of time to shop and prepare healthy food, high cost of healthy food, lack of social support and lack of access to healthy food (Reed et al., 2016).

Limitations

Findings should be interpreted with caution as there are limitations to this study. The study was cross-sectional and only captured data from a proportion of the WIC population. A longitudinal study would have been appropriate to follow participants over time to assess the impact of the revision. Participants were asked to recall food consumption behaviors in the past, which could lead to recall bias since we may not know how much over reporting or under reporting was done. The sample of border participants was lower compared to non-border participants, and there were few Black participants, which may affect results. Even though data was collected from WIC clinics/agencies in Texas, findings are not generalizable to the entire WIC population.

Despite these limitations, this study closes the research gap by providing a new perspective on how the WIC-FP policy impacted Texas participants. To date, this is the first study to specifically examine the impact of the WIC-FP revision on postpartum women. Additionally, the large overall sample size allowed us to detect any disparities in rural, non-rural, border and non-border participants.

Implications for Practice

The findings from this study emphasize the importance of ensuring that all WIC participants in Texas benefit from the WIC program. Findings may also inform state policies among rural regions or regions with extreme poverty. Nutrition education efforts should be tailored to provide culturally relevant information to promote healthy eating geared towards meeting recommendations of the DGA and reducing obesity. This may include, improved communication with vendors on splitting and other transactions with the CVVs, and identification of cost effective ways to utilize CVVs to gain maximum nutritional benefit. Expanded efforts should also specifically target postpartum WIC participants to lessen barriers to healthy eating and increase access to affordable food.

Future Directions

Studies are needed to identify the reason why a large number of postpartum WIC participants in Texas do not meet the recommendations in the DGA. Additional research is also needed to address supply and accessibility of food. In Texas, not everyone has access to affordable healthy food but to high caloric food (Cole, 2012). It is important to assess whether high caloric/empty caloric foods are replacing healthy food in WIC participants. Furthermore, studies are needed to understand redemption and choice of food consumption, as well as gain new perspectives on additional barriers to healthy eating in this population.

5. CONCLUSION

The overall purpose of this study was to identify whether postpartum women participating in WIC are benefitting from the WIC-FP revision. The specific aims were to 1) identify existing literature on the impact of the WIC-FP revision on rural postpartum WIC participants, 2) examine changes in food consumption behaviors among postpartum women participating in WIC in rural areas, after the WIC-FP revision, and 3) examine changes in food consumption behaviors among postpartum women participating in WIC in Texas, after the WIC-FP revision.

Chapter 2 presents the first study, a scoping review that systemically identifies existing literature on the impact of the WIC-FP revision on postpartum women. A detailed assessment of the five articles retrieved revealed several methodological and theoretical issues. None of the studies reported any theoretical basis and reliability or validity. Based on the scoping review, there was also a lack of studies that focused primarily on rural postpartum participants even though they were included in the study. Findings reveal a positive impact of the WIC-FP revision on WIC participants' food consumption behaviors. After the WIC-FP revision, there was an increase in fruit, vegetables, low fat dairy and whole grain consumption. Results from the review produced few studies, which necessitates the need for additional research on postpartum WIC participants. Future researchers are recommended to improve quality of studies by providing research grounded in theory to help conceptualize ideas, and reporting reliability and validity to ensure accurate measurements. The lack of existing studies that focus on rural postpartum WIC participants led to the second study.

The second study, in chapter 3 examines changes in food consumption behaviors among postpartum women participating in WIC in rural areas, after the WIC-FP revision. Findings from this study show that the WIC-FP revision had a positive change in food consumption behaviors in rural postpartum women. After the WIC-FP revision, there was an increased likelihood of meeting the recommended daily amounts for fruit and the increased likelihood of consuming reduced or low fat/fat free milk compared to before the revision. However, in rural postpartum WIC participants, there was no change in meeting the recommended daily amounts of vegetable and milk consumption after the WIC-FP revision compared to before. These findings may inform policy makers on how to better target rural postpartum women in meeting recommended amounts for vegetables and milk consumption. The need for a microanalysis to assess if living in a border region compounded by living in a rural areas affects food consumption behaviors in postpartum WIC participants led to the third study.

In chapter 4, the third study examines changes in food consumption behaviors among postpartum women participating in WIC in Texas, after the WIC-FP revision. Findings reveal that in postpartum WIC participants in Texas, the WIC-FP revision led to a change in the right direction in meeting the DGA. After the WIC-FP revision, postpartum WIC participants in Texas were more likely to meet the recommended daily amounts for fruit and more likely to consume reduced fat or low fat/fat free milk compared to before the revision. However, there was no significant change in meeting the recommended amounts of vegetable and milk consumption after the revision. There were also no disparities between border and non-border regions with respect to food consumption behaviors. Future research should focus on identifying why a large proportion of

postpartum WIC participants fail to meet recommendations in the DGA. Findings will inform state policies in addressing low-income rural populations.

As a whole, this dissertation is one of the first to specifically examine the impact of the WIC-FP revision of postpartum women, and aids in closing the research gap by providing insight into how the WIC-FP revision impacted postpartum WIC participants' food consumption behaviors. The lack of previous studies focusing on postpartum WIC participants led to the other two studies. Overall, after the WIC-FP revision, there was a positive move towards meeting the recommendation of the DGA. However, additional efforts are needed in low-income rural postpartum WIC participants to move them closer to the meeting the recommendations of the DGA. Healthy eating is vital in postpartum WIC participants and their children. Children are more likely to consume a healthy diet if their parent modeled the behavior (Ritchie et al., 2011). The positive shift towards healthy eating will eventually impact obesity rates (Ashe et al., 2011).

It is important to recognize limitations of this dissertation. The data from study 2 and 3 were cross-sectional and only sampled a proportion of participants so findings are not generalizable to the entire WIC population. However, NATFAN was nationally administered providing a wide snapshot of WIC participants that are demographically similar to the WIC population nationwide. The study utilized and required participants to recall frequencies, this could be subject to recall bias. Furthermore, data was collected 6 months after the revision so we cannot determine the long-term effect of the revision.

Findings from this study can help inform state and national policies. Additionally, other federal policies may benefit from these finding to guide the improvement of other federal feeding program such as Supplemental Nutrition Assistance Program (SNAP).

Findings of this dissertation highlight the need for targeted nutrition education and formulation of policies geared towards postpartum WIC participants.

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APPENDIX A

KEYWORD SEARCH FOR MANUSCRIPT 1

(AB food n1 packag* OR TI food n1 packag*) OR (AB (2009 n1 (revision* or chang*)) OR TI (2009 n1 (revision* or chang*)) OR AB ((packag* n1 (revision* or chang*)) OR TI ((packag* n1 (revision* or chang*))) OR MH "Food Packaging"

MH "Food Assistance" OR (AB (wic or “Special Supplemental Nutrition Program for Women, Infants, and Children”)) OR (TI (wic or “Special Supplemental Nutrition Program for Women, Infants, and Children”))

AND (AB food n1 packag* OR TI food n1 packag*) OR (AB (2009 n1 (revision* or chang*)) OR TI (2009 n1 (revision* or chang*)) OR AB ((packag* n1 (revision* or chang*)) OR TI ((packag* n1 (revision* or chang*))) OR (MH "Food Packaging+")

APPENDIX B

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