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An Examination of the Relationship between  
Household Food Insecurity and WIC Participation

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## **Abstract**

### **An Examination of the Relationship between Household Food Insecurity and WIC Participation**

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Over the last decade, a growing number of American families have struggled to put food on the table. The most recent USDA ERS report, released September 2012, estimates that a record one in five children, over sixteen million in total, currently live in food insecure homes throughout the country. Household food insecurity, defined as not having ‘access to enough food for an active, healthy life,’ is a key indicator of population health and has been recognized as an important area for improvement by initiatives such as Healthy People 2020. Improving access to healthy foods is a cornerstone of many public health programs including SNAP, TANF and the Special Supplemental Nutrition Program for Women, Infants and Children, WIC. WIC’s mission is to safeguard the health of low-income maternal-child populations who are at nutrition risk by providing resources such as nutritious foods, nutrition counseling and health care referrals. As a federally mandated program, WIC is uniquely positioned to not only impact the

experience of food insecurity but also improve the life course health of vulnerable maternal-child populations in the US. While research to date supports the notion that participation in WIC has a dose-dependent effect on household food insecurity among participating families, WIC participation rates, defined as participation among eligible families, and coinciding rates of household food insecurity, had yet to be examined.

The purpose of this study was to explore the presence and nature of a cross-sectional and longitudinal relationship between state-level household food insecurity rates and WIC participation rates over time. The first aim was to examine the relationship between annual state-level household food insecurity and WIC participation rates cross-sectionally from 2000-2010, controlling for relevant sociodemographic characteristics. The second aim was to examine the relationship between annual state-level household food insecurity and WIC participation rates longitudinally from 2000-2010, controlling for relevant sociodemographic characteristics and national economic trends.

This study was an exploratory analysis of existing secondary data. Data sources included the Current Population Survey, WIC administrative files, and US Census. I used a pooled time-series regression model to examine the associations between household food insecurity rates, WIC participation rates, and sociodemographic characteristics. I examined the longitudinal association between household food insecurity and WIC participation with a pooled time-series regression model and marginal effects equations using a linked state-level dataset for years 2000 through 2010, first described in my cross-sectional analysis.

The cross-sectional analysis uncovered a complicated relationship between household food insecurity and WIC participation dependent upon the state sociodemographic characteristics, namely the proportions of Hispanic and/or Foreign-Born populations and the rates of teenage and unmarried pregnancies. The longitudinal analysis expanded upon the understanding of the relationship between household food insecurity and WIC participation rates by examining the presence and nature of this relationship over time. A normalized pattern of association, where a change in state-level food insecurity was associated with a similar change in WIC participation, was evident during periods 2000, 2001 and 2010. In contrast, the non-recessionary period from 2002-2006 and Great Recession from 2007-2009 disrupted this pattern. During 2002-2006 and 2007-2009, a state-level change in food insecurity did not elicit a measurable change in WIC participation.

This work adds to the overall understanding of the relationship between state-level maternal-child food and nutrition needs and the current public health system's ability to meet these needs. This research supports public health programming's ability to positively influence the lives of low-income, vulnerable maternal-child populations in the US struggling with food insecurity. Overall, it is hoped that this evidence of the relationship between food insecurity and WIC participation will encourage consideration of state-level sociodemographic characteristics and national economic climate in the planning and implementation of public health services intended to reduce food insecurity and improve maternal-child health over time.

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## **Dedication**

To mothers and babies everywhere,  
That you may be healthy and happy.

&

To Jordan, my rock and my shield.

## CHAPTER 1: INTRODUCTION

### **Background and Significance**

#### **Introduction to Food Insecurity**

According to UN statistics, “hunger and malnutrition are the number one risks to health worldwide,” impacting the lives of 870 million undernourished people in the world today (Food and Agriculture Organization of the United Nations [FAO], World Food Programme [WFP], International Fund for Agricultural Development [IFAD], 2012). Hunger is not only a pressing issue globally, but also domestically. In 2010 an estimated 15% of the US population, 18 million people, were unable to acquire adequate food due to insufficient money or other resources (U.S. Department of Agriculture [USDA], Economic Research Service [ERS], 2012). In the public health literature, the term food insecurity collectively refers to issues related to hunger and the inability to have consistent, dependable access to enough food for active, healthy living (Belsky, Moffitt, & Arsenault, 2010 & USDA, ERS, 2012). In an effort to monitor the extent and severity of food insecurity, the US Department of Agriculture (USDA) began collecting nationwide annual data on this issue in 1996. According to the most recent annual report on food security, one in five children live in a home struggling with food insecurity (USDA, ERS, 2012).

Food security is a difficult matter to address given its highly complex nature. Food insecurity is often triggered by an event that challenges a household’s budget (Rose, 1999 & American Dietetic Association [ADA], 2010). Factors that contribute to food insecurity including poverty, high housing and utility costs, unemployment, medical and health costs, mental health problems, lack of education, transportation costs and

substance abuse and smoking. The large number of determinants creates many challenges in successfully staging food security intervention research (ADA, 2010, U.S. Conference of Mayors [USCM], 2007, & Cutler-Triggs, C., Fryer, G.E., Miyoshi, T.J. & Weitzman, M., 2008). Also, the experience of food insecurity is generally episodic in nature, contributing to difficulties with proper measurement of the scope of the problem (USDA, ERS, 2012).

### **Food Insecurity's Impact on Maternal-Child Health**

Food insecurity has significant impacts on the health of maternal-child populations. Empirical studies have indicated that food insecurity influences many physical and mental health indicators, both in the short and long term. A life course perspective, which supports the notion that one's health, from the time of conception forward, impacts one's future health as well as the health of generations to come, allows us to examine the impacts of food insecurity on the health of childbearing women and their children (World Health Organization [WHO], 2007). The life course approach is comprised of two key concepts: the presence of critical periods in the life course, and the accumulation of risk over time (WHO, 2007).

A critical period is defined as a specific period in the human development process during which exposure to a risk has lifelong consequences on health (WHO, 2007). This concept supports the notion of fetal origins of adult diseases. Pregnancy and fetal development represent a critical period for both the mother and the unborn child. The critical periods concept allows us to examine the effect of food insecurity on the health of childbearing women and their infants. The nutritional status of a woman before, during and following pregnancy is critically important for both members of the maternal-child

dyad. In the US, food insecurity causes pregnant women to be undernourished, leading to a state of biological and social stress (Khan & Bhutta, 2010). Research associates food insecurity during pregnancy with maternal pregravid weight status, maternal gestational weight gain, increased pregnancy complications, chronic stress, depressive symptoms, and decreased maternal-infant interaction. Infants whose mothers experienced food insecurity during pregnancy are at increased risk for low birth weight and certain birth defects (Lee, Gundersen, Cook, Laraia, & Johnson, 2012, Hromi-Fiedler, Bermudez-Millan, Segura-Perez, & Perez-Escamilla, 2011, & Carmichael, Yang, Herring, Abrams, & Shaw, 2007).

The accumulation of risk concept suggests that “factors that raise disease risk may accumulate gradually” over an individual’s lifetime (WHO, 2007). This idea is complementary to the notion that as the intensity, number, and duration of risk exposures increase, there is increasing cumulative damage to biological systems. Food insecurity in children has been shown to be associated with increased rates of overweight and obesity (Metallinos-Katsaras, Sherry & Kallio, 2009). Food insecurity, coupled with obesity, creates a barrier to normal growth, maturation and development in US pediatric populations. Currently, approximately 16% of US children are considered obese, with an additional 18% classified as overweight (Metallinos-Katsaras, Sherry & Kallio, 2009). With more than one in five children living in food-insecure homes, it is feared that this abnormal growth and development will persist into adulthood (USDA, ERS, 2012). Long-term negative outcomes for food insecure children include poor general health, and increased hospitalization (Eisenmann, Gundersen, & Stewart, 2011). Longitudinally, research also shows that food-insecure children have lower IQs and higher levels of

behavioral and emotional problems relative to their peers (ADA, 2010). These concerns are said to reflect their experiences of discomfort and humiliation associated with hunger (Belsky et al., 2010). Furthermore food insecurity negatively affects children's lifelong social skills, especially those emphasizing self-control, attentiveness and task persistence (Howard, 2011).

With numerous physiological and psychological adverse effects of maternal-child food insecurity documented, it is clear that this public health concern poses both immediate and long-term serious health challenges in the United States. Without proper resources to meet critical growth and development needs during the childbearing and childhood years of life, these individuals are at increased risk for numerous chronic health conditions. Unfortunately, while individual level impacts of food insecurity on childbearing women and children have been explored in many small-scale, retrospective studies, little is known about the impact of food insecurity on this population at the systems level—where policy interventions could have a large population-level impact.

### **Introduction to WIC**

One resource utilized by childbearing families who are experiencing food insecurity is the Special Supplemental Nutrition Program for Women, Infants and Children (WIC). Since the time of the program's inception in 1972, the mission of WIC has been to safeguard the health of low-income women, infants and children up to age 5 who are at nutritional risk (U.S. Department of Agriculture [USDA], Food and Nutrition Service [FNS], 2012). WIC addresses these issues by providing participants with supplemental nutritious foods, nutrition education and counseling, as well as screening and referrals to other health, welfare and social services. Over the past four decades, the

program has grown significantly and currently provides assistive services to half of the nation's infants and one quarter of children aged 1-4 (Oliveira, Racine, Olmsted, & Ghelfi, 2002). Of the nearly 8 million individuals enrolled in the program each month, pregnant (11%), postpartum (7%), and breastfeeding (5%) women constitute nearly 2 million, a significant portion of the participating population (Oliveira et al., 2002).

WIC programming plays an essential role in improving the health of at-risk maternal-child populations. Studies have concluded that participation in WIC results in reduced fetal death and infant mortality, improved birth weights and duration of pregnancy, improved growth of at-risk infants and children, decreased incidence of iron deficiency, improved pregnancy weight gain and dietary intake of mothers, earlier initiation to prenatal care, improved immunization rates, savings in health care costs and a stable source of medical care (USDA, FNS, 2012). Study of the relationship between food insecurity and WIC participation could help identify further factors that may facilitate WIC's ability to improve maternal-child health outcomes.

### **Relationship between Food Insecurity and WIC**

The World Health Organization's Partnership for Maternal, Newborn and Child Health promotes evidence, advocacy and accountability for women and children's health on a global scale. One of the WHO Partnership's main goals is reducing food insecurity both domestically and internationally. The World Health Organization encourages "rapid progress" toward reducing food insecurity among maternal-child populations by focusing efforts on "scaling up" evidence-based, cost-effective public health programs (WHO, 2013).



One such evidence-based, cost-effective approach to improving maternal-child health here in the US is WIC, as demonstrated by the many values of the program that past research has brought to light. Despite evidence of WIC's ability to improve birth outcomes and growth and development of young children, understanding of the relationship between food insecurity and WIC is limited.

Three known published studies have examined WIC and food insecurity. In the first of these, Black's 2004 multisite surveillance study examined the association between WIC participation, indicators of child wellbeing, caregiver-perceived health, and household food insecurity among infants under 1 year of age. This study utilized the Children's Sentinel Nutritional Assessment Program data collected at 6 urban hospital and clinic settings from 1998-2001. Data included the household-level surveys and coinciding medical records of 11,567 children, living in Baltimore, MD, Minneapolis, MN, Washington, DC, Boston, MA, Little Rock, AR, and Los Angeles, CA. The survey assessed household participation in federal assistance programs, including WIC, and used the complete 18-item USDA Food Security Scale to assess household food security status. Indicators of child wellbeing collected from participants' medical records included infant weight, length, age and sex. These values were used to calculate weight-for-age to assess for underweight and overweight status of each infant based on normative values. Results of this study included that growth among infants receiving WIC were consistent with national normative values. Families who did not enroll in WIC due to WIC program access problems had higher rates of food insecurity and had infants who were more likely to be underweight. The study concluded that infants benefit from participation in WIC and health care providers should promote WIC participation and eliminate barriers that

interfere with eligible populations gaining access to this resource (Black, Cutts & Herren, 2004).

In a 2011 study, Metallinos-Katsaras and colleagues examined the longitudinal association between women's and children's participation in the Massachusetts WIC program and household food security status among 21,863 mothers and their 57,377 children over 5 years from 2001-2006. The study sample consisted of primipara WIC participants, for whom data were available and complete for the study period. Household food security status was measured at multiple points including prenatally, postnatally, and at each six-month WIC recertification visit. Household food security status was assessed using a 4-question subscale of the 18-question USDA Food Security Module (Metallinos-Katsaras, Sherry, & Kallio, 2009). Questions included: (1) We couldn't afford to eat balanced meals. Was that often, sometimes or never true for your household in the last 12 months? Often true, Sometimes true, or Never true. (2) In the past 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money to buy food? Yes or No. (3) If yes [to question 2], how often did this happen? Almost every month, some months but not every month, 1 or 2 months, or I don't know how often. (4) In the past 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? Yes or No (USDA, ERS, 2012). Metallinos-Katsaras found that household food security status at the last WIC visit was found to be associated with measures of WIC duration-- specifically the number of trimesters on WIC for pregnant women, and the total number of WIC visits among children. Among women who reported prenatal household food insecurity with hunger, early participation in WIC greatly reduced

likelihood of postpartum household food insecurity. Among children in food insecure homes, each additional WIC visit significantly reduced the odds of household food insecurity. Their study concluded that earlier and longer WIC participation by childbearing women and their young children may improve long-term household food security status among this vulnerable population (Metallinos-Katsaras, Sherry, & Kallio, 2009).

Mayer and colleagues in Philadelphia, PA examined the relationship between food insecurity and WIC participation using data from the 2008, 2010, and 2012 waves of the Southeastern Pennsylvania Household Health Survey. The study examined the association between food insecurity, neighborhood food access (self-reported access to fruits and vegetable and quality of local grocery stores), and receipt of food assistance (N = 11,599). The Southeastern Pennsylvania Household Health Survey was administered every 2 years to a random sample of households in the five counties surrounding Philadelphia. The participating households were selected using computerized random digit dialing within each geographic region and the survey was conducted with a household member via phone interview. Food insecurity was assessed during all three time points using the following single-item survey question modified from the USDA Household Food Security Survey, “In the past 12 months, since (date one year ago) did you or other adults in your household ever cut the size of your meals or skip meals because there was not enough money in the budget for food?” Neighborhood food access was assessed by asking two questions, “(1) How easy or difficult is it for you to find fruits and vegetables in your neighborhood? Very easy, Easy, Difficult, or Very difficult. (2) How would you rate the overall quality of groceries available in the stores in your

neighborhood? Excellent, Good, Fair or Poor” (Mayer, Hillier, Bachhuber & Long, 2014). They combined responses regarding SNAP and WIC participation into a single variable to categorize households as having received no food assistance, only SNAP, only WIC, or a combination of SNAP and WIC. Mayer found that individuals receiving SNAP were significantly more likely to be food insecure in comparison with those not receiving food assistance. For those receiving a combination of SNAP and WIC, or WIC alone, no significantly different odds of food insecurity were found (Mayer, Hillier, Bachhuber & Long, 2014). This study’s lack of significant findings regarding the relationship between WIC participation and food insecurity could be related to the use of a single-item survey question to assess food insecurity (Mayer, Hillier, Bachhuber & Long, 2014).

Nonetheless, the presence of a significant relationship between food insecurity and SNAP participation does lead to further questions about the participation in food assistance programs and related levels of food insecurity.

The relationship between WIC and food assistance programs and food insecurity is a priority in public health research due to its relevance in informing program improvements, policy-making, and advocacy. While two of these three studies support the notion that participation in WIC may have an effect on household food insecurity among participating families, WIC’s ability to reach low-income maternal-child populations has not been well described from a public health systems-level perspective.

These studies of food insecurity and WIC did not have the adequate sample size, demographic variability or geographic reach to examine the impact that sociodemographic characteristics may have on this relationship at the population-level. It is, nonetheless, well documented that both food insecurity rates and WIC participation

rates vary considerably among subgroups of the domestic maternal-child population. Population-level research has shown a consistent history of higher rates of food insecurity among minority populations, including Blacks, Hispanics, and Foreign-Born populations and increased likelihood of participation in food assistance programs, including WIC, among Hispanic and Foreign-Born populations (Chilton & Black, 2009; USDA, ERS, 2012; USDA, FNS, 2014; Bitler, et al., 2003; Castner et al., 2009; Fortuny, 2010; Swann, 2003; Tiehen & Jacknowitz, 2008). Exploration of the relationship between household food insecurity and WIC cannot be attained without consideration of and integration of population-level sociodemographic characteristics into the study model. Examination of how these relationships vary among population subgroups may inform outreach efforts and program improvements.

Studying the relationship between household food insecurity and WIC participation longitudinally, specifically from 2000 to 2010, allows for consideration the influence of changes in the national economic climate on this key relationship of interest. The decade from 2000 to 2010, included periods of growth/non-recession as well as periods of recession--an initial small-scale recession in 2001, and a subsequent major recession, known as the Great Recession, from 2007-2009 (National Bureau of Economic Research [NBER], 2010). This Great Recession resulted in the highest poverty rates the US had seen in more than two decades (NBER, 2010). During the Great Recession housing values fell 34 percent, national unemployment rose from 4.4% to 10% (Hanson & Essenburg, 2014). The federal government's budget crisis surrounding the Great Recession had major impacts on the well being of domestic populations, putting an additional 10 million people into poverty (Hanson & Essenburg, 2014). The effects of

this Great Recession particularly influenced the populations living in poverty, including those who experienced food insecurity and participated in food assistance programs such as WIC. Examining the presence of a longitudinal relationship between household food insecurity rates and WIC participation, particularly during this time period, can provide evidence on the influence of economic climates on food insecurity and public health programming participation among vulnerable populations.

WIC's focus on increasing access to healthy foods, nutrition education and health services can improve health and potentially alleviate food insecurity among low-income maternal-child populations in the US. Prevention and health promotion programs, such as WIC, however, may be more effective when specific sociodemographic characteristics and economic influences are fully understood and taken into account so that efforts may be made to support and encourage adequate enrollment and program utilization. Study of the relationship between household food insecurity and WIC participation at the aggregate-level broadened understanding of the needs of maternal-child populations and the effectiveness of public health programming.

### **Dissertation Purpose**

The purpose of this study was to explore the presence and nature of a cross-sectional and longitudinal relationship between state-level household food insecurity rates and WIC participation rates during years 2000-2010.

## **Specific Aims**

Specific aims of this study were to:

Aim 1. Examine the relationship between annual state-level household food insecurity and WIC participation rates cross-sectionally from 2000-2010, controlling for relevant sociodemographic characteristics.

Aim 2. Examine the relationship between annual state-level household food insecurity and WIC participation rates longitudinally from 2000-2010, controlling for relevant sociodemographic characteristics and national economic trends.

## **Methodological Approach**

### **Methodology & Rationale for Selected Approach**

This study is a secondary analysis of population-level data collected by US governmental agencies. This methodological approach was selected, in part, due to the feasibility of obtaining state-level for each variable of interest. The data were available digitally online and free of cost. This methodological approach was also chosen based upon appropriateness of fit with the study aims. Utilizing demographically representative state-level data over 11 years allowed for examination of both a cross-sectional and longitudinal relationship between household food insecurity and WIC participation while controlling for sociodemographic characteristics.

### **Sources of data: Strengths and Limitations**

The chief data source regarding food insecurity and WIC participation for this study was the Current Population Survey (CPS), a joint effort between the United States Department of Labor's Bureau of Labor Statistics and the United State Department of Commerce Census Bureau (U.S. Department of Commerce [USDC], U.S. Census Bureau

[USCB], 2012). “The CPS is one of the oldest, largest, and most well recognized surveys...providing information on many of the things that define us as individuals and as a society [including] our work and education” (U.S. Department of Labor [USDL], U.S. Department of Commerce [USDC], U.S. Census Bureau [USCB], 2006). The CPS is the primary source of labor force statistics on employment, earnings and demographics, and is used to improve understanding of labor market conditions (USDC, USCB, 2012). The CPS originated as the Enumerative Check Census of 1937, the first attempt to estimate unemployment nationwide in response to the Great Depression of the 1930s (USDL, USDC, USCB, 2006). While aspects of the CPS have changed over time, including modification to survey questions to enhance participant understanding, introduction of computer-assisted data collection methods and inclusion of various supplemental surveys, the basic approach to collecting labor force data has remained the same (USDL, USDC, USCB, 2006).

The CPS is a multistage stratified representative sample of approximately 72,000 US households that is obtained and continually updated from the most current Census records (USDL, USDC, USCB, 2006). It provides monthly data about labor force activity and participant demographics including age, sex, race, and Hispanic origin. The CPS is a scripted phone-interview between a trained interviewer and one adult representative of each household. The CPS includes three distinct sections whose topics include household and demographic information, labor force information, and supplemental information. The first two sections remain the same during each interview whereas the supplemental surveys change from month to month and cover a variety of topics (USDL, USDC, USCB, 2006).



The CPS' broad population-level coverage creates the opportunity for various federal sponsors to use this as a vehicle to collect supplemental information on diverse health indicators. All CPS data in this study come from supplement surveys. The two supplemental surveys that were used in this investigation are the Annual Social and Economic (ASEC) Supplement, also known as the Annual Demographic Supplement, and the Food Security Survey, sponsored by the Food and Nutrition Service of the US Department of Agriculture (USDL, USDC, USCB, 2006). The Annual Social and Economic Supplement provided the raw data that was combined with WIC administrative files to yield state-level WIC program participation data as well as state-level sociodemographic covariates (U.S. Census Bureau, 2012). The Food Security Survey provided this study's household food security data (USDA, ERS, 2012).

Among the CPS' many strengths, considerable and continual efforts are made to maintain the quality of the questionnaire. Every change to the CPS is approached with caution as to minimize disruption to the reliability of the longitudinal data of each variable that had been collected over previous years (USDL, USDC, USCB, 2006). In addition, CPS researchers continue to make efforts to maintain longitudinally representative data by adjusting sample size and characteristics in accordance to the most recent US Census, weighting sample elements, adjusting for nonresponse, and using poststratification techniques as needed (USDL, USDC, USCB, 2006).

Limitations of the CPS are discussed in detail within the methodology reports of the Survey (USDL, USDC, USCB, 2006). One limitation of the data for this study is the presence of nonsampling error in the data. Nonsampling error is defined as the difference between an estimated value calculated from the survey sample and the true value in the

general population. Nonsampling error can enter the survey process at any point or stage in the process, making its presence difficult to find. The CPS is also susceptible to error imported from other sources of information. US Census data omissions and errors impact CPS data as they are used to establish the study sample of representative households throughout the US (USDL, USDC, USCB, 2006). CPS staff regularly examine the potential for errors and put preventive measures into place to protect the survey process and minimize limitations.

### **Description of Measures of Key Variables**

Household food security data are collected annually in the CPS Food Security Supplement (FSS). The CPS FSS is the US Department of Agriculture's method of monitoring the extent and severity of food insecurity among the US population (USDA, ERS, 2012). Food insecurity is broadly defined by the United States Department of Agriculture as "limited or uncertain availability of nutritionally adequate and safe foods... or uncertain ability to acquire acceptable food in a socially acceptable way;" that is to say, without resorting to emergency food supplies, scavenging, stealing or use of other coping mechanisms (Eisenmann, Gundersen, & Stewart, 2011, & Stevens, 2010).

For the purposes of this study, definitions are consistent with the CPS FSS. The CPS supplemental survey conceptually defines household food insecurity as lack of "access by all people at all times to enough food for an active, healthy life" (USDA, ERS, 2012). The operational definition of household food insecurity is affirmative responses to FSS questions about conditions and behaviors that characterize households when they are having difficulty meeting basic food needs (USDA, ERS, 2012). In these analyses, a composite percentage of food insecure households with children over all households with

children, in each state for each fiscal year, represented state-level household food insecurity rate values.

Each FSS survey question asks whether the condition or behavior occurred at any time during the previous 12 months and specifies a lack of money or other resources to obtain food as the reason. The series includes 18 questions in total: 3 about food conditions of the household as a whole, 7 about food conditions of adults in the household, and 8 additional questions for households with children which ask specifically about their food conditions. Examples of questions include, “‘We worried whether our food would run out before we got money to buy more.’ Was that often, sometimes, or never true for you in the last 12 months?” and ‘In the last 12 months, were the children ever hungry but you just couldn’t afford more food?’ (USDA, ERS, 2012). All questions are dichotomous with a yes or no response.

Households are classified as food secure if they report 0-2 food-insecure conditions on the CPS. They are classified as food insecure if they report three or more food-insecure conditions. Food-insecure households are further classified as having either low food security or very low food security. Households are deemed as having low food security if they reported multiple indications of food access problems but few, if any, indication of reduced food intake. Households are deemed to have very low food security if they report multiple indications of reduced food intake and disrupted eating patterns due to inadequate resources, such as insufficient funds for food. In most households of very low food security, the survey respondents report that he/she was hungry at some point during the year but did not eat because there was not enough money for food (USDA, ERS, 2012).

For the purposes of this study households with children were of interest. The CPS food insecurity variable specifically for households with children was utilized in this study. Households with children are quantified as having low food security if they report eight or more food insecure conditions, among both adults and children in the household, questions 1-18. These households are further classified as having very low food security among children if they report five or more food-insecure conditions specifically among the children in the household, questions 11-18. (USDA, ERS, 2012)

Food security, as measured by the CPS, is a self-reported measure based on respondents' perceptions of whether the household was able to obtain enough food to meet their needs over the past 12 months (USDA, ERS, 2012). To enhance the validity and reliability of this survey's data, screening procedures, supplement questions and timing of the supplement have been kept very similar over the past decade. Screening procedures were put into place in the mid 1990s to reduce respondent burden and after a few years of refinement, have remained essentially unchanged since 1998. (USDA, ERS, 2012).

Originally, the CPS FSS was measured at different times in the calendar year, April in odd-number years, and August or September in even-numbered years. (USDA, ERS, 2012). The measured prevalence of food insecurity was higher in the samples collected in August and September suggesting a seasonal effect on response rates (USDA, ERS, 2012). To address this issue, the CPS FSS has been conducted in December every year beginning in 2001, with a smaller FSS was also conducted in April of 2001 to assess seasonal effects to make the necessary adjustments in analyses over time.

This measure of household food security does not specifically address whether the household members' food intake was sufficient for active, healthy lives. Nonetheless, research based on other surveys have found food security, as measured in the CPS, to be associated with health, nutrition, and children's development in a manner that generally supports the conceptualized link with sufficiency for active, healthy lives (USDA, ERS, 2012).

The data source for this study's WIC participation rate variable originated from the CPS ASEC Supplement. This survey is completed annually each March in tangent with the general CPS survey. It provides data on respondent and household level work experience, income, benefits, and welfare program participation. The ASEC also allows for evaluation of the demographic status of the US population by collecting data on household members' age, sex, race, marital status, educational attainment and family structure (U.S. Census Bureau, 2012).

Leading up to 2003, numerous models and data sets, including state-level administrative data, and individual-level data, from the CPS ASEC survey and other sources, were evaluated in pursuit of finding the data source and methodology that would best estimate the US population eligible for WIC services and participation among this population. (Bitler, Currie, Scholz, 2003 & U.S. Department of Agriculture [USDA], Food and Nutrition Service [FNS], National Research Council [NRC], 2003). In examining multiple databases for the best fit, the goal was to find a database that was collected consistently on an annual basis and included characteristics necessary to calculate eligibility, namely a categorically eligible person must have income less than or equal to 185 percent of federal poverty guidelines, or be enrolled in a program, for

example Medicaid, which confers adjunctive eligibility (Bitler et al., 2003, & USDA, FNS, NRC, 2003). As proper estimation requires nationally representative data, the result of these studies was published by in a Committee on National Statistics of the National Research Council (CNSTAT) CNSTAT report ultimately recommending using CPS-ASEC data, in tandem with WIC administrative data, to compile national estimates of WIC eligibility and participation (USDA, FNS, NRC, 2003). After determining that the CPS-ASEC was the most appropriate source of WIC eligibility and participation data, lead investigators from the CNSTAT report went on to describe annual state-level WIC participation rates for years 2000-2010, which as a key variable in this study (U.S. Department of Agriculture [USDA], Food and Nutrition Service [FNS], Office of Research and Analysis [ORA], 2011).

In keeping with USDA definitions, for the purposes of this study, state-level WIC participation rates were conceptually defined as “the ratio of WIC participants to the estimated number of eligible persons” (USDA, FNS, NRC, 2003). WIC participation rates are intended to measure performance of each state’s WIC program’s ability to meet the needs of low-income maternal-child population in their represented area. State-level WIC participation was operationally defined as the ratio of “WIC participants per state for each fiscal year” as recorded WIC administrative data per fiscal year divided by the state-level WIC eligible population as calculated using CPS-ASEC demographic, income and adjunctive eligibility indicators (USDA, FNS, ORA, 2011). It is expressed as a value out of 100%. In its most basic form Betson et al.’s state-level WIC participation rate (WICPR), calculated from the participant population (P) divided by the eligible population (E) for a given fiscal year, is written as:

$$\text{WICPR}_{\text{year}} = P_{\text{year}}/E_{\text{year}}$$

Many variables, from both the CPS and the US Census' American Community Survey (ACS) were used to weight the ASEC values to give most accurate WIC eligibility values. These variables and their weights are detailed in Chapter 9 of the CNSTAT report, Estimating Eligibility and Participation for the WIC Program, and tables detailing each variable and its adjustments can be found in Appendices 1 through 3(USDA, FNS, NRC, 2003). State-level WIC participation rate variables for 2000-2010, as calculated by Betson and his colleagues, were obtained from the publicly available reports published on the USDA FNS website.

The CPS Annual Social and Economic Supplemental (ASEC) survey also assesses household demographic characteristics, including “household composition, marital status, education attainment, health insurance coverage, Foreign-Born population, previous year’s income from all sources, work experience, poverty, program participation and geographic mobility” on an annual basis (USDL, USDC, USCB, 2006). This survey is used by the US Census Bureau to create annual intercensal estimates of sociodemographic characteristics of populations in between the full census surveys that are completed each decade. These intercensal estimates served as my source of sociodemographic covariate data. Covariates were selected based upon theoretical and empirical evidence of an association with WIC participation and/or household food insecurity as well as data availability and feasibility.

The prevalence of food insecurity varies considerably among households with specific demographic and economic characteristics. Among the many groups for whom rates of food insecurity are significantly higher than the national average are: households

headed by single parents, Black households, Hispanic households and urban households (USDA, ERS, 2012). These household level variables were considered for model fit during the processes of study design. Per the Estimating Eligibility and Participation for the WIC Program FNS CNSTAT report, there are also state-level variables, present in the ASEC database, that are correlated with the main variables of interest (2003). As seen in the 2011 Annual Report on Food Security, it is noted that the share of the state population that is Hispanic, Foreign-Born or Black has strong effects on WIC participation (USDA, ERS, 2012). Bitler and colleagues, who first examined the strength of the relationship between demographic data and WIC participation also noted a significant relationship with state-level unemployment rates, median household income, health insurance coverage rates, and percentage of births to unmarried mothers (USDA, FNS, NRC, 2003). These variables were added to my study model as well. In total, these numerous covariates, based upon both previous research and evidence to date, will help to elucidate the relationship between WIC coverage and household food insecurity across states.

### **Data Analysis Approach**

Data management, preparation and analysis were completed using Microsoft Excel and Stata software. The USDA ERS recommended managing data using Stata software, as it is most compatible with the CPS and US Census data. Stata allows for use of pre-determined weighted values to ensure that the Current Population Survey data for both the ASEC and FSS are reliable for each individual fiscal year. Dr. Jerry Herting, staff at the University of Washington School of Nursing's Office of Nursing Research, provided data analysis consultation.



First, descriptive statistics were conducted to assess data quality and variation, investigate variable anomalies including outliers and potential data errors, and to examine the overall nature of the key study variables. Data distributions, including each variable's central tendencies, dispersion, and measures of spread were evaluated.

The primary specific aim was to examine the presence of a cross-sectional relationship between state-level household food insecurity and WIC participation rates, with consideration for how state population-level sociodemographic characteristics might impact this association. As detailed in Chapter 2, a pooled time-series regression model was utilized to examine the relationships among these variables.

The second aim of this study was to examine the presence of a longitudinal relationship between state-level household food insecurity and WIC participation rates over time, from 2000-2010, and how fluctuations in the economic climate may have impacted this relationship of interest, discussed in Chapter 3. To best capture the nature of the longitudinal relationship between household food insecurity and WIC participation rates, dummy variables were created representing each of the five distinct non-recessionary and recessionary economic periods from 2000 to 2010. Marginal effects equations were utilized to examine the varying longitudinal relationship between household food insecurity and WIC participation dependent upon specific state sociodemographic characteristics.

Given the de-identified, publicly available, and aggregate nature of the study data, this study received exemption status from the University of Washington School of Nursing and University of Washington Institutional Review Board. Data storage and analysis were made possible by Center for Studies in Demography and Ecology

Computing, the Center for Social Science Computation and Research, and the University of Washington Student Technology fee.

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## CHAPTER TWO: THE ASSOCIATION BETWEEN HOUSEHOLD FOOD INSECURITY AND WIC PARTICIPATION: UNCOVERING STATE-LEVEL SOCIODEMOGRAPHIC PATTERNS

### **Abstract**

While individual-level studies provide evidence that participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) may reduce rates of food insecurity among participating families, the nexus between WIC participation and food insecurity at the population level, and how certain population characteristics mediate this nexus, remains poorly understood. This study examined state-level associations between household food insecurity and WIC participation rates in the U.S. and factored in the influence of sociodemographic characteristics on this relationship. This study was a secondary analysis of annual state-level data from 2000 through 2010 (N = 561) originating from the Current Population Survey, USDA Economic Research Service reports, and the US Census Bureau. Generalized estimating equations were used to explore the relationships among study variables while controlling for other factors. Study findings indicate a significant interaction between high proportions of Hispanic and Foreign-Born immigrants and food insecurity rates, with increases in food insecurity rates being associated with increases in WIC participation rates—suggestive of a system response to the demands of increasing food insecurity. Family composition, represented by rates of teenage and/or unmarried pregnant women, was found to have an inverse relationship with WIC participation. Cross-sectionally, states with higher rates of teenage and unmarried pregnancies had significantly lower

WIC participation rates. Findings illustrate a relationship between state sociodemographic characteristics and corresponding WIC participation and household food insecurity rates. The unique characteristics of state populations should be taken into account in tailoring WIC programming and outreach efforts.

### **Introduction**

The federal Special Supplemental Nutrition Program for Women, Infants and Children (WIC) has widespread reach among low-income families, annually serving over 8.6 million people throughout the United States. This reach includes 2 million pregnant, postpartum, and breastfeeding women; 4.6 million children; and 2 million infants or 53% of all infants born in the US (US Department of Agriculture [USDA], Food and Nutrition Service [FNS], 2014). The ostensible benefits of the program are amply documented: WIC provides access to nutritious foods, nutrition education, and referrals to health services to low-income women, infants and children up to age 5 who are at nutrition risk. WIC participation is associated with improving the health of at-risk maternal-child populations at the individual level by improving infant birth weight, reducing risk of preterm labor and infant mortality, and improving participant dietary intake (USDA, FNS, 2014). At the population level, higher state WIC participation rates are associated with higher rates of early initiation to prenatal care, improved immunization rates, and savings in health care costs (USDA, FNS, 2014). Healthy People 2020 includes objectives to eliminate food insecurity among children and reduce overall food insecurity and hunger among domestic populations (US Department of Health and Human Services [USHHS], 2012).

WIC's mission is to decrease the nutritional risks experienced by participating families such as inadequate diets or excessive or inadequate weight gain in pregnancy and early childhood. Nutrition risks are exacerbated by hunger and/or the inability to have consistent, dependable access to enough food for healthy living—issues collectively referred to as food insecurity (Belsky, Moffitt, & Arsenault, 2010; USDA, Economic Research Service [ERS], 2012). Food insecurity disproportionately affects vulnerable maternal-child populations and is a growing concern as annual rates continue to rise with estimates indicating that one in five children in the US live in homes struggling with food insecurity (USDA, ERS, 2012). In pediatric populations, food insecurity impedes normal growth and development: It is associated with obesity, poor general health, and increased hospitalizations (Eisenmann, Gundersen, & Stewart, 2011); as well as negative impacts on children's lifelong social skills including self-control, attentiveness and task persistence (Howard, 2011). Among mothers and their newborns, food insecurity during pregnancy has been found to be associated with increased complications, chronic stress, depressive symptoms, low birth weight, increased risk of certain birth defects, and decreased maternal-infant interaction (Carmichael, Yang, Herring, Abrams, & Shaw, 2007; Hromi-Fiedler, Bermudez-Millan, Segura-Perez, & Perez-Escamilla, 2011; Lee, Gundersen, Cook, Laraia, & Johnson, 2012).

While research on WIC participation and proximal health indicators related to prenatal, infant, and child health has been considerable, research focused on measuring WIC's ability to address maternal-child population-level food insecurity remains limited. A review of the literature yielded three studies focusing on the relationship between food insecurity and WIC participation. A multisite cross-sectional survey study by Black

(2004) and colleagues examined the association between WIC participation, infant health, and household food insecurity among 5,923 WIC-eligible caregivers of infants  $\leq 12$  months of age in the Washington DC area from 1998 to 2001. They found that families that did not receive WIC assistance because of access problems—such as a waiting list, missed appointments, no time to pick up vouchers, relocation, or lack of identification or transportation—had higher rates of food insecurity (28%) compared to participating families (23%); although these results were not of significance after controlling for sociodemographic conditions (Black et al., 2004). Metallinos-Katsaras (2011) and colleagues conducted a longitudinal study of WIC participation duration and household food insecurity from 2001 to 2006 among 21,863 mothers and 57,377 children from the Massachusetts WIC program, using self-report data collected during WIC visits. They found that each additional WIC visit beyond the initial assessment reduced the odds of household food insecurity, indicating a potential dose-response relationship. The authors concluded that earlier and longer WIC participation might improve long-term household food insecurity status (Metallinos-Katsaras, Gorman, Wilde, & Kallio, 2011). Most recently, Mayer (2014) and colleagues studied food insecurity and food assistance participation, including WIC and the Supplemental Nutrition Assistance Program (SNAP), among the 11,599 respondents of the Southeastern Pennsylvania Household Health Survey for years 2008, 2010, and 2012. Compared to those not receiving food assistance, individuals receiving SNAP benefits were significantly more likely to report being food-insecure, while those receiving WIC or a combination of WIC and SNAP did not report a significant difference in food security status (Mayer, Hillier, Bachhuber, & Long, 2014). Overall, these studies suggest that WIC participation may have an impact

on food insecurity on a population level, but these studies have been rather inconclusive, focused on a small number of states, and in the case of the study by Mayer (2014) and colleagues, drawn from a single survey question.

Understanding the relationship between food insecurity and WIC is a first step toward maximizing the ability of WIC to be part of the solution to food insecurity. Prior population-level studies of the relationships between WIC and food insecurity focused on specific states (Massachusetts and Pennsylvania) and Washington DC and did not examine the role that variability in the sociodemographic characteristics of a population may play in moderating the relationship between food insecurity and WIC. Food insecurity among the eligible WIC population, in fact, varies by household demographic characteristics. Higher rates of food insecurity are found in households with children, in homes with incomes below 185 percent of the poverty line, and among Black, Hispanic, and Foreign-Born immigrant populations (Chilton & Black, 2009; USDA, ERS, 2012; USDA, FNS, 2014). There are also a number of factors that affect WIC participation, including personal characteristics such as race, external factors such as the economy, differences in WIC program characteristics from state to state, and participation in other assistance programs (Bitler, Currie, & Scholz, 2003; USDA, FNS, NRC, 2003).

Considering the first factor, personal characteristics, it is evident that WIC program utilization varies among differing populations. Hispanic mothers, for example, have been found to have a higher predicted probability of participation in WIC than non-Hispanic mothers (Bitler et al., 2003; Castner et al., 2009; Fortuny, 2010; Swann, 2003; Tiehen & Jacknowitz, 2008). And the greatest national growth in WIC participation rates from the mid-1990s to 2006 was seen in immigrant mothers and their children (Fortuny, 2010;

Vericker, Fortuny, Finegold & Ozdemir, 2010). While there have been reports of a relationship between various sociodemographic variables and either food insecurity or WIC participation, no known study has examined the relationship between food insecurity and WIC at the aggregate level, or how sociodemographic characteristics may modify this primary relationship (USDA, ERS, 2012).

The aim of this study was two-fold: first, to ascertain if there is a cross-sectional, state-level relationship between household food insecurity and WIC participation rates; and second, if such a relationship can be detected, to determine how state sociodemographic characteristics might be shown to moderate this relationship.

### **Methods**

I used a pooled time-series regression model to examine the associations between household food insecurity rates, WIC participation rates, and sociodemographic characteristics by compiling a linked dataset of state-level data for years 2000 through 2010. Given the de-identified and aggregate nature of the data, this study received an exemption from the University of Washington's Institutional Review Board.

Study data originated from the Current Population Survey (CPS) and the US Census. The CPS is the nation's primary source of labor force statistics on employment, earnings, and demographics (U.S. Department of Commerce [USDC], U.S. Census Bureau [USCB], 2012; USDL, USDC, USCB, 2006). This study utilized aggregate data originating from two of the CPS' supplement surveys—the Food Security Survey (CPS-FSS) for household food insecurity data and the Annual Social and Economic Supplement (CPS-ASEC) for self-reported WIC participation data (USDA, ERS, 2012; USDL, USDC, USCB, 2006). State sociodemographic characteristics were obtained from

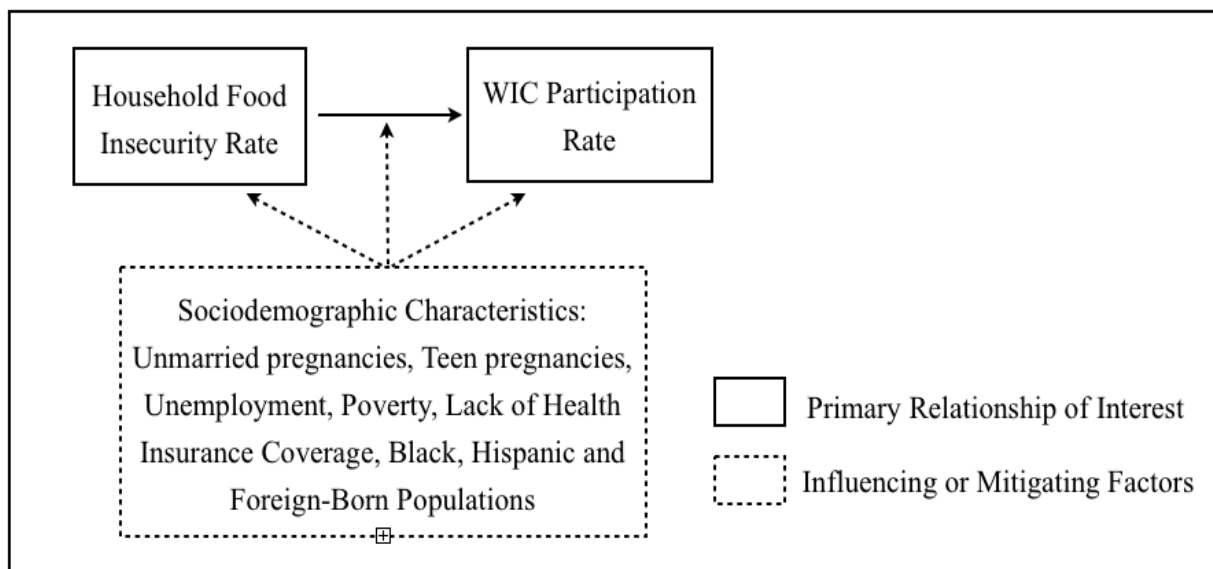
US Census databases. Annual data from 2000 through 2010 for household food insecurity, WIC participation, and sociodemographic characteristics were compiled for all fifty states and the District of Columbia from the above data sources, yielding 561 observations over 51 units and 11 years.

Household food insecurity, from the CPS Food Security Survey (CPS-FSS), is a self-report measure in which affirmative responses indicate homes experiencing conditions and/or behaviors related to having difficulty meeting basic food needs (USDA, ERS, 2012). In this analysis, the composite percentage of food-insecure households with children, over all households with children, in each state and for each fiscal year represented state-level household food insecurity rates.

WIC participation rates are expressed as a percentage and represent the number of self-reported WIC participants divided by the total WIC-eligible population in each state (USDA, FNS, ORA, 2011). This study utilized WIC participation rates calculated by the USDA using methodology first described by Betson and colleagues (USDA, FNS, ORA, 2011; USDA, FNS, NRC, 2003).

Based on empirical evidence of a relationship with WIC participation or food insecurity, availability of state-level data, and overall model fit, I included sociodemographic variables in my study model. Covariates presented in this model served to contextualize the sociodemographic make-up of each state. Figure 1 depicts the hypothesized relationship between household food insecurity and WIC participation rates, and illustrates how sociodemographic covariates could influence the nature of this relationship indicated by the data.

**Figure 1** General Conceptual Model for Hypothesized Relationships among Study Variables



## Analysis

For all statistical analyses, I used STATA (13.0, College Station, TX, USA). I conducted descriptive statistics to assess data quality including checks for data completeness as well as identification and exploration of outliers and skewed variables. State-level data for household food insecurity and WIC participation rates were complete for all observations. Imputation by regression with random error techniques was used to create values for missing data for two of the sociodemographic variables—rate of no health insurance coverage and percentage of Foreign-Born residents. In all study analyses, I used approaches to control for the pooled-time series nature of the data, including employing a quadratic form of time (year and year squared) and creation of time-period dummy variables.

My covariate selection procedure included a series of regression models analyzing the simple relationship between WIC participation rates and each variable of interest, net of time, with  $p < 0.05$  as the inclusion criteria. I then examined sociodemographic



characteristics in groups to assess for data similarities using pairwise correlation and factor analysis techniques. To optimize study design, I grouped together sociodemographic variables that were found to be strongly correlated with one another, in order to create composite indices. My Family Composition Index represented statewide rates of pregnancy to unmarried women and of teenage pregnancy. My Economics Index represented a composite of state unemployment, poverty, and rate of no health insurance coverage. Lastly, my Hispanic and Foreign-Born Index represented a composite of the percentages of Hispanic and Foreign-Born populations in each state. In my statistical examinations, percentage of Black Residents functioned differently from the other sociodemographic variables and as such was left as an individual variable.

## **Results**

Mean WIC participation rates varied widely across states and years, ranging from 40.0%–81.0%, and household food insecurity ranged from 6.2%–9.4%. State variation was also apparent among sociodemographic characteristics, including wide ranges for teen pregnancy rates and for percentages of Black, Hispanic, and Foreign-Born populations. State-level sociodemographic values were used to calculate composite mean z-score values for each of the model's indices, the Family Composition Index, Economics Index, and Hispanic and Foreign-Born Index. Table 1 presents the mean characteristics of the study sample over all 561 state-year observations as well as the minimum and maximum values in the study dataset.

**Table 1** Characteristics of the Data in Study Sample, Aggregated over years 2000-2010

<b>State Characteristics</b>	<b>All US States + D.C. (N = 561) Mean <math>\pm</math> SD</b>	<b>Min</b>	<b>Max</b>
WIC Coverage Rate (%)	57 $\pm$ 7	40.0	81.0
Household Food Insecurity Rate (%)	11.7 $\pm$ 2.7	6.2	19.4
<i>Family Composition Index</i>			
Unmarried Pregnancy Rate (per 1,000 women)	36.7 $\pm$ 7.2	17.2	60.3
Teen Pregnancy Rate (per 1,000 women under 20)	41.1 $\pm$ 12.6	15.7	80.7
<i>Economics Index</i>			
Unemployment Rate (%)	5.5 $\pm$ 2	2.3	13.8
Poverty Rate (%)	12.6 $\pm$ 3.3	5.5	22.4
No Health Insurance Coverage Rate (%)	13.8 $\pm$ 3.8	4.3	25.5
Black (% of total population)	11.3 $\pm$ 11.4	0.31	61.0
<i>Hispanic and Foreign-Born Index</i>			
Hispanic-Origin (% of total population)	9.3 $\pm$ 9.4	0.8	46.3
Foreign-Born (% of total population)	8 $\pm$ 5.9	0.7	27.4

WIC Coverage Rate = WIC participants/WIC eligible population

Household Food Insecurity Rate = food insecure households with children/all households with children

**Figure 2** Hispanic and Foreign-Born Index: Mean Pooled Z-Score by State

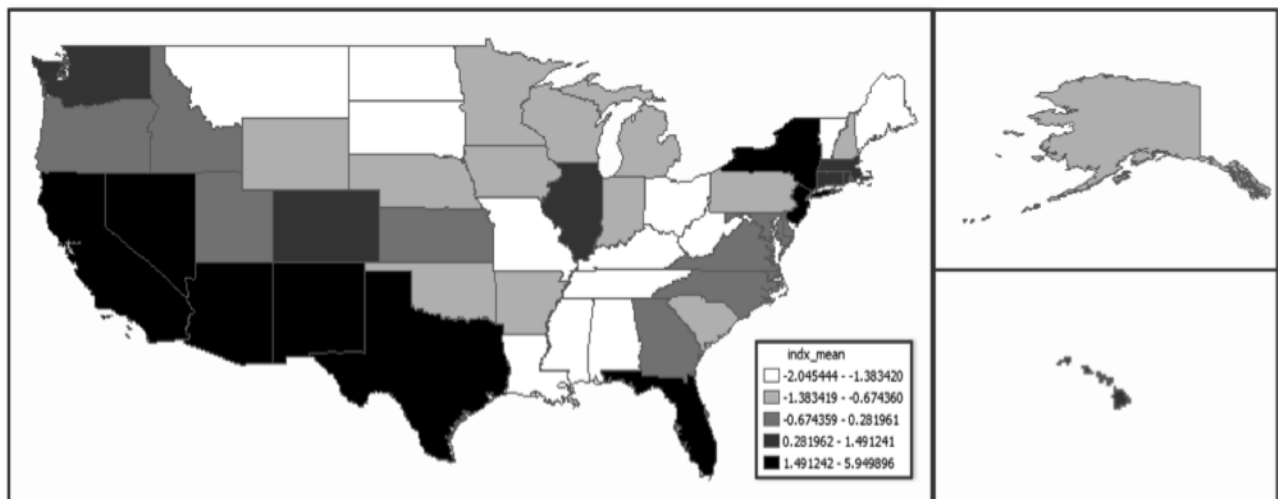


Figure 2 illustrates the variability in distribution of study data by mapping the mean pooled z-score of the Hispanic and Foreign-Born Index of each state over the 11-year study period. In this figure, negative z-score values signify states with overall low numbers of Hispanics and Foreign-Born immigrants. States with z-scores around zero represent the overall mean Hispanic and Foreign-Born percentages in the 51 states. Positive z-scores indicate states that have high proportions of Hispanic and Foreign-Born residents for years 2000 through 2010. Figure 2 presents these z-scores in shades of grey, with lighter shades indicating lower state proportions of Hispanic and Foreign-Born immigrant populations and deeper shades representing higher state proportions of Hispanics and Foreign-Born immigrant populations.

My hypothesized relationship between household food insecurity and WIC participation rates was not found to be significant (coeff. .0021;  $p = 0.209$ ) (Table 2). The Family Composition Index, however, indicated a significant inverse relationship between WIC participation and the composite of rates of unmarried and teenage pregnancies (coeff. -.01;  $p = 0.015$ ). States with higher rates of unmarried and/or teenage mothers each year had lower WIC participation rates. The Economics Index did not have a significant relationship with WIC participation (coeff. -.0015;  $p = 0.443$ ). Similarly, there were not significant associations found between WIC participation rates and the percentage of Black residents (coeff. .0009;  $p = 0.143$ ) or the Hispanic and Foreign-Born Index (coeff. -.0209;  $p = 0.09$ ).

**Table 2** Regression Results: Factors Associated with WIC Participation Rates

WIC Participation Rate	Coefficient	Robust SE	Z	P>z	95% CI	
Household Food Insecurity	.0021	.0017	1.26	0.209	-.0012	.0054
Family Composition Index	-.01	.0041	-2.44	0.015*	-.0182	-.0019
Economics Index	-.0015	.002	-0.77	0.443	-.0054	.0023
% Black	.0009	.0007	1.46	0.143	-.0003	.0023
Hispanic/Foreign-Born Index	-.0209	.0124	-1.70	0.09	-.0452	.0033
Household Food Insecurity * Hispanic/Foreign-Born Index Interaction Term	.002	.0007	2.94	0.003*	.0007	.0034

In testing for potential interaction effects, the interaction term between household food insecurity and the Hispanic and Foreign-Born Index was significant (coeff. .002;  $p = 0.003$ ) (Table 2). This interaction term modified the relationship between household food insecurity and WIC participation rates. The effect of this interaction term was of statistical significance in states with large proportions of Hispanics and Foreign-Born resident populations. The effect of the Hispanic and Foreign-Born Index was quantified as *Hispanic and Foreign-Born Index* =  $-.0209 + .0021 * \text{household food insecurity rate}$ . Because the state z-score values of the Hispanic and Foreign-Born Index were centered around zero, the nature of this interaction term changed from a positive value in states with high proportions of these populations to a negative value in states with low proportions of these populations. In states with high proportions of Hispanic and Foreign-Born populations, there was a significant and positive association between household food insecurity and WIC participation rates. In these states, increases in household food insecurity rates were associated with increases in WIC participation rates. In states with low proportions of these populations, the interaction term became negative and the relationship between household food insecurity and WIC participation weakened. In

these states increased household food insecurity rates were not associated with changes in corresponding WIC participation rates.

### **Discussion**

A significant interaction term between household food insecurity and the Hispanic and Foreign-Born Index on WIC participation indicates that there was a significant conditional relationship between the ethnic composition of a state's population, food insecurity, and WIC participation during study years 2000 through 2010. These findings are supported by reports indicating that food insecurity rates are higher among Hispanic and Foreign-Born populations and that these populations are also more likely to participate in WIC (Chilton & Black, 2009; Fortuny, 2010; USDA, ERS, 2012; Vericker, Fortuny, Finegold & Ozdemir, 2010). The significance of the relationship between the experience of food insecurity and enrolling in WIC in these Hispanic and Foreign-Born populations may be a function of WIC playing a particularly critical role for these young families, as WIC is available to low-income immigrant populations ineligible for many other resources due to their recent immigration or undocumented status (Fomby & Cherlin, 2004; Fortuny, 2010). These populations may also be more willing to apply for and receive WIC benefits given the program's "absence of immigration-related barriers," accessibility, and simple application—all of which may reduce "reluctance and/or fear of interacting with government agencies" (Fortuny, 2010). For these populations, the limited availability of other resources may mean they perceive the benefits of WIC participation more favorably than do other demographic groups, thus encouraging their uptake of WIC services during periods of food insecurity.

Beyond WIC's apparent accessibility for Hispanic and Foreign-Born populations, there may also be a culture of the acceptability of WIC program participation in these communities. High WIC participation among immigrants is supported by networks operating within ethnic communities that transmit information about the availability of particular types of benefits upon their arrival in the US (Borjas & Hilton, 2001). Public aid, including WIC, among Mexican-immigrant communities is used as a source of transitional financial support between jobs (Van Hook & Bean, 2009). In these situations, assistance may "foster economic integration rather than promote dependency" upon the public aid system (Bean, Stevens, & Van Hook, 2003; Van Hook & Bean, 2009).

Also, the significant levels of food insecurity and growing visibility of these populations may be encouraging tailored outreach by local WIC providers. Studies have documented the effectiveness of having lay health care workers from minority groups provide culturally appropriate health education to members of their own community and have indicated that culture-specific programs are effective in increasing health-related knowledge, attitudes, and planned behavior (Ikeda, Pham, Nguyen, & Mitchell, 2002). The provision of WIC services in Spanish and high outreach efforts in immigrant communities might be contributing to higher WIC participation among these families (Castner, Mabli, & Sykes, 2009; Fortuny, 2010).

While the primary relationship being explored in this study—the cross-sectional association between state-level household food insecurity rates and WIC participation rates—was not statistically significant, two significant findings did emerge: (1) the aforementioned interaction relationship between household food insecurity, the Hispanic

and Foreign-Born Index, and WIC participation; and (2) an inverse relationship between teenage and unmarried pregnancies and WIC participation. This inverse relationship between the family composition index and WIC participation, present when controlling for the other sociodemographic characteristics in the study model, indicates that WIC participation rates are lower in states with higher rates of pregnancies among unmarried women and teenagers. This finding may be related to late entry to prenatal care, as 22% of births to teens under age 15, and 10% of births to teens age 15-19, receive late or no prenatal care (Child Trends, 2014).

Overall, the findings suggest that many factors influence both risk of food insecurity and participation in food assistance programs, and for specific subgroups of maternal-child populations, the relationship between food insecurity and WIC participation is not simple.

### **Implications**

Tailoring approaches to WIC outreach and retention based upon local population characteristics may help to improve WIC participation among young families experiencing food insecurity. Systematic collection of self-report food insecurity data during participants' visits to WIC clinics may also help to better clarify these relationships. Regarding future research, follow-up studies should examine the relationship between food insecurity and WIC participation within states and among states that share similarities in sociodemographic composition. The significant relationship among Hispanic and Foreign-Born populations, household food insecurity, and WIC participation indicated by my study data in turn suggests the probability of an

equally distinct, albeit more complex, relationship for other demographic populations as well.

### **Limitations**

The primary relationship being explored in this study—the cross-sectional association between state-level household food insecurity rates and WIC participation rates—did not yield significant results. These findings may have been due to the wide range of variability in study data among the 50 states. If the study had focused on states in a specific region of the country that share similar household food insecurity and WIC participation patterns, a significant relationship may have emerged. My findings may also have been influenced by certain changes in the economic environment in the US over the study time period. Furthermore, the insignificant findings may be related to an inability, given the lack of data availability, to measure food insecurity rates specifically in WIC-participating families. Limitations in available data also precluded me from examining within-state variation in this national study, a factor that may have muted the results regarding the overall relationship between food insecurity and WIC participation.

Other limitations involved characteristics of the study data as well as some measurement problems. An example of the former included the self-report nature of household food insecurity study data in the CPS-FSS and the CPS' overall use of limited pools of participants in each state to statistically calculate population-level representative data. Regarding the latter, my ability to capture the true nature of the relationship among study variables was complicated by measurement problems, as participation in WIC and other food assistance programs is widely under-reported in large scale self-report surveys (Bohn, Danielson, Levin, & McConville, 2013; Kreider, Pepper, & Roy, 2014; Parker,



2011). Using the CPS-FSS, household food insecurity is only assessed on an annual basis and may be imprecise at capturing true food insecurity levels, as it is known to have seasonal and transient qualities (USDA, ERS, 2012). Since I selected sociodemographic characteristics for the study based upon data feasibility, my ability to control for all unobserved confounders was limited. State politics, culture, attitudes toward public health programming, and other unobserved place-specific variables may have influenced observed and unobserved associations among study variables.

### **Conclusion**

The relationships among household food insecurity and WIC participation remain highly complex. What can be ascertained from these preliminary findings suggests that the relationship between household food insecurity and WIC participation differs significantly based upon specific state-level demographics. This study serves to highlight the relationship between household food insecurity and WIC participation among specific population groups, raising new research questions about this topic and presenting opportunities for improving the impact of WIC program implementation to best meet the needs of the increasingly diverse at-risk maternal-child populations.

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# CHAPTER THREE: EXAMINING THE IMPACT OF THE GREAT RECESSION AND US POPULATION DEMOGRAPHICS ON THE LONGITUDINAL RELATIONSHIP BETWEEN FOOD INSECURITY AND WIC PARTICIPATION

## **Abstract**

I examined the association between rates of household food insecurity and WIC participation longitudinally from 2000 to 2010, throughout distinct economic time periods of the 2000s. This study utilized aggregated state-level data from the Current Population Survey, US Department of Agriculture, and US Census Bureau. Dummy variables were created representing each of the distinct economic time periods during the decade to best examine the relationship between household food insecurity and WIC participation over time. Using logistic regression and marginal effects analyses, household food insecurity and WIC participation demonstrated a positive baseline relationship during years 2000, 2001, and 2010. This baseline relationship was disrupted during the time period 2002-2006 and most significantly 2007-2009. The longitudinal relationship between household food insecurity and WIC participation was also significantly impacted by state-level proportions of Hispanic and Foreign-Born residents, a finding consistent with the first paper in this series, with differences in associative trends throughout varying economic time periods. Economic climate and state demographics were found to significantly impact the relationship between household food insecurity rates and coinciding WIC participation rates over time. WIC providers

and policy makers should use knowledge of the economic climate and state population characteristics to predict need and to best serve domestic food insecure populations.

### **Introduction**

The term food insecurity collectively refers to hunger and/or the inability to have consistent, dependable access to enough food for active, healthy living (Belsky, Moffitt, & Arseneault, 2010; USDA, ERS, 2012). Food insecurity has significant impacts on the health and wellbeing of domestic populations and disproportionately affects the health of impoverished young families. Food insecurity is of significant concern among maternal-child populations as it is associated with many negative health outcomes for childbearing women, during and following pregnancy, as well as for the biological and cognitive development of their children (Carmichael, Yang, Herring, Abrams, & Shaw, 2007; Eisenmann, Gundersen, & Stewart, 2011; Howard, 2011; Hromi-Fiedler, Bermudez-Millan, Segura-Perez, & Perez-Escamilla, 2011; Lee, Gundersen, Cook, Laraia, & Johnson, 2012). Food insecurity places mothers at increased risk for reduced micronutrient intake, obesity, higher gestational weight gain, gestational diabetes mellitus, difficulty returning to pregravid weight status, depression, and decreased overall mental health (Casey et al., 2004; Laraia, Siega-Riz, Gundersen, & Dole, 2006; Olson, 1999; Olson, Strawderman, Hinton, & Pearson, 2003; Rose & Oliveira, 1997; Townsend, Pearson, Love, Achterberg, & Murphy, 2001; Stuff et al., 2004). In pediatric populations, food insecurity is associated with increased rates of chronic health conditions, hospitalizations and iron deficiency anemia, as well as psychosocial issues including increased behavioral problems, anxiety and depression, poor cognitive development, and



poor academic achievement (Child Trends Databank, 2014; Cook et al., 2013; Nord, 2009; Zaslow et al., 2009).

Federal food and nutrition assistance programs help meet the needs of food insecure families. Sixty-two percent of all food insecure households, and an estimated four out of five low-income food-insecure households with children, participate in at least one federal nutrition assistance program each year (USDA ERS, 2012; Nord, 2009). Among the federal assistance programs available to these families is the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). WIC seeks to safeguard the health of low-income women, infants and children up to age five who are at risk for poor nutrition by providing young families with access to healthy foods, nutrition education and health and social service referrals. Participation in WIC has been associated with improved birth outcomes, improved diet, and savings in healthcare costs (USDA, FNS, 2014).

The Supplemental Nutrition Assistance Program (SNAP) has been consistently shown to reduce the likelihood of food insecurity among program participants by up to 30% (Mykerezi & Mills, 2010; Ratcliffe, 2011). The relationship between food insecurity and WIC participation has not been demonstrated to the same extent. The benefits of participation in food assistance programs such as SNAP and WIC are difficult to quantify given the impact of self-selection programs and confusion about eligibility and enrollment processes among the eligible populations (Nord & Golla, 2009; Kaiser, 2008). Nonetheless, research to date suggests that WIC participation may have a dose-response reduction in household food insecurity in participating families and among specific population subgroups, such as unmarried and teen mothers and Hispanic and Foreign-

Born resident groups. The nature of the relationship between household food insecurity and WIC participation, however, has yet to be studied longitudinally at the population-level (Black, Cutts, Frank, Geppert, & Herren, 2004; Metallinos-Katsaras, Gorman, Wilde, & Kallio, 2011; Mayer, Hillier, Bachhuber, & Long, 2014; Simonovich, Unpublished).

The USDA writes strategic plans every two years to direct their time, funding, and research. For the fiscal years 2000 through 2010, the USDA's strategic plans consistently stated that "a plentiful supply of safe and nutritious food is essential to the wellbeing of every family and the healthy development of every child in America." Among the USDA's many goals, Strategic Goal 4 focused on ensuring that all of America's children have access to safe, nutritious, and balanced meals—including a commitment to increasing access to, and utilization of, food assistance programs by those eligible to participate (2002). Furthermore, the USDA included performance measures with goals of reducing the rate of food insecurity among low-income households from 10.5% in 2000 to 7.4% by 2007 (USDA, 2002). The plan to achieve this goal included the increased participation in food assistance programs including WIC. Unfortunately, these goals were not met over the last decade as food insecurity rates rose 43% from 10.5% in 2000 to 14.5% in 2010 (USDA, 2002, & USDA, ERS, 2012). Over this same time period, WIC participation rates, defined as the proportion of those eligible for WIC who actually participate, also did not significantly improve, with rates of 57.8% in 2000 and 62.6% in 2010 respectively (USDA, FNS, ORA, 2011). Evidence is needed to understand the relationship between food insecurity and WIC participation and how

pertinent state sociodemographic characteristics might be in their impact on the USDA's ability to make meaningful progress toward its performance goals.

The USDA's ability to create meaningful change in the rates of household food insecurity and WIC participation may have been hampered by the economic climate changes that took place from 2000 to 2010. The National Bureau of Economic Research's (NBER) Business Cycle Dating Committee identified two recession periods as recorded throughout this time period (2010). The NBER defines a recession as the period between a peak and a trough during which a significant decline in economic activity spreads across the economy and lasts from a few months to more than a year (NBER, 2010). From 2000 to 2010, the US economic business cycle included two periods of recession, the first in 2001 and the second known as the "Great Recession" from December 2007 to June 2009. In addition, there were three periods of non-recession/growth during 2000, 2002-2006, and 2010 (NBER, 2010). Difficult economic times, such as the Great Recession, led to increased unemployment and poverty rates, increasing food insecurity rates, and placing increased burden on public assistance programs (Setari & Zimmerman, 2013). Examining the longitudinal nature of the relationship between food insecurity and WIC across these varied economic time periods could elucidate the baseline relationship during non-recession periods as well as the impact of economic recessions on this relationship.

The aim of this study was to explore longitudinal state-level associations between household food insecurity rates and WIC participation rates and how the national economic climate might have impacted such a relationship. This study was the first known population-level longitudinal analysis of the relationship between household food

insecurity and WIC participation rates. Findings provide preliminary population-level knowledge of the longitudinal association between household food insecurity and WIC participation.

## **Methods**

### **Study Design and Data Sources**

I examined the longitudinal association between household food insecurity and WIC participation with a pooled time-series regression model using a linked state-level dataset for years 2000 through 2010, first described in Chapter 2 (Simonovich, Unpublished). Publicly available data representing household food insecurity, WIC participation, and sociodemographic characteristics of the 50 US states and the District of Columbia from 2000 to 2010 were drawn from the Current Population Survey (CPS) and the US Census. The CPS is a population-based survey of 72,000 US households in which demographic characteristics and labor force information are collected. Additional data on pertinent issues, such as assistive program usage and household food security, are obtained through annual supplemental surveys such as the CPS Food Security Survey (CPS-FSS) and the CPS Annual Social and Economic Supplement (CPS-ASEC) (USDC USCB, 2012; USDL USDC USCB 2006). The study data are comprised of CPS and US Census data aggregated at the state-level for a total of 561 observations of the 50 US states as well as Washington, D.C., over a period of 11 years.

### **Measures**

#### *Household Food Insecurity*

Household food insecurity data from the CPS-FSS are collected annually each December and serve as the USDA's method of monitoring the extent and severity of food

insecurity in the U.S. population (USDA ERS, 2012). Household food insecurity is conceptually defined as “[the absence of] access by all people at all times to enough food for an active, healthy life” (USDA ERS, 2012). The CPS-FSS includes 18 questions regarding the conditions and behaviors that characterize households that are having difficulty meeting food needs (USDA ERS 2012). CPS-FSS survey items consist of statements and subsequent questions such as the following: *“We relied on only a few kinds of low-cost foods to feed our children because we were running out of money to buy food.” Was that often, sometimes, or never true for you in the last 12 months?*

Households are classified as food-insecure if they self-report three or more positive responses affirming food-insecure conditions (Bickel, Nord, Price, Hamilton, & Cook, 2000). CPS-FSS responses are analyzed both at the state and national level and reported yearly by the USDA Economic Research Service (ERS). The USDA ERS reports also include rates of household food insecurity classified by specific demographic and economic characteristics. For purposes of analysis, this study operationally defined household food insecurity in terms of the USDA ERS annual state-level rates of food insecurity among households with children.

#### *WIC Participation*

WIC participation rates are calculated using CPS-ASEC and WIC administrative data following methodological procedures recommended by the Committee on National Statistics of the National Research Council and are reported annually by the USDA (USDA, FNS, NRC, 2003). In this study, WIC participation was operationally defined as the estimated state-level ratios of WIC program participants to the eligible state

population for each year, 2000 through 2010, and is expressed as a value out of 100% (USDA, FNS, ORA, 2011).

### *State-level Sociodemographic Characteristics*

To control for possible spurious effects in the relationship between household food insecurity and WIC participation, state-level sociodemographic characteristics were included in this study's model. All of the sociodemographic variables originated from the U.S. Census Bureau's annual statistical abstracts that incorporate data from the Census Bureau, Bureau of Labor Statistics, Bureau of Economic Analysis, and many other Federal agencies and private organizations producing an "authoritative and comprehensive summary of statistics on the social, political and economic organization of the United States" (U.S. Census Bureau, 2014). Inclusion of sociodemographic variables in the study model was reliant upon an evidence-based relationship with key study variables as well as their fit within the study model. To account for state variability, control variables included the following: (1) a family composition index that represented state rates of unmarried and teenage pregnancies; (2) an economic index that represented state unemployment, poverty, and health insurance coverage rates; (3) state-level demographics including percentage of Black residents; and (4) a Hispanic and Foreign-Born Index that represented composite rates of these two populations. The model also included an interaction term between household food insecurity, the Hispanic and Foreign-Born Index, and WIC participation, previously found to be of significance during cross-sectional analyses (Simonovich, Unpublished).

## Analysis

Analyses were performed using Stata V.13 (College Station, TX, USA), with a  $P$  value of  $<0.05$  denoting statistical significance. As the aggregated data contained no identifying information for individuals, I received an exemption from the University of Washington's Institutional Review Board.

### *Creation of Recession and Non-Recession Dummy Variables*

As simple linear regression models proved insufficient in exploring a possible longitudinal relationship between household food insecurity and WIC participation, I created dummy variables representing each of the distinct economic time periods during the decade to examine the relationship of between household food insecurity and WIC participation by era. I used the NBER-identified three periods of non-recession and two periods of recession during the study time period from 2000-2010 (Table 1). Non-recession time periods and coinciding dummy variable names from 2000 to 2010 included 2000 (Non-Recession 1), 2002-2006 (Non-Recession 2), and 2010 (Non-Recession 3). Recession time periods and coinciding dummy variable names during this time period include 2001 (Recession 1) and 2007-2009 (Recession 2). Creation of these unique clusters of years allowed for an accounting of each time-period's unique economic climate while examining the possibility of a longitudinal association between household food insecurity and WIC participation.

**Table 1** Study Years by Non-Recession and Recession Designations

Time Period Title	Representing Year(s)
Non-Recession 1	2000
Recession 1	2001
Non-Recession 2	2002-2006
Recession 2	2007-2009
Non-Recession 3	2010

Beyond including the recession and non-recession period variables in this longitudinal analysis' main model, I included interaction terms between household food security and each time period to examine whether the association between household food insecurity and WIC participation changed during these time periods. In testing for the potential importance of these interaction terms I compared the additive model to the model with the interaction term and noted a significant improvement in fit over a simple additive model ( $\chi^2(4) = 16.03$  with a  $\text{prob} > \chi^2 = 0.003$ ).

## **Results**

My sample of state-level data over 11 years (Table 2) included an average WIC participation rate of 57% and an average household food insecurity rate of 11.7%. The aggregate state-level populations throughout the study time period were diverse in racial and ethnic group representation (11.3% Black, 9.3% Hispanic, and 8% Foreign-Born, on average), family composition (36.7 unmarried pregnancies per 1,000 women, 41.1 teen pregnancies per 1,000 women under 20), economic factors (5.5% unemployment rate, 12.6% poverty rate, 13.8% with no health insurance coverage, on average), and captured variability over time (Simonovich, Unpublished).

The regression analysis (Table 2) revealed a statistically significant difference in the relationship between time period and WIC participation during Recession 2, as well as a statistically significant interaction relationship between Recession 2 and household food insecurity. I also found a statistically significant interaction relationship between Hispanic and Foreign-Born populations and household food insecurity in this longitudinal analysis, first noted in the cross-sectional analyses presented in Chapter 2 (Simonovich,



Unpublished). Key findings in the regression model were complex given the nature of the specific interactions between recession/non-recession periods and the Hispanic/Foreign-Born Index with the household food insecurity measure. The singular simple effect in the model findings was with the family composition index, which suggests a weak negative relationship with WIC participation (coefficient = .008,  $p = .054$ ). The relationship of interest between food insecurity and WIC participation was best illustrated by examining its marginal effects.

**Table 1** Characteristics of the Data in Study Sample, Aggregated over years 2000-2010

<b>State Characteristics</b>	<b>All US States + D.C. (N = 561) Mean <math>\pm</math> SD</b>	<b>Min</b>	<b>Max</b>
WIC Participation Rate (%)	57 $\pm$ 7	40.0	81.0
Household Food Insecurity Rate (%)	11.7 $\pm$ 2.7	6.2	19.4
<i>Family Composition Index</i>			
Unmarried Pregnancy Rate (per 1,000 women)	36.7 $\pm$ 7.2	17.2	60.3
Teen Pregnancy Rate (per 1,000 women under 20)	41.1 $\pm$ 12.6	15.7	80.7
<i>Economics Index</i>			
Unemployment Rate (%)	5.5 $\pm$ 2	2.3	13.8
Poverty Rate (%)	12.6 $\pm$ 3.3	5.5	22.4
No Health Insurance Coverage Rate (%)	13.8 $\pm$ 3.8	4.3	25.5
Black (% of total population)	11.3 $\pm$ 11.4	0.31	61.0
<i>Hispanic and Foreign-Born Index</i>			
Hispanic-Origin (% of total population)	9.3 $\pm$ 9.4	0.8	46.3
Foreign-Born (% of total population)	8 $\pm$ 5.9	0.7	27.4

WIC Participation Rate = WIC participants/WIC eligible population

Household Food Insecurity Rate = food insecure households with children/all households with children

**Table 3** Relationship between Household Food Insecurity and WIC Participation over Recession and Non-Recession Time Periods from 2000-2010

WIC Participation	Coefficient	Robust SE	z	P >  z	95% CI	
Household Food Insecurity	0.0074	0.004	2.02	0.043	0.0002	0.015
Family Composition Index	-0.008	0.004	-1.92	0.054	-0.016	0.0002
Economics Index	-0.0025	0.002	-1.13	0.259	-0.007	0.002
Black Residents (%)	0.00082	0.0007	1.19	0.235	-0.001	0.002
Hispanic and Foreign-Born Index	-0.021	0.012	-1.7	0.09	-0.045	0.003
<i>Household Food Insecurity &amp; Hispanic and Foreign-Born Interaction Term</i>	0.0021	0.0007	2.97	<b>0.003*</b>	0.001	0.003
Nonrecession1 (2000-2001)	-0.0076	0.058	-0.13	0.895	-0.121	0.106
Recession1 (2002-2003)	-0.0027	0.055	-0.05	0.96	-0.111	0.105
Nonrecession2 (2004-2006)	0.0544	0.049	1.1	0.27	-0.042	0.151
Recession2 (2007-2009)	0.0728	0.027	2.67	<b>0.008*</b>	0.019	0.126
<i>Nonrecession1 and Food Insecurity Interaction Term</i>	-0.00046	0.005	-0.1	0.921	-0.01	0.009
<i>Recession1 and Food Insecurity Interaction Term</i>	-0.0023	0.004	-0.56	0.576	-0.01	0.006
<i>Nonrecession2 and Food Insecurity Interaction Term</i>	-0.0064	0.003	-1.87	0.062	-0.013	0.0003
<i>Recession2 and Food Insecurity Interaction Term</i>	-0.0051	0.002	-2.7	<b>0.007*</b>	-0.009	-0.001
_cons	0.484	0.049	9.84	0	0.387	0.579

The following equation demonstrates how this relationship varied by economic circumstance and by value of the Hispanic/Foreign-Born Index. The modeled interactions significantly improved the fit over the additive model indicated previously.

**Figure 1.** Marginal Effects Equation

$$\Delta \text{ WIC Participation} / \Delta \text{ Food Insecurity} = .0074 + -.00046(\text{Nonrecession1}) + -.0023(\text{Recession1}) \\ + -.0064(\text{Nonrecession2}) + -.0051(\text{Recession2}) \\ + .0021 (\text{Hispanic/Foreign-born Index})$$

The above marginal effects equation (Figure 1) measures the longitudinal relationship between household food insecurity and WIC participation, detecting change

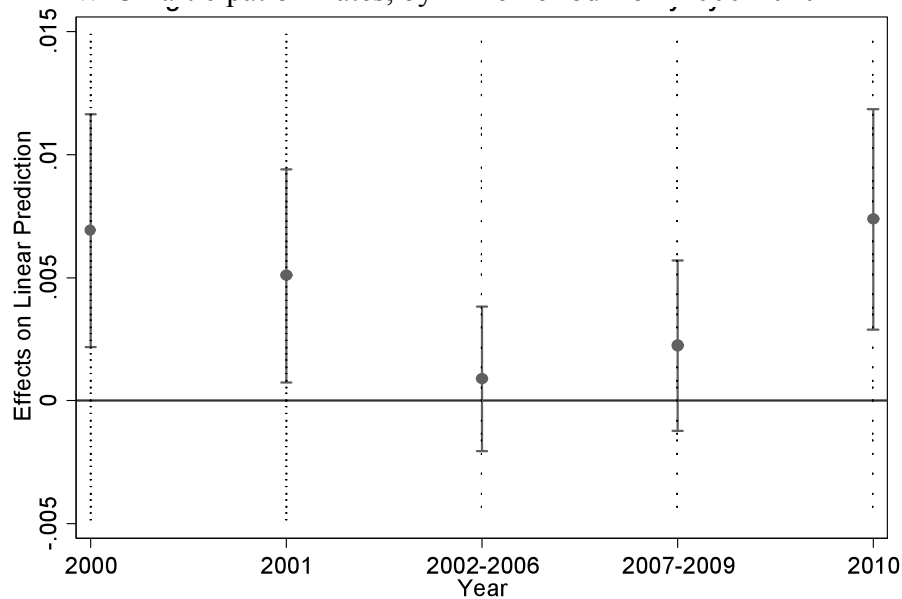
in the associative relationship between the two variables from one time period to the next. Given the interaction between recession/non-recessionary periods and household food insecurity in the first two periods (2000 and 2001) and in the last period (2010), household food insecurity appears to have had a stronger and similar relation to WIC participation compared to what transpired during the two periods (2002-2006 and 2007-2009), where the effect is much weaker—roughly an effect of .007 compared to an effect of .001, evaluated at the mean of the Hispanic/Foreign-Born index.

This associative relationship between household food insecurity and WIC participation was weaker during Nonrecession 3, 2010, Nonrecession 2, 2002-2006 ( $p = .06$ ), and Recession2, 2007-2009 ( $p = .007$ ). During these time periods, a state-level rate of household food insecurity had a weaker association with the corresponding rate of WIC participation. An increased food insecurity demand did not net the same response in WIC participation during Nonrecession 2 and Recession 2 as it did in the other time periods—Nonrecession 1, Recession 1, and Nonrecession 3. While Nonrecession 2 did not demonstrate significance, the coefficient of this dummy variable and the trend toward significance were noteworthy.

The marginal effects allowed us to examine the strength and weakness of the association between food insecurity and WIC participation over time. The y-axis quantifies the value for food insecurity relative to WIC participation during a specific time period: the more positive the value, the stronger the association between the two variables; the less positive the value, the weaker the association—with negative values indicating an inverse relationship between food insecurity and WIC participation during that time period. The general shape of the relationship was drawn utilizing the mean of

each of the study variable during each distinct time period in the model (Figure 2). The strength of the association between household food insecurity and WIC participation followed this shape displayed in Figure 2 when using mean values for study variables, but the absolute magnitude of the predicted value of the association between food insecurity and WIC participation was found to be dependent upon the state-level proportion of Hispanic and Foreign-Born residents.

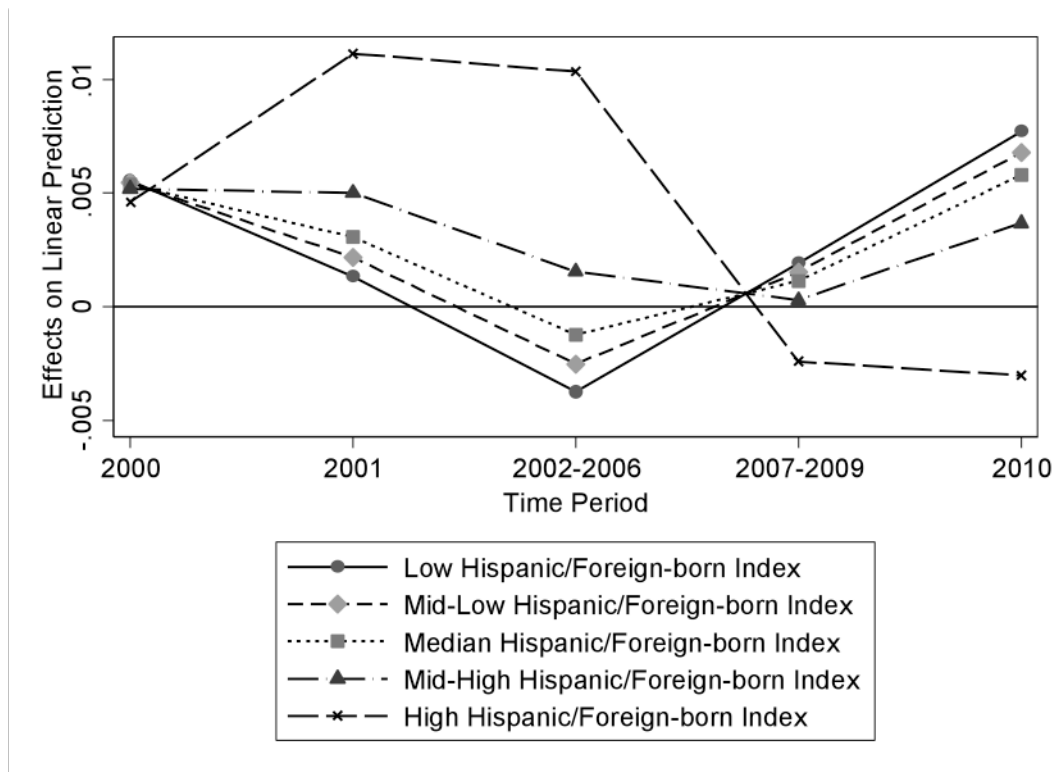
**Figure 2.** Marginal Effect of the Association between Household Food Insecurity and WIC Participation Rates, by Time Period from 2000-2010



Using the additive regression equation above, I calculated the predicted relationship between household food insecurity and WIC participation based upon proportion of Hispanic and Foreign-Born populations by dividing the states into quartiles. In states that fell within the three lower quartiles, demonstrating lower proportions of Hispanic and Foreign-Born resident populations, the association between household food insecurity and WIC participation generally followed the trend presented in Figure 2, although the relationship for some of these groups, Low, Mid-Low and Median

Hispanic/Foreign-Born Index values, fell below zero during Nonrecession 2, 2002-2006 indicating an inverse relationship during this time period (Figure 2). In comparison to states with Low, Mid-Low, and Mid- High Hispanic/Foreign-Born Index values, states in the highest quartile of Hispanic and Foreign-born resident populations, including California, Florida, New York, and much of the southwest, the relationship between household food insecurity and WIC participation followed a distinctly different trend over the study time period; with a stronger association during Recession 1 and Nonrecession 2 and weaker during Recession 2 and Nonrecession 3 (Figure 3).

**Figure 3.** The Marginal Effect of Household Food Insecurity on WIC Participation Rates Evaluated at Different Levels of Hispanic/Foreign Born Index, By Time Period



I also found that for states in this study with a high proportion of Hispanic and Foreign-Born resident populations, the relationship between household food insecurity and WIC participation was significantly different than the consistent general patterns of association identified in 2000, 2001, and 2010. Figure 3 demonstrates the overall shape of

the food insecurity and WIC participation relationship among states with high, median and low proportions of these populations. States with high proportions of Hispanic and Foreign-Born populations had an even stronger association between household food insecurity and WIC in the years leading up to the Great Recession (Figure 3). Prior to the recession, states with high proportions of these populations appeared strongly able to meet growing food insecurity needs with WIC participation.

### **Discussion**

The primary finding of this longitudinal analysis was the departure from the overall positive and direct relationship between household food insecurity and WIC participation rates—as seen during 2000, 2001, and 2010—to a weakened and significantly different relationship between the study variables during Recession 2, 2007-2009. During this time period, the Great Recession’s economic decline placed unprecedented demands on the public health systems and services sector, which may have impacted the relationship between household food insecurity and WIC.

Throughout the decade of 2000-2010, rates of household food insecurity and socioeconomic indicators such as poverty in the US rose consistently, and most dramatically during the period of the Great Recession (USDA, ERS, 2012). During the Great Recession, 2007 through 2009, not only did these poverty indicators increase but the relationship among these indicators also changed. While traditionally, rates of household food insecurity and socioeconomic indicators had followed a consistent pattern, during the Great Recession, rates of food insecurity increased beyond coinciding rates of poverty and unemployment (Stanford, 2013). During the Great Recession, even working families above the poverty line experienced difficulty in meeting basic food

needs (Stanford, 2013). This departure from the general population previously associated with food insecurity impacted the data's ability to adequately capture the relationship between food insecurity and WIC participation, contributing to the significant difference observed in this relationship during the Great Recession.

During this same time period, WIC participation hit a record high in August 2009 at 9.326 million participants (USDA, FNS, 2011). The larger economic challenges of the Great Recession time period, high unemployment and poverty rates, contributed to substantial growth in numbers of WIC eligible populations. Increased numbers of eligible populations, and greater demand among those eligible prior to the Great Recession, led to substantial growth in WIC enrollment during this time period. This presented a challenge to the public health system as administrators sought to stretch WIC funding as far as possible (Martinez-Schiferl, 2012). Due to the demands being placed on the system, The American Recovery and Reinvestment Act (ARRA), commonly referred to as the Stimulus or The Recovery Act economic stimulus package, was enacted by congress in 2009 (2009). One of the ARRA's chief goals was to enhance funding to entitlement programs and as such it provided WIC with a total of \$500 million, \$400 million of which was to support the unprecedented increase in demand for WIC services (American Recovery and Reinvestment Act of 2009). During the Great Recession, the social safety net programs, including Medicaid, Social Security Income, Housing Aid, and food assistance programs such as SNAP and WIC, all experienced increases in participation. Much research has demonstrated that SNAP had substantial increases in participation due to the program's ease of enrollment, eligibility for several immigrant groups, and phasing in of electronic benefit transfers (Moffitt, 2012). While WIC participation during the

Great Recession has not been investigated to the same extent, these same benefits may have accounted for increased WIC participation as well.

The significant change in the relationship between household food insecurity and WIC participation during the Great Recession may have been influenced by the record demand for WIC, federal supplemental funding during the Great Recession, and program features encouraging ease of access among eligible populations.

Aside from the challenges placed on the relationship between household food insecurity and WIC participation during the Great Recession, I identified a relatively consistent association between state-level household food insecurity and WIC participation rates during time periods/years Non-Recession 1, 2000, Recession 1, 2001, and Non-Recession 3, 2010. During these stable economic periods, an increase in household food insecurity was consistently met with an increase in WIC participation as depicted in Figure 3. During these time periods, the WIC system was able to meet demands placed on it, perhaps through outreach and enrollment efforts or policies at the state-level.

During the recession, the relationship between household food insecurity and WIC participation weakened significantly for states with high proportions of Hispanic and Foreign-Born populations, as the increased food insecurity demand and record-high WIC enrollment came to a head. The poverty rate for minority groups has historically been substantially higher and more responsive to NBER business cycles than the poverty rate for non-Hispanic Whites. Between 2007 and 2010, the poverty rate among Hispanics rose 4.5%, from 17.9 to 22.4%, while it only rose by half of that proportion (2.2%) for non-Hispanic Whites (Danziger, Chavez & Cumberworth, 2012). The increased



proportion of this population that was at high risk for food insecurity and was eligible for WIC may have particularly burdened an already taxed system, weakening WIC's relationship with food insecurity. These results build upon the findings of the cross-sectional analysis in that I found state demographics to be an important factor in understanding the relationship between household food insecurity and WIC participation rates, but this adds to that research in clarifying that having a high state-level proportion of Hispanic and Foreign-Born populations does not equate to a constant positive associative relationship but instead leads to a significantly different relationship that varies from the norm throughout economic time periods.

Non-Recession 2 did not look like the years of the baseline relationship between food insecurity, 2000, 2001 and 2010, but more closely resembled the significant change in the relationship between household food insecurity and WIC participation seen during the Great Recession. The weakened food insecurity and WIC participation relationship identified during this time period may have been related to the changing economic tide or state-level policy changes. The weakened relationship during this period may also have been unduly influenced by undetected correlations among study variables during this time period, the high number of years in this time period, or by the high degree of variability among the time period's data, as indicated by its coefficient's high standard error value (.062).

This study highlights the importance of considering the national economic climate throughout time periods when conducting public health systems and services research. Future studies should consider how economic factors impact safety net programs, such as WIC and other food assistance programs, to determine how to

effectively meet the needs of state populations throughout differing economic time periods, as well as how to safeguard the health of specific minority populations.

### **Conclusion**

Using generalized linear modeling techniques, I found that the relationship between WIC participation and household food security differed significantly from 2000 through 2010, through various economic time periods and among diverse state demographic groups. WIC program advocates, policy makers, and practitioners should be aware of the economic climate and state demographics when developing and implementing policy and allocating funding for the WIC program. Understanding the relationships between service delivery and need can help predict demand and direct critical access to services during economic recessions and more broadly can help safeguard the health of the vulnerable populations. Future studies should include economic and sociodemographic characteristics of study populations when examining important public health program effectiveness indicators such as WIC participation and related health indicators such as household food insecurity.

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## CHAPTER FOUR: IMPLICATIONS FOR NURSING AND FINAL REMARKS

This chapter includes a discussion of the major findings of the study as they relate to previous research and to research within the field of systems-level public health.

Limitations, strengths and lessons learned are outlined. Contributions of this study to the body of nursing science, as well as recommendations for future research are described.

### **Summary and Discussion of Key Findings**

In this study, I sought to provide a preliminary examination of the presence and nature of associations between food insecurity and WIC participation through secondary analyses of aggregate state-level data. The study was also designed to contextualize the association between food insecurity and WIC participation by examining the impact of population sociodemographic characteristics. Furthermore, I investigated the presence and nature of a longitudinal relationship between food insecurity and WIC participation. The findings highlighted the importance of considering state-level sociodemographic characteristics and the variability in the relationship between food insecurity and WIC over time. Consideration of these relationships is critically needed by public health leaders for planning and decision making purposes.

The cross-sectional analysis, detailed in Chapter 2, uncovered a complicated relationship between household food insecurity and WIC participation dependent upon the state sociodemographic characteristics, namely the proportions of Hispanic and/or Foreign-Born populations and the rates of teenage and unmarried pregnancies. States with high rates of teenage and unmarried pregnancies were associated with lower WIC participation rates. While barriers to prenatal care that coincide with WIC participation are well documented among teenage and unmarried populations, research to date had not

described this relationship at the population-level. The relationship between food insecurity and WIC participation varies across populations as demonstrated by the interaction term found between household food insecurity and Hispanic/Foreign-Born populations and its relationship with WIC. This further elucidates that not all maternal-child populations experience similar rates of food insecurity and that different populations have different behaviors when it comes to enrolling in assistance programs such as WIC. Separate annual reports published by the USDA Economic Research Service had noted that Hispanic and Foreign-Born populations were at increased risk for food insecurity while other reports documented higher rates of participation in WIC than other racial and ethnic groups. This study established a previously undescribed interaction relationship between the two. Overall, the cross-sectional analysis in Chapter 2 highlighted the importance of considering each state's unique population characteristics when examining food insecurity and participation in WIC.

The longitudinal analysis, detailed in Chapter 3, expanded upon the understanding of the relationship between household food insecurity and WIC participation rates by examining the presence and nature of this relationship over time. Given the high level of variability across the 11-year study period, from 2000 through 2010, the relationship between household food insecurity and WIC participation rates did not follow a simple linear trend requiring examination using dummy variables representing each distinctly different time period in the data set. Grouping of the study years by recession and non-recession periods allowed for consideration of the role that the national economy may have had on the associative relationship between household food insecurity and WIC participation rates. It has been well documented that changes in unemployment and

poverty, which impact these variables, took place over the study time period. A normalized pattern of association, where a change in state-level food insecurity was associated with a similar change in WIC participation, was evident during periods 2000, 2001 and 2010. In contrast, the non-recessionary period from 2002-2006 and Great Recession from 2007-2009 disrupted this pattern. During 2002-2006 and 2007-2009, a state-level change in food insecurity did not elicit a measurable change in WIC participation.

While many factors influenced the longitudinal relationship between household food insecurity and WIC participation, it should be noted that the relationship over time did not follow the same pattern for all population subgroups. States with high proportions of Hispanic and Foreign-Born populations were seen to follow a significantly different trajectory over time, especially during the Great Recession. In contrast to states with low, mid-low, median and mid-high proportion of Hispanic and Foreign-Born populations, states with high proportions of these populations had a stronger association between household food insecurity and WIC during time periods 2000, 2001 and 2002-2006 and a weaker relationship during time periods 2007-2009 and 2010. In the years leading up to the Great Recession, states with high proportions of Hispanic and Foreign-Born populations appeared strongly able to meet increased food insecurity needs with increased WIC participation. This associative relationship was not detected during the Great Recession. This study established a previously undescribed association between household food insecurity and WIC participation rates over time and through varying economic time periods. Overall, the longitudinal analysis in Chapter 3 highlighted the importance of considering the national economic climate and state-level

sociodemographic characteristics when conducting longitudinal studies of food insecurity and participation in WIC.

In sum, the study demonstrated evidence of a cross-sectional and longitudinal associative relationship between household food insecurity and WIC participation. This relationship was most detectable during stable economic time periods and among specific populations, namely the Hispanic and Foreign-Born. These findings suggest that there is a meaningful relationship between food insecurity and WIC participation in which increases in food insecurity rates correspond with improved WIC participation rates.

The noted interaction term between food insecurity and Hispanic and Foreign-Born populations in their relationship with WIC participation might suggest that there is a stronger orientation toward support and enrollment in preventive services in some communities or among specific demographic groups. The detected strength of the association between food insecurity and WIC participation among Hispanic and Foreign-Born populations may be related to local or state-level policies or tailoring to the preferences of these specific populations. There are many factors that may be influencing the detected relationship between the Hispanic and Foreign-Born populations, household food insecurity and WIC. Hispanic and Foreign-Born populations have higher WIC participation rates, as well as higher WIC coupon redemption rates, than non-Hispanic US-born populations (USDA, ERS, 2012). This relationship may also be influenced by the WIC program's absence of immigration-related barriers. WIC is a highly accessible program with a simple application process that may reduce reluctance and/or fear of interacting with government agencies. Furthermore, the limited availability of other assistance resources to these populations, due to recent immigration or undocumented

status may encourage them to perceive the benefits of WIC participation higher than other demographic groups. The relationship between household food insecurity, WIC participation, and Hispanic and Foreign-Born populations may also be reflecting these groups' culture of acceptability. Social networks within ethnic communities transmit information about public assistance programming to newcomers upon their arrival in the US. Many ethnic communities are encouraging of public aid utilization, including WIC, as they view these resources as a source of transitional financial support as they work to gain financial independence and provide prosperous lives for their family members (Borjas & Hilton, 2001; Castronova, Kayser, Frick & Wagner, 2001; Chilton & Black, 2009; Fomby & Cherlin, 2004; Fortuny, 2010; USDA, ERS, 2012; Van Hook & Bean, 2009; Vericker, Fortuny, Finegold & Ozdemir, 2010).

The relationship among household food insecurity, Hispanic and Foreign-Born populations, and WIC participation highlights the importance of considering each state's unique population characteristics to tailor approaches to reducing food insecurity and increasing participation in assistance programs. WIC providers have the opportunity to target outreach efforts to their area's local demographic groups through tailoring of materials, providing WIC services in other languages and employing lay health care workers from the local WIC-eligible groups to provide culturally appropriate health promotion education to members of their own community (Ikeda, Pham, Nguyen & Mitchell, 2002).

A longitudinal relationship between food insecurity and WIC participation was present during stable economic time periods, with strongest associations noted for states with high proportions of Hispanic and Foreign-Born populations. The longitudinal results

suggest that changes in food insecurity rates correlate with changes in WIC participation over time, during stable economic time periods. The detected strength of the longitudinal association between food insecurity and WIC participation during non-recession years suggests that perhaps upon further examination, a predictive relationship between food insecurity rates and WIC participation rates might be discovered. The Great Recession placed unprecedented demands on the public health systems and services sector, which may have impacted the relationship between household food insecurity and WIC participation during this time period. While traditionally, rates of household food insecurity and socioeconomic indicators had followed a consistent pattern, during the Great Recession, rates of food insecurity increased beyond coinciding rates of poverty and unemployment (Stanford, 2013). During the Great Recession, even working families above the poverty line experienced difficulty in meeting basic food needs (Stanford, 2013). This departure from the general population previously associated with food insecurity impacted the data's ability to adequately capture the relationship between food insecurity and WIC participation, contributing to the significant difference observed in this relationship during the Great Recession. During this same time period, WIC participation hit a record high in August 2009 at 9.326 million participants (USDA, FNS, 2011). The larger economic challenges of the Great Recession time period, high unemployment and poverty rates, contributed to substantial growth in numbers of WIC eligible populations. Increased numbers of eligible populations, and greater demand among those eligible prior to the Great Recession, lead to substantial growth in WIC enrollment during this time period. This presented a challenge to the public health system as administrators sought to stretch WIC funding as far as possible (Martinez-Schiferl,

2012). The unprecedented demand for WIC services led to an additional \$500 million in funding from the American Recovery and Reinvestment Act of 2009 to better meet the needs of those struggling with poverty and food insecurity during the Great Recession. The Great Recession and its influence on the relationship between household food insecurity and WIC participation highlights the importance of monitoring the national economic climate and using fluctuations to anticipate corresponding changes in the experience of food insecurity and need for WIC services among domestic populations.

This study demonstrated the importance of considering state-level sociodemographic characteristics and the national economic climate in food insecurity and WIC participation research. Understanding characteristics of each state's vulnerable maternal-child populations can lead to tailoring approaches to reduce local food insecurity rates and improve WIC participation. Consideration of national-level issues, such as fluctuations in the economic climate, should inform future food insecurity and WIC participation research and policy decisions. It is hoped that this study will give public health practitioners, policy makers and researchers alike evidence to help drive decision making and funding priorities toward tailoring WIC programs to the local population served and preparing for anticipated needs of eligible populations with changes in the national economy.

### **Limitations of the Study**

This study has limitations that could inform the design of future studies. The Current Population Survey (CPS) data used in this study required participants to have a hard-line telephone number that was selected at random. Given this inclusion criteria, all



households who did not own a hard-line were excluded, possibly affecting the generalizability of the data.

Limitations to data validity may exist given the nature of self-reported survey data. This study assumes that CPS respondents were able to accurately recall food insecurity and WIC program participation experiences over the past 12 months. Recall may be further compromised as each of the study variables is assessed only once annually, and during different monthly telephone calls (WIC participation was assessed in March and food insecurity was assessed in December). Also, given food insecurity's temporary and episodic nature that generally peaks in summer months, delaying the assessment of food insecurity until December may impact respondents' recall. Furthermore, only one household member serves as the respondent for the CPS. This individual may not accurately represent the actual experiences of all household members.

Data collection on stigmatizing issues such as the experience of hunger and food insecurity and participation in food assistance programs is challenging. Underreporting is common, potentially decreasing confidence in survey results. Despite these limitations, CPS data are the only source of information available to the USDA for state-level estimates of food insecurity and WIC program participation.

### **Strengths of the Study**

This novel study was the first known examination of the presence and nature of a population-level relationship between household food insecurity and WIC participation. Previous studies were reliant upon individual-level survey data and were not able to capture this relationship at the aggregate-level.

This study's strength also lies in the size and scale of the data set. The data set included state-level data over a total of 561 state units, 51 state-year units for each of the 11 years, 2000-2010 of the study. The data set was thorough, including complete observations for food insecurity rates and WIC participation rates as well as state-level values of a large number of sociodemographic variables. The size and scope of this data set allowed for analytic modeling which brought to light relationships of significance that could not have been otherwise detected. Furthermore, the depth and breadth of the data set allowed for examination of both cross-sectional and longitudinal relationships among the study variables describing not only a snap-shot view of the relationship between food insecurity and WIC participation, but also the trajectory of that relationship over time.

### **Lessons Learned in the Study of Food Insecurity and WIC**

It is imperative to begin the process of conducting a research study with a wide reaching literature review. It is important to consider any and all sources of related literature on the designated topic. Research on food insecurity and/or WIC participation is found not only in peer-reviewed research journals, but also in the published reports of government agencies, such as the USDA's Economic Research Service, and position papers developed and published by leadership councils within professional organizations such as the American Dietetic Association. When seeking to read all available materials related to public health research topics such as these, it is important to consider all sources of potential information.

It is also of critical importance in population-level research to allow data exploration to guide the nature of the analysis. Analyses such as those utilized in this study require detailed data exploration, which can point to data characteristics or patterns

that require specific analytic approaches. In addition to considering the nature of the data itself, is it equally important to look outside of the data at the context in which it was collected. In ecological data there are a number of external factors that may impact the data characteristics. In this study's longitudinal analysis, exploration of the outside factor of the varying economic climate strongly influenced my analytic approach, and ultimately the chief findings.

### **Implications for Nursing Science, Practice and Policy**

The interconnectedness between human health and one's environment has been reinforced throughout the ages by nursing theorists who focused on the importance of considering patients' environments and life circumstances in the planning and implementation of nursing care. As early as Florence Nightingale's *Notes on Nursing* concept of the environment was prominent within the nursing discipline's theoretical foundation (1959). Contemporary guidelines for nursing practice continue to highlight nurses' duty to pay "attention to the range of human experiences and responses to health and illness within the physical and social environment (American Nurses Association, 2010)."

Considering the impact of the environment on patients' health in nursing is true to the historical roots of nursing, contemporary definitions of nursing practice, and provides perspective when conducting population-level nursing science. Studying the environment and context of patient populations' lives has always been central to care. Nurses have an inherent responsibility to ensure that health promotion activities are effective in reaching target vulnerable populations. This study reinforces the importance of tailoring approaches to care to local populations and considering the role of the environment,

including the economic climate, on human health when conducting health promotion and prevention programming. To meaningfully reduce food insecurity and improve WIC participation, nurses must work to understand the patient populations whom they serve and the environmental context of these populations' daily lives. This level of understanding will best help nurses to collaborate with public health practitioners and policy makers to tailor programming to meet the needs of target populations.

This research builds upon foundational nursing theory and practice by encouraging specific changes to the current Public Health Nursing Scope and Standards of Practice (2013). The current standards do not adequately emphasize the importance of tailoring nursing approaches to local demographic groups and also do not appropriately highlight the relationship between population health and the economic climate. Furthermore, the current scope and standards list assessment work as a linear process, as opposed to an iterative process in which population-level health indicators are continually monitored and assess to provide timely changes in care provisions to vulnerable populations. It is essential that health indicators are continually reassessed to watch for variability over time and that any fluctuations are used to anticipate related changes in health status and need. As nurses, we need to fully understand the populations that we are serving and under what specific circumstances to best meet health needs.

This research has implications for both public health nursing practice and policy. The noted relationship between household food insecurity, Hispanic and Foreign-Born populations, and WIC participation, may indicate that current WIC outreach efforts may be more effective with specific population subgroups. In reviewing current WIC policy and practice guidelines, I believe that many of the current mandated approaches are

outdated in appropriately reaching target audiences. The availability of WIC is currently announced via newspaper, radio, posters, letters and brochures, predominantly distributed at health facilities and community and faith-based organizations. This methodology does not include technology-based platforms such as internet advertising and social networking sites which may improve interest in WIC participation among eligible populations. Also, current policy does not adequately inform the public health workforce about key demographic and economic trends at the local, state, regional, and national level that may lead to fluctuations in food insecurity or WIC participation in their areas. WIC policies are designed to support the reallocation of WIC caseload and funding as necessary but this work can only be accomplished in a timely manner by using evidence from population-level research to help drive decision making and funding priorities.

### **Specific Recommendations for Further Research in this Area**

As evidenced by the findings of this research, a cross-sectional and longitudinal associative relationship exists between state-level household food insecurity rates and WIC participation rates. This relationship is influenced by the sociodemographic make up of state populations and varies over time, depending upon the economic climate of the country.

Lacking in the literature are rigorous methodological studies that synthesize population-level quantitative data with individual level qualitative data that explain why the relationship between food insecurity and WIC participation is not equal among all population groups or over all time periods. Building on this study, future research should seek to confirm and expand upon the understanding of why and how the presence of Hispanic and Foreign-Born populations impacts the relationship between food insecurity

and WIC participation. Interviews with key informants, including public health practitioners and policymakers, in states with high proportions of these populations may uncover meaningful differences in practice and policy for the vulnerable maternal-child populations in these states. Focus group studies with members of Hispanic and Foreign-Born communities may uncover differences in their beliefs and practices about public health issues or their lived experience of food insecurity. Future investigators examining the ties between these populations, food insecurity, and WIC participation should focus their analyses on mixed methods approaches, utilizing population-level data in addition to individual-level qualitative data, focusing within states, or geographic regions, with high proportions of Hispanics and Foreign-Born populations.

Research surrounding the impact of the Great Recession on public health in the US is emerging, now 6 years from the trough of the 2007-2009 recession. It has been documented that this recession increased unemployment and poverty rates, health seeking behaviors of the public, and mental health (Modrek & Cullen, 2013; Althouse, Allem, Childers, Dredze & Ayers, 2014); less understood is specifically how recessionary time periods effect the health and wellbeing of vulnerable maternal-child populations. Until there is a better understanding of how WIC eligible families were affected by the economic burdens of these time periods, effective public health policies and strategies to improve assistance programs like WIC will go undeveloped. Future studies must focus on how WIC participation and proximal outcomes such as food insecurity were impacted during the 2007-2009 time period. With national WIC participation peaking in late 2009, it is clear that families reach out to services such as WIC in times of need. Efforts to

improve outreach, increase enrollment, and secure adequate funding during recessionary time periods are a priority.

The following research questions are offered for consideration as next steps within this field of inquiry and based on this study:

1. How do policies and practices surrounding food insecurity and WIC participation differ in states with high proportions of Hispanic and Foreign-Born populations? How do these differing policies and practices influence state-level food insecurity and/or WIC participation rates? How might effective policies and practices be applied to other locations and demographic groups?

2. How are Hispanic and Foreign-Born populations beliefs/practices surrounding food insecurity and WIC participation different from other populations? How might these beliefs/practices influence the relationship between food insecurity and WIC participation? How do these beliefs/practices compare to those of other demographic groups?

3. To what extent did WIC program policies and practices differ during the Great Recession in comparison to years preceding and following the recession? How do these policies and practices compare to those of other recessionary time periods? Did these policies and practices equally affect all sociodemographic groups in the US?

## **Conclusion**

In this study, I described the cross-sectional and longitudinal relationship between food insecurity and WIC participation, influenced by state-level sociodemographic characteristics and economic time periods. These findings strengthen support for the role that public health services play in the lives of vulnerable populations. This work adds to

the overall understanding of the relationship between state-level maternal-child food and nutrition needs and the current public health system's ability to meet these needs. This research supports public health programming's ability to positively influence the lives of low-income, vulnerable maternal-child populations in the US struggling with food insecurity. Overall, it is hoped that this evidence of the relationship between food insecurity and WIC participation will encourage consideration of state-level sociodemographic characteristics and national economic climate in the planning and implementation of public health services intended to reduce food insecurity and improve maternal-child health over time.



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