The Great Recession and Health Disparities:

A Study of Maternal and Child Health Outcomes

in Washington and Florida

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Abstract

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Introduction: The Great Recession (GR) (December 2007-June 2009) resulted in widespread increases in need, prompting concern about negative effects on maternal and child health (MCH) outcomes. This dissertation explores relationships between MCH outcomes and disparities before, during, and after the GR in three research papers.

Methods: Analyses for each paper (1, 2, 3) utilized de-identified birth certificate and linked community characteristic data from Washington (WA) and Florida (FL). First (1), Healthy People protocols were used to assess the degree of disparities on seven MCH outcomes (study period 2005-2011; n= 897,483). Next (2), regression modeling was used to estimate relative contributions of individual, community, and local health department (LHD) expenditure covariates on the probability of a pregnant woman entering prenatal care late or not at all (late/no

PNC) (study period 2005-2010; n= 678,235). Finally (3), interactions between enrollment in the WIC Supplemental Nutrition Program and individual characteristics in relation to BW were modeled among a higher need subset of the study population (study period 2005-2009; n= 226,835).

Results: In the first paper (1), MCH disparities increased for some groups during and after the GR. There were more total increases in disparities in WA than in FL and more disparity increases after the GR than during. The second paper (2) revealed consistent contributions of individual-level maternal predictors (e.g., young age, low education) to late/no PNC but varied associations among some community-level predictors (e.g., % voting Republican; LHD expenditures). Also, women enrolled in WIC had a lower probability of late/no PNC than those without WIC. In the third paper (3), WIC interactions revealed beneficial BW effects for infants of mothers with late/no PNC and non-Hispanic Black infants. Supplemental materials are available.

Conclusions: Some MCH outcomes and disparities worsened during the GR (1). In the case of late/no PNC, augmented associations between percent voting Republican and LHD expenditures should be further explored (2). Beneficial WIC interaction effects on BW were found among some groups in a high-need population. Further research is needed to explore how benefits of WIC and other programs might be increased or extended to more comprehensively address MCH disparities (3).

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Paper One

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Paper Two

Glossary

ACA	Affordable Care Act
AIC	Akaike Information Criteria
ARRA	American Recovery and Reinvestment Act
BIC	Bayesian Information Criteria
BW/LBW	Birth Weight/Low Birth Weight
CBSA	Core Based Statistical Area
CHAMPUS	Civilian Health and Medical Program of the Uniform Services
CONSORT	Consolidated Standards of Reporting Trials
DFB	Difference from Best
DHHS	Department of Health and Human Services
FL	State of Florida
FM	Family Medicine
FP	Family Planning
FY	Fiscal Year
GA	Gestational Age
GED	General Education Diploma
GP	General Practitioner
GR	Great Recession (December 2007-June 2009)
HP	Healthy People
HS	High School
IID	Increase in Disparity
IM	Infant Mortality

IRB	Institutional Review Board
LBW	Low Birth Weight (<2500 grams)
LHD	Local Health Department
LHJ	Local Health Jurisdiction
LPM	Linear Probability Model
MCH	Maternal/Child Health
2MCH	combined FP and MICA expenditures
MD	Medical Doctor
MICA	Maternal, Infant, Child, and Adolescent service line composite LHD expenditures
MICH	Maternal, Infant, and Child Health
NBER	National Bureau of Economic Research
PHAST	Public Health Activities and Services Tracking Study
PNC	Prenatal Care
PTB32	Preterm Birth < 32 weeks
PTB37	Preterm Birth < 37 weeks
SD	Standard Deviation
SE	Standard Error
SES	Socioeconomic Status
SNAP	Supplemental Nutrition Assistance Program
TANF	Temporary Aid for Needy Families
U.S.	United States
USDA	United States Department of Agriculture
VLBW	Very Low Birth Weight (<1500 grams)

WA	State of Washington
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

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Dedication

With love and heartfelt thanks this dissertation is dedicated to:

Don—for being an adventurous, kind, encouraging and all around fabulous partner—as always, "you're my favorite".

Afifa—whose absence during the last year and a half is a constant reminder of the fleetingness of life as well as for having been an inspiring example of someone whose life focused on appreciating and engaging with the people and issues she cared about.

My mom—for being a model of lifelong optimism and resilience in good times and bad.

You have all inspired and supported me as well as helped me to keep the PhD/dissertation process in perspective. Thank you.

General Introduction

The Great Recession (December 2007-June 2009) lasted 18 months—longer than any recession since the Great Depression in the 1930s.[1] It was accompanied by widespread increases in individual unemployment as well as other indicators of individual and community level need, including both state and local budget cuts. At the same time, supplemental federal government funding was made available for a variety of social safety nets as well as financial and other private sector businesses. Since its official end in 2009, the Great Recession has become generally acknowledged to be the most devastating global economic crisis since the Great Depression.[1,2] Its significance is due to a number of factors:

> …it was brought on and prolonged by an unusually dramatic housing crisis; because the housing crisis in turn engendered a financial crisis that evoked memories of the Wall Street Crash of 1929; because the associated financial problems triggered a deep labor-market crisis that continues to this day; and because the federal government's response to these housing, financial, and labor-market crises were both substantial and multipronged. Taken together, all of these factors make it at least plausible that the Great Recession will prove to be an event that transforms beliefs, behaviors, and even institutions. To regard the recession as a purely economic event—even one of historic severity—may well be to underestimate its impact on U.S. society (Grusky, Western, & Wimer, 2011, [1] page 5).

While it is still too early to predict long-lasting effects, this dissertation study explored potential consequences of the Great Recession for maternal and child health (MCH) outcomes and disparity relationships in three distinct but complementary research papers.

The overall conceptual framework used to explain how the Great Recession might impact MCH outcomes was a multi-faceted social determinants of health model (Figure 1).[3] The model

helps elucidate the pathways of both how and when macro to micro social and biological systems may interact with each other to influence individual and population health outcomes. Specifically in relation to this dissertation study, the model demonstrates mechanisms through which it is not only plausible but highly likely that the Great Recession resulted in disparate increases in stress among pregnant women and that stressors influenced both infant health outcomes and health disparities.

Analyses for each of the three dissertation research papers were carried out using de-identified birth certificate and linked community characteristic data from the states of Washington and Florida. All analyses were limited to first-time mothers and singleton births and examined changes in MCH outcomes identified in Healthy People (HP) including prenatal care (PNC) (both late entry and adequacy), birth weight (both low and very low), gestational age (preterm birth at 37 and 32 weeks), and infant mortality (death within the first 365 days of life).[4] Healthy People is a set of goals and objectives with 10-year targets designed to guide national health promotion and disease prevention efforts in order to improve the health of all Americans.[4]

In the first paper , "The relationship between the Great Recession and widening maternal and child health disparities: Findings from Washington and Florida", Healthy People protocols[5] were used to assess the degree to which disparities widened on seven MCH outcomes from before to during and after the Great Recession (study period 2005-2011; n= 897,483) for 14 unique subpopulations and their 47 component groups (e.g. the maternal ethnicity subpopulation consisted of five component groups including non-Hispanic White, Hispanic White). We found that of the >500 total opportunities for disparities among component groups and various outcomes to increase during the study period (from baseline to Period 1 and from baseline to Period 2), MCH disparities increased by 10% or more for 115 component groups (47 component

groups during the Great Recession (Period 1) as well as 68 groups during Period 2). There were more outcomes with increases in disparities in Washington (Period 1: 22 versus Period 2: 37) than in Florida (Period 1: 25 versus Period 2: 31) compared to the Baseline Period as well as more disparity increases during Period 2 than during the official Great Recession period (Period 1).

From the perspective of individual-level component groups—disparity increases tended to cluster among those with low education (less than high school or high school graduate but no college) as well as minority race/ethnicity groups—particularly among Black mothers (of both Hispanic and non-Hispanic ethnicity). For example, we identified consistent increases in disparities around timing of entry into PNC among non-Hispanic Black women in both Washington and Florida during both recession periods. Binomial probability calculations suggested that identified increases in MCH outcome were unlikely to be due to chance; supporting further investigation into relationships between MCH outcomes and the GR.

Thus, for the second paper, we chose to focus on timing of entry into PNC—specifically late entry (after the first trimester of pregnancy) or non-entry to PNC (late/no PNC)—and used regression modeling to assess relative contributions of individual, community, and local health department expenditure covariates on probability of late/no PNC before, during, and after the Great Recession (study period 2005-2010; n=678,235). Exploration of predictors of late/no PNC in the second study revealed consistent contributions of individual-level predictors (including consistently disparate associations among distinct race/ethnicity groups and the outcome of late/no PNC) but varied associations among some community level predictors (e.g., % voting Republican; LHD expenditures) that had been included to capture potential changes in community resources and/or policies. In the second paper , participation in the Special

Supplemental Nutrition Program for Women, Infants and Children (WIC) program emerged as having a beneficial association with late/no PNC; women enrolled in WIC had a lower probability of late/no PNC than those without WIC.

Based on the WIC-related finding in the second paper, we chose to focus on WIC-related relationships in a more uniformly high-need (WIC-eligible) population for the third paper . We explored birth weight (BW) effects of WIC participation interactions with individual-level covariates before and during the recession among the subset of the overall study population who were uninsured or for whom Medicaid was the payer (study period 2005-2009; n= 226,835). WIC interactions with individual-level characteristics revealed beneficial BW relationships (reduced probability of low birth weight (LBW), increased absolute BW in grams) for non-Hispanic Black infants as well as those whose mothers entered PNC late or not at all both before and during the Great Recession.

Overall, some MCH outcomes and disparities worsened during the Great Recession. In the case of late/no PNC, individual-level predictors remained consistent contributors; increased magnitude of associations between both percent voting Republican and LHD expenditures should be further explored. Delving into WIC interactions among a high-need (WIC-eligible) population, we found beneficial BW relationships for Black mothers as well as those who entered PNC late or not at all. While further research is needed to explore how these benefits might increase as well as be extended to other groups with disparate BW outcomes, these three papers provide an original and timely contribution to the growing evidence base around the effects of the Great Recession on MCH outcomes and outcome disparities for researchers, practitioners, and policymakers.

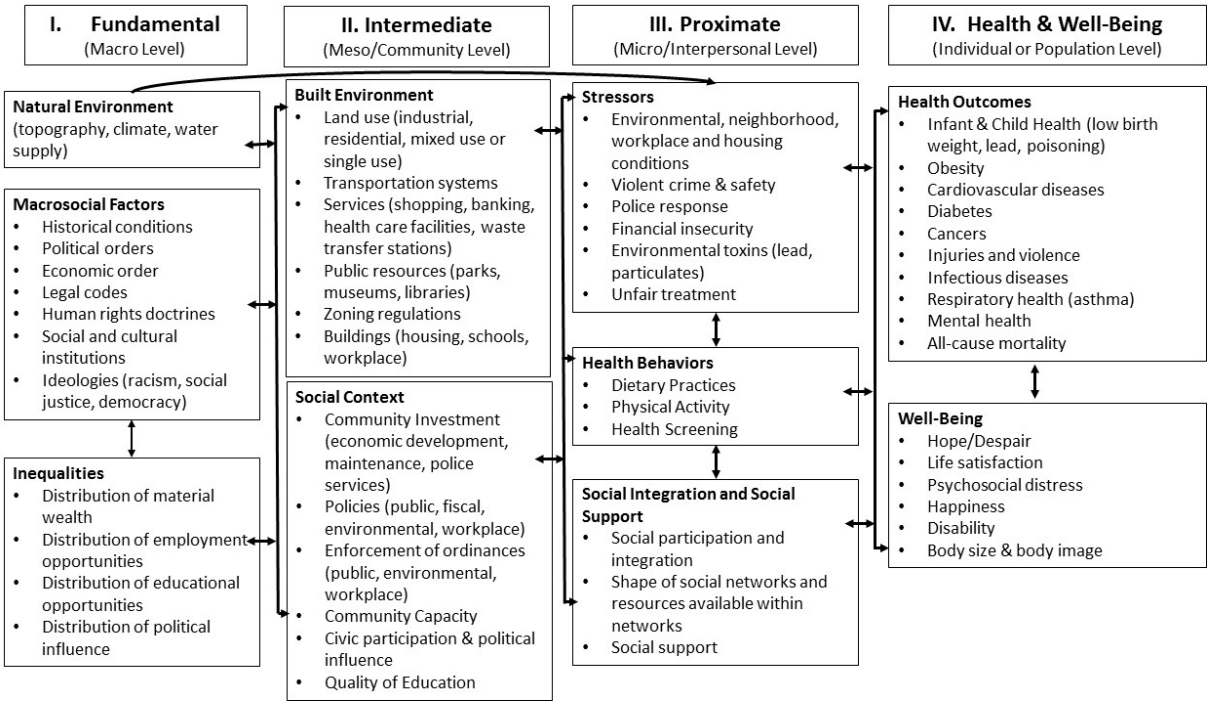

Figure 1. Social determinants of health and environmental health promotion conceptual framework.[3]

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PAPER ONE

THE RELATIONSHIP BETWEEN THE GREAT RECESSION AND WIDENING MATERNAL AND CHILD HEALTH DISPARITIES: FINDINGS FROM WASHINGTON AND FLORIDA

Abstract

Objectives

The purpose of this study was to explore relationships between the Great Recession and maternal and child health (MCH) disparities in prenatal care, birth weight, gestational age, and infant mortality.

Methods

Using individual-level Washington (WA) and Florida (FL) birth certificate data, MCH outcome rates and disparities were analyzed. Attention was focused on whether disparities widened during two recession periods: Period #1 (December 2007-June 2009—official dates of Great Recession), and Period #2 (January 2010-December 2011), compared to a Baseline Period (January 2005- March 2007).

Results

Of 14 unique subpopulations and their 47 component groups (e.g., subpopulation 'maternal ethnicity' divided into five component groups such as non-Hispanic White, non-Hispanic Black), disparities widened on at least one MCH outcome for 22 groups in WA during Period #1 and 37 groups during Period #2, compared to baseline. In FL, disparities widened for 25 groups during Period #1 and 31 during Period #2. Disparities increased in both periods on the same outcomes for 11 groups in WA and seven groups in FL. Disparity increases among individual-level component groups tended to cluster among those with young age, low education,

and among members of minority race/ethnicity groups—particularly Black mothers (of both Hispanic and non-Hispanic ethnicity).

Conclusions

Findings support hypothesized connections between increased individual and community level need, the Great Recession, and MCH outcomes and disparities. Compared to baseline, there were more increases in Period #2 than #1. Additional research on predictors/contributors influencing changes in disparities are needed.

Background

This study explores relationships between the Great Recession and maternal and child health (MCH) outcome disparities. Individual birth certificate data from the states of Washington (WA) and Florida (FL) from 2005-2011 were analyzed. Outcomes examined were: prenatal care (PNC), birth weight (BW), gestational age (GA), and infant mortality (IM).

The conceptual framework that guided this study was a multi-faceted social determinants of health model.[1] The framework elucidates pathways through which it is not only plausible but highly likely that the Great Recession resulted in decreased resources and increased stress for pregnant women and that these challenges may have influenced MCH outcomes and disparities. MCH disparities in PNC, BW, GA, and IM persist throughout the United States (U.S.) by race/ethnicity, socioeconomic status (SES), and geography.[2-7] Disparities are calculated in relationship to each other by comparing rates among groups and improving these relationships (reducing and eliminating disparities) has been a main goal nationally and among governmental public health programs.[3,8-11]

Public health practitioners widely reported perceived negative impacts to MCH outcomes and disparity reduction goals during the Great Recession (official National Bureau of Economic Research recession dates: December 2007-June 2009).[12-15] Negative economic indicators that

increased during the recession, from individual unemployment to local health department (LHD) budget reductions, did not return to pre-recession levels at the end of the official recession in June 2009.[13,16-24] WA and FL were selected for inclusion in this study for three reasons: (1) both states were greatly affected during the recession; (2) both states had harmonized local public health system data included in the Public Health Activities and Services Tracking (PHAST) database; and (3) both states had demonstrated county/local health jurisdiction (LHJ) level relationships between LHD spending on MCH services and MCH outcomes.[16,17,25-29]

Research connecting economic recessions and health outcomes has yielded inconsistent results.[30-45] Among studies that specifically address recessions and MCH outcomes, most found recessions (usually measured by time and/or unemployment rate) to be negatively associated with timing of entry to PNC and BW and positively associated with IM.[30-38,43, 45] For example, a 1985 individual-level study by Fisher, LoGerfo, and Daling in WA (after the recession in the early 1980s) found increased rates of late or no PNC (late/no PNC) among mothers in both low and high income census tracts during the peak recession year (1982) compared to baseline (1980).[45] They also found the proportion of low BW (LBW) infants to have increased in low (but not high) income census tracts.[45] In addition, two studies of ecologic level data found that higher unemployment rates were associated with increased rates of LBW and very LBW (VLBW).[35,36] These findings contrast with research on connections between recessions and all ages mortality which generally find that mortality (including IM) decreases during recessions.[31-33,35,37] These results suggest a connection between economic trends and MCH outcomes, wherein economic recessions (characterized by increased unemployment) may be associated with increases in late entry to PNC and LBW but decreases in IM.

The major mechanism underlying links between recessions and fetal and infant development (and subsequent health outcomes) at the individual level may be attributable to maternal stress. It has been well documented that economic adversity can be a major source of stress.[46-50] An individual-level study by Dooley and Prause[31] found maternal transitions from full to less or no employment during pregnancy to be associated with decreased BW.[31] They also found that decreased economic security was associated with increases in racial/ethnic disparities between non-Hispanic Black and non-Hispanic White populations.[31] Research findings also suggest that of the effects of poverty are greater if experienced earlier rather than later in childhood[46] and that episodic financial strains have fewer negative impacts than ongoing financial strains.[48] In the context of the Great Recession this suggests that while many people may experience more stress than normal during fiscal crises, those who were not previously struggling financially may fare better than those who were already under financial strain. The implication is that MCH outcomes are likely to worsen with increased maternal stress and existing stress-influenced disparities are unlikely to narrow during periods of widespread financial uncertainty. In light of the concerns raised above, the aim of this study was to explore relationships between the Great Recession and MCH outcome disparities in WA and FL at three time periods: Period #0, baseline or pre-recession January 2005 to March 2007; Period #1 (the official Great Recession)[13], December 2007-June 2009; and Period #2, January 2010 to December 2011 (see Appendix I for a detailed description of recession dating).

Methods

This study utilized Healthy People (HP) recommended protocols and secondary data to calculate MCH outcome rates and to measure changes in disparities in WA and FL during the Great Recession.[7-10, 51, 52] Healthy People is a set of goals and objectives with 10-year targets

designed to guide national health promotion and disease prevention efforts in order to improve the health of all Americans.[4] Seven specific Healthy People objectives were used as measurable indicators of MCH outcomes with previously documented disparities targeted for improvement.[53,54]

Outcome rates in WA and FL were compared at three different time periods: Period #0, baseline or pre-recession January 2005 to March 2007; Period #1, December 2007-June 2009; and Period #2, January 2010 to December 2011. Period #2 dates were identified by reviewing unemployment and consumer distress trends for WA and FL, as well as considering consumer sentiment for the entire U.S. from 2005 to 2011.[16-18] None of these economic indicators (unemployment, consumer distress, consumer sentiment) had returned to baseline/pre-recession levels by the end of the study period in 2011.[16-18] See Appendix I for a detailed description of our approach to Recession Period dating.

Study Population. Birth certificate data from WA and FL for the years 2005-2011 were obtained with human subjects (IRB) approval and via data-sharing agreements with the WA and FL State Departments of Health. In total, 2,213,825 de-identified individual records were retrieved—622,364 from WA and 1,591,461 from FL (Appendix II: Study Population Flow Diagrams for Washington and Florida). The population for analysis was restricted to first births and singleton births. Non-first time births were excluded to reduce the issues of repeated measures if women had more than one birth during the study period as linking of maternal data between years was not possible. Multiple births were also excluded (only singletons were kept) as multiple births are associated with increased risk of preterm birth, low birth weight, and infant mortality. The final study population included 897,238 births—248,290 in WA and 648,948 in FL (Table 1).

Health Status Indicators/Outcomes. Seven specific Healthy People (HP) health status indicators associated with the four primary MCH outcomes were analyzed in detail (associated HP 2010 and 2020 objective codes are listed below):

Primary Outcome #1: Prenatal Care (PNC) (HP objectives 16-6 (2010) and MICH-10 (2020)):

Indicator 1: PNC beginning in first trimester (coded as an adverse event—Late/No PNC for entry after 1st trimester, included no PNC)
Indicator 2: Early and adequate PNC (coded as an adverse event—Inadequate and Intermediate PNC) (calculated using Kotelchuck Index).[60]

Primary Outcome #2: Birth Weight (BW) (HP objectives 16-10 (2010) and MICH-8 (2020)):

Indicator 3: LBW (<2500 grams)
Indicator 4: VLBW (<1500 grams).

Primary Outcome #3: Gestational Age (GA) (HP objectives 16-11 (2010) and MICH-9 (2020)):

Indicator 5: Preterm Birth (PTB37) (<37 weeks)
Indicator 6: Early Preterm Birth (PTB32) (<32 weeks gestation).

Primary Outcome #4: Infant Mortality (IM) (HP objectives 16-1 (2010) and MICH-1 (2020)):

Indicator 7: Infant death within the first year of life (on/before age 364 days).

Binary variables were created from continuous variables (e.g., BW) to facilitate analysis and calculation of rates for the baseline and recession periods for each outcome measure (Appendix III: Data Dictionary). Using HP recommended protocols, all outcomes were expressed in terms of adverse events.[8,9] For example, timing of entry into PNC was measured in terms of how many mothers entered care after the first trimester or not all (late/no PNC).

Other Measures. Multiple subpopulations of interest were identified a priori based on historic MCH outcome disparities and Healthy People populations of interest

(Table 2).[8,9] Subpopulations defined from individual-level birth certificate data were: (1) mother's race, (2) mother's ethnicity, (3) education, (4) health insurance coverage, (5) age, (6) marital status, (7) utilization of the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) during pregnancy, (8) whether mother was foreign-born, (9) alcohol use during pregnancy (only available for FL), (10) cigarette use during pregnancy (only available for WA), (11) adequacy of PNC, and (12) infant sex.

Individual-level maternal county of residence data allowed linkage to the Public Health Activities and Services Tracking (PHAST) study database maintained by researchers at the University of WA.[25] The PHAST database contains community characteristics, service, and unique LHD/MCH expenditure data at the county/local health jurisdiction (LHJ) level. While LHJs in FL follow county lines, LHJs in WA also follow county lines, but three LHJs are multi-county aggregates; LHDs serve LHJs.[26,27] From the PHAST database, two community level variables were defined: (1) geographic characteristics of LHJ of maternal residence by Core Based Statistical Area (CBSA) (to categorize LHJs as metropolitan, micropolitan or rural) and (2) a binary geographic poverty variable to identify maternal residents of the top 1/3 poorest LHJs in both states (vs. the remaining 2/3 of "non-poor" LHJs). The geographic poverty variable represented a stratification of annual estimates of percent residents age 0-17 years in poverty in maternal LHJs of residence.[27] In total, 14 unique subpopulations and their 47 component groups (e.g., subpopulation "maternal ethnicity" is divided into five component groups, such as non-Hispanic White and non-Hispanic Black) were defined. Table 2 presents a summary of all subpopulation and component groups. Specific definitions of all measures and subpopulation component group breakdowns can be found in a data dictionary (Appendix III).

Analysis

Data analysis involved (1) calculation of health outcome rates in the study population (by state, recession periods, and subpopulation component groups), (2) identification of changes in outcomes over time (by state and subpopulation component groups to identify "best" group rates within time periods), and (3) comparison of changes in disparity relationships within and between study time periods.[7-9,51] STATA statistical software version 12 was used to clean and process data, and to conduct analyses of outcome rates/percentages. Microsoft Office 2013 Excel spreadsheets were then used to calculate changes in disparity relationships over time following the Healthy People-recommended protocol.[7-9] All calculations were carried out for both states at Period #0, Period #1, and Period #2. Changes in disparity relationships were expressed in percentage points—positive differences represented an increase in disparity, and negative differences represented a decrease in disparity.[51] Appendices IV (WA) and V (FL) contain tables of outcome and disparity rate calculations (see Supplemental Dissertation Materials).

Following guidelines for data suppression in Healthy People data established by Klein, Proctor, Boudreault, and Turczyn (2002),[52] changes in disparities were considered notable if there were at least 20 occurrences of a negative outcome among individuals within a component group in WA or FL during each time period in question and a difference of greater than 10 percentage points in disparity from Period #0.[9,52] Instances in which 20 or fewer events of the outcome occurred are available for reference in Appendices IV, V, and VI (rate calculation and disparity summary tables) with the abbreviation DQI, as recommended for vital statistics data by Klein et al.[51] Component group rate changes in disparities in relation to the "best group rate" within and between time periods are depicted in disparity summary tables (Tables 3 and 4 and

Appendix VI). Aggregate WA and FL analysis was also carried out, but individual state analyses were found to be more informative and are presented here.

Results

Characteristics of Study Population

Within the study population WA and FL were consistently different in race, ethnicity, and other subpopulation characteristics across all three time periods (Periods #0, #1, and #2); thus, between-state characteristics are described in Table 1 and compared to available U.S. data. Mothers in WA were more likely to be non-Hispanic White than in FL or the U.S.; in FL a higher percentage of mothers were non-Hispanic Black or of Cuban ethnicity. There were more teenage mothers in FL and the U.S. than in WA.

In addition to differences by race and ethnicity there were economic/resource differences; a higher percentage of FL mothers were enrolled in WIC during their pregnancy (49.1% vs. 38.1%) and more births were funded by Medicaid (44.3% vs. 34.5%) than in WA. Over the course of the recession (Periods #1 and #2), both WIC and Medicaid utilization increased in FL; WIC utilization in FL increased from 45.2% at baseline to 49.8% during Period #1, and increased further to 52.9% during Period #2. Medicaid-funded births in FL increased from 42.5% at baseline to 43.7% during Period #1 and to 47.3% during recession Period #2. In contrast, Medicaid utilization in WA did not increase and WIC utilization increased only slightly from a baseline of 37.8% to 38.8% in Period #1 and to 38.1% in Period #2.

Missing data in the study population were relatively minimal, with the exception of five variables that had > 2% missing data: (1) late/no PNC (FL 9.5%/WA7.9%), (2) intermediate and inadequate PNC (FL 10.9%/WA 11.4%), (3) maternal ethnicity (FL 5.8%/WA 16.9%), (4) insurance status (FL 0.5%/WA 2.7%), and (5) maternal WIC status (FL 1.2%/ WA 9.3%).

Rate Calculation and Identification of "Best" Rates

Tables 5 (FL) and 6 (WA) provide a summary of rates over time among the subpopulation component groups and outcomes with increasing disparities during the study period. As disparities were calculated in relation to "best" component groups, changes in "best" group outcome rates (improving or worsening) influenced whether disparities widened or narrowed in a component group above and beyond rate changes within that group. For example, in FL from Period #0 to Period #1, late/no PNC rates improved for the component group with no insurance (from 32.2 to 30.7) compared to those with private insurance (best group rate; improved from 8.2 to 7.5) (Table 5). The difference between the two rates is still large (311.7% difference from best (DFB)) and the increase in disparity (IID) was 16.9%. In this example, disparities increased even though the rate of the disadvantaged group improved—due to the larger percentage of improvement in the "best" group than occurred in the component group in question. This occurred in nine of the 25 instances of worsening disparities in FL from Period #0 to Period #1 and in eight of the 31 in FL from Period #0 to Period #2. WA had zero occurrences of "best" groups getting better in the 22 instances of disparities widening from Period #0 to Period #1 and 13 in the 37 instances from Period #0 to Period #2 (Table 6).

The opposite case, worsening outcome rates across all component groups in a subpopulation (including "best" groups), also occurred during the study period. This collective worsening resulted in narrowed disparities but continued poor outcomes. An example of collective worsening across all component groups can be found in WA from Period #0 to Period #1 for the outcome late/no PNC (Appendices IV and VI). Rates of late/no PNC worsened among all groups and disparities were unchanged or narrowed because the "best" groups worsened just as much or more than other subpopulation component groups.

Changes in Disparity Relationships by Outcome and Component Groups

Of the 14 unique subpopulations, 47 component groups, and seven MCH outcomes considered in this analysis (Table 2), disparities widened during one or both recession periods (compared to Period #0) in at least one state for all outcomes and subpopulations. In WA, disparities had widened for 22 component groups at Period #1 and 37 groups at Period #2 (Table 6). In FL, disparities widened for 25 groups at Period #1 and 31 at Period #2 (Table 5). There was an increase in disparities on the same outcomes from Period #0 to both Periods #1 and #2 for 11 component groups in WA and seven groups in FL (Figure 1). Tables 3 and 4 present a visual summary of change in disparity relationships over all outcomes for race/ethnicity groups during the study period; Appendix VI contains these visuals for all outcomes and component groups.

Florida. In FL during Period #1 (compared to Period #0), disparities widened > 10% for at least one component group in six of the seven outcome indicators, including 12 groups with increasing disparities in late/no PNC (Table 5). When looked at from the perspective of specific component groups rather than outcomes, three groups—maternal alcohol use, Hispanic White, Hispanic Black—experienced increased disparities across at least two outcomes at Period #1 (Figure 2). At Period #2, there were increases in at least one component group for all seven MCH outcome indicators (Table 5). Of those with disparity increases >10%, six groups had increased disparities across two or more outcomes: maternal alcohol use, high school (HS) graduate/no college, less than HS education, non-Hispanic Black, Hispanic Black, and Rural CBSA (Figure 2). Notably, more women reported drinking alcohol during pregnancy at Period #1 than at baseline and adverse outcome rates and disparities increased on five of the six calculable MCH outcomes for this component group (IM rates/changes in disparities were not calculable due to small numbers). At Period #2 (compared to Period #0) only two of the seven

MCH outcomes, VLBW and PTB32, showed increased maternal alcohol use rates and associated increased disparities (Table 5).

Washington. In WA from Period #0 to Period #1, disparities widened by > 10% for at least one component group in each of the seven MCH outcome indicators including nine groups with increasing disparities in IM (Table 6). Also by Period #1, three groups—(1) mothers with less than a HS education, (2) those with no health insurance, and (3) those living in a metropolitan CBSA—experienced increases of > 10% in disparities across at least two outcomes (Figure 2). During Period #2 (compared to baseline), notable increases (>10%) in disparities across at least two outcomes were experienced by eight component groups: less than HS education, non-Hispanic Black, Intermediate PNC, Maternal Age 40+, Maternal age 30-34, Native Hawaiian and Pacific Islander, HS graduate/no college, and Medicaid (Figure 2). In Period #2 there were two fewer component groups (n=7) with increases in IM compared to during Period #1 (n=9). However, more groups in Period #2 experienced increased disparities across all outcomes; all groups (except Inadequate/Intermediate PNC) had at least four subpopulation component groups with increases in disparity from the baseline (Table 6).

Probability of Increased Disparities

A relevant question when reviewing these results is whether the number of significant increases in disparities, when looking across several health indicators and specific classes of individuals, is sufficiently large enough to be meaningful evidence of actual increases in disparities over the population or simply the result of general fluctuation over time; i.e., if one were to expect that some indicators of health would periodically increase and some periodically decrease in a random fashion. To gauge this we calculated a binomial probability distribution to assess how likely some number of significant changes in disparities would occur across a large

set of indicators and groups given certain probability regimes for observing such changes. As the actual probability of an increase is not known, we calculated binomial probability distributions for five different levels of probability (0.05, 0.10, 0.15, 0.20, and 0.30) of the chance of an increase in disparities. Given a change in disparity was considered notable if it was more than 10% from the Baseline Period #0 to either Period #1 or Period #2, it is unlikely that the probability of such a large shift is high; for example, 0.50 is likely an unreasonable expectation. In contrast, if our gauge was simply a 1% change in the indicator then perhaps a 0.50 or 0.40 probability would be a reasonable assessment and 0.10 or 0.05 unreasonable. We set up the binomial probability calculation by tallying the number of trials—e.g., the number of different component groups times the number of health indicators examined in each group over both Periods #1 and #2—and the actual number of times disparities within these trials increased (usually referred to in binomial probabilities as successes) (total trials = 483 (238 in FL and 245 in WA); "best rate" groups not included in total trials). We included only four (late/no PNC, LBW, PTB37, IM) of the possible seven health outcomes to reduce potential overlap between similar outcomes (e.g., LBW and VLBW). We did this for the total sample population as well as for WA and FL separately. We considered that the probability of an increase in disparity (of more than 10%) would be somewhere between 30% and 5%. The results suggest that if there was, in fact, a 30% chance of a substantial increase in any given health indicator, there would be a 99.9% chance of observing 92 or more increases in disparity indicators out of 483 tries; observing 92 would not be unusual. In contrast with a probability of 0.05, 0.10, or 0.15 the probability of 92 or more indicators showing a substantial increase in health disparities is very small (less than 0.01 for each). Based on this sensitivity approach, observing the numbers of health indicators showing substantial increases is arguably indicative of real increases in health

disparities during this period rather than simple random fluctuations in the indicators. Only when the probability of seeing a 10% change is above 0.15 do we really question whether the observed numbers are potentially due to chance. We suggest that it would be unlikely that the probability of such large 10% changes in any given indicator is likely to be much less and therefore suggest that the disparity increases we report reflect an actual increase in health disparities in general for WA and FL.

Discussion

Disparities in MCH outcomes appeared to widen during the Great Recession for groups in both WA and FL from Baseline to the two identified recession periods. There was an increase in disparities by Period #1 (from Period #0) and more disparities increased by Period #2. There were increases in disparities for all outcomes during both recession periods in subpopulation component groups. The majority of disparity increases occurred during only one time period (e.g., at Period #1 or Period #2 but not at both). However, disparities increased during both recession periods, compared to Baseline, for 11 component groups in WA and seven groups in FL (Figure 1). In WA, the 11 groups with increases in disparities during both recession periods (in comparison to Baseline) were spread over five outcomes; and in FL, the seven groups were spread over four outcomes. The worsening of disparities over both time periods among predominantly race/ethnicity and social status-related groups was consistent with findings from Pearlin, Schieman, Fazio, and Meersman (2005)[48] suggesting that episodic financial strains, like the Great Recession, presented a longer term challenge to groups already stressed than majority/best groups which may rebound more quickly.

Consistent with previous studies on recessions and MCH outcomes, this study found increased negative BW outcomes and widening disparities during the Great Recession.[31] A strong connection between economic downturns and improvements in IM was not found in this

study—there were groups in both states that experienced worse outcomes and increased disparities during both recession periods. Worsening of IM outcome rates and widening of IM disparities among component groups were more frequent in WA than FL during both recession periods. However, at the aggregate state population level, findings were more consistent with previous research.[31-33, 35, 37] IM rates improved overall for FL during the study period (Period #0: 6.4; Period #1: 6.4; Period #2: 5.6) and only worsened slightly in WA (Period #0: 4.3; Period #1: 4.4; Period #2: 4.4).

In terms of community-level services this study found that WIC may have been protective against increased disparities during the recession, as evidenced by only one WIC component group (in WA during Period #2 for PTB37) with increased disparities during the study period (WIC 9.8→9.5, 18.7% DFB, 15.8% IID), while other SES-based component groups (e.g., less than HS education) experienced more increases (Tables 5 and 6). These results are consistent with the recent findings from Bekemeier, Dunbar, Bryan, and Morris (2012)[26] indicating that WIC programs in WA and FL successfully responded to increased need during Recession Period #1, while other services (e.g., family planning and maternal, infant, child, adolescent services) were less responsive. The other two community level groupings—top 1/3 poorest Local Health Jurisdictions (LHJs) and CBSAs—did show some widening of existing disparities but not as large or as consistently as SES or race/ethnicity groupings. These community/LHJ level groupings represented heterogeneous resident groups (e.g., within poor LHJs there are people with a variety of incomes/resources) so it was not surprising that individual-level characteristics exhibited more clear trends towards widening disparities during the Great Recession.

Also of note are trends for some outcomes among almost all component groups in a subpopulation (including the "best" groups) to improve (or worsen) over time. This collective bettering (or worsening) influenced disparity relationships and it is possible that the effects of the Great Recession were more universal for both these outcomes and subpopulations than others. For example, collective improvement appears to have occurred in late/no PNC in FL during both Periods #1 and #2 (compared to Period #0) where, despite increases in disparities, eight of 12 component groups in Period #1 and six of eight in Period #2 had improved outcome rates (Table 5). Improvement among higher need component groups may be related to the increased WIC and Medicaid enrollment in FL as a response to increased need. However, increased need-based program enrollment does not explain improvements in "best" groups.[26] Despite these collective trends for some outcomes, "best" groups overwhelmingly continued to stay "best" and disparities persisted, and in many cases widened. This could have been due to a number of factors including changing patterns of who became pregnant as well as who chose to terminate pregnancies during the study period. Since 2006 long-acting contraceptives (reducing unintended pregnancy rates) and medication abortions have become increasingly available and used.[61,62] At the same time, while overall abortion rates have dropped, there were increases in abortion among younger and poorer mothers.[61,62] Thus, it is possible that improvements among component groups (including "best" groups) during the study period were influenced by having more women enter PNC within the first trimester because more of their pregnancies were planned/intended.

Differences between WA and FL

Minimal overlap was found between WA and FL with regard to which outcomes or component groups experienced the most increases in disparities during either Period #1 or #2

(Figure 2). Among the component groups with the most increases in disparities during Period #1 (compared to Period #0) there was no overlap between WA and FL. During Period #2, there was only overlap among mothers who (a) had less than a HS education, (b) were HS graduates (no college), or (c) were non-Hispanic Black (Figure 2). Differences identified between the trends observed in WA and FL may be related to differences in the lived experience of the recession in the two states. In FL, as a center of the subprime mortgage crisis in March 2007,[63] the recession started earlier than in WA and disparities were shown to increase during both recession periods. By contrast, WA did not start to exhibit signs of the recession until nearly a year later, where increased unemployment and consumer distress did not occur until early 2008 (for more detail see Appendix I).[16,17] Also in WA during Period #2, there were over a third more disparity increases compared to baseline than in Period #1 in WA. This pattern lends support to the hypothesized connection between the timing of the recession and MCH disparities.

Limitations

There are several limitations to this study. First, this analysis represents just one approach to exploring whether MCH disparities widened during the course of the Great Recession. While we did follow an approach to disparity analysis recommended by Healthy People,[9,10] it may be argued that other methods (e.g., those that incorporate statistical control) or different cut points (we used 10% change) might be more effective for discerning policy implications of findings. Second, while birth certificate data are often used for surveillance and research purposes, they are collected and reported during a busy clinical time (birth) so coding may be under- or mis-reported.[64-67] Despite these concerns, the granularity of the individual-level data found in birth certificates added value by enabling analysis at subpopulation component group levels. Third, while the initial intention was to aggregate data from each state

to increase population size for analysis of rates in less numerous component groups (e.g., American Indian and Alaska Natives) and for rare outcomes (e.g., IM), large demographic differences at the subpopulation levels were found, making individual state analysis more informative than multi-state aggregate analysis. As a result some group sizes were still too small to report results with confidence.

In these analyses, the phenomenon of missing data was explored and component groups representing those with missing/unknown data in each subpopulation were identified and included in preliminary analyses (e.g., those missing race or ethnicity). These groups tended to have worse outcomes rates and worsening disparities than those that were defined (e.g., those with known race or ethnicity information). Previous research findings have indicated that more vulnerable subpopulation component groups— women of racial and ethnic minorities, women younger than age 24, women with less education, unmarried mothers, and those with LBW or VLBW infants—were more likely to have missing data (e.g., birth certificate data).[64-67] Trends identifying widening disparities among these groups, therefore, may be underestimated in our study.

Generalizability

This study found increases in and widening of disparities in both study states during both time periods despite state differences in both state-level economic circumstances and demographic composition. Findings suggest that other states or regions may also find similar trends or relationships, though depending on local context some may have fared better or worse than others. Results support the importance of states being able to assess and respond to local circumstances as they may be very different from state to state or locality to locality. At the same time, national need-based programs like WIC appear to have been beneficial as there was

only one disparity increase for a WIC component group in one state during recession Period #2. An important next step in this research is to explore potential factors associated with changes in disparities. Further, it will be important to continue to monitor changing MCH rates and disparity relationships during Affordable Care Act (ACA) implementation. WA and FL may continue to be a source of useful comparisons as WA expanded Medicaid as part of ACA implementation and FL thus far has not.[22]

Conclusion

This was the first known study to use birth certificate data to explicitly explore recession periods in terms of trends in MCH disparities. Findings support previous research and build upon it by including individual-level data and by exploring more outcomes and more subpopulation component groups, providing a broader picture of how multiple outcome trends and disparity relationships changed during a documented recession. Findings lend support to the concern that MCH disparity relationships may have been influenced by both individual and community level changes in resources and stress during the Great Recession.

Table 1

Comparison of Demographic and Perinatal Characteristics: Study Population for United States (U.S.), FL, and WA (n/% and 1st births only unless otherwise indicated) (n=897,238)

	U.S. (2008) First births: n=1,703,921[55] Total births: n= 4,247,694[56]	FL (2005-2011) n= 648,948	WA (2005-2011) n=248,290
Mother's Age			
Mother's Age, years (mean, SD)	Total births: 25.1(--)[57]	Mean: 25.31 (SD: 6.19)	Mean: 25.90 (SD 6.01)
Number and proportion of Teenage Births (<19) as component group of total study population* **Note: U.S. data defines as age 10-19*	354897 (20.8%)[55]	125734 (19.37)	39191 (15.78%)
Infant Gender			
Male Infant	-- (52%)[55]	332655 (51.25%)	127468 (51.32%)
Mother's Race			
White-only	1307615 (76.74%)[55]	481428 (74.38)	196720 (79.20)
African American/ Black-only	263,304 (15.45%)[55]	129430 (20.00)	9603 (3.87)
American Indian/ Alaska Native-only	17,670 (1.04%)[55]	1062 (0.16)	3954 (1.59)
Asian-only	1st births combined with NHOPI: 115,332 (6.77%)[55]	19966 (3.08)	23745 (9.56)
Native Hawaiian or Pacific Islander-only (NHOPI)a	Total births: 9725 (0.22)[55,56*]	452 (0.07)	2095 (0.84)
Two or more races	--	9011 (1.39)	9367 (3.77)
Missing	--	5880 (0.91)	2906 (1.17)
Mother's Ethnicity			
Non-Hispanic White	952,478 (55.90%)[55]	361829 (59.20)	162125 (78.57)
Hispanic White **this represent ALL Hispanic White ethnicity mothers (except Cuban)*	360,966 (21.18%)[55]	83234 (13.62)	34408 (16.67)
Non-Hispanic Black	244,340 (14.34%)[55]	127165 (20.81)	9244 (4.48)
Hispanic Black	--	1750 (0.29)	339 (0.16)
Cuban	7817 (0.46%)[55]	37197 (6.09)	232 (0.11)
Maternal SES			
Foreign-Born Mother **report cites 2004 data*	Total births : -- (24.00%)[56*]	193146 (29.76)	37448 (15.08)

Married (Mother)	Total births: 2523146 (59.35%)[56]	314343 (48.43)	150244 (60.66)
Education Less than High School **for age>20 in WA & FL; unclear of definition related to age in cited materials*	Total births: -- (20.00%)[56*]	38179 (5.88)*	14693 (5.51)*
Medicaid Birth **denominator=4,280,854*	Total births 2008: 1,715,957 (40.08)[58*]	287408 (44.28)	85535 (34.54)
WIC Utilization **infants in 2008 (up to their first birthday)*	Total births: 2,432,006 (57.25%)[59*]	314998 (49.13)	85712 (38.06)
Health Behaviors			
Maternal Alcohol Use[b] *FL-only variable*	Total births: -- (10.6%)[53*]	2241 (0.35)	Not available
Mean Number of Cigarettes Per Day (mean, SD) *WA-only variable*	--	N/A	n= 244936 0.85 (SD: 3.04)
Cigarette Smoking During Pregnancy *WA-only variable*	Total births: -- (10.4%)[53*]	N/A	26100 (10.51)

Note . [a]Calculated API-only population by subtracting Asian or Pacific Islander 'n' in NVSS 2008[55] from Asian 'n' in Pew Report[56] (from 2008). [b]Alcohol-related data in HP reports (MICH-11.1) based off of a question asking pregnant women if they had abstained from alcohol in the past 30 days; birth certificate data in WA and FL asks "Was alcohol used at any time during pregnancy?"

Table 2

List of Unique Subpopulations (n=14) and their Component Groups (n=47)

Total
1) Mothers Race (irrespective of Ethnicity)
1.1 White only
1.2 Black or African American only
1.3 American Indian and Alaska Native only
1.4 Asian only
1.5 Native Hawaiian and other Pacific Islander only
1.6 Two or more races
2) Mother's Ethnicity
2.7 non-Hispanic White
2.8 Hispanic White
2.9 non-Hispanic Black
2.10 Hispanic Black
2.11 Cuban
3) Infant Gender
3.12 Female
3.13 Male
4) Mother's Education Level (for age ≥ 20 years)
4.14 Less than HS (less than 12 yrs schooling OR no HS diploma)
4.15 HS Graduate (12 yrs schooling, OR HS diploma OR GED)
4.16 At least some college (HS diploma OR GED OR 13 or more years of schooling)
5) Geographic Location (CBSA)
5.17 Metropolitan
5.18 Micropolitan
5.19 Rural
6) Health Insurance Status
6.20 Medicaid
6.21 Private Insurance
6.22 No Insurance/Self Pay
6.23 Public Insurance (all except Medicaid)
7) Specific Maternal Age Groups (in years)
7.24 Age < 14
7.25 Teen Birth (<20 years; 15-19)
7.26 Age 20-24
7.27 Age 25-29
7.28 Age 30-34
7.29 Age 35-39
7.30 Age 40+
8) Marital Status of Mother
8.31 Unmarried (mother)
8.32 Married (mother)
9) WIC
9.33 No WIC
9.34 Yes WIC
10) Foreign-Born Mother?
10.35 Mother NOT Foreign-Born
10.36 Mother Foreign-Born
11) Community Poverty
11.37 Top 1/3 poorest LHDs
11.38 Bottom 2/3 Non-poor LHDs
12) Adequacy of Prenatal Care
12.39 Inadequate
12.40 Intermediate
12.41 Adequate
12.42 Adequate Plus
Health Behaviors
13) Smoking (Washington only)
13.43 Maternal Smoking—no smoking
13.44 Maternal light smoking
13.45 Maternal heavy smoking
14) Alcohol Use (Florida only)
14.46 Yes—Alcohol use during pregnancy
14.47 No—Alcohol use during pregnancy

Table 3

Disparity Changes among Race Ethnicity Groups over Time for Infant Mortality, Late/No PNC, Intermediate/Inadequate PNC

	Infant Deaths (IM) (Baseline)	**IM (Period #1)**	**IM (Period #2)**	**Late/No PNC (Baseline)**	**Late/No PNC (Period #1)**	**Late/No PNC (Period #2)**	**Intermediate/ Inadequate PNC (Baseline)**	**Intermediate/ Inadequate PNC (Period #1)**	**Intermediate/ Inadequate PNC (Period #2)**
Washington									
non-Hispanic White (1) (n=162,125)	b	**b**	**b**	b	**b**	**b**	b	**b**	b
Hispanic White (2) (n=34,408)					↓	↓			
non-Hispanic Black (3) (n=9,244)		DQI ↓	↓		↑	↑			
Hispanic Black (4) (n=339)	(n/a) DQI	(n/a) DQI	(n/a) DQI	DQI	DQI	DQI			↓
Cuban (5) (232)	(n/a) DQI	(n/a) DQI	(n/a) DQI	DQI	DQI ↓	DQI ↓↓	DQI	DQI ↓	DQI ↓
Florida									
non-Hispanic White (1) (n=361,829)		↓	↓		↑	↑			↑
Hispanic White (2) (n=83,234)		↓↓	↓↓		↑				
non-Hispanic Black (3) (n=127,165)		↓↓	↓↓		↑	↑↑			↑
Hispanic Black (4) (n=1,750)	DQI	DQI ↓↓↓	DQI ↓		↑	↑			
Cuban (5) (37,179)	b	**b**	**b**	b	b	b	b	**b**	b

Table 4

Disparity Changes among Race Ethnicity Groups over Time for Low Birth Weight, Very Low Birth Weight, and Preterm Birth (<37 weeks and <32 weeks)

	Low birth weight (Baseline Period)	**Low birth weight (Period #1)**	**Low birth weight (Period #2)**	**Very low birth weight (Baseline Period)**	**Very low birth weight (Period #1)**	**Very low birth weight (Period #2)**	**Preterm births: <37 weeks (Baseline Period)**	**Preterm births: <37 weeks (Period #1)**	**Preterm births: <37 weeks (Period #2)**	**Preterm births: <32 weeks (Baseline Period)**	**Preterm births: <32 weeks (Period #1)**	**Preterm births: <32 weeks (Period #2)**
Washington												
non-Hispanic White (1) (n=162,125)	b	**b**	b	b	**b**	b	b	b	b	b	**b**	b
Hispanic White (2) (n=34,408)					↓						↓	↑
non-Hispanic Black (3) (n=9,244)						↑			↑		↓	↑
Hispanic Black (4) (n=339)	DQI	DQI ↓	DQI ↓↓	DQI	DQI ↑↑↑	DQI ↓	DQI	DQI ↓	DQI ↓	DQI	DQI ↓	DQI ↑↑
Cuban (5) (232)	DQI	DQI ↑	DQI ↑↑↑	DQI	DQI ↑↑↑	DQI ↑↑↑	DQI	DQI ↑	DQI ↑↑	DQI	DQI ↑↑↑	DQI ↑↑↑
Florida												
non-Hispanic White (1) (n=361,829)		b	b	b	b	b	b	b	b	b	**b**	b
Hispanic White (2) (n=83,234)		↑			↑							↓
non-Hispanic			↑								↓	

Black (3) (n=127,165)												
Hispanic Black (4) (n=1,750)		↑	↑	DQI	DQI ↓↓	DQI ↓↓↓			↓	DQI	DQI ↓	DQI ↓↓
Cuban (5) (37,179)	b	n/c	n/c						↑		↓	↑

Interpretation Notes for Tables 3 and 4: Disparity Summary Table

(1) The "best group rate" for each sub-population (e.g., mother's ethnicity) at the most recent data point is indicated by the letter 'b'. Any 'b' when underlined and bolded indicates if the rate of the best group worsened over time in comparison to the Baseline Period (b=the group with the best rate for specified characteristic; **b (bold)** = rate worsened over time; n/a = not calculable (e.g., best group rate changed between time periods))

(2) Degree of rate difference within a time period is indicated by shading: (1) lightest color = less than 10% different from best group rate, (2) second lightest color = 10-49% difference, (3) second darkest color = 50-99% difference, (4) darkest color = 100% or more difference from best group rate).

(3) Arrows in the disparity summary tables indicate whether and in which direction (and magnitude) a disparity relationship changed over time during the study period (Increase in disparity: ↑ = 10-49 points; ↑↑ = 50-99 points; ↑↑↑ = 100 points or more; Decrease in disparity: ↓ = 10-49 points; ↓↓ = 50-99 points; ↓↓↓ = 100 points or more)

(4) Availability of Data—DQI= data quality/quantity issue (not available)

Table 5

Outcomes with One or More Increases in Disparities by Recession and Population Component Group compared to Baseline in FL

	Baseline Rate	Period #1 Rate	Difference from Best within Period (DFB)	Increase in Disparity (IID) from Baseline	Period #2 Rate	Difference from Best within Period (DFB)	Increase in Disparity (IID) from Baseline
Late/No PNC							
Non-Hispanic White	15.4	15.5	67.9%	27.6%	14.1	82.3%	41.9%
Hispanic White	26.5	23.5	154.6%	13.0%			
Non-Hispanic Black	25.3	25.2	173.5%	43.0%	21.7	180.7%	50.3 %
Hispanic Black	21.9	22.4	142.2%	42.8%	19.2	148.1%	48.8%
NHOPI	25.3				30.1	117.0%	45.7%
Medicaid	26.7	26.3	252.5%	25.7%			
No Insurance/Self Pay	32.2	30.7	311.7%	16.9%			
Public Insurance	21.2	21.1	182%	22.1%	20.4	183.2%	23.0%
Age <14	49.9	49.2	465.2%	21.8%			
Teen Birth	32.4	31.6	262.9%	10.4%			
Age 20-24	21.0	21.3	144.5%	16.4%			
Unmarried Mother	26.1	25.1	141.7%	11.4%			
Maternal Alcohol Use	32.7	34.8	92.3%	16.3%			
Micropolitan CBSA	23.7				22.7	45.0%	15.6%
Rural CBSA	19.5				19.7	26.0%	21.2%
Top 1/3 Poorest LHJs	22.2				21.3	35.4 %	14.5%
Inadequate/ Intermediate PNC							
Non-Hispanic White	23.6				24.7	40.5%	21.5%
non-Hispanic Black	31.6				32.6	85.3%	26.0%
Rural CBSA	28.5				32.9	24.0%	14.8%
Top 1/3 Poorest LHDs	30.5				34.6	30.3%	13.7%
Low Birth Weight							
Hispanic White	7.3	7.9	25.2%	13.5%			
non-Hispanic Black	13.3				13.3	115.1%	12.5%
Hispanic Black	9.9	11.7	86.2%	35.4%	10.3	66.7%	15.9%
Asian	8.0				8.3	30.8%	10.4%
Ed Less than HS	9.3				10.2	51.0%	14.1%
Maternal Alcohol Use	13.8	15.2	91.5%	18.5%			
Very Low Birth Weight							
Hispanic White	1.3	1.4	33.3%	16.8%			
Black (all ethnicities)	3.3	3.2	263.6%	12.0%			
Two or more Races	1.7	1.8	100.0%	15.1%			
Unmarried Mother	1.8				1.9	56.8%	14.6%

Maternal alcohol use	3.0	3.6	131.8%	37.7%	3.2	111.2%	17.1%
Ed Less than HS	1.6				1.8	44.1%	21.4%
HS grad, no college	1.8				2.0	54.3%	16.5%
Preterm Birth (<37 weeks)							
AIAN	15.1				16.0	60.6%	14.6%
Cuban	11.9				12.3	27.2%	12.4%
Maternal alcohol use	15.2	17.9	50.0%	22.6%			
Preterm Birth (<32 weeks)							
Cuban	1.8				2.0	4.0%	21.7%
Age < 14	5.3				6.1	272.6%	42.8%
Maternal Alcohol Use	3.1	6.0	188.8%	135.4%	3.5	72.5%	19.1%
HS grad, no college	2.3	2.4	50.6%	10.5%			
Micropolitan CBSA	2.2	2.8	38.4%	31.5%			
Rural CBSA	2.4				2.6	47.4%	29.7%
Top 1/3 poorest LHJs	2.3	2.7	32.5%	21.7%			
Infant Mortality							
Black/AA	12.1				11.2	166.7%	29.4%
Mother not Foreign	6.7	7.0	40.0%	22.5%			
No Insurance/Self-Pay	7.1				6.9	72.5%	14.7%
Ed Less than HS	6.8				7.4	85.0%	23.1%
HS grad, no college	7.0				7.2	80.0%	13.3%
Adequate Plus PNC	8.8	8.9	169.7%	10.9%			

Table 6

Outcomes with One or More Increases in Disparities by State, Recession Period, and Population Component Groups compared to Baseline in WA.

	Baseline Rate	Per. #1 Rate	Difference from Best within Period (DFB)	Increase Disparity (IID) from Baseline	Per #2 Rate	Difference from Best within Period (DFB)	Increase Disparity (IID) from Baseline
Late/No PNC							
Non-Hispanic Black	20.9	28.4	63.4%	26.8%	24.6	59.1%	22.5%
Black (all Ethnicities)	20.7	28.0	51.1%	13.9%	24.3	47.5%	10.4%
Mother Foreign-Born	18.0	22.4	11.2%	10.8%			
Heavy Smoking	18.5	26.2	32.8%	26.1%	21.9	26.3%	19.6%
Maternal Age 40+	9.9				14.4	25.8%	19.1%
Inadequate/ Intermediate PNC							
NHOPI	55.1				52.0	84.4%	13.2%
No Insurance/Self-Pay	45.8	51.6	22.8%	78.8%			
Micropolitan CBSA	35.1	36.8	16.6%	12.8%			
Public Insurance	42.4				42.0	70.9%	15.7%
Low Birth Weight							
Asian	6.9				7.1	33.5%	13.3%
Maternal Age 40+	8.2				8.3	69.6%	18.9%
Ed Less than HS	7.0	8.0	35.4%	17.0%	7.9	42.8 %	24.4%
Medicaid	6.5				6.9	42.2%	14.3%
No Insurance/Self-Pay	6.9	8.8	67.6%	32.0%			
Intermediate PNC	4.0				4.3	25.0%	13.7%
Light Smoking	7.1				7.5	35.9%	12.8%
Very Low Birth Weight							
Female Infant	1.2				1.0	8.5%	13.5%
non-Hispanic Black,	2.5				2.2	152.9%	15.2%
Maternal Age 40+	1.5				2.0	133.3%	78.6%
Ed Less than HS	1.3	1.7	44.4%	32.4%	1.3	38.5%	26.5%
HS grad, no college	1.2				1.2	34.1%	31.5%
Light Smoking	1.1	1.4	19.0%	18.0%	1.3	42.9%	42.0%
Metropolitan CBSA	1.1	1.2	37.2%	28.6%			
Preterm Birth (<37 weeks)							
non-Hispanic Black,	11.8				11.0	42.2%	12.8%
NHOPI	13.4				12.7	56.3%	10.0%

AIAN	14.3				14.5	77.3%	21.5%
Age < 14	12.6				18.3	147.9%	99.2%
Ed Less than HS	11.5				11.3	37.1%	14.8%
Intermediate PNC	4.6				4.9	38.0%	30.1%
WIC	9.8				9.5	18.7%	15.8%
Preterm Birth (<32 weeks)							
non-Hispanic Black	3.0				2.5	128.7%	14.4%
Ed Less than HS	2.1	2.3	48.4%	12.3%			
HS grad, no college	1.8				1.6	26.0%	13.1%
Maternal Age 40+	2.0				2.3	122.9%	74.3%
Medicaid	1.7				1.6	45.1%	14.3%
Maternal Age 30-34	1.5				1.3	21.9%	13.7%
Infant Mortality							
White (all ethnicities)	4.0	4.3	72.0%	23.9%	4.1	64.0%	15.9%
Two or More Races	7.6				8.2	228.0%	46.5%
Male	4.7	5.1	37.8%	17.3%			
Teen Birth	7.7	7.8	169.0%	20.6%			
Age 20-24	4.2	4.3	51.7%	16.2%	4.9	53.1%	17.6%
Maternal Age 30-34	3.2				4.4	37.5%	34.3%
Mother Not Foreign	4.5	4.7	74.1%	33.5%			
Top 1/3 Poorest LHJs	5.9	6.5	62.5%	11.2%			
Intermediate PNC	3.0				4.7	95.8%	75.8%
Adequate Plus PNC	6.1	6.8	172.0%	28.0%	7.0	191.7%	47.7%
Ed Less than HS	5.1	6.3	46.5%	22.1%	7.2	71.4%	47.0%
Metropolitan CBSA	4.2	4.3	34.8%	14.4%			

Note. Baseline rate indicated to left of arrow; rates at second time point indicated to the right (e.g., baseline rate →Period #1 rate); DFB= % different from best group rate within time period; IID = % increase in disparity from baseline; Rates or component group name underlined if rate improved over time but disparities widened (e.g., if "best" group rate improved more). Abbreviations: DFB = % different from best; IID = Increase in Disparity from Baseline; IM = infant mortality; Late/No PNC = did not enter prenatal care during the first trimester (includes no prenatal care); Early/Ad PNC = received only inadequate or intermediate prenatal care as measured by Kotelchuck Index; LBW = low birth weight; VLBW = very low birth weight; PTB37 = preterm birth; PTB32 = early preterm birth.

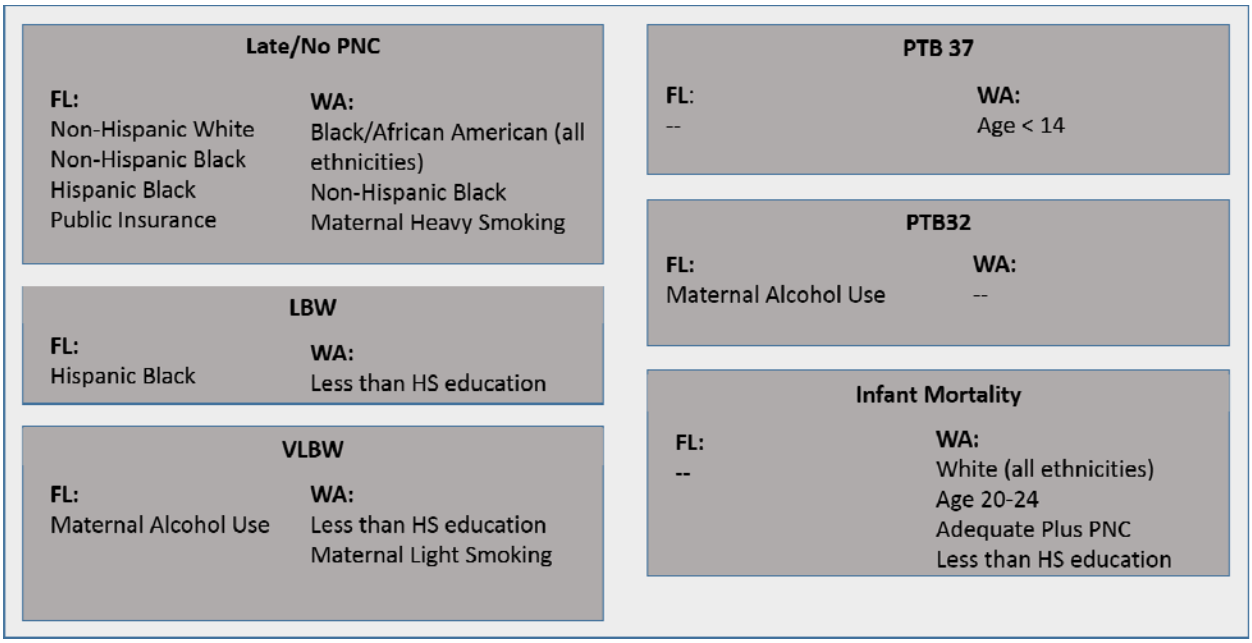

Figure 1. Outcomes with increased disparities during both recession periods by state and component group compared to baseline

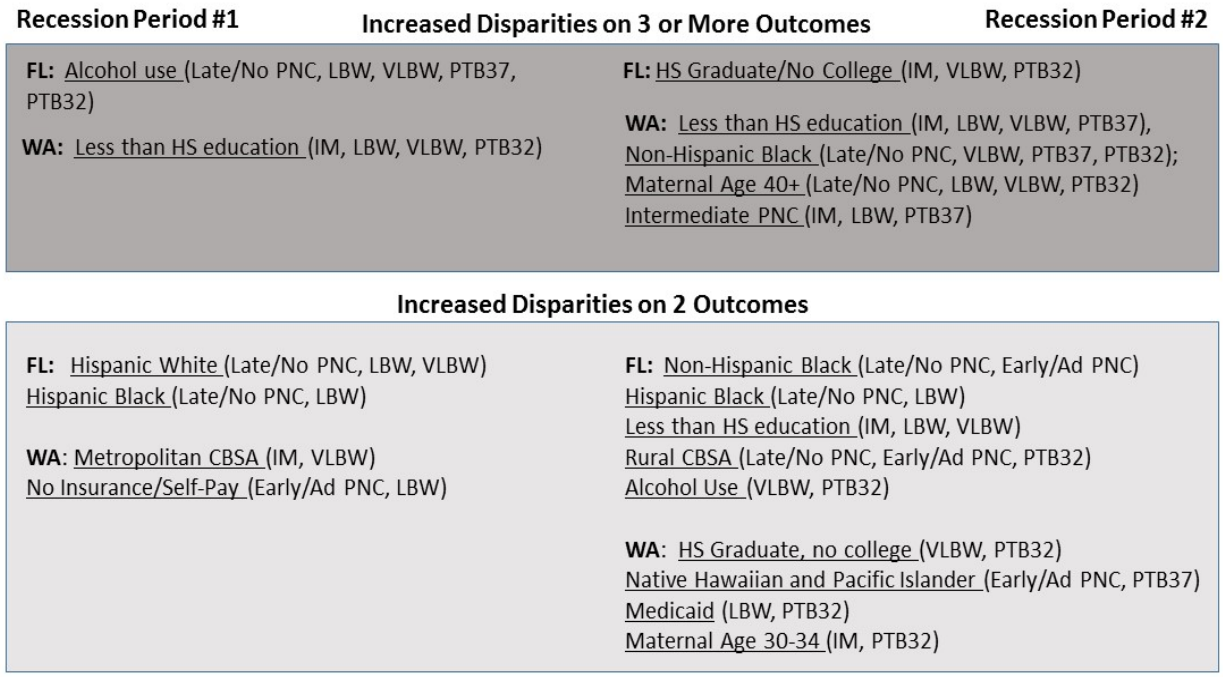

Figure 2. Population component groups with increasing disparities on two or three MCH outcomes compared to baseline

Appendix I: Recession Dates based on Economic and Stress Indicators

The recession was a surprise for most people, economists included.[1] However, by the time it was formally announced in December 2008 as having an official start date (December 2007) it was well understood that the United States and (by extension) the rest of the world were headed into a serious fiscal crisis.[2,3] The official Great Recession dates are December 2007 to June 2009.[3] These dates are based on an economic definition of recession and were retrospectively labeled by representatives from the National Bureau of Economic Research (NBER).[2,3] In order to try to define the recession from an individual perspective, I reviewed key recession events/dates as well as existing data on consumer sentiment (at the national level), unemployment (for both Washington (WA) and Florida (FL)), and a consumer stress index (for both WA and FL) that provide insight as to when individual stress levels related to the economy might have increased (Figures 1, 2, 3, 4).

In retrospect, the housing market increased from 2004-2006 (peaked in July 2006) and the first real signs of broad financial trouble came in March 2007 with the collapse of the subprime mortgage industry.[4,5] The subprime mortgage industry collapsed after higher than expected foreclosures which prompted many lenders to announce losses, declare bankruptcy, and/or put themselves up for sale.[4] This event, as can be seen in the consumer sentiment and consumer stress index graphs (Figures 2 and 3) coincided with downward financial and consumer sentiment trends starting in 2007—particularly in Florida.

Starting in August/September 2007, the Federal Reserve cut interest rates (these cuts were maintained, and at times increased as part of economic stimulus activities through 2013). Then, during 2008, three of the largest investment banks either went bankrupt or were sold at fire sale prices—Lehman Brothers (bankrupt); Bear Stearns & Merrill Lynch (sold); and others

shifted from investment-only status to commercial to obtain access to credit through the Federal Reserve.[6]

By July 2008, year-to-date home prices had declined in 24 of 25 U.S. metropolitan areas, with California and the southwest experiencing the greatest price falls.[7] It wasn't until October 2008—almost a year and a half after the subprime mortgage crisis—that the first large-scale government bailouts occurred (HR 1424/Bush Bailout which bought troubled stocks in banks and some troubled mortgages).[8] The Bush stimulus package was followed relatively quickly by the Obama Stimulus Plan (proposed in January 2009) which provided money for tax rebates, Medicaid support, social/unemployment assistance, and health system reform.[9] As of January 2009 California, Michigan, Ohio, and Florida were the states with the highest foreclosure rates.[10]

These events reverberated around the world and led to widespread financial distress—including increases in unemployment (Figure 1: Unemployment). To ascertain approximate dates of the onset and collective realization of the financial crisis in WA and FL we reviewed publicly available longitudinal data about unemployment, consumer sentiment, and consumer stress (Figures 1, 2, 3, 4).[11]

Unemployment was higher in WA than FL at the start of 2006 (FL = slightly above 3%; WA = about 5%) (Figure 1). In the latter part of 2006, FL unemployment started increasing and accelerated at an increasingly steep trajectory from the beginning of 2007 to surpass WA's level by late 2007. FL's rate of unemployment continued to increase after the official end of the recession in June 2009—peaking in late 2009/early 2010 (at above 11%) then slowly decreasing through the 2011 year—though it was still above 9% by the end of 2011. WA unemployment decreased from 2006 (around 5%) through the early part of 2008 (to approximately 4.75%) and then increased steeply and dramatically through 2008 and into 2009—peaking in late 2009/early

2010 (at just above 10%). Throughout 2010 and 2011, WA unemployment slowly decreased but was still just below 9% at the end of 2011. Based on unemployment rates FL's recession appears to have started at the beginning of 2007 (with rapidly rising unemployment) but WA's recession did not get started until the early part of 2008. Unemployment in both states continued to worsen until well into 2010 (almost a year after the official end of the recession).

Consumer sentiment and consumer stress levels also provide useful information about public experiences/perceptions of recession timing and dates. Historically, consumer sentiment is a labile index over time. For the purposes of this study, consumer sentiment was considered at the national level (as state levels were not readily available). The consumer sentiment index graph (Figure 3), retrieved from Federal Reserve Economic Data (FRED), was collected from the Primary Consumer Sentiment Index (PCSI) (a Thomson Reuters product) to provide insight into how consumers felt about current and future economic conditions, intentions, and expectations.[11,12] The index measures eleven key conditions as perceived by primary consumers in 24 countries and is highly correlated with other consumer confidence indices.[12] As can be seen in the Figure 2, a downward trend in consumer sentiment started at the beginning of 2007 (from a peak around 95%) and continued dropping, with some ups and downs along the way, until mid-2009 (with a trough around 57%). Since the beginning of 2009, sentiment slowly increased but took a steep dip in mid-2011 (back to about 57%). By the end of 2011 it leveled out to within two to five percentage points of 70%.

Similarly, the Consumer Stress Index, a quarterly measure, reflected increasing consumer stress among the population from 2006 onwards. The Consumer Stress Index is based on a proprietary 100-point scale that uses both publicly and privately available data about the following indices: (1) Employment, (2) Housing, (3) Credit, (4) Household Budget, and (5) Net

Worth to assess the financial condition of the average American consumer. Higher numbers indicate better conditions (Figures 3 and 4).[13]

As can be seen in Figure 3 for both FL and WA, scores decreased from 2005 to the beginning of 2006: both states were at about 77% just before the end of 2005. From there, both state's scores increased to above 80% in the early part of 2006 then FL's Index scores started to drop. FL's Index scores decreased at a steep rate but still remained above 75% until the beginning of 2007. From the beginning of 2007 Index scores in FL continued to fall, with little slowdown, until the end of 2008/beginning of 2009; bottoming out at approximately 60% in Dec 2008/Jan 2009. Since early 2009 there was a slow increase (with some ups and downs) but towards the middle/end of 2011 Florida's Consumer Stress Index score was still less than 65%.

WA's Consumer Stress Index Scores on the other hand, didn't start to decrease until late 2007. In late 2007, at the time of the official beginning of the recession, WA's Index score was approximately 77%; compared to FL's Index score which was just crossing from the 70th percentile into the 60s during the same time period. WA's Stress Index scores bottomed out in late 2009 at approximately 67%. From late 2009 through the end of 2011 its Index scores remained below 70%—with the exception of a brief rise above 70% (71/72%) in the early part of 2011.

Based on the Consumer Stress Index it appears that stress levels related to the economy started to increase in FL throughout 2006 then dramatically started increasing in 2007. In contrast, in WA, consumer confidence more closely reflects the official recession dates—with increasing stress starting in late 2007 through the end of 2009. In both WA and FL during the 2010-2011 years consumer stress remained higher than during the pre-recession period.[10]

In order to carry out pooled analyses of both WA and FL we decided to use the following time periods to represent pre-, intra-, and post-recession periods.

Period 1: January 2005-February 2007: Pre-recession for both WA and FL =January 2005-December 2006;

Period 2 (official Great Recession Period)[3]*: December 2007-June 2009:* Recession period for WA and FL

Period 3: January 2010-December 2011: Slow recovery/post-recession period

Alternate Period #2: July 2009-December 2010 (in the event that 2011 data was not available).

Despite indications that the recession may have started earlier and/or ended later than the official recession dates we chose to specify the Great Recession Period according to official dates as to be most comparable with other research during the time period.

Figures

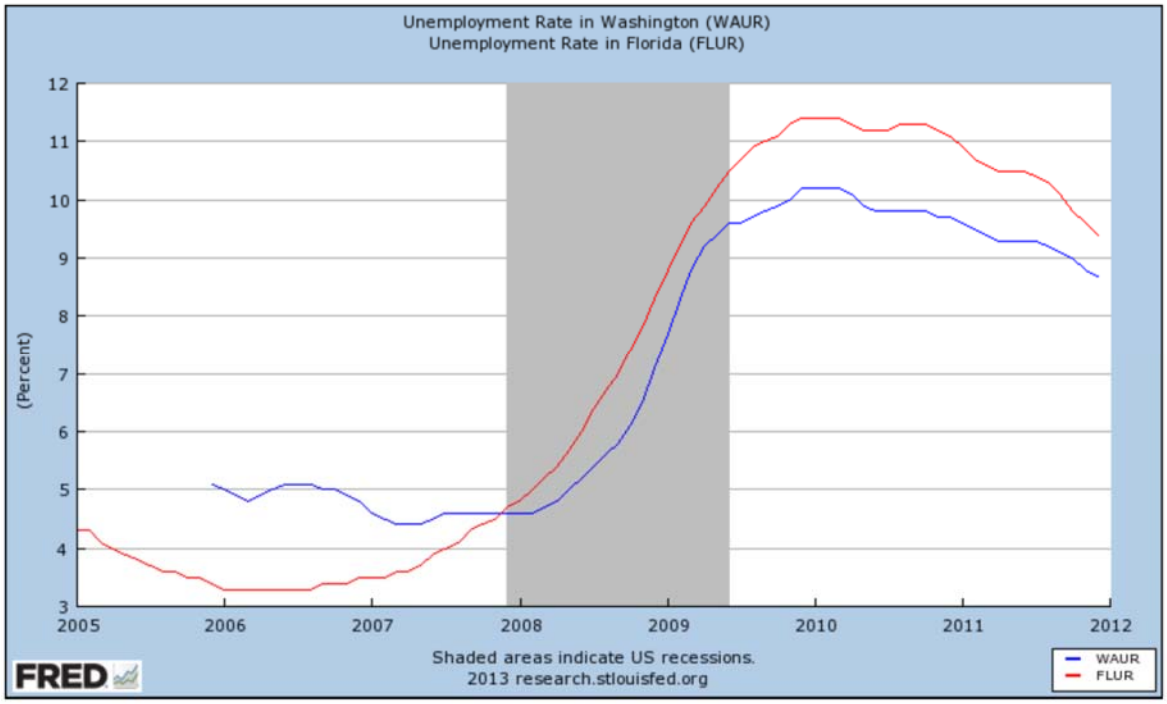

Figure 1. Unemployment[11]

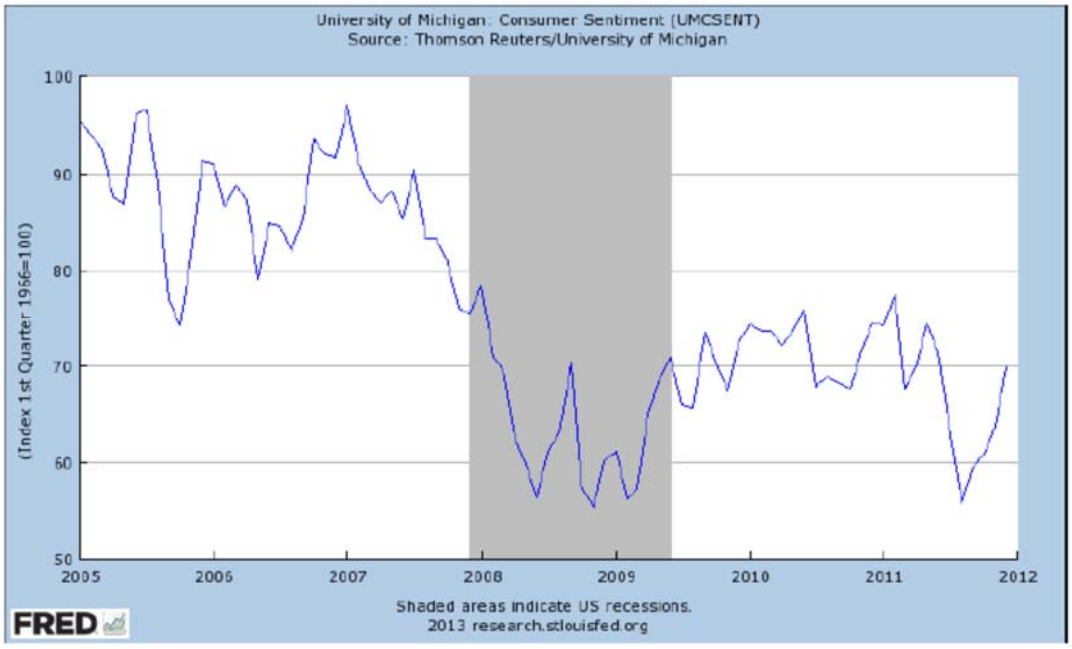

Figure 2. Consumer Sentiment[11]

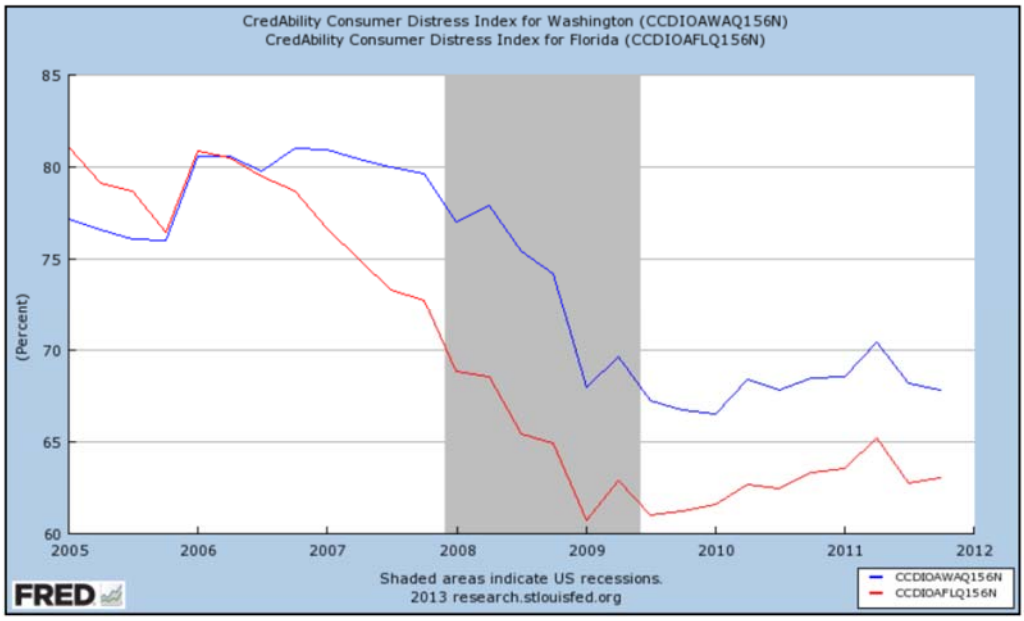

Figure 3. Consumer Stress Index[11]

LESS THAN 60	60-69	70-79	80-89	90-100
Emergency/Crisis	Distressed/Unstable	Weakening/At-Risk	Good/Stable	Excellent/Secure
The consumer is in the midst of a crisis and needs direct intervention to regain stability	The consumer is financially unstable and needs to take immediate action to address their problem	The consumer is at-risk of sliding into trouble and needs to take stabilizing action to prevent further problems	The consumer is stable, but should evaluate and explore options to strengthen their position	The consumer is secure and should continue current financial behavior and focus on long-term goals

Figure 4. Consumer Stress Index Categories[13]

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Appendix II: Study Population Flow Diagrams for Washington and Florida

Diagram 1: Florida Study Population Flow Diagram (Total Population→ Population included in Analysis)

Stage/Step	2005	2006	2007	2008	2009	2010	2011	Total
Initial (dta's /in STATA)	227695	238386	240289	232579	222491	215687	214334	1591461
Limit to 1st Births-Part 1 (limit to live births now living =1)	94518	99903	100831	97872	93028	89283	88683	757401
Limit to 1st Births-Part 2 (limit to live births now dead =0)	93943	99234	100181	97336	92467	88772	88219	660152
Limit to Singletons (plurality =1)	92435	97616	98518	95720	90905	87254	86645	649093
Population 'n' for analysis	**92435**	**97616**	**98518**	**95720**	**90905**	**87254**	**86645**	**649093**

Diagram 2: Washington State Study Population Flow Diagram (Total Population→ Population included in Analysis)

Stage/Step	2005	2006	2007	2008	2009	2010	2011	Total
Initial (dta's/in STATA)	84390	88634	90760	92157	90521	87730	88172	622364
Limit to 1st Births-Part 1 (limit to live births now living =1)	33050	35888	37576	38641	37842	36652	36510	256159
Limit to 1st Births-Part	33026	35861	37545	38621	37834	36638	36502	256027

2 (limit to live births now dead =0)								
Limit to Singletons (plurality =1)	32178	34865	36461	37377	36665	35413	35431	248390
Population 'n' for analysis	**32178**	**34865**	**36461**	**37377**	**36665**	**35413**	**35431**	**248390**

Appendix III: Data Dictionary

English Translation	Variable Name	Type (e.g., binary, continuous)	Data Dictionary Definition
Outcomes			
infant death	infant_death	numeric, binary (0,1)	1=infant died within first year of life (death before 365 years of age) **Missingness: Not able to determine if any missing; this is only coded as 1 (if infant died in 1st year of life); 0 (not recorded that infant died in 1st year of life)*
Late and No entry to prenatal care	late_no_tri	numeric (0,1)	1= Entered after 1st trimester, including those who never entered prenatal care **Missingness (checked for pnatalmo):* *FL (1): 61,890 (9.53%)* *WA (2): 19,667 (7.92%)* *Overall: 81,557 (9.09%)*
Inadequate + Intermediate PNC composite variable	early_adPNC	Numeric, binary (., 0, 1)	(.)= missing information 0= adequate or adequate plus =1 1= inadequate or intermediate care **Missingness:* *FL (1): 70,580 (10.87%)* *WA (2): 28,259 (11.38%)* *Overall: 98,839 (11.01%)*
Low birth weight	lbw	numeric, binary (0,1)	1=birth weight of less than 2500 grams **Missingness (assessed on wt_grams):* *FL (1): 44 (0.0067%)* *WA (2): 651 (0.26%)* *Overall: 695 (0.077%)*
Very low birth weight	vlbw	numeric, binary (0,1)	1=birth weight of less than 1500 grams **Missingness (assessed on wt_grams):* *FL (1): 44 (0.0067%)* *WA (2): 651 (0.26%)* *Overall: 695 (0.077%)*
Preterm (<37 weeks)	preterm_37	numeric, binary (0,1)	1=born before 37 weeks 0=born during or later than 37 weeks **Missingness (assessed on gestcalc)* *FL (1): 387 (0.06%)* *WA (2): 577 (0.23%)*

			Overall: 964 (0.11%)
Preterm (< 32 weeks)	preterm_32	numeric, binary (0,1)	1=born before 32 weeks (used for HP 2010 & HP 2020) **Missingness (assessed on gestcalc)* *FL (1): 387 (0.06%)* *WA (2): 577 (0.23%)* *Overall: 964 (0.11%)*
State & Date Variables			
Numeric state abbreviation	state	numeric, binary (1, 2)	1=FL 2=WA Numeric state abbreviation calculated based on which records have certno_e (ID for WA records) or idall (ID for FL records) **Missingness—no missing (0/0%)*
Date of birth year	birth_year	Numeric (2005, 2006, 2007, 2008, 2009, 2010, 2011)	Infant year of birth **Missingness (assessed on dob_yr):* *No missing data*
Official (NEBR recession dates)	recess_nebr	numeric (0, 1)	Official NEBR recession dates—Dec 2007-June 2009 1= born during NEBR recession period; 0=not during NEBR recession period **Missingness (assessed on dob_yr):* *No missing data*
Recession periods (2005-2011)	recess_yrs	numeric , categoric (1,2,3)	1= recess_baseline (Jan 2005-March 2007); 2= recess_1 (December 2007-June 2009); 3=recess_2 (Jan 2010-Dec 2011) **Missingness (assessed on dob_yr):* *No missing data*
Sub-population Variables			
Mother's race	race_mat1	numeric, categoric (1, 2, 3, 4, 5, 6, 9)	Mother's race (single race and binary 2 or more races): 1=white only; 2=Black/African American only; 3=American Indian/Alaska Native (AIAN) only; 4=Asian only; 5=Native Hawaiian or Pacific Islander (NHOPI) only; 6=2 or more races; 9 = missing For FL: Asian includes—Chinese (4), Japanese (5), Filipino (7), Korean(8), Vietnamese (10), Asian Indian (11), Asian other (12)

			For FL: NHOPI includes—Hawiian (6), Pacific Islander (15), Samoan (14), Guamanian (13) *Missingness:* *FL (1):7744/649093=1.19%* *WA (2): 2906/248390=1.17%* *Overall: 10650/897483=1.19%*
Mother's ethnicity	mat_hisp	numeric, categoric (1, 2, 3, 4, 5)	Mother's ethnicity: 1=non-Hispanic White, 2=Hispanic White, 3=non-Hispanic Black; 4= Hispanic Black, 5=Cuban *Missingness:* *FL (1): 37918/649093=5.84%* *WA (2): 42042/248390=16.92%* *Overall: 79960/897483=8.9%*
Infant Sex	SEXBC	numeric, binary (1, 2)	1=female, 2=male *note: per Kotelchuck Index protocol unknown sex assigned to female; total n missing converted to female (<10)
Composite maternal education categoric variable, limited to mothers at least 20 years of age	educat_m	numeric, categoric (1,2,3)	1= Less than High School Education (ed_less_hs) 2= High School Diploma or GED, no College (ed_hs) 3= Some College (ed_scoll) ***Note—missingness is higher because moms under the age of 20 are excluded* *FL (1):173297/ 649093=26.70%* *WA (2):56610/248390 = 22.79%* *Overall: 229907/897483 = 25.62%* **Missingness drops dramatically if not limiting to mom's age>20* *1356/668932 = 0.20%*
Payment Source for Delivery	pay_source	numeric, categoric (1, 2, 3, 8, 9)	1=Medicaid (or a comparable state program); 2=private insurance (Blue Cross/Blue Shield, Aetna, etc.); 3=self-pay (no third party identified); 8=other (indian health service, CHAMPUS/Tricare, other government, federal, state local); 9= unknown *Missingness (missing or unknown):* *FL (1): 3332/649093=0.51%* *WA (2): 6670/248390=2.70%* *Overall: 10002/897483=1.11%*

Mother's age categories	agecat_m	numeric, categoric	1=min to age 14; 2=15-19 years; 3=20-24; 4=25-29; 5=30-34; 6=35-39; 7=40+ **Missingness:* *FL (1): 145/649093=0.02%* *WA (2): 100/248390=0.04%* *Overall: 245/897483= 0.03%*
Mother married?	married_n	numeric, binary (0, 1)	Is the mother married? 0=no (in FL "no" includes 40 widowed); 1=yes *Missingness--Note: missing includes unknowns* *FL (1): 79/649093=0.01%* *WA(2):688/248390=0.30%* *Overall:767/897483=0.09%*
Mother received WIC?	mat_wic	numeric, binary (0, 1)	Did the mother receive WIC during pregnancy? 0=no; 1= yes *Note: missing includes 31208 unknowns* *Missingness:* *FL (1): 7996/649093=1.23%* *WA(2):23212/248390=9.34%* *Overall:31208/897483=3.48%*
Mother foreign-born	fborn_m	numeric/ categoric (0,1)	=1 if mother not born in the United States based off: FL: mother_birth_country_code; WA: bctrymom **Missingness:* *FL (1): 790/ 649093 = 0.12%* *WA (2): 0/248390 = 0.00%* *Overall: 790/897483 = 0.09%*
Two factor summary Kotelchuck index	INDEXSUM	numeric, categoric (0, 1, 2, 3, 4)	Two factor summary index (combines EVINDEX and MOINDEX4): 1=inadequate utilization of prenatal care (0-49% of expected visits; 2=intermediate utilization of prenatal care (50-79% of expected visits; 3=adequate utilization of prenatal care (80-109% of expected visits; 4=adequate plus utilization of prenatal care (110% + of expected visits; 0=missing information

			Missingness: *FL(1):70580/649093=10.87%* *WA(2):28259/248390=11.37%* *Overall: 98839/11.01%*
Maternal alcohol use during pregnancy	mat_alcohol *FL only	numeric, binary (0, 1)	Q: "was alcohol used at any time during pregnancy?" 1= yes 0=no *Missingness:* *2465/649093 = 0.38%*
Mean number of cigarettes per day during 3 months before and during 3 trimesters of pregnancy	mean_cigs *WA only	numeric, continuous	Continuous, includes reported average # of cigarettes per day during 3 months before and each of the three trimesters of pregnancy *inclusion of 3 months prior to pregnancy included based on recs of *Lynch et al., 2011 "Smoking in pregnancy and parenting stress"* *Missingness:* *3454/248390 = 1.43%*
Categoric smoking variable	cat_cigs *WA only	numeric, categoric (1, 2, 3)	Categorizes maternal smoking into 3 groups (based off mean_cigs calculations): 1=nonsmokers (no cigarettes/day) 2= light smokers (up to avg 14 cigarettes/day) 3=heavy smokers (avg of 15 or more cigarettes/day) *Missingness:* *1589/248390 =0.64%*
LHD's PHAST study ID number	PHAST_ID	alpha+numeric, categoric	Local health department ID number (same as PHAST study) **Missingness:* *FL(1): 5029/649093=0.77%* *WA(2): 63/248390=0.03%* *Overall: 5092/897483=0.57%* **NOTE—WA Missingness increases for some vars below as there is a category of out of state LHD in PHAST_ID and LHD that converts to missing for other vars*
Top 1/3 poorest LHDs	PHAST_poor	numeric, categoric (1, 2)	1=Top 1/3 poorest LHJs as identified by PHAST study (using SAIPE 2005 data—top 1/3 of LHJs where % of people age 0-17 were in poverty by state)

			2=Not poor-- Not in top 1/3 poorest LHDJ as identified by PHAST study *Missingness:* *FL(1): 5029/649093= 0.77%* *WA(2): 3376/248390= 1.36%* *Overall: 8405/897483= 0.94%*
Core Based Statistical Area	cbsa_2005	numeric, categoric (1, 2, 3)	1=metro (area contains a core urban area of 50,000 or more population) 2=micro (area contains an urban core of at least 10,000 (but less than 50,000) population) 3=rural (neither categorized as metro or micro) Note: "each metro or micro area consists of one or more counties and includes the counties containing the core urban area as well as any adjacent counties that have a high degree of social and economic integration (as measuring by commuting to work) with the urban core." (Census.gov) *Missingness:* *FL(1): 5029/649093= 0.77%* *WA(2): 3376/248390= 1.36%* *Overall: 8405/897483= 0.94%*

For Appendices IV, V, and VI, see Supplemental Dissertation Materials.

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Paper One

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PAPER TWO

SOCIAL DETERMINANTS OF HEALTH AND DISPARITIES IN PRENATAL CARE DURING THE GREAT RECESSION

Abstract

Objectives

Early, regular prenatal care (PNC) is an important strategy for improving maternal and infant health outcomes. The purpose of this study is to better understand contributing factors to disparate PNC outcomes among women of different racial/ethnic and social status groups before, during, and after the Great Recession (December 2007-June 2009).

Methods

Data from 678,235 birth certificates were linked to local community (county/local health jurisdiction) and state characteristic data to carry out cross-sectional pooled time series analyses. Predictors of late or no entry to PNC (late/no PNC) among pregnant women in the states of Washington and Florida were identified and compared. A simulated triadic relationship among time (within recession-related periods), social characteristics, and PNC by clustering individual predictors into three scenarios representing low, average, and high degrees of social disadvantage was also explored.

Results

Individual and community indicators of need (e.g., maternal Medicaid enrollment, unemployment rate) increased during the Recession. Associations between late/no PNC and individual-level characteristics (including disparate associations among race/ethnicity groups) did not shift greatly. However, the magnitude of association between community level partisan

voting patterns and expenditures on some MCH programs increased in non-beneficial directions. In contrast, maternal WIC enrollment exhibited a protective association against late/no PNC.

Conclusions

Our findings provide a compelling picture of the important roles that individual characteristics—particularly low education and young age—play in late/no PNC among pregnant women. Simulated scenarios show a high combined impact on PNC among women who have multiple disadvantages. Associations between partisan voting patterns and late/no PNC should be further explored. Finally, WIC may have played a valuable role in reducing late/no PNC, and its effectiveness during the Great Recession should be further explored.

Background

Nearly one-third of births in the United States (U.S.) have a pregnancy-related complication.[1] Early (within the first trimester) and regular prenatal care (PNC) is known to be an important strategy for improving health outcomes for mothers and infants.[2] Improved birth weight and decreased risk of preterm delivery are two of the most significant benefits of early and ongoing PNC.[3] Infants born to women who do not receive PNC are three times more likely to have a low birth weight and five times more likely to die than infants born to mothers who receive PNC.[4,5] Improved infant health outcomes associated with early PNC have both quality of life and cost implications. Average medical costs for a premature or low birth weight infant during the first year of life are about $55,393, whereas annual costs for a newborn without complications averages $5,085.[6]

Racial/ethnic disparities in timing of entry to PNC are well documented and persistent in the U.S.—despite improvements in recent years and national attention to disparity elimination as a primary goal of the U.S. Department of Health and Human Services (DHHS) Healthy People

program.[2,7] Disparities are widely recognized to be complex and multi-faceted at many levels. Their existence ranges from differences that are apparent at the individual level to health outcomes that represent macro-social differences in political ideologies and wealth distribution.[8,9] Previous research has found that persistent disparities associated with PNC are predominantly related to social determinants of health including social circumstances, access to medical care, and behavioral patterns.[10]

Despite literature pointing to access to care as a major contributor to disparate PNC outcomes, recent research by Oakman, Blendon, Campbell, Zaslavsky, and Benson (2010) suggests that public perceptions of access to care issues (for all types of care, not just PNC) may split along largely partisan lines.[11] In a 2009 survey, Oakman et al. (2010) found that the perception of 34% of Republican-identifying respondents was that the "uninsured are able to get necessary care" and that obtaining care was "not too difficult" or "not at all difficult," while only 18% of Democrat-identifying respondents responded the same way.[11] These differences in perceptions about the difficulties encountered in accessing care also carried over to perceptions of whether the uninsured "receive the same quality of care as insured Americans": 42% of Republican-identifying respondents felt that this was the case in contrast to only 27% of Democrat-identifying respondents. Given these findings, partisan differences in perceptions of access to care and quality of care might conceivably translate into differences in health policy and funding of safety net programs at state and local levels that may also influence PNC for some populations.

Using methods recommended by the DHHS Healthy People program,[12-14] we recently found that late/no PNC increased among some groups during the Great Recession (December 2007-June 2009) in Washington (WA) and Florida (FL) (Appendix I). We also confirmed the

presence of PNC outcome disparities in WA and FL (the same study population used in this study) among groups defined by race/ethnicity and other social status characteristics (e.g., education, insurance status, age, marital status).[15] Specifically, we identified widened PNC disparities among non-Hispanic Black (Black) women compared to groups with "best" outcomes—non-Hispanic White (White) women in WA and Cuban in FL—during and after the Great Recession. For example, our study showed that prior to the Great Recession, 15.3% of White and 20.9% of Black mothers in WA received late or no PNC. During the Great Recession, rates of late/no PNC increased for both groups—to 17.4% and 28.4%, respectively. The steeper increase among Black mothers yielded a 26.8% increase in disparity in relation to White mothers (see Blakeney (n.d.)[15] (Paper One) for additional details).

During the Great Recession in the U.S. indicators of need—such as the percent of children in poverty, unemployment rates, and consumer distress—increased.[16,17] Historically, Black and Hispanic populations have had higher rates of unemployment compared to Whites, and during and after the Great Recession these disparate rates were maintained.[18] All ethnic groups experienced increases in unemployment during the Great Recession, but Blacks continued to have the highest unemployment rates, Whites had the lowest, and Hispanics fell between the two.[18] At the same time, community level safety-net resources, including many MCH programs provided by local health departments (LHDs) experienced cuts which may have contributed to increased difficulties among pregnant women in accessing PNC—particularly during the earlier phases of the Great Recession and before stimulus funds became available.[19-22]

Existing research into associations between community-level economic decline and MCH health outcomes largely demonstrate negative effects.[23,24] Little is known about implications of the Great Recession for MCH disparities as differential experiences or impacts among vulnerable

groups (e.g., by race/ethnicity) because they were rarely taken into consideration in published studies related to past recessions.[23,24] During a recession in the early 1980s, Fisher, LoGerfo, and Daling (1985) found increases in late entry to PNC in WA.[25] In that study, the authors found a specific increase among those who resided in low income census tracts (compared to high); however, they did not explore differential increases among race/ethnicity groups. While few studies are as directly relevant to our study as the research by Fisher et al. (1985), a robust complementary body of research describes how economics/jobs can be a major source of stress with serious health implications.[25] Pearlin, Schieman, Fazio, and Meersman (2005) described how episodic financial strains have fewer negative impacts on health than ongoing financial strains.[26] In the context of the Great Recession, this suggests that while people of all levels of social advantage/disadvantage may have experienced more stress than normal during fiscal crises, those with greater social advantage and less combined stress may fare better in terms of their finances and health than those who were already under financial strain and greater combined social disadvantage. Pearlin et al. (2005) also suggested that stress proliferates (more stress leads to more stress) and that transitional events, especially those that are undesired and involuntary (e.g., layoffs/unemployment), may negatively impact well-being and over the long term take a toll on health.[26] The implication for MCH outcomes is that, during a recession, both maternal and infant outcomes are likely to worsen with increased maternal stress for women of all social status levels—but existing stress-influenced disparities are likely to increase.

Methods

In this study we assembled and linked a variety of individual and community-level indicators to better understand factors contributing to PNC outcome differences and persistent (or widening) disparity associations using a cross-sectional pooled time series design. Particular

attention was focused on indicators that may have changed during the Recession, such as unemployment rate, partisan voting patterns, or per capita LHD expenditures on WIC and other MCH programs (Table 1). We also examined a simulated triadic relationship among time, degree of social disadvantage, and late/no entry to PNC during three recession-related time periods among pregnant women of different race/ethnicity groups to compare predicted probabilities of late/no PNC for three representative scenarios of social disadvantage ("high," "average," and "low").

The three recession-related time periods were defined: Baseline Period #0 before the Recession (January 2005-March 2007), Recession Period #1 (December 2007-June 2009—as officially defined by the National Bureau of Economic Research (NBER)[20]), and Recession Period #2 (July 2009-December 2010).[15] Recession Period #2 was defined to encompass the months and years after the official Recession Period (#1) during which community-level economic indicators such as unemployment continued to be elevated above baseline (Period #0) levels.[18,35]

Data

De-identified data from all birth certificates from WA and FL for the years 2005-2010 were retrieved through data-sharing agreements with the Departments of Health (DOH) in FL and WA with institutional review board approval from the University of Washington and the FL State Department of Health. These states were selected for inclusion as both experienced a tremendous downturn in economic markers during the Great Recession and both had comparable LHD expenditure data available for the study time period.[17,19,20,34-36] The LHD and community data derive from publicly available datasets and have been incorporated into recent MCH-focused studies.[28,34] Individual birth certificates were linked to county/Local Health Jurisdiction

(LHJ)/LHD data using maternal county of residence. All data were cross-sectional and secondary.

The study population consisted of 678,235 individual pregnant women having their first singleton live births (492,691 in FL; 185,544 in WA) who resided in the 102 LHJs in WA and FL. LHJs follow county lines in FL and in WA, and in WA, three LHJs were comprised from multiple counties. The study was limited to women whose infants had complete birth certificate information on race/ethnicity, maternal county of residence, and timing of entry to PNC.

Measures

Predictors for entering PNC after the first trimester of pregnancy were examined. To measure this outcome, a binary variable was created with "0" indicating those who entered PNC during the first trimester and "1" indicating those who entered PNC after the first trimester of pregnancy, or who did not receive PNC at all. Covariates were selected based on conceptual and previous research linking them to MCH outcomes—individual, community and LHD expenditure measures and state dummy variables were included. Table 1 provides a complete list of these covariates and related literature supporting their incorporation.

To facilitate estimation of combined effects of social disadvantage during the second part of the analysis, individual characteristics found to be related to late/no PNC were grouped into scenarios representative of low, average, or high social disadvantage (Table 2).[37] The low social disadvantage scenario was specified with characteristics associated with "best" outcomes in a previous study using similar data.[15] In our regression models these groups were the referents. The average disadvantage scenario was defined based on majority/modal population characteristics. Fewer characteristics were defined for the average scenario as there was not a clear majority with regard to marital status and insurance type at the time of delivery. The high

disadvantage scenario was defined as those individual-level characteristics most associated with late/no PNC. In this scenario, while maternal age <14 is the age most highly associated with late/no PNC, we substituted maternal age 15-19 as it occurs much more frequently.

Analysis

We carried out analyses in three steps: (1) descriptive statistics of study variables (Tables 3 and 4); (2) regression model specification to identify predictors of late/no entry to PNC for each recession-related period; and (3) estimation of predicted probabilities for race/ethnicity groups for the three social disadvantage scenarios (low, average, and high) at Recession Periods #0, #1, and #2.

Regression Model Specification. Using a pooled cross-sectional time series design, multivariate linear probability regression models (LPMs) were estimated to identify which covariates were predictive of late/no PNC for the total study population (WA + FL) during Recession Periods #0, #1, and #2. Models were adjusted first for individual, then community, and finally LHD expenditure covariates described above and in Table 1. We conducted all analyses using STATA version 12.[43] Clustering of individuals within LHJs was addressed using robust standard errors (SEs), correcting for effects of geographically clustered data[44] and for the inherent heteroscedasticity in LPM. Entry to PNC by definition occurs at some point during the nine-month course of pregnancy—because of this proximate relationship, no time lags were introduced into the economic data. A value of $P<0.05$ was used to establish statistical significance. Model specification included running models with each of the available LHD expenditure variables. Final preferred model selection was informed by comparing results of Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) tests for specified models.[45] The LPM model results are reported as their coefficients because they are more

readily interpretable than odds ratios produced by logit models and, given the large N and robust SEs, the assessment of the statistical significance in the LPM is not a significant problem. Final models were also estimated using logistic regression to ensure consistent outcomes and are available in Appendix II.

Calculation of Predicted Probabilities for Three Social Disadvantage Scenarios. Following regression modeling, we estimated the predicted probability an individual has of late/no PNC given a set of fixed characteristics.[46] Values for individual covariate characteristics were set for each of the three social disadvantage scenarios—low, average, and high—and predicted probabilities of late/no PNC were calculated for White, Black, and Hispanic subpopulations (Tables 2 and 5). This approach facilitated practical interpretation of the combined effects of social status characteristics that tend to cluster together along the range of social advantage/disadvantage. In these calculations, non-specified variables were assessed at their actual observed values.[46,47] Predicted probability of late/no PNC was estimated for the total study population as well as for each state by specifying state dummy variables within scenarios (Table 5).

Results

Profile of Women Who Entered PNC Late and Summary of Economic Indicators

The characteristics of the study population are presented in Table 3. Women who entered PNC late or not at all (compared to those who entered in the first trimester) were younger (twice as likely to be teenagers), less likely to be married, slightly more likely to be foreign-born, and almost twice as likely to have less than a high school (HS) education (9.49% vs. 5.11%) (of those who could have finished HS). They were also nearly twice as likely to be on Medicaid and had a higher rate of WIC utilization.

During the study period, unemployment increased dramatically in both states (Table 4). FL unemployment rates more than doubled by Period #1 and then tripled by Period #2 from its baseline. In WA, unemployment increased, but not as dramatically—from 5.14% (SD 0.94%) at baseline to 6.61% (SD 2.20%) during Period #1 and to 9.71% (SD 1.54%) during Period #2. WIC enrollments and Medicaid as a proportion of payers also increased in both states, but more in FL than in WA for both indicators. Per capita LHD expenditures varied widely in both states, but mean expenditures had an overall trend toward decreased per capita spending for family planning (FP) and for a composite of maternal/infant/child/adolescent (MICA) service lines.[28,34] We also combined FP and MICA to create the 2MCH expenditure variable (combined expenditures for two MCH services (FP and MICA)) in our regression models (Table 1) in both states over the course of the study period. Among LHDs in FL, per capita 2MCH expenditures decreased from $8.79 (SD $5.67) during the baseline period to $8.18 (SD $5.54) during Period #1 to $7.84 (SD $5.11) during Period #2. In contrast to LHD decreases in 2MCH expenditures, WIC expenditures among LHDs generally increased during the study period in both states—from $4.10 (SD = $1.98) during the baseline period to $4.55 (SD=$2.30) during Period #1 and $5.02 (SD = $2.60) during Period #2.

Regression Models Results Within and Between Periods

Table 6 summarizes the results of all final models (for Recession Periods #0, #1, and #2). Only minor variations in coefficient magnitudes were found among individual-level categoric characteristics within model steps or across study periods. For example, the difference in probability of late/no PNC for Black mothers (compared to the White reference group) was positive during all steps and periods and increased only slightly over time (from 0.032 to 0.037). All individual-level coefficients were positive with the exception of maternal WIC enrollment—

which exhibited a relatively stable negative coefficient (-0.010 to -0.012). The largest magnitude individual-level predictors were young age (age <14 and to a lesser degree age 15-19) and having less than a HS education. Those aged 14 years and younger had a 0.259 to 0.262 greater probability of late/no PNC compared to the referent group (age 30-34), while those age 15-19 had a 0.087 to 0.097 greater probability of late/no PNC than the referent group. Women who had less than HS education had a 0.061 to 0.084 greater probability of late/no PNC compared to women with at least some college. Having Medicaid or being uninsured (self-pay) were also significant positive predictors during both Recession Periods #1 and #2, but not during the Baseline Period.

Three continuous community level variables were significantly associated with late/no PNC: (1) per capita MDs (negative coefficient, only significant during the Baseline Period); (2) maternal residence in a high poverty LHJ (negative coefficient, significant during Periods #1 and #2 but not during the Baseline); and (3) percent of LHJ residents voting Republican in a national election (positive coefficient significant during all model steps and time periods—increasing from 0.001 at Baseline to 0.002 during Periods #1 and #2 in the final models). In terms of LHD expenditures, per capita WIC expenditures were negative for late/no PNC but not significant at any time period. However, the 2MCH coefficient representing LHD FP and MICA expenditures was positive during each time period (Baseline Period #0 = 0.0012, Period #1 = 0.0019, Period #2 = 0.0025) and significant during Periods #1 and #2. The state dummy variable was not significant.

Predicted Probability Results and Comparisons

Results of predicted probability calculations for each of the three social disadvantage scenarios (low, average, high) are summarized in Table 5. Those with combined social

characteristics associated with low social disadvantage would be less likely to enter PNC late or not at all (range = 0.033 to 0.076) than those with average social status (range = 0.116 to 0.158) for all race/ethnicity groups at all time periods. Those with characteristics representing a high degree of social disadvantage would be the most likely to enter PNC late or not at all for all race/ethnicity groups at all time periods (range = 0.379 to 0.522). Differences between race/ethnicity groups within social disadvantage scenarios were much smaller within as compared to between scenarios (the difference between Hispanics and Whites is non-significant and the difference between Blacks and Whites is significant at about 0.03).

Discussion

Overall, young maternal age and having less than a HS education were found to be the largest individual-level contributors to late/no PNC among pregnant women in WA and FL during all three recession-related periods. Relative contributions of individual-level predictors were found to exhibit minimal variation across time periods compared to themselves. In contrast, associations between community (particularly percent voting Republican) and LHD expenditure variables and late/no PNC revealed variation over time (compared to Baseline Period #0).

Predicted probability results clearly demonstrate the increased levels of late/no PNC among women with higher degrees of social disadvantage (Tables 2 and 5). There was little change in these relationships despite changes in need and resources over the course of the Great Recession. While only small changes in coefficient size of race/ethnicity variables were observed in regression modeling and some covariates consistently contributed to a larger degree than others (e.g., education and age were larger contributors than foreign-born status or marital status), the effects of combined social disadvantage were visible in the disparate racial/ethnic

relationships in late/no PNC in predicted probability results. Disparate relationships in PNC among Black versus White race/ethnicity groups were maintained, within each level of social disadvantage, with Whites being least likely and Blacks being most likely to enter PNC late or not at all. Hispanics consistently fell between Whites and Blacks, though once individual characteristics were controlled for, the difference between Whites and Hispanics was non-significant. These findings are consistent with differential patterns of unemployment by race/ethnicity groups over the course of the Great Recession as well as the findings of Pearlin et al. (2005) and Braveman et al. (2014).[18,26,37]

Evidence emerged that WIC may have contributed to reductions in late/no PNC over the course of the recession periods—even in the face of increasing local need. In addition, WIC may have been more effective at reducing late/no PNC than the other MCH safety net programs for which we had LHD expenditure data. This finding suggests that the increased WIC enrollment and related increases in local WIC expenditures observed over the course of the Recession may have been particularly beneficial and protective against late/no PNC among disadvantaged populations. WIC was the only safety net program for which both individual and community level data were available. It is possible that more nuanced effects among high-need populations targeted by family planning and/or MICA programs with decreasing expenditures were missed; alternatively, results may reflect the general decline in LHD expenditures.

Regarding LHD expenditures, our findings are consistent with Bekemeier, Yang, Dunbar, Pantazis, and Grembowski (2014) who found (using the same LHD expenditure data) that WIC did and 2MCH did not follow changes in local need during the Recession. In our case, LHD expenditures on WIC services were negatively predictive of late/no PNC, but not significant at any point. Our findings related to 2MCH were also consistent with Bekemeier et al. (2014).[28]

The coefficient size for 2MCH increased over time and was positive rather than negative as might be expected of an MCH program. When considered from the perspective of a $10 increase in per capita MCH expenditures (which would be unlikely as 2MCH budgets generally decreased during the Recession but is a useful example), the probability of late/no PNC increased over the course of the study period from 0.01 (0.001 x 10) to 0.03 (0.003 x 10). This is about the same difference in probability observed between Black and White women. During this same time need increased and 2MCH budgets decreased, indicating that the observed increased association may be related to increases in level of need and LHDs stretched to essentially do 'more with less' during this study period.[48] Further exploration would be beneficial to understanding this association.

Regarding partisan voting and access to care issues raised by Oakman et al. (2010),[11] we found that the coefficient of percent of residents voting Republican in an LHJ doubled from the Baseline (0.001) to Recession Period #1 (0.002) and Recession Period #2 (0.002). The range of percent of Republican voters in WA and FL LHJs during the Baseline Period was 29.94% to 78.25% and 28.60% to 82.95% during Recession Period #1; with mean percentages of LHJ residents voting Republican in the 2004 election at 50.56% during the Baseline Period (2004 presidential election data) and 45.86% during the Great Recession (2008 presidential election data). This translates to a difference in probability of late/no PNC ranging from 0.03 to 0.08 at Baseline and 0.06 to 0.17 during the Recession. This suggests that women in LHJs with the lowest percent of residents voting Republican had nearly a 0.05 difference in probability of late/no PNC compared to those in the highest percent voting Republican LHJs during the Baseline, which increased to 0.11 during the Recession. In other words, the effect of living in an LHJ with approximately 50% of the population voting Republican (the mean)—compared to the

LHJs with lowest proportion voting Republican—had about the same effect during the Recession (0.092-0.06 = 0.032) on a woman's probability of late/no PNC as being unmarried (0.032-0.042) or Black (0.032-0.037). This represents an increase from the Baseline Period (0.051-0.03 = 0.021).

Limitations

There were many limitations to this study and some are associated with the review of secondary data (missing or inaccurate). First, while we limited analysis to first-time mothers with singleton births (to reduce issues of repeated measures and increased health infant risks associated with multiple births), generalizability of our results may be limited. Second, WA and FL both had heavy economic downturns during the Great Recession and lumping them in the modeling may not have captured key differences or differential impacts within states. To allow for consideration of individual states' results, we included state-only models for reference in Appendices III and IV. While no significant state-level differences were identified in the models of the total population, demographic differences with WA and FL may have influenced state-level model results. Third, we used 2008 presidential voting data for both Recession Periods #1 and #2, and there may be better measures that would more effectively describe the differences in policy-making than what the partisan voting covariate identifies. Finally, not all WIC expenditures in each state were represented in our models—only those that were expended by LHDs. Some LHJs may have alternative providers of WIC and other MCH services. The non-significant associations that we identified with LHD WIC expenditures may be due in part to this as well as to the fact that WIC is a targeted, need-based program while our study population represented all pregnant women and not only those with need and/or who were eligible.

Conclusion

In this study we found that relative contributions of individual predictors remained largely consistent over the course of the Great Recession. Young maternal age and low maternal education were the largest magnitude individual predictors of late/no PNC during all three recession-related periods. Clustering of individual predictors into low, average, and high social disadvantage scenarios clearly demonstrated the disparate combined probability of late/no entry to PNC, as well as persistent racial/ethnic disparity within each level of social advantage/disadvantage. Community and LHD expenditure variables exhibited greater variation—over time, percent voting Republican and 2MCH were both increasingly associated with late/no PNC in a non-beneficial direction, while WIC enrollment at the individual level appears to have been protective against late/no PNC. These associations should all be further explored. Our findings provide a compelling rationale for targeted outreach to pregnant women with high disadvantage characteristics—particularly those with low education and young age. WIC may represent an effective approach to reducing late/no PNC and its effects during the Great Recession should be further explored.

Table 1

Covariates for Regression Models

Covariate Level	Covariate Name/Description
Individual	• Race/ethnicity: non-Hispanic White (White), Hispanic White (Hispanic), non-Hispanic Black (Black)[a] • Maternal age • Marital status (Married/Unmarried) • Mother foreign-born (Yes/No) • Maternal education (Less than HS; HS Diploma or GED; some college not assessed (age < 20 years)) • WIC (maternal WIC enrollment) (Yes/No) • Maternal insurance status (e.g., Medicaid or private insurance).
Community[b] (at the LHJ level unless otherwise indicated)	• Core Based Statistical Area (CBSA) (metropolitan, micropolitan, or rural) • Community poverty (binary variable, 1 for LHJs with highest percentage (top 1/3) of residents age 0-17 in poverty in each state, 2 for lower number of residents age 0-17 in poverty (non-poor LHJs)[28,29] • Partisan Voting Patterns: Percent of voters voting Republican (vs. Democrat or Independent) in the 2004 and 2008 presidential elections [11,30,31] • Gini coefficient (2000 census; measure of income distribution/inequality (0-1), larger number > inequality), measuring levels of income inequality[32] • Per Capita General and Family Practitioner MDs/LHJs (for years 2005, 2008, 2010)[28,33,34] • Per capita LHJ unemployment rate[d]
Expenditure[e]	• Total LHD expenditures • WIC expenditures • Family Planning (FP) expenditures • Maternal/Infant/Child/Adolescent (MICA) services expenditures • 2MCH--Combined expenditures for 2 MCH services (FP and MICA)[f][28,34]
State	• State-level dummy variables were created for WA and FL to capture any state-level differences.

Note. [a]Race/ethnicity groups were defined using data from two separate variables (maternal race and maternal ethnicity) to create a 3-category combined race/ethnicity variable. [b]Community level covariates were selected based on previous research or for which social determinants of health theories suggest a plausible association to MCH outcomes in the context of the Recession.[9,10,27] [c]The partisan voting patterns measure was intended to act as a proxy for differences in political orientation at the community level as previous research has identified Republican voters as less likely than Democrats to perceive that there are people in the United States who encounter access to care issues and are less likely to support public health reform.[11] [d]Individual unemployment data were not available. [e]LHD-specific per capita expenditure data were included in the preliminary model as the Recession yielded widespread reports of budget cuts to LHDs.[22] Per capita rates were calculated using total LHJ population as a denominator. Differences in fiscal years between WA and FL were reconciled by assigning FL's FY to the earlier year (e.g., FL FY 2005-2006 associated with WA FY 2005). [f]MICA[28,34] represents a composite of similar expenditure categories for WA and FL LHDs that includes comparable intervention activities among LHDs in both states—e.g., home visiting, prenatal health programs.

Table 2

Social Disadvantage Status Characteristic Constellations

Low Disadvantage	Maternal age 30-34 years old, married, not foreign-born, at least some college education, private insurance.
Average	Maternal age 25-29, not foreign-born, at least some college education.
High Disadvantage	Maternal age 15-19 years old, foreign-born, not married, having less than a HS education, without insurance at the time of delivery.

Note. (1) Characteristics representative of an "average" scenario were defined based on majority (modal) population characteristics. (2) Not all possible characteristics included in scenarios (e.g., maternal age 20-24) as they were defined to represent extreme ends of the social advantage/disadvantage spectrum.

Table 3

Compari.son of Demographic and Perinatal Characteristics: Study Population for FL, WA, Total Study Population, and United States (n/% unless otherwise indicated) by timing of Entry to Prenatal Care (for entire study period)[a]

	FL Late Entry n=100,471 (17.79%)	**FL Non-Late Entry** n=457,510 (82.2%)	**WA Late Entry** n=40,037 (18.87%)	**WA Non-Late Entry** n=169,938 (81.12%)	**Total Late Entry** n=140,508 (18.30%)	**Total Non-Late Entry** n=627,448 (81.70%)	**U.S. (2008)**[38] n=1,703,921 *(first births unless otherwise indicated)*
Mother's Age							
Mother's Age, years (mean, SD)	22.67 (SD 5.91)	25.78 (SD 6.11)	23.46 (SD 5.70)	26.40 (SD 5.97)	22.90 (SD=5.86) t-test: p=0.00	25.95 (SD=6.08) t-test: p=0.00	Total births: 25.1(--)[39]
Number and proportion of Teenage Births (<19) as component group of total study population[b]	35.28% n=35,443	16.60 % n=75,930	27.99 % n=11,211	13.39 % n=22,762	33.20% n=46,654	15.73 % n=98,692	20.8%[38] n=354897
Mother's Race/Ethnicity							
Non-Hispanic White	15.24 % n=48,306	84.76% n=268,648	16.15 % n=22,117	83.85 % n=114,856	15.51 % n=70,423	84.49 % n=383,504	55.90%[38] 952,478
Hispanic White **this represent ALL Hispanic White ethnicity mothers (except Cuban)*	24.31 % n=16,215	75.69 % n=50,483	27.77% n=8,231	72.23 % n=21,408	25.38 % n=24,446	74.62% n=71,891	21.18%[38] n=360,966
Non-Hispanic Black	24.75 % n=26, 975	75.25 % n=82,009	25.87 % n=1,998	74.13 % n=5,725	24.83 % n=29,205	75.17 % n=87,734	14.34%[38] n=244,340

Maternal SES							
Foreign-Born Mother **report cites 2004 data*	32.08 % n=32,233	29.58 % n=135,358	16.27% n=6,518	14.81 % n=25,177	27.58% n=38,751	25.58% n=160,535	Total births : 24.00%[38]* n= --
Married (Mother)	28.47 % n=28,598	52.84 % n=241,714	42.27 % n=16,860	64.95 % n=110,142	32.39 % n=45,458	56.11 % n=351,856	Total births: 59.35%[38] n=2523146
Number and proportion of Births those with Less than High School[c] Education as component group of total study population	9.79 % n=9,795	5.17 % n=23,558	8.75% n=3,505	4.94 % n=8,406	9.49 % n=13,300	5.11 % n=31,964	Total births: 20.00%[40*] n= --
Medicaid Birth **denominator=4,280,854*	62.88% n=63,180	39.62 % n=181,290	53.52 % n=21,392	30.22 % n=51,180	60.22% n=84,572	37.08 % n=232,470	Total births 40.08%[41*] n=1,715,957
WIC Utilization **infants in 2008 (up to their first birthday)*	66.20 % n=65,434	44.72 % n=202,041	54.55 % n=19,779	34.32% n=52,869	63.07 % n=85,213	42.079% n=254,910	Total births: 57.25%[42*] n=2,432,006

Note. [a]All categoric variables were tested with chi-square and found to be significant at $p<0.00$ level. [b]U.S. data define teens as age 10-19. [c]For age>20 in WA and FL; unclear of definition related to age in cited material related to U.S. population.

Table 4

Summary of Economic Indicators before and during Recession Periods in WA and FL (Total Study Population)

	FL baseline	FL Period 1	FL Period 2	WA baseline	WA Period 1	WA Period 2	Total baseline	Total Period 1	Total Period 2
Mother Enrolled in WIC while pregnant	45.25% n=94,590	49.88 % n=72,677	53.21% n=69,921	37.91 % n=24,915	38.79% n=20,706	38.78 % n=19,078	43.49% n=119,505	46.91% n=93,383	49.28% n=88,999
Medicaid births	42.53% n=90,375	43.76 % n=64,495	47.06% n=62,501	34.72% n=25,769	34.45 % n=19,811	35.11 % n=18,688	40.51% n=116,144	41.14% n=84,306	43.64% n=81,189
LHD Expenditures									
Avg. Total (per capita) LHD expenditures	$46.77 (SD = $21.64) range = $26.48 to $312.71 n range = 7568-2543492	$46.16 (SD= $22.13) range = $25.29 to $314.94 n range = 7775-2499262	$46.30 (SD = $21.82) range = $26.52 to $315.91 n range = 7901-2534220	$57.89 (SD = $30.21) range= $19.32 to $148.43 n range= 2076 – 1857877	$56.29 (SD = $29.02) range= $18.75 to $132.63 n range = 2080 - 1922645	$54.38 (SD= $29.71) range= $18.75 to $132.64 n range = 2080 - 1948445	$49.64 (SD=$24.63) range = $19.32 to $312.72 n range = 2076 - 2453492	$49.00 (SD = $24.68) range= $18.75 to $314.94 n range = 3080 - 2499262	$48.50 (SD=24.53) mean= $18.75 to $317.97 n range = 2080 - 2534220
Avg. 2 MCH (per capita) expenditures	$8.79 (SD = $5.67)	$8.18 (SD = $5.53)	$7.84 (SD = $5.11)	$11.01 (SD = $ 9.06)	$10.46 (SD = $9.36)	$9.85 (SD = $9.47)	$9.37 (SD= $6.79)	$8.82 (SD= $6.90)	$8.41 (SD = $6.72)

Note: FL has July start FY	range = $2.50 to $50.48	range = $2.31 to $48.12	range = $2.31 to $43.84	range = $0.41 to $32.35	range = $0.59 to $29.40	range = $0.33 to $28.88	range = $0.41 to $50.49	range= $0.59 to $48.11	range= $0.33 to $43.84
Avg. Family Planning (per capita) expenditures	$3.58 (SD = $2.25) range = $0.69 to $29.85	$3.19 (SD = $1.80) range = $1.18 to $28.45	$3.08 (SD = $1.77) range = $1.20 to $ 18.66	$2.40 (SD = $2.66) range = $0 to $17.36	$2.00 (SD = $2.48) range = $0 to 18.92	$1.72 (SD = $2.29) range = $0 to $18.92	$3.28 (SD= $2.42) range = $0.00 to $29.85	$2.86 (SD = $2.08) range = $0 to $28.45	$2.69 (SD = $2.03 range = $0 to $18.92
Avg. MICA (per capita) expenditures	$5.21 (SD = $4.44) range = $0.01 to $34.70	$4.99 (SD = $4.51) range = $0.01 to $32.93	$4.76 (SD = $4.10) range = $0.02 to $31.20	$8.56 (SD = $6.75) range = $0.41 to $27.49	$8.42 (SD = $7.19) range = $0.00 to $20.14	$8.12 (SD = $7.49) range = $0.00 to $18.86	$6.07 (SD=$5.34) range = $0.01 to $34.70	$5.95 (SD = $5.62) range = $0.00 to $32.93	$5.72 (SD = $5.51) range = $0.00 to $31.20
Avg. WIC (per capita) expenditures	$4.64 (SD = $1.79) range = $0 to $20.03	$5.37 (SD = $1.96) range = $0 to $22.54	$5.99 (SD = $2.13) range = $0 to $22.54	$2.57 (SD= $1.70) range = $0 to $13.47	$ 2.48 (SD = $1.70) range= $0 to $8.87	$ 2.60 (SD = $2.03) range = $0 to $10.28	$4.10 (SD = $1.98) range = $0.00 to $20.03	$4.55 (SD = $2.30) range = $0.00 to $22.54	$5.02 (SD = $2.60) range = $0.00 to $22.54
Un-employment rate	3.64 % (SD=0.56 %) range= 2.14 %-7.28 %	7.39 % (SD=2.28 %) range= 2.61 %-14.52 %	11.02 % (SD= 1.41 %) range= 5.69 %-15.13 %	5.14 % (SD = 0.94 %) range= 1.43 %-8.52 %	6.61 % (SD=2.20 %) range= 3.44 %-14.36 %	9.71% (SD= 1.54%) range= 5.67 %-14.36 %	4.02% (SD =0.95%) range= 1.43%-8.52%	7.17% (SD = 2.29%) range= 2.61%-14.62%	10.65% (SD 1.56%) range = 5.67%-15.13%

Percent voting Republican	2004: 51.97% (SD= 10.24%) range= 29.94%-8.25%	2008: 47.50% (SD= 10.14%) range = 30.42%-82.95%	2008: 47.50% (SD= 10.14%) range = 30.42%-82.95%	2004: 46.80% (SD= 10.56%) range = 33.30%-74.04%	2008: 41.51% (SD= 10.67%) range = 28.60%-71.54%	2008: 41.51 % (SD= 10.67%) range = 28.60%-71.54%	2004: 50.56% (SD = 10.58%) range = 29.94%-78.25%	2008: 45.86 (SD=28.60% range = 28.60%-82.95	2008: 45.86 (SD=28.60% range = 28.60%-82.95
Per Capita MDs Family Medicine and General Practitioners	2005 0.03 (SD = 0.01) range = 0 to 0.06	2008 0.03 (SD = 0.01) range = 0 to 0.06	2010 0.03 (SD = 0.01) range = 0 to 0.06	2005 0.04 (SD = 0.01) range = 0 to 0.09	2008 0.04 (SD = 0.01) range = 0 to 0.09	2010 0.04 (SD = 0.01) range = 0 to 0.08	2005 0.03 (SD = 0.01) range = 0 to 0.09	2008 0.03 (SD = 0.01) range = 0 to 0.09	2010 0.03 (SD = 0.01) range = 0 to 0.08

Note. See methods section for explanation of FY: FL has July start FY.

Table 5

Predicted Probability of Late/No PNC by State and Total Study Population for Low, Average, and High Social Status Characteristics

	Low Social Disadvantage Case					
	Baseline Period		**Period 1**		**Period 2**	
Florida	**Prob.* (SE)**	**[95% Conf. Interval]**	**Prob.* (SE)**	**[95% Conf. Interval]**	**Prob.* (SE)**	**[95% Conf. Interval]**
Non-Hispanic White	0.020* (0.008)	0.005 - 0.035	0.019* (0.009)	0.002 - 0.036	0.026* (0.009)	0.008 - 0.045
Hispanic White	0.039* (0.014)	0.013 - 0.066	0.026 (0.015)	-0.003 - 0.055	0.035* (0.013)	0.010 - 0.060
Non-Hispanic Black	0.052* (0.011)	0.031 - 0.074	0.056* (0.013)	0.031 - 0.081	0.063* (0.012)	0.040 - 0.086
Washington						
Non-Hispanic White	0.075* (0.027)	0.022 - 0.129	0.073* (0.024)	0.026 - 0.120	0.073* (0.023)	0.029 - 0.117
Hispanic White	0.095* (0.030)	0.037 - 0.153	0.080* (0.024)	0.033 - 0.127	0.082* (0.023)	0.037 - 0.126
Non-Hispanic Black	0.108* (0.029)	0.051 - 0.165	0.110* (0.024)	0.063 - 0.157	0.110* (0.022)*	0.066 - 0.153
Total						
Non-Hispanic White	0.033* (0.005)	0.024 - 0.043	0.033* (0.006)	0.022 - 0.045	0.039* (0.005)	0.029 - 0.049
Hispanic White	0.053* (0.012)	0.029 - 0.077	0.040* (0.012)	0.017 - 0.063	0.048* (0.009)	0.030 - 0.066
Non-Hispanic Black	0.066* (0.010)	0.048 - 0.084	0.070* (0.010)	0.051 - 0.089	0.076* (0.008)	0.061 - 0.091
	Average Case					
	Baseline Period		**Period 1**		**Period 2**	
Florida						
Non-Hispanic White	0.103* (0.009)	0.086 - 0.120	0.112* (0.009)	0.095 - 0.129	0.108* (0.009)	0.091 - 0.126
Hispanic White	0.123* (0.014)	0.096 - 0.149	0.119* (0.013)	0.093 - 0.145	0.117* (0.012)	0.093 - 0.141
Non-Hispanic Black	0.135* (0.010)	0.116 - 0.155	0.148* (0.011)*	0.127 - 0.170	0.145* (0.011)	0.124 - 0.166
Washington						
Non-Hispanic White	0.159* (0.027)	0.106 - 0.211	0.166* (0.024)	0.119 - 0.212	0.155* (0.023)	0.110 - 0.200
Hispanic White	0.178* (0.029)	0.121 - 0.235	0.173* (0.023)	0.128 - 0.218	0.164* (0.023)	0.120 - 0.208

Non-Hispanic Black	0.191* (0.028)	0.136 - 0.246		0.203* (0.023)	0.158 - 0.247		0.192* (0.022)	0.148 - 0.235
Total								
Non-Hispanic White	0.116* (0.005)	0.106 - 0.126		0.126* (0.005)	0.116 - 0.136		0.121* (0.005)	0.111 - 0.131
Hispanic White	0.136* (0.012)	0.113 - 0.159		0.133* (0.010)	0.114 - 0.152		0.130* (0.008)	0.113 - 0.146
Non-Hispanic Black	0.149* (0.008)	0.133 - 0.164		0.163* (0.007)	0.149 - 0.178		0.158* (0.007)	0.145 - 0.171
	High Social Disadvantage Case							
Florida	**Prob.* (SE)**	**[95% Conf. Interval]**		**Prob.* (SE)**	**[95% Conf. Interval]**		**Prob.* (SE)**	**[95% Conf. Interval]**
Non-Hispanic White	0.432* (0.037)	0.361 - 0.504		0.431* (0.031)	0.371 - 0.491		0.366* (0.023)	0.320 - 0.412
Hispanic White	0.452* (0.036)	0.382 - 0.522		0.438* (0.029)	0.381 - 0.495		0.375* (0.024)	0.329 - 0.421
Non-Hispanic Black	0.465* (0.035)	0.396 – 0.533		0.468* (0.028)	0.413 - 0.522		0.403* (0.023)	0.358 - 0.447
Washington								
Non-Hispanic White	0.488* (0.042)	0.406 - 0.569		0.485* (0.039)	0.408 - 0.562		0.413* (0.033)	0.348 - 0.477
Hispanic White	0.507* (0.041)	0.427 - 0.588		0.492* (0.036)	0.421 - 0.564		0.421* (0.032)	0.359 – 0.484
Non-Hispanic Black	0.520* (0.041)	0.441 - 0.600		0.522* (0.036)	0.452 - 0.593		0.449* (0.032)	0.387 - 0.512
Total								
Non-Hispanic White	0.446* (0.035)	0.377 - 0.514		0.446* (0.030)	0.386 - 0.505		0.379* (0.023)	0.334 - 0.423
Hispanic White	0.465* (0.034)	0.398 – 0.532		0.452* (0.028)	0.397 - 0.508		0.387* (0.022)	0.344 – 0.431
Non-Hispanic Black	0.478* (0.033)	0.412 - 0.543		0.482* (0.027)	0.429 - 0.535		0.415* (0.022)	0.373 - 0.458

Table 6

Final Late/No PNC Linear Regression Models for Baseline, Period 1 and Period 2 (controlled for 102 LHD Clusters)

	Baseline Period n=270775			**Period 1 n=195921**			**Period 2 n=178254**		
	Coef.	**SE**	**95% C.I.**	**Coef.**	**SE**	**95% CI**	**Coef.**	**SE**	**95% C.I.**
Maternal Race/Ethnicity									
Non-Hispanic White	referent			referent			referent		
Hispanic White	0.020*	0.010	0.000 - 0.039	0.007	0.009	-0.010 - 0.024	0.009	0.007	-0.005- 0.022
Non-Hispanic Black	0.032*	0.006	0.020 - 0.045	0.037*	0.006	0.025 - 0.049	0.037*	0.005	0.027 - 0.046
Age									
< 14 years	0.259*	0.015	0.229 - 0.289	0.261*	0.018	0.224 - 0.297	0.262*	0.031	0.201 - 0.323
15-19 years	0.097*	0.007	0.084 - 0.110	0.091*	0.011	0.069 - 0.112	0.087*	0.006	0.075 - 0.098
20-24 years	0.040*	0.005	0.031 - 0.048	0.050*	0.006	0.038 - 0.060	0.039*	0.004	0.031 - 0.048
25-29 years	0.009*	0.002	0.004 - 0.013	0.011*	0.003	0.005 - 0.018	0.011*	0.003	0.006 - 0.016
30-34 years	referent			referent			referent		
35-39 years	0.002	0.002	-0.002 - 0.007	0.005	0.003	-0.000 - 0.010	0.010*	0.005	0.001 - 0.019
40+ years	0.049*	0.009	0.032 - 0.066	0.045*	0.007	0.032 - 0.058	0.029*	0.008	0.014 - 0.044
Marital Status									
Married	referent			referent			referent		

Not Married	0.042*	0.003	0.035 - 0.049	0.042*	0.006	0.031 - 0.053	0.032*	0.004	0.024 - 0.040
Foreign-Born Status									
Not Foreign-Born	referent			referent			referent		
Foreign-Born	0.034*	0.010	0.014 - 0.055	0.028*	0.008	0.012 - 0.044	0.022*	0.007	0.009 - 0.035
Education									
Less than HS education	0.084*	0.010	0.064 - 0.104	0.079*	0.010	0.059 - 0.099	0.061*	0.008	0.046 - 0.076
HS diploma or GED	0.021*	0.004	0.012 - 0.029	0.016*	0.005	0.005 - 0.026	0.020*	0.004	0.012 - 0.029
Some College	referent			referent			referent		
Age <20; ed attainment not assessed	0.056*	0.007	0.041 - 0.070	0.055*	0.009	0.036 - 0.073	0.039*	0.008	0.023 - 0.056
Insurance Payer									
Medicaid	0.100	0.007	0.087 - 0.114	0.113*	0.008	0.097 - 0.129	0.099*	0.007	0.085 - 0.113
Private Insurance	referent			referent			referent		
Self-Pay/ Uninsured	0.155	0.020	0.115 - 0.195	0.173*	0.017	0.140 - 0.205	0.138*	0.018	0.102 - 0.173
Other (Indian Health Service, CHAMPUS, Tricare, etc.)	0.057	0.020	0.017 - 0.096	0.057*	0.023	0.011 - 0.103	0.070*	0.015	0.039 - 0.100
Unknown	0.038	0.023	-0.008 - 0.083	0.054	0.029	-0.003 - 0.111	0.060*	0.023	0.016 - 0.105

WIC Enrollment Status									
Yes WIC	-0.012*	0.005	-0.022 - -0.002	-0.012*	0.005	-0.023 - 0.001	-0.010	0.006	-0.021 - 0.002
No WIC	referent			referent			referent		
Unemployment Rate	-0.002	0.008	-0.018- 0.014	-0.000	0.001	-0.003 - 0.002	-0.001	0.004	-0.010 - 0.007
Community Poverty									
Top 1/3 Poor LHJs	-0.031	0.017	-0.065 - 0.004	-0.045*	0.021	-0.086 - -0.003	-0.056*	0.021	-0.096 - -0.015
Bottom 2/3 (Non) Poor LHJs	referent			referent			referent		
Median HH Income	7.55E-07	1.26E-06	-1.75 E-06 - 3.26 E-06	1.53E-06	1.18E-06	-8.13E-07 - 3.88E-06	8.83E-07	1.27E-06	-0.000 - 0.000
Core Based Statistical Area									
Metro-politan	referent			referent			referent		
Micro-politan	0.010	0.016	-0.021 – 0.041	0.003	0.018	-0.033 - 0.039	0.019	0.016	-0.013 - 0.050
Rural	-0.016	0.020	-0.054 - 0.023	-0.023	0.021	-0.065 - 0.020	-0.026	0.024	-0.073 - 0.022
Gini Coefficient	0.025	0.236	-0.442 - 0.493	-0.184	0.246	-0.672 - 0.304	-0.152	0.228	-0.604 - 0.301
Percent Republican	0.001*	0.0005	0.0004- 0.0020	0.002*	0.0007	0.0003 - 0.0029	0.002*	0.0007	0.0005 - 0.0031
Per Capita MDs (GPs and FM)	-1.498*	0.737	-2.959 - -0.036	-0.949	0.637	-2.213 - 0.316	-0.895	0.691	-2.265 - 0.475

State									
Florida	0.056	0.033	-0.011 - 0.122	0.054	0.030	-0.006 - 0.114	0.047	0.030	-0.013 - 0.106
Washington	referent			referent			referent		
LHD Per Capita 2MCH Expenditures	0.0012	0.0009	-0.0007 - 0.0030	0.0019*	0.0009	0.0002 - 0.0036	0.0025*	0.0008	0.0009 - 0.0042
LHD Per Capita WIC Expenditures	-0.0010	0.0028	-0.0067 - 0.0046	-0.0014	0.0026	-0.0065 - 0.0038	-0.0022	0.0028	-0.0077 - 0.0033

Appendix I: Rates of Late/No PNC and Calculated Disparity Relationships by Race/Ethnicity Groups during Three Recession-Related Time Periods[15]

	Baseline (Period 0)	Period 1	Period 2
FL			
Non-Hispanic White (n=361,829)	15.4% DFB=40.4%	15.5% DFB= 67.9% IID= 27.6%	14.1% DFB= 82.3% IID= 41.9%
Hispanic White (n=83,234)	26.5% DFB= 141.6%	23.5% DFB= 154.6% IID=13.0%	18.0% DFB= 132.6% IID= -9.02%
Hispanic Black (n=1,750)	21.9% DFB= 99.4%	22.4% DFB= 142.2% IID= 42.8%	19.2% DFB= 148.1% IID= 48.8%
Cuban (n= 37,197)	11.0% (B)	9.2% (B)	7.7% (B)
WA			
Non-Hispanic White (n=162,125)	15.3 (B)	17.4% (B)	15.5% (B)
Hispanic White (n=34,408)	27.8% DFB=81.4%	28.4% DFB=63.4%; IID= -18.0%	24.8% DFB= 60.6% IID= -20.8%
Non-Hispanic Black (n=9,244)	20.9% DFB=36.6%	28.4% DFB=63.4% IID=26.8%	24.6% DFB=59.1% IID=22.5%
Cuban (n=232)	DQI N/A	DQI N/A	DQI N/A

Note. (1) Calculations of disparity relationships followed methods recommended by Healthy People/Keppel et al.[12] (2) DFB = difference from best group. (3) B = best group. (4) IID = increase in disparity. (5) DQI = data quality insufficient.

Appendix II: Logit Model Results of Late/No PNC in Total Study Population (WA + FL)

	Baseline Period (n=270775)			Period 1 (n=195921)			Period 2 (n=178254)		
	Coef-ficient	**Robust SE**	**95% Conf. Interval**	**Coeff-icient**	**Robust SE**	**95% Conf. Interval**	**Coef-ficient**	**Robust SE**	**95% Conf. Interval**
Maternal Race/Ethnicity									
Non-Hispanic White (1)	referent			referent			referent		
Hispanic White (2)	0.0840	0.0554	-0.0245 - 0.1925	0.0090	0.0479	-0.0848 - 0.1028	0.0334	0.0427	-0.0504 - 0.1171
Non-Hispanic Black (3)	0.2247*	0.0365	0 .1532 - 0.2962	0.2509*	0.0403	0.1720 - 0.3298	0.2578*	0.0307	0.1977 - 0.3180
Age									
< 14 years (1)	1.3213*	0.0702	1.1838 - 1.4588	1.3342*	0.0893	1.1592 - 1.5092	1.3447	0.1420*	1.0664 - 1.6230
15-19 years (2)	0.6644*	0.0442	0.5779 - 0.7510	0.6259*	0.0635	0.5015 - 0.7504	0.6003*	0.0382	0.5255 - 0.6751
20-24 years (3)	0.4019*	0.0361	0.3311 - 0.4727	0.4602*	0.0394	0.3831 - 0.5374	0.3830*	0.0256	0.3329 - 0.4331
25-29 years (4)	0.1402*	0.0242	0.0927 - 0.1877	0.1640*	0.0323	0.1007 - 0.2274	0.1581*	0.0232	0.1126 - 0.2036
30-34 years (5)	referent			referent			referent		
35-39 years (6)	0.0371	0.0289	-0.0195 - 0.0937	0.0618*	0.0305	0.0020 - 0.1215	0.1214*	0.0523	0.0190 - 0.2239
40+ years (7)	0.5232*	0.0669	0.3921 - 0.6544	0.4838*	0.0552	0.3757 - 0.5918	0.3337*	0.0764	0.1840 - 0.4835
Marital Status									
Married (1)	referent			referent			referent		
Not Married (0)	0.3268*	0.0206	0.2864 - 0.3673	0.3368*	0.0339	0.2703 - 0.4034	0.2760*	0.0233	0.2303 - 0.3217

Foreign-Born Status									
Not Foreign-Born (0)	referent			referent			referent		
Foreign-Born (1)	0.2781*	0.0675	0.1458 - 0.4105	0.2366*	0.0533	0.1321 - 0.3410	0.2000*	0.0469	0.1080 - 0.2919
Education									
Less than HS education (1)	0.5444*	0.0486	0.4492 - 0.6396	0.4801*	0.0531	0.3750 - 0.5842	0.3942*	0.0494	0.2974 - 0.4910
HS diploma or GED (2)	0.2214*	0.0313	0.1602 - 0.2827	0.1641*	0.0360	0.0935 - 0.2347	0.1924*	0.0269	0.1397 - 0.2451
Some College (3)	referent			referent			referent		
Age <20; ed attainment not assessed (4)	0.3924*	0.0412	0.3116 - 0.4731	0.3712*	0.0439	0.2851 - 0.4572	0.2897*	0.0401	0.2111 - 0.3683
Insurance Payer									
Medicaid (1)	0.7979*	0.0419	0.7157 - 0.8800	0.8669*	0.0486	0.7716 - 0.9621	0.8214*	0.0494	0.7246 - 0.9182
Private Insurance (2)	referent			referent			referent		
Self-Pay/ Uninsured (3)	1.0720*	0.0718	.9313419 1.21263	1.2122*	0.0652	1.0844 - 1.3401	1.0784*	0.0751	0.9311 - 1.2256
Other (Indian Health Service, CHAMPUS, Tricare, etc.) (8)	0.5480*	0.1433	0.2672 - 0.8289	0.5433*	0.1654	0.2192 - 0.8674	0.6496*	0.1162	0.4218 - 0.8774
Unknown (9)	0.4226*	0.1593	0.1104 - 0.7348	0.5182*	0.1979	0.1303 - 0.9061	0.5764*	0.1690	0.2452 - 0.9077
WIC Enrollment Status									
Yes WIC (1)	-0.0564	0.0307	-0.1166 - 0.0039	-0.0463	0.0351	-0.1151 - 0.0224	-0.0363	0.0407	-0.1161 - 0.0435
No WIC (0)	referent			referent			referent		

Unemployment Rate	-0.0121	0.0552	-0.1204 - 0.0962	-0.0032	0.0075	-0.0179 - 0.0116	-0.0061	0.0310	-0.0668 - 0.0546
Community Poverty	-0.2033	0.1094	-0.4177 - 0.0111	-0.2882*	0.1337	-0.5501 - 0.0262	-0.3882*	0.1345	-0.6518 - 0.1246
Median HH Income	0.0000	0.0000	-0.0000 - 0.0000	0.0000	0.0000	-3.48e-06 - 0.0000	0.0000	0.0000	-9.57e-06 - 0.0000
Core Based Statistical Area									
Metro-politan (1)	referent			referent			referent		
Micro-politan (2)	0.0604	0.1059	-0.1471 - 0.2680	0.0140	0.1182	-0.2176 0.2456	0.1245	0.1051	-0.0816 - 0.3306
Rural (3)	-0.0860	0.1351	-0.3508 - 0.1789	-0.1549	0.1430	-0.4352 - 0.1255	-0.1983	0.1714	-0.5342 - 0.1377
Gini Coefficient	-0.1083	1.6231	-3.2895 - 3.0730	-1.4975	1.7262	-4.8808 - 1.8857	-1.2660	1.7388	-4.6740 - 2.1420
Percent Republican	0.0097*	0.0034	0.0031 - 0.0163	0.0121*	0.0044	0.0035 - 0.0208	0.0140*	0.0048	0.0047 - 0.0234
Per Capita MDs (GPs and FM)	-10.7779*	5.2387	-21.0455 - 0.5104	-6.9354	4.6536	-16.0562 - 2.1854	-6.461736	5.1762	-16.6070 - 3.6835
LHD Per Capita 2MCH Expenditures	0.0073	0.0062	-0.0048 - 0.0193	0.0139*	0.0059	0.0023 - 0.0254	0.0190*	0.0061	0.0071 - 0.0309
LHD Per Capita WIC Expenditures	-0.0060	0.0187	-0.0427 - 0.0306	-0.0070	0.0171	-0.0405 - 0.0264	-0.0143	0.0200	-0.0535 - 0.0249
State									
Florida (1)	referent			referent			referent		
Washington (2)	0.4144	0.2325	-0.0413 - 0.8702	0.4335*	0.2076	0.0267 - 0.8404	0.3912	0.2105	-0.0214 - 0.8038
Constant	-3.3989	1.0361	-5.4296 - 1.3683	-3.3255*	0.9594	-5.2059 - 1.4452	-3.23935	1.2188	-5.6281 - -0.8506

Appendix III: WA-only Regression Model Results

Washington State: Late/No PNC									
	Coef.	**Robust Std. Err.**	**95% Conf. Interval**	**Coef.**	**Robust Std. Err.**	**95% Conf. Interval**	**Coef.**	**Robust Std. Err.**	**95% Conf. Interval**
	Baseline (n= 64814)			**Period 1 (n= 52460)**			**Period 2 (n= 48628)**		
Maternal Race/Ethnicity									
Non-Hispanic White (1)	referent			referent			referent		
Hispanic White (2)	0.038*	0.011	0.016 - 0.061	0.023	0.012	-0.002 - 0.047	0.030*	0.007	0.017 - 0.044
Non-Hispanic Black (3)	-0.013*	0.012	-0.038 - 0.013	0.015	0.008	-0.001 - 0.032	0.006	0.007	-0.008 - 0.021
Age									
< 14 years (1)	0.298*	0.032	0.233 - 0.364	0.341*	0.057	0.226 - 0.457	0.306*	0.069	0.166 - 0.446
15-19 years (2)	0.147*	0.011	0.124 - 0.169	0.144*	0.014	0.116 - 0.172	0.113*	0.007	0.099 - 0.126
20-24 years (3)	0.062*	0.006	0.049 - 0.075	0.078*	0.008	0.061 - 0.095	0.056*	0.005	0.045 - 0.066
25-29 years (4)	0.014*	0.004	0.007 - 0.021	0.021*	0.005	0.011 - 0.031	0.017*	0.002	0.012 - 0.022
30-34 years (5)	referent			referent			referent		
35-39 years (6)	0.000	0.003	-0.006 - 0.007	0.005	0.004	-0.003 - 0.014	0.007	0.008	-0.010 - 0.023
40+ years (7)	0.002	0.005	-0.010 - 0.013	0.039*	0.009	0.020 - 0.057	0.013	0.009	-0.006 - 0.032
Marital Status									
Married (1)	referent			referent			referent		
Not Married (0)	0.059*	0.008	0.042 - 0.077	0.053*	0.014	0.025 - 0.082	0.045*	0.008	0.028 - 0.061
Foreign-Born Status									

Not Foreign-Born (0)	referent			referent			referent		
Foreign-Born (1)	0.056*	0.010	0.035 - 0.076	0.066*	0.011	0.043 - 0.089	0.063*	0.007	0.048 - 0.078
Education									
Less than HS education (1)	0.058*	0.015	0.042- 0.077	0.051*	0.008	0.034 - 0.067	0.037*	0.012	0.012 - 0.061
HS diploma or GED (2)	0.022*	0.006	0.011- 0.034	0.010	0.006	-0.002 - 0.021	0.026*	0.006	0.014 - 0.038
Some College (3)	referent			referent			referent		
Insurance Payer									
Medicaid (1)	0.089*	0.011	0.067 - 0.110	0.101*	0.016	0.068 - 0.134	0.084*	0.012	0.060 - 0.108
Private Insurance (2)	referent			referent			referent		
Self-Pay/ Uninsured (3)	0.187*	0.015	0.157 - 0.216	0.224*	0.024	0.175 - 0.273	0.153*	0.023	0.107 - 0.198
Other (Indian Health Service, CHAMPUS, Tricare, etc.) (8)	0.030	0.026	-0.023 - 0.083	0.022	0.029	-0.037 - 0.081	0.047*	0.021	0.005 - 0.090
Unknown (9)	0.010	0.019	-0.029 - 0.049	0.047	0.040	-0.035 - 0.129	0.041	0.027	-0.013 - 0.095
WIC Enrollment Status									
Yes WIC (1)	-0.004	0.007	-0.019 - 0.011	0.006	0.010	-0.014 - 0.027	0.003	0.013	-0.023 - 0.030
No WIC (0)	referent			referent			referent		
Unemployment Rate	-0.002	0.009	-0.020 - 0.015	0.000	0.002	-0.003 - 0.003	-0.005	0.005	-0.015 - 0.005
Community Poverty	-0.019	0.024	-0.068 - 0.030	-0.061*	0.030	-0.123 - 0.001	-0.081*	0.027	-0.136 - -0.026
Median HH Income	2.35E-06	2.48E-06	-2.69e-06 - 7.40e-06	4.71E-06	3.03E-06	-1.45e-06 - 0.000	1.79E-06	2.47E-06	-3.22e-06 - 6.81e-06

Core Based Statistical Area									
Metro-politan (1)	referent			referent			referent		
Micro-politan (2)	0.027	0.025	-0.024 - 0.078	0.020	0.029	-0.039 - 0.040	0.018	0.027	-0.037 - 0.073
Rural (3)	0.061	0.043	-0.027 - 0.149	0.089*	0.042	0.004 - 0.175	0.059	0.042	-0.026 - 0.145
Gini Coefficient	0.251	0.530	-0.826 - 1.328	0.670	0.572	-0.491 - 1.831	-0.300	0.465	-1.245 - 0.646
Percent Republican	-0.0000	0.0017	-0.0035 - 0.0034	0.0016	0.0027	-0.0039 - 0.0072	0.0033	0.0021	-0.0010 - 0.0075
Per Capita MDs (GPs and FM)	-2.053*	0.603	-3.278 - -0.828	-1.449*	0.650	-2.770 – -0.128	-1.157	0.702	-2.584 - 0.269
LHD Per Capita 2MCH Expenditures	-0.0011	0.0025	-0.0062 - 0.0040	-0.0010	0.0030	-0.0070 - 0.0051	0.0042	0.0022	-0.0002 - 0.0086
LHD Per Capita WIC Expenditures	-0.0019	0.0067	-0.0156 - 0.0118	-0.0043	0.0074	-0.0193 - 0.0106	-0.0088	0.0058	-0.0207 - 0.0030
Constant	-0.0750	0.3464	-0.7789 0.6290	-0.4806	0.4286	-1.3517 - 0.3904	0.0392	0.3394	-0.6506 - 0.7290

Appendix IV: FL-only Regression Model Results

Florida: Late/No PNC									
	Coef.	**Robust Std. Err.**	**95% Conf. Interval**	**Coef.**	**Robust Std. Err.**	**95% Conf. Interval**	**Coef.**	**Robust Std. Err.**	**95% Conf. Interval**
	Baseline n= 205961			**Per 1 n=143461**			**Per 2 n=129626**		
Maternal Race/Ethnicity									
Non-Hispanic White (1)	**referent**			**referent**			**referent**		
Hispanic White (2)	0.0142	0.0111	-0.0080 - 0.0364	0.0006	0.0095	-0.0184 - 0.0195	0.0007	0.0077	-0.0146 - 0.0161
Non-Hispanic Black (3)	0.0362*	0.0058	0.0245 - 0.0478	0.0375*	0.0063	0.0250 - 0.0500	0.0348*	0.0050	0.0248 - 0.0447
Age									
< 14 years (1)	0.2522*	0.0159	0.2204 - 0.284	0.2431*	0.0187	0.2057 - 0.2804	0.2512*	0.0344	0.1825 - 0.3120
15-19 years (2)	0.0899*	0.0053	0.0793 - 0.1005	0.0792*	0.0084	0.0626 - 0.0959	0.0816*	0.0052	0.0713 - 0.0919
20-24 years (3)	0.0306*	0.0029	0.0250 - 0.0363	0.0360*	0.0026	0.0307 - 0.0412	0.0310*	0.0037	0.0236 - 0.0383
25-29 years (4)	0.0070*	0.0021	0.0027 - 0.0113	0.0074*	0.0031	0.0012 - 0.0136	0.0086*	0.0031	0.0025 - 0.0147
30-34 years (5)	referent				referent				
35-39 years (6)	0.0033	0.0030	-0.0026 - 0.0093	0.0043*	0.0032	-0.0020 - 0.0106	0.0108*	0.0048	0.0013 - 0.0204
40+ years (7)	0.0586*	0.0091	0.0404 - 0.0768	0.0449*	0.0082	0.0286 - 0.0612	0.0336*	0.0086	0.0164 - 0.0507
Marital Status									
Married (1)	referent			referent			referent		

Not Married (0)	0.0373*	0.0023	0.0328 - 0.0419	0.0393*	0.0052	0.0289 - 0.0497	0.0288*	0.0037	0.0214 - 0.0362
Foreign-Born Status									
Not Foreign-Born (0)	referent			referent			referent		
Foreign-Born (1)	0.0333*	0.0112	0.0110 - 0.0557	0.0217*	0.0078	0.0061 - 0.0372	0.0148*	0.0058	0.0031 - 0.0264
Education									
Less than HS education (1)	0.0918*	0.0118	0.0683 - 0.1153	0.0896*	0.0138	0.0621 - 0.1170	0.0701*	0.0079	0.0543 - 0.0860
HS diploma or GED (2)	0.0217*	0.0053	0.0111 - 0.0323	0.0193*	0.0067	0.0059 - 0.0327	0.0200*	0.0052	0.0096 - 0.0305
Some College (3)	referent			referent			referent		
Age <20; ed attainment not assessed (4)	0.0645*	0.0072	0.0502 - 0.0788	0.0656*	0.0086	0.0484 - 0.0829	0.0464*	0.0075	0.0315 - 0.0614
Insurance Payer									
Medicaid (1)	0.1041*	0.0077	0.0887 - 0.1196	0.1156	0.0091	0.0975 - 0.1337	0.1033*	0.0088	0.0857 - 0.1210
Private Insurance (2)	referent			referent			referent		
Self-Pay/ Uninsured (3)	0.1561*	0.0207	0.1148 - 0.1973	0.1757	0.0170	0.1418 - 0.2096	0.1432*	0.0190	0.1053 - 0.1810
Other (Indian Health Service, CHAMPUS, Tricare, etc.) (8)	0.0752*	0.0304	0.0144 - 0.1360	0.0840	0.0351	0.0141 - 0.1540	0.0814*	0.0235	0.0345 - 0.1284
Unknown (9)	0.0959*	0.0306	0.0349 - 0.1569	0.0654	0.0274	0.0107 - 0.1202	0.0813*	0.0350	0.0113 - 0.1512
WIC Enrollment Status									
Yes WIC (1)	-0.0156*	0.0052	-0.0261 - 0.0051	-0.0176*	0.0054	-0.0283 - -0.0069	-0.0133*	0.0057	-0.0246 - 0.0020
No WIC (0)	referent			referent			referent		
Unemployment Rate	-0.0053	0.0097	-0.0247 - 0.0140	-0.0009	0.0010	-0.0029 - 0.0011	-0.0009	0.0055	-0.0119 - 0.0101

Community Poverty	-0.0417	0.0277	-0.0971 - 0.0137	-0.0339	0.0279	-0.0896 - 0.0218	-0.0451	0.0256	-0.0961 - 0.0060
Median HH Income	0.0000	0.0000	-2.69e-06 - 4.02e-06	0.0000	0.0000	-1.66e-06 - 4.30e-06	0.0000	0.0000	-2.57e-06 3.84e-06
Core Based Statistical Area									
Metro-politan (1)	referent			referent			referent		
Micro-politan (2)	0.0140	0.0229	-0.0318 - 0.0597	0.0046	0.0290	-0.0532 - 0.0624	0.0288	0.0244	-0.0200 - 0.0775
Rural (3)	-0.0290	0.0282	-0.0853 - 0.0272	-0.0534	0.0299	-0.1130 - 0.0063	-0.0537	0.0394	-0.1323 - 0.0249
Gini Coefficient	0.1556	0.2475	-0.3386 - 0.6498	-0.1628	0.2699	-0.7017 - 0.3762	-0.0573	0.2550	-0.5664 - 0.4517
Percent Republican	0.0013	0.0007	-0.0002 - 0.0028	0.0016*	0.0007	0.0001 - .0030864	0.0018*	0.0008	0.0002 - 0.0033
Per Capita MDs (GPs and FM)	-1.4921	0.9801	-3.449 - .4648048	-1.0235	0.8486	-2.7178 - 0.6709	-0.7734	1.0032	-2.7764 - 1.2296
LHD Per Capita 2MCH Expenditures	0.0019	0.0016	-0.0013 - 0.0051	0.0022	0.0013	-0.0005 - 0.0048	0.0028*	0.0013	0.0001 - 0.0055
LHD Per Capita WIC Expenditures	0.0002	0.0037	-0.0071 - 0.0075	-0.0009	0.0030	-0.0069 - 0.0052	-0.0013	0.0032	-0.0077 - 0.0052
Constant	-0.0979	0.1822	-0.4618 - 0.2659	-0.0125	0.1727	-0.3572 - 0.3324	-0.0337	0.2047	-0.4424 - 0.3751

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PAPER THREE

WIC SERVICES AND BIRTH WEIGHT DURING THE GREAT RECESSION

Abstract

Objectives

The objectives were to explore whether associations between maternal enrollment in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) services during pregnancy and infant birth weight (BW) interacted with diverse race/ethnicity and social characteristic groups during the Great Recession (December 2007 to June 2009), compared to baseline (January 2005 to March 2007).

Methods

Using a retrospective cross-sectional design and birth certificate data representing Medicaid and uninsured births from Washington (WA) and Florida (FL), we analyzed two BW outcome measures—a binary low BW (LBW) measure and a continuous measure of BW in grams. We looked at the interactions between maternal WIC enrollment with race/ethnicity and other social status groupings on BW within regression models during pre- and intra-Recession periods.

Results

Beneficial WIC interaction effects were identified, during both recession periods in both models. Infants of Black women, of very young mothers, and of those who entered prenatal care (PNC) late showed less disparate outcomes compared to the infants of Whites, those aged 30-34, and those who entered PNC in the first trimester, respectively. Some positive WIC effects among infants of mothers with young age and/or low education were also identified.

Conclusions

WIC enrollment appears to have contributed to infant BW benefits (reducing probability of LBW and increasing BW in grams) among some groups during the Great Recession. Further research is needed to explore how these benefits might be increased as well as extended to other groups with disparate BW outcomes.

Background

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is a government-funded nutritional supplementation and education program. WIC started in 1972 in response to concerns about malnutrition among pregnant women and its impacts on their unborn children.[1,2] Today, WIC services provide nutritional assistance (vouchers for specific foods) and health education for low-income pregnant and postpartum women, infants, and children up to age five.[1] Food vouchers are valued at approximately $50/month for pregnant women.[3] To be eligible for WIC services, applicants must have income at or below 185% of the United States (U.S.) Poverty Income Guidelines or be enrolled in Temporary Aid for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), or Medicaid. Applicants are screened medically (e.g., for anemia, underweight, smoking) and for their risk of nutritional deficits (e.g., low dietary consumption of protein or iron).[4]

The U.S. Department of Agriculture (USDA) renews WIC services through annual discretionary funding by the U.S. Senate and House Appropriations Committee.[5] Funding is disbursed to states who then distribute it to WIC provider agencies such as private nonprofits and local health departments (LHD) that generally serve multi-county, county, or city local health jurisdictions (LHJ). Staff in these agencies engage with individual WIC enrollees, recruit/review WIC applicant eligibility, distribute food vouchers, and make health education available to WIC

enrollees. Enrollees are encouraged but not required to participate in health education. Findings of numerous studies suggest that the WIC program is effective and helps to (a) reduce premature births; (b) reduce low birth weight (LBW) and very LBW babies; (c) reduce fetal and infant deaths; (d) reduce incidence of low-iron anemia;(e) increase access to prenatal care (PNC) earlier in pregnancy; (f) increase pregnant women's consumption of key nutrients such as iron, protein, calcium, and vitamins A and C; (g) increase immunization rates; (h) improve diet quality; and (i) increase regular access to health care.[6-16]

A robust body of research exists documenting disparities in maternal and child health (MCH) outcomes in the U.S.[17] One goal of programs like WIC is to address and reduce these disparities, and findings suggest that WIC participation can improve outcomes and narrow gaps.[7-10] Given the varied baselines from which different groups start, previous research has also documented differential WIC effects among subpopulations. For example, Bitler and Currie (2005) and Kowaleski-Jones and Duncan (2002) found that mothers who participate in WIC are more likely to have babies with a healthy birth weight (BW) and to breastfeed their infants—with more pronounced effects among mothers with greater disadvantage (e.g., who received other forms of public assistance).[8,9] Other researchers have reported more pronounced WIC effects among Black mothers. For example, Khanani, Elam, Hearn, Jones, and Maseru (2010) identified differential WIC effects by race for both infant mortality and preterm birth with infants of Black women who enrolled in WIC being much less likely to die than the infants of Black women who did not enroll in WIC.[10] Further, WIC utilization in this population was associated with decreased Black/White disparities in infant mortality and WIC participants were less likely to have extremely preterm (between 20 and <34 weeks gestation) deliveries.[10]

WIC enrollment increased during the Great Recession of 2007-2009 and the WIC Program received additional funding at the federal level through the American Recovery and Reinvestment Act (ARRA).[18,19] Prior to the Great Recession, WIC served approximately 50% of infants born in the U.S.[6] During the Great Recession, WIC enrollment increased by about 5%, despite decreases in birth rate.[19] However, WIC enrollment did not increase as much as some other federally funded programs like unemployment insurance, SNAP, or Medicaid coverage.[5,20-22] Further, the WIC Program only used $38,000,000 of the $400,000,000 in additional program funding allocated to WIC services as part of the stimulus package.[21] Less than estimated caseload growth and decreased food costs during the Great Recession partially explain the under-utilization of additional WIC funding.[18,21] Widespread reports of LHDs cutting MCH-related programs (reducing hours, laying off or not hiring staff, etc.) due to budget cuts may also have contributed to reduced referrals and participant access to WIC program resources, despite federal level increases in funding.[23] Some recent research has also suggested that the population using WIC changed over the course of the Great Recession—that those with higher education and at a higher income eligibility spectrum participated in WIC at greater rates than previously reported.[20] Specifically, prior to the Great Recession, mothers with more education or higher income were less likely to participate in WIC. Jackson and Schwartz (2014) found an 18% gap in the probability of WIC exposure during PNC prior to the Great Recession between mothers who had less than a high school education and those with some college education, but during the Great Recession this gap declined to 6%.[20]

A recent study demonstrated that MCH outcomes (e.g., preterm birth, LBW) and disparities persisted and/or increased in absolute numbers during the Great Recession.[24,25] Upon controlling for social determinants of health that were associated with late or no entry into PNC

(late/no PNC), individual social status characteristics (particularly low education and young age) were found to be associated with late/no PNC—more so than LHD expenditures on MCH services or other community economic factors (e.g., unemployment). While these studies were not limited to a WIC-eligible population, Blakeney (n.d.) did find that enrollment into WIC services was identified as having a positive association (indicating a potential beneficial effect) with late/no PNC.[25]

All of these changes, combined with previous research indicating differential WIC effects among race/ethnicity and other social characteristic groups, suggest that associations between BW and maternal WIC enrollment may have changed conditional on social characteristic groups with high-need (WIC eligible) during the Great Recession.

Methods

Using secondary data and a cross-sectional design, we explored whether maternal WIC enrollment had a differing effect on BW by social groups during the recent Great Recession. To do this we tested the interaction between maternal WIC enrollment with race/ethnicity and other social characteristic groupings on BW within regression models representing pre- and intra-Recession periods. The first period (pre-Recession/baseline) was from January 2005-March 2007. The second period encompasses the official Recession dates (December 2007-June 2009).[26]

Study Population

De-identified, individual-level, birth certificate data were obtained from the state Departments of Health in Washington (WA) and Florida (FL) with relevant human subjects approvals from both Institutional Review Boards (IRB) to carry out the analyses. The study population included first-time mothers of singletons in WA and FL who were uninsured or for

whom Medicaid paid for their births during two Recession-related time periods. Limiting the study population to uninsured and Medicaid births allowed us to closely approximate a WIC-eligible population as maternal income is not available in birth certificate data. We further restricted inclusion to records that included complete WIC enrollment data, BW, and county of residence information (to allow for linking with county/LHJ data) (n=226,835).

Measures

We considered two outcome measures of BW—a binary LBW measure (yes/no) and a continuous measure of BW in grams. BW was selected as the outcome measure for this study because other studies show that WIC services have an impact on BW and constitute one of the more reliable pieces of birth certificate data.[8,9,15,16,27] We limited analysis to infants with BW between 3,500-8,000 grams to ensure infants most likely to be considered viable across jurisdictions, thus improving consistency in registration of births (as there is variation across jurisdictions in registration practices of births considered non-viable).[28] Covariates were selected based on a multi-faceted social determinants of health conceptual framework and previous research that linked them to MCH outcomes.[29-31] Individual, community and LHD expenditure measures, and state dummy variables (categoric variable representing each state) were included (Table 1).[24]

Analysis

Linear probability regression models (LPMs) were specified for both time periods (pre- and intra-Recession) as well as for each BW outcome (binary LBW and continuous BW in grams). STATA 12.0 was used with robust standard errors (SEs) to control for clustering within LHJs and to produce robust SEs.[40,41] WIC interactions with conceptually relevant individual level covariates were also introduced in the models and included the following factors: maternal

race/ethnicity, maternal age, marital status, maternal birth place, education, timing of entry to PNC, payer (Medicaid vs. uninsured), and geography (core-based statistical area (CBSA)). Interaction analyses are typically carried out within regression models to determine whether the effect of a variable (in this case maternal WIC enrollment) on an outcome (e.g., LBW, BW in grams) varied depending on the value of another variables.[42-44] In this case, we modeled WIC interactions with a variety of individual categorical social characteristics (e.g., with race/ethnicity to assess differential WIC interaction effects between White vs. Black mothers).

Results

Table 2 summarizes demographic characteristics of the study population by WIC or no WIC enrollment before and during the recent Great Recession. As the study population was limited to pregnant women who were uninsured (self-pay) or insured through Medicaid, the majority of the population is enrolled in WIC. Similar to the nationally reported increase in WIC enrollment during the Great Recession, WIC enrollment in our study population increased by approximately 5% (from 73.78% during baseline to 78.77% during the Great Recession).[19] Those enrolled in WIC were less likely to be married or to be foreign-born than non-WIC participants. They were also slightly more likely to have entered PNC late or not at all, but were less likely to have given birth to LBW infants. Demographic characteristics did not shift dramatically between baseline and the Great Recession periods for any group.

To test for the presence and magnitude of interactions between WIC and a variety of individual social characteristics on LBW, regression models were conducted. During both periods (Baseline and Recession) we found positive WIC interaction effects for both Black women and those who entered PNC late or not at all (Table 3). WIC enrollment among Black mothers was associated with a reduction in the difference of the probability of delivering a LBW

infant (-0.031 Baseline/-0.025 Recession) compared to infants of Black mothers without WIC (0.084/0.080). Compared to the infants of White mothers (the referent group), infants of Black mothers using WIC had a 0.053/0.052 greater probability of LBW (e.g., 0.084-0.031 = 0.053), while non-WIC Black mothers had a .084/.080 greater probability of LBW compared to White mothers.

Among women who entered PNC late or not at all, WIC also provided a beneficial effect. Without WIC, women who entered PNC late had a 0.005 greater (Baseline) and 0.017 greater (Great Recession) probability of LBW (compared to late/no PNC mothers without WIC). During both periods, the sign (+/-) of the relationship changed such that infants of late/no PNC mothers with WIC had a slightly lower probability of LBW (-0.007/-0.006) than infants of early PNC mothers (the referent group). During the Baseline Period, there was also a positive interaction between WIC and age for young mothers (under age 14) compared to the young mothers who did not enroll in WIC. Similar to the late/no PNC group, infants of young mothers with WIC had a lower probability of LBW compared to the referent group (maternal age 30-34). During the Great Recession Period, the WIC interaction was no longer significant for mothers under the age of 14, but it was positive and significant for those with less than a high school education as well as for those under age 20. (Note: Young age and finishing HS are difficult to disentangle as it is unlikely for young mothers to have finished high school; and as a result, HS completion is only assessed for those over age 20).

Table 4 presents the results of the regression modeling and WIC interaction effects for the continuous outcome variable—BW in grams. Similar to LBW, there were beneficial WIC interactions for infants of Black mothers and for those who entered PNC late or not at all compared to not having WIC during both periods. Among infants of Black mothers, WIC

enrollment increased BW by 53.61 grams (Baseline) and by 58.46 grams (Recession), respectively, to 196.17 and to 196.58 less than White mothers during the same time periods. While these BWs were still less than infants of White mothers, infants of Black mothers without WIC were 249.78/245.22 grams less than White mothers. Among mothers with late or no PNC, WIC interaction effects added 36.75 (Baseline)/48.17 (Recession) grams which brought them up to 7.48 (Baseline)/9.71 (Recession) grams higher than infants of women who entered PNC on time. During the Baseline Period, but not during the Great Recession, there was a positive WIC interaction among infants of young mothers (<age 14). Those without WIC had infants 245.22 grams less than their referent group (women aged 30-34) while those young mothers with WIC had infants only 50.97 grams less than their referent group (women aged 30-34).

Discussion

Consistent with previous studies, we found beneficial WIC interaction effects on BW between race and WIC, between PNC and WIC, and between very young mothers and WIC.[8,9,10] Specifically, Black mothers who entered PNC late or not at all, and in some periods/models young mothers and those with low education, evidenced better outcomes in the presence of WIC compared to those without WIC. While the relationship between the probability of LBW and WIC remained stable among Black mothers over the study period, it is notable that the benefit (in terms of reduced probability of LBW) among women who received late/no PNC nearly doubled from Baseline to the Great Recession. However, the WIC effect also increased (-0.012 to -0.023) from Baseline to the Great Recession, with the result that mothers who entered PNC late but enrolled in WIC had a lower chance of having a LBW baby than those who entered on time and had WIC during either period. As such, it appears that the positive effects of WIC may have become more pronounced for this group during the recent Great Recession. It is not clear

whether this is due to WIC having more of an effect during a stressed/difficult time, or whether the population using WIC changed such that women with different characteristics, for example high education (though this was controlled for in regression models), became eligible and started using WIC during the Great Recession.[20]

WIC interactions were tested for multiple individual variables and, while there were clear differences in probability of LBW as well as differences in BW in grams between/among groups (e.g., based on marital status, foreign-born status), no other WIC interactions were significant. This paper supports previous research linking WIC services to improved BW and as an effective means of helping improve BW (both reducing LBW and increasing infant BW in grams) among some high disadvantage groups.[8,9,10] While it is encouraging to find that the positive benefits of WIC did not appear to diminish over the course of the Great Recession for those that it was already benefiting, clear gaps are still present among other social characteristic groups (e.g., for Hispanic and Asian mothers as well as for unmarried mothers for which we did not find WIC to have detectable value in promoting better outcomes). These results are consistent with findings from Khanani et al. (2010) who found more pronounced WIC effects (when looking at infant mortality and preterm birth) among Black women.[10] Future research needs to examine how WIC (and/or other MCH programs) could be made to work better and reach farther to address persistent disparities in BW outcomes.

Recent research has suggested that WIC recruitment efforts and program supports during the Great Recession were attenuated by cuts to LHD budgets/staffing[23]—despite millions of dollars being unused for WIC response to increased need during the Great Recession.[21] Prah (2012) also reported that some potential recipients did not avail themselves of WIC services during the Great Recession—despite increased need—as they found the process of enrolling in

the WIC Program to be more troublesome than it was worth.[45] Prah cites the relative ease of enrolling in and using SNAP, as well as how much the benefit is worth compared to WIC as one possible explanation for lower than expected increases in WIC enrollment during the Great Recession.[45] The average person on SNAP (food stamps) receives $134/month and the average mother on WIC receives $50/month; SNAP benefits are also accessed via unobtrusive debit cards while WIC continues to use paper vouchers.[45] While we were not able to include SNAP utilization data in this study, it will be valuable to see—as the WIC Program shifts to electronic benefit methods—whether more individuals eligible for WIC services enroll and what the impact of these services will be on MCH outcomes among WIC recipients.

Limitations

While providing evidence for associations among BW, WIC and other covariates, it is not possible to establish causal relationships with cross-sectional data and findings must be interpreted with caution as information may be missing or innaccurate.[46] Our study population may also limit generalizability of our results. In this study we limited inclusion to those with Medicaid or self-pay (uninsured) as the payer for their delivery, since we did not have maternal income or other specific information to be able to assess WIC eligibility. All Medicaid recipients are eligible for WIC services and, similar to other studies, it appears that WIC recipients were more likely to have disadvantaging characteristics (e.g., more likely to have less than a high school education, less likely to be married), yet WIC was demonstrated to be beneficial.[8] Those who were self-pay (uninsured) were also included, as over 50% were WIC enrollees during each study year (confirming that they were a predominantly high need group). It would be valuable to confirm these results in a broader WIC eligible population. Further, it was not possible with the data used in this study to identify when mothers enrolled in WIC

and/or Medicaid, so it may be possible that we did not capture differential dose/response relationships between being enrolled in WIC for longer and having a larger benefit—which may understate the magnitude of WIC effects on BW. Finally, during the Great Recession there were massive increases in enrollments/payments for SNAP and unemployment insurance and we were not able to capture these services in our dataset to assess contributions to infant BW of other government supports beyond, instead of, or in addition to WIC.

Conclusion

WIC appears to have been beneficial to infant BW (reducing LBW; increasing BW in grams) among the very young, Black, and late/no PNC enrollees in this high-need population, both before and during the Great Recession. Further research is needed to explore how these benefits might be increased or extended to other groups with disparate BW outcomes.

Table 1

Covariates (Blakeney[24])

Covariate Level	Covariate Name/Description
Individual	• Race/ethnicity: non-Hispanic White, Hispanic White, non-Hispanic Black[a] • Maternal age • Marital status (married/unmarried) • Mother foreign-born (Yes/No) • Maternal education (less than HS; HS diploma or GED; some college; not assessed (age < 20 years) • WIC (maternal WIC enrollment) (Yes/No) • Maternal insurance status (e.g., Medicaid or private insurance). • Late/No PNC (0-mother entered PNC during first trimester; 1-mother entered PNC after the first trimester or not at all)
Community[b] (at the LHJ level unless otherwise indicated)	• Core Based Statistical Area (CBSA) (metropolitan, micropolitan, or rural) • Community poverty (binary variable 1 = LHJs with the highest percentage (top 1/3) of residents age 0-17 in poverty by state; and 2 lower 2/3 of residents in poverty (non-poor LHJs)[32,33] • Percent of voters voting Republican (vs. Democrat or Independent) in the 2004 and 2008 presidential elections[c 34-36] • Gini coefficient (2000 census: measure of income distribution/inequality (0-1), larger number > inequality) [37] • Per Capita General and Family Practitioner MDs/LHJs (for years 2005, 2008, 2010)[32,38,39] • Per capita LHJ unemployment rate[d]
Expenditure[e]	• Total LHD expenditures • WIC expenditures • Family Planning (FP) expenditures) • Maternal/Infant/Child/Adolescent (MICA) services expenditures • 2MCH—Combined expenditures[f 32,39]
State	• State-level dummy variables were created for WA and FL to capture any state-level differences

Notes. [a]Race/ethnicity groups were defined using data from two separate variables (maternal race and maternal ethnicity) to create a 3-category combined race/ethnicity variable. [b]Community level covariates were selected based on previous research or for which social determinants of health theories suggest a plausible association to MCH outcomes in the context of the Recession.[29-31] [c]The voting patterns measure was intended to act as a proxy for differences in political orientation at the community level as previous research has identified Republican voters as less likely to perceive that there are people in the United States who encounter access to care issues as well as less likely to support public health reform.[36] [d]Individual unemployment data were not available. [e]LHD-specific per capita expenditure data were included in the preliminary model as the Recession yielded widespread reports of budget cuts to LHDs.[23] Per capita rates were calculated using total LHJ population as a denominator. Differences in fiscal years between WA and FL were reconciled by assigning FL's FY to the earlier year (e.g., FL FY 2005-2006 associated with WA FY 2005). [f]MICA represents a composite of similar budget categories for WA and FL that includes comparable intervention activities across both states—e.g., home visiting, prenatal health programs.[32,39]

Table 2

Demographic Characteristics of Study Population with and without WIC during Baseline and Recession Periods

	Baseline		**Recession**	
	No WIC n=34,485 (26.22%)	**WIC** n=97,033 (73.78%)	**No WIC** n=20,236 (21.23%)	**WIC** n=75,081 (78.77%)
Birth Weight				
BW in grams	3179.68 (SD = 620.61) n=34485	3216.99 (SD=562.15) n=97033	3199.18 (SD=616.52) n=20236)	3210.48 (SD= 561.36) n=75081
LBW	9.53% n=3285	8.13% n=7,886	9.36% n=1,895	8.16% n=6,128
Mother's Age				
Mother's Age, years (mean, SD)	24.02 (SD = 5.96) n=34478	22.08 (SD=5.25) n=97024	24.49 (SD=5.90) n=20234	22.19 (SD=5.15) n=75077
Number and proportion of Teenage Births (<19) as component group of total study population*	24.01% n=8,279	35.87 % n=34,810	21.32 % n=4,315	34.68 % n=26,041
Mother's Race/Ethnicity				
Non-Hispanic White	56.90 % n=19,319	45.25% n=43,515	58.36 % n=11,600	45.20 % n=33,550
Hispanic White **this represent ALL Hispanic White ethnicity mothers (except Cuban)*	15.07 % n=5,116	21.46 % n=20,635	12.59% n=2,502	19.84 % n=14,459
Non-Hispanic Black	16.07 % n=5,457	23.87 % n=22,959	16.28 % n=3,236	24.67 % n=18,309
Non-Hispanic Asian	4.59% n=1,557	1.65% n=1,588	4.95% n=983	1.86% n=1,381
Maternal SES				
Foreign-Born Mother	36.06 % n=12,437	28.72% n=27,872	35.00% n=7,082	26.72 % n=20,058
Married (Mother)	38.50 % n=13,260	24.00% n=23,264	37.89 % n=7,661	21.40 % n=16,057
Education Less than High School* **for age>20*	10.44 % n=3,660	11.76 % n=11,414	8.79 % n=1,778	10.03 % n=7,533
Late or No Entry to PNC	28.26% n=9,746	27.32% n=26,509	28.74% n=5,815	27.53% n=20,671

Table 3

Regression Model Results for LBW during Baseline and Recession Periods

	Baseline		**Recession**	
	Coef. (SE)	**95% C.I.**	**Coef. (SE)**	**95% C.I.**
Maternal Race/Ethnicity				
White, Non-Hispanic (1)	Referent		Referent	
White, Hispanic (2)	0.018* (0.005)	0.008-0.029	0.019* (0.007)	0.005 - 0.032
Black, Non-Hispanic (3)	0.084* (0.006)	0.073 - 0.095	0.080* (0.007)	0.067 - 0.093
Asian (6)	0.034* (0.007)	0.020 - 0.047	0.047* (0.014)	0.020 - 0.074
WIC x Maternal Race/Ethnicity				
White x WIC	Referent		Referent	
Hispanic x WIC	-0.012 (0.006)	-0.024 - 0.000	-0.011 (0.008)	-0.026 - 0.004
Black x WIC	-0.031* (0.006)	-0.042 - -0.019	-0.025* (0.007)	-0.039 - -0.012
Asian x WIC	-0.014 (0.010)	-0.033 - 0.005	-0.023 (0.017)	-0.057 - 0.011
Maternal Age				
Age < 14 (1)	0.107* (0.043)	0.022 - 0.192	0.037 (0.053)	-0.068 - 0.141
Age 15-19 (2)	0.001 (0.010)	-0.019 - 0.021	-0.002 (0.013)	-0.029 - 0.025
Age 20-24 (3)	-0.019* (0.006)	-0.031 - -0.006	-0.016* (0.006)	-0.028 - -0.004
Age 25-29 (4)	-0.017* (0.006)	-0.029 - -0.006	-0.015 (0.009)	-0.033 - 0.004
Age 30-34 (5)	Referent		Referent	
Age 35-39 (6)	0.020* (0.008)	0.005 - 0.035	0.027 (0.017)	-0.007 - 0.060
Age 40 + (7)	0.068* (0.024)	0.021 - 0.115	0.063* (0.016)	0.032 - 0.095
Maternal Age x WIC				
Age < 14 x WIC	-0.116* (0.043)	-0.201 - -0.030	-0.044 (0.059)	-0.161 - 0.074
Age 15-19 x WIC	-0.027 (0.015)	-0.056 - 0.002	-0.011 (0.017)	-0.046 - 0.023
Age 20-24 x WIC	-0.007 (0.010)	-0.027 - 0.013	-0.010 (0.009)	-0.027 - 0.007
Age 25-29 x WIC	-0.002 (0.009)	-0.020 - 0.016	-0.000 (0.013)	-0.026 - 0.025
Age 30-34 x WIC	Referent		Referent	
Age 35-39 x WIC	0.013 (0.009)	-0.005 - 0.031	-0.015 (0.020)	-0.055 - 0.025
Age 40 + x WIC	-0.016 (0.030)	-0.077 - 0.044	-0.014 (0.029)	-0.071 - 0.042
Marital Status				
Married	Referent		Referent	
Unmarried	0.015* (0.004)	0.007 - 0.022	0.010* (0.004)	0.003 - 0.018
Marital Status x WIC				
Married x WIC	Referent		Referent	
Unmarried x WIC	-0.008 (0.005)	-0.017 - 0.001	-0.003 (0.004)	-0.011 - 0.006
Maternal Birthplace				
Born in U.S.				
Born outside U.S.	-0.020* (0.006)	-0.033 - -0.008	-0.023* (0.007)	-0.037 - -0.009

Maternal Birthplace x WIC				
Born in U.S. x WIC	Referent		Referent	
Born Outside U.S. x WIC	0.006 (0.005)	-0.003 - 0.016	0.010 (0.006)	-0.002 - 0.022
Maternal Education				
Less than H.S. (1)	0.023* (0.006)	0.012 - 0.034	0.040* (0.010)	0.020 - 0.060
H.S. Diploma (2)	0.017* (0.004)	0.008 - 0.026	0.021* (0.005)	0.010 - 0.032
Some College (3)	Referent		Referent	
Not Assessed; maternal age < 20 (4)	0.009 (0.006)	-0.003 - 0.021	0.022* (0.009)	0.004 - 0.041
Maternal Education X WIC				
Less than H.S. x WIC	-0.007 (0.006)	-0.019 - 0.005	-0.025* (0.012)	-0.048 - -0.002
H.S. Diploma x WIC	-0.006 (0.004)	-0.014 - 0.003	-0.012 (0.007)	-0.025 - 0.001
Some College x WIC				
Not Assessed; maternal age < 20 x WIC	0.004 (0.009)	-0.013 - 0.020	-0.026* (0.010)	-0.046 - -0.005
Timing of Prenatal Care Entry				
During First Trimester	Referent		Referent	
After First Trimester (including no PNC) (1)	0.005 (0.004)	-0.003 - 0.013	0.017* (0.005)	0.008 - 0.027
Prenatal Care X WIC				
First Trimester x WIC	Referent		Referent	
Late x WIC	-0.012* (0.004)	-0.019 - -0.005	-0.023* (0.005)	-0.034 - -0.013
Maternal WIC				
Not Enrolled	Referent		Referent	
Enrolled (1)	0.005 (0.012)	-0.019 - 0.029	0.015 (0.010)	-0.004 - 0.035
Medicaid or Uninsured				
Medicaid	Referent		Referent	
Uninsured (3)	-0.010* (0.003)	-0.017 - -0.004	-0.008 (0.006)	-0.019 - 0.003
Medicaid or Uninsured X WIC				
Medicaid x WIC	Referent		Referent	
Uninsured x WIC	-0.002 (0.007)	-0.015 - 0.012	0.001 (0.006)	-0.010 - 0.012
Geography				
Metropolitan (1)	Referent		Referent	
Micropolitan (2)	-0.020* (0.006)	-0.032 - -0.007	0.007 (0.013)	-0.018 - 0.031
Rural (3)	-0.018 (0.011)	-0.040 - 0.005	0.017 (0.014)	-0.011 - 0.046
Geography X WIC				
Metropolitan x WIC	Referent		Referent	
Micropolitan x WIC	0.000 (0.008)	-0.014 - 0.015	-0.011 (0.013)	-0.037 - 0.015

Rural x WIC	0.009 (0.010)	-0.012 - 0.029	-0.018 (0.015)	-0.048 - 0.013
Community Poverty				
Residence in Top 1/3 Poorest LHJS	0.009* (0.004)	0.002 – 0.017	0.008 (0.004)	-0.001 - 0.016
Residence in Other 2/3 of LHJs (non-poor)	Referent		Referent	
State				
Florida (1)	Referent		Referent	
Washington (2)	-0.007 (0.005)	-0.016 – 0.002	-0.014* (0.004)	-0.023 - -0.006
Unemployment Rate	0.000 (0.002)	-0.003 - 0.004	-0.000 (0.000)	-0.001 - 0.001
Median Household Income	-0.000* (0.000)	-0.0000 – -0.000	-0.000 (0.000)	-0.000 - 0.000
Gini Coefficient	0.056 (0.040	-0.023 – 0.136	0.003 (0.031)	-0.058 - 0.064
Percent Voting Republican in 2004 or 2008 Presidential Election	0.00003* (0.0001)	0.00008 – 0.0006	0.0000 (0.0001)	-0.0002 - 0.0002
Per Capital FM and GP Physicians	-0.205* (0.091)	-0.386 – -0.025	0.067 (0.095)	-0.120 - 0.255
Per Capita LHD Expenditures				
2MCH (lagged)	0.0003* (0.0001)	0.0000 – 0.0006	-0.0002 (0.0002)	-0.0006 - 0.0001
WIC (lagged)	0.0005 (0.0004)	-0.0003 - 0.001	0.0014* (0.0005)	0.001 - 0.002
Constant	0.056* (0.028)	0.001 - 0.111	0.068* (0.025)	0.019 - 0.116

Table 4

Regression Model Results for Birth Weight in Grams during Baseline and Recession Periods

	Baseline		Recession	
	Coef. (SE)	95% C.I.	Coef. (SE)	95% C.I.
Maternal Race/Ethnicity				
White, Non-Hispanic (1)	Referent		Referent	
White, Hispanic (2)	-77.08* (13.33)	-103.53 - -50.63	-76.72* (16.62)	-109.69 - -43.75
Black, Non-Hispanic (3)	-249.78* (13.02)	-275.61 - -223.95	-255.04* (14.89)	-284.57 - -225.51
Asian (6)	-184.93* (15.98)	-216.62 - -153.23	-208.59* (20.42)	-249.09 - -168.09
WIC x Maternal Race/Ethnicity				
White x WIC	Referent		Referent	
Hispanic x WIC	14.06 (16.23)	-18.13 - 46.26	28.03 (16.23)	-4.17 - 60.24
Black x WIC	53.61* (10.55)	32.68 - 74.54	58.46* (15.20)	28.31 - 88.61
Asian x WIC	-2.34 (20.39)	-42.78 - 38.10	46.29 (24.76)	-2.83 - 95.41
Maternal Age				
Age < 14 (1)	-245.22* (64.83)	-373.83 - -116.61	-55.24 (71.62)	-197.33 - 86.84
Age 15-19 (2)	-27.29 (23.12)	-73.15 - 18.57	-26.28 (25.52)	-76.90 - 24.34
Age 20-24 (3)	29.34* (11.58)	6.37 - 52.31	22.58 (11.83)	-0.89 - 46.04
Age 25-29 (4)	32.74* (9.38)	14.13 - 51.33	38.12* (14.91)	8.53 - 67.70
Age 30-34 (5)	Referent		Referent	
Age 35-39 (6)	-50.76* (18.04)	-86.55 - -14.98	-44.83 (32.23)	-106.80 - 17.14
Age 40 + (7)	-169.01* (40.77)	-249.88 - - 88.13	-117.76* (31.05)	-179.35 - -56.18
Maternal Age x WIC				
Age < 14 x WIC	195.54* (57.39)	81.69 - 309.38	9.64 (84.13)	-157.25 - 176.52
Age 15-19 x WIC	34.57 (24.45)	-13.92 - 83.07	35.41 (31.89)	-27.85 - 98.67
Age 20-24 x WIC	-2.48 (17.54)	-31.32 - 26.36	5.48 (14.61)	-23.51 - 34.47
Age 25-29 x WIC	-9.64 (12.27)	-33.98 - 14.71	-14.46 (21.75)	-57.61 - 28.69
Age 30-34 x WIC	Referent		Referent	
Age 35-39 x WIC	-34.21 (21.35)	-76.56 - 8.14	2.70 (39.13)	-74.93 - 80.33
Age 40 + x WIC	33.67 (42.39)	-50.43 - 117.77	-10.15 (50.24)	-109.82 - 89.52

Marital Status				
Married	Referent		Referent	
Unmarried	-43.78* (9.83)	-63.28 - -24.28	-35.24* (12.96)	-60.96 - -9.52
Marital Status x WIC				
Married x WIC	Referent		Referent	
Unmarried x WIC	14.25 (9.81)	-5.22 - 33.71	7.74 (14.70)	-21.43 - 36.91
Maternal Birthplace				
Born in U.S.	Referent		Referent	
Born outside U.S.	20.56 (12.98)	-5.18 -46.30	25.15 (15.01)	-4.62 - 54.92
Maternal Birthplace x WIC				
Born in U.S. x WIC	Referent		Referent	
Born Outside U.S. x WIC	10.13 (11.53)	-12.74 - 32.99	1.72 (13.65)	-25.36 - 28.79
Maternal Education				
Less than H.S. (1)	-77.49* (18.65)	-114.48 - -40.49	-87.06* (20.69)	-128.11 - -46.01
H.S. Diploma (2)	-40.51* (9.47)	-59.30 - -21.73	-56.62* (10.99)	-78.41 - -34.83
Some College (3)	Referent		Referent	
Not Assessed; maternal age < 20 (4)	-40.51* (13.92)	-68.12 - -12.89	-44.90* (15.63)	-75.90 - -13.90
Maternal Education x WIC				
Less than H.S. x WIC	22.27 (17.33)	-12.12 -56.65	27.61 (20.30)	-12.66 - 67.88
H.S. Diploma x WIC	10.53 (9.23)	-7.77 - 28.84	26.11 (14.12)	-1.89 -54.11
Some College x WIC	Referent		Referent	
Not Assessed; maternal age < 20 x WIC	-0.73 (17.02)	-34.49 - 33.03	16.99 (18.90)	-20.50 - 54.48
Timing of Prenatal Care Entry				
During First Trimester	Referent		Referent	
After First Trimester (including no PNC) (1)	-29.28* (7.54)	-44.24 - -14.31	-38.46* (9.98)	-58.25 - -18.66

Prenatal Care x WIC				
First Trimester x WIC	Referent		Referent	
Late x WIC	36.75* (7.89)*	21.10 - 52.40	48.17* (11.64)	25.08 - 71.26
Maternal WIC				
Not Enrolled	Referent		Referent	
Enrolled (1)	3.52 (18.84)	-33.86 - 40.89	-16.71 (18.61)	-53.62 - 20.20
Medicaid or Uninsured				
Medicaid	Referent		Referent	
Uninsured (3)	36.60* (9.32)	18.10 - 55.10	23.16 (13.73)	-4.08 - 50.41
Medicaid or Uninsured x WIC				
Medicaid x WIC	Referent		Referent	
Uninsured x WIC	-8.49 (11.68)	-31.65 - 14.68	0.12 (13.91)	-27.47 - 27.71
Geography				
Metropolitan (1)	Referent		Referent	
Micropolitan (2)	46.30* (18.79)	9.03 - 83.58	69.94* (26.07)	18.22 - 121.65
Rural (3)	44.79 (29.67)	-14.07 - 103.65	22.35 (27.80)	-32.80 - 77.50
Geography X WIC				
Metropolitan x WIC	Referent		Referent	
Micropolitan x WIC	-0.55 (21.24)	-42.68 - 41.59	-45.36 (28.76)	-102.41 - 11.69
Rural x WIC	-35.05 (29.97)	-94.51 - 24.41	-20.31 (31.35)	-82.50 - 41.89
Community Poverty				
Residence in Top 1/3 Poorest LHJS	-47.68* (11.29)	-70.08 - -25.27	-31.56* (13.98)	-59.28 - -3.84
Residence in Other 2/3 of LHJs (non-poor)	Referent		Referent	
State				
Florida (1)				
Washington (2)	69.33* (15.09)	39.39 - 99.27	62.81* (11.07)	40.86 - 84.77
Unemployment Rate	-1.02 (3.84)	-8.65 - 6.60	1.66* (0.72)	0.24 - 3.09

Median Household Income	0.00 (0.00)	-0.00 - 0.00	0.00 (0.00)	-0.00 - 0.00
Gini Coefficient	-180.08 (113.99)	-406.22 - 46.05	-174.15 (100.95)	-374.40 - 26.10
Percent Voting Republican in 2004 or 2008 Presidential Election	-0.52* (0.26)	-1.05 - 0.00	-0.09 (0.30)	-0.69 - 0.52
Per Capital FM and GP Physicians	457.72 (242.90)	-24.12 - 939.57	281.13* (264.45)	-243.47 - 805.73
Per Capita LHD Expenditures				
2MCH (lagged)	0.07 (0.37)	-0.66 - 0.79	0.88* (0.42)	0.06 - 1.71
WIC (lagged)	-1.35 (1.01)	-3.35 - 0.64	-3.37* (1.09)	-5.52 - -1.22
_cons	3351.76* (71.20)	3210.52 - 3492.99	3342.32* (68.15)	3207.13 - 3477.50

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Paper Three

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