***Title*: Understanding Associations Between State-Level Policy Factors and Very Short Inter-Pregnancy Intervals in the United States: The Role of County-Level Urban-Rural Status**

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INTRODUCTION

Women's ability to choose when and whether to have children may influence their social, economic, and emotional well being.[1] In order for women to control their own fertility, the availability of affordable and accessible family planning services is critical. The national changes in United States (U.S.) health care in recent years have dramatically shifted the landscape of state coverage of family planning services. In 2010, the Affordable Care Act (ACA) *expanded* contraceptive coverage by allowing states to expand Medicaid, mandating that marketplace plans and Medicaid expansion programs cover 18 FDA-approved methods, and greatly reducing administrative burden required to implement Medicaid family planning waivers.[2] These waivers provide Medicaid-covered contraceptive services to women (and men, in some states) who would not otherwise be eligible for Medicaid.[3] Most states base program eligibility on income, and tend to match the eligibility level for pregnancy-related services; often, these benefits are also extended to individuals leaving Medicaid postpartum.[2,3] As of July 2018, 33 states had adopted these waivers.[3] Evidence suggests that Medicaid family planning waivers have lead to increased contraceptive access and use[9] and decreased birth rates, especially to teens.[4,5]At the same time, abortion is becoming increasingly *restricted* as a large number of states – including many that expanded Medicaid and/or adopted Medicaid family planning waivers – have proliferated laws restricting access to abortion.[3] These laws include mandatory ultrasounds, compulsory waiting periods, regulations on abortion facilities, and requiring inaccurate or misleading counseling.[6] Importantly, these state policies have real-world implications for reproductive health; for example, greater access to abortion is associated with decreased risk of low birth weight, teen pregnancy, prematurity, and infant mortality.[7,8] About half (45%) of pregnancies in the U.S. are unintended and an estimated 40% of those end in abortion, suggesting that about one-fifth of pregnancies could be expected to be affected by these restrictive laws.[9]

While research suggests that state-level policies around contraception and abortion may impact infant health, the influence of such policies on birth *spacing* is unclear. Intervals of less than 18 months between a live birth and a subsequent pregnancy are considered "short" and include about one-third of second- or higher-order singleton births.[10] In the U.S., about one-third of second- or higher-order births occur within an 18-month inter-pregnancy interval; of these, about one-sixth occur within a 6 month interval (5% total).[10] These "very short " interval births are associated with greater risk of preterm birth,[11–13] low birth weight,[12] and severe neonatal morbidity,[14] and these outcomes tend to be more common than even among short interval births. Further, very short intervals are strongly correlated with unintended pregnancy, especially among lower-income women and women of color.[15–18] In one study,[17] 84% of pregnancies within a 6 month inter-pregnancy interval were unintended. Therefore, it is theoretically plausible that improving access to contraception and abortion may result in fewer unintended births.

In addition to understanding overall effects of these policies on birth spacing, it is important to understand how these policies may affect individuals who have less access to enabling resources. The effects of policies on health outcomes may be heterogeneous, especially if they are influenced by health care access. In the U.S., urban-rural status may serve as a proxy for access to reproductive health care services. Accessing reproductive health care can be challenging in rural areas due to factors such as greater geographic distance,[19] lack of transportation,[20] shortage of obstetric-gynecologic providers,[20] and limited access to hospital facilities not associated with Catholic health care systems (which restrict contraceptive care).[21] Abortion can be especially difficult for women in rural areas because abortion clinics are generally concentrated in urban centers, even in rural states.[22] As a result, policies that aim to expand health coverage eligibility but do not address other issues related to access may be less effective among women in more rural areas than in more urban areas.[23–25] The Andersen model of healthcare utilization[26] is a useful framework for considering these issues, because it views systems and environmental factors, as well as community-level factors, as key predictors of use of health services.

In the current study, we investigate the associations between three state-level health care access policies that may facilitate or restrict women's ability to control their fertility – (1) Medicaid expansion; (2) Medicaid family planning waivers; and (3) degree of abortion restriction in state laws – on incidence of very short (<6 month) inter-pregnancy intervals using cross sectional data. We hypothesize that fewer women living in states with Medicaid expansions and/or family planning waivers will have very short interval pregnancies, while the opposite will be true for women living in states with greater abortion restrictions. We then explore whether associations between policy variables and very short birth spacing are heterogeneous across county urban-rural categories.

METHODS

Data

Data for this analysis derived from the 2015 National Center for Health Statistics' geocoded natality file, obtained from the National Association for Public Health Statistics and Information Systems (NAPHSIS) through a data use agreement. The study was deemed exempt by the UW-Madison Institutional Review Board. We computed inter-pregnancy interval by subtracting gestational age from inter-birth interval, which is available in the 2003 Revised Certificate of Live Birth. Our sample included singleton non-first births between 20 and 45 weeks gestation to U.S. residents for whom Medicaid was listed as the payor of record. Non-singleton births were excluded because for plural deliveries, the birth certificate does not specify inter-birth interval between index births and the previous birth. We included only deliveries covered by Medicaid because we expected that these mothers would be most likely to be affected by Medicaid family planning waivers.[9] Connecticut was excluded due to 98% of cases missing outcome data. Our final analytic sample included nearly one million births (n=970,633).

Our main exposure variables were three state-level indicators measured in 2014, one year before births took place: (1) presence of Medicaid expansion (yes vs. no); (2) presence of a Medicaid family planning waiver (yes vs. no); and (3) degree of abortion restriction in state laws (less restrictive vs. more restrictive). Information on Medicaid family planning waivers was collated from a variety of online sources, while the degree of abortion restriction variable was based on the Guttmacher Institute's categorization of states by the number of restrictive laws in place.[27]A state was considered "less restrictive" if it had three or fewer restrictive laws and "more restrictive" if it had four or more such laws. The National Center for Health Statistics' Urban Rural Classification Scheme for Counties[28] was used to reflect six levels of county-level geography: large central metro, large fringe metro, medium metro, small metro, micropolitan, and non-core.[28] Finally, to account for regional differences, we included an indicator for U.S. Census Bureau region (Northeast, Midwest, South, or West).[29]

Analysis

We first conducted univariate logistic regressions predicting <6 month inter-pregnancy interval. Then, we ran separate multivariate logistic regressions for each of the three state-level policy factors, adjusting for the potential individual level confounders of age, race, nativity, marital status, educational attainment, region, and county urban-rural category. Because state-level policies may have different effects in rural vs. urban areas due to disparities in access, each multivariate model included an interaction term between county-level urban rural status and one of the state-level policy variables. Finally, we tested random intercepts for state and county in our fully-adjusted models to determine the need to account for clustering by those factors.

PRELIMINARY RESULTS

We found greater than two-and-a-half fold variation in percentage of second- or higher-order singleton Medicaid-covered births occurring within a 6 month inter-pregnancy interval, from 4.9% in Massachusetts to 12.9% in North Dakota. Other states with very high rates included South Dakota (11.1%) and Arkansas (10.2%). Women living in states that did not expand Medicaid, did not have a family planning waiver, and had a higher degree of abortion restriction were disproportionately represented in the group of women experiencing a <6 month inter-pregnancy interval, as were women living in the South and West and women living in more rural areas (all $p<.0001$).

In our multilevel models, the intraclass correlation coefficients (ICCs) of the state and county random intercepts were very close to zero (less than 1%), indicating that there was little covariation between states or counties with respect to <6 month inter-pregnancy interval. Therefore, we switched to a single-level model to conserve power. **Table 1** shows unadjusted and adjusted odds from logistic regression models predicting <6 month inter-pregnancy interval. Unadjusted odds show significant main effects in the expected direction for Medicaid expansion, Medicaid family planning waiver, and greater abortion restriction (all p<.0001). Model 1 presents results from the adjusted model that includes Medicaid expansion; Model 2, Medicaid family planning waiver; and Model 3, degree of abortion restriction. Model 1 shows no association between Medicaid expansion and <6 month inter-pregnancy interval (p=.62). In Model 2, women living in states with a Medicaid family planning waiver were about 10% less likely to experience a <6 month inter-pregnancy interval compared to women living in states without a waiver (OR: .92, CI: .88-.93). In Model 3, there was a modest but significant positive association between greater abortion restriction and <6 month inter-pregnancy interval (OR: 1.04, 95% CI: 1.01-1.07).

The urban-rural *x* Medicaid family planning waiver interaction was highly significant (p=.005), while the urban-rural *x* abortion restriction interaction was of borderline significance (p=.0497). These interactions are depicted in **Figures 1 and 2** using predicted probabilities from the fully-adjusted model. Living in a state with a Medicaid family planning waiver was associated with a decreased risk of <6 month inter-pregnancy interval in large central metropolitan counties only; the magnitude of the difference was smaller in all of the more rural counties. Conversely, living in a state with a greater degree of abortion restriction is associated with increased risk of <6 month inter-pregnancy interval in micropolitan and non-core counties, but not in large metropolitan counties.

Discussion

In this preliminary investigation, we sought to understand whether reproductive health policy factors were associated with very short birth spacing in the U.S. among women with Medicaid-covered births. In this population, women living in states with a family planning waiver were 10% less likely to experience a very short-interval birth compared to women in states without waivers. Women living in states with a greater degree of abortion restriction were slightly (4%) more likely to experience a very short-interval birth compared to women in states with less restriction. Given that very short interval births are associated with poor birth outcomes,[11–14] these findings may help explain the observed link[8] between family planning funding and infant mortality rate.

Further, we found that associations between Medicaid family planning waivers and very short birth spacing were strongest in large central metro counties, while associations between degree of abortion restriction and very short birth spacing were strongest in the most rural counties (micropolitan and non-core). These findings are consistent with the idea that *coverage* does not automatically confer *access*, as well as prior literature suggesting that rural counties face unique barriers to care.[19–23] Our results add to the literature demonstrating significant urban-rural disparities, especially in perinatal outcomes;[20,30] therefore, identifying effective policy strategies for preventing very short inter-pregnancy intervals is an important matter of health equity.

A chief limitation of this analysis is that it is not causal. There may be policy endogeneity; i.e., states that adopt policies supportive of reproductive health care access may do so precisely because residents experience poor reproductive health outcomes.[4,31] However, we did adjust for individual-level demographic characteristics and delivery payer (by restricting to Medicaid-covered deliveries only) in an effort to control for major compositional differences by state. Important data source limitations include that the birth record does not include income data (thus limiting our ability to isolate the target sample that would likely be affected by the policy), that we were restricted to intervals between live births (i.e., we cannot observe intervals including stillbirths), and potential measurement error in assessment of gestational age and live birth interval in the birth certificate. Finally, we were unable to control for more nuanced cultural and societal factors that may influence birth spacing, such as religious views and cultural norms around health-seeking behavior.[4]

Our next steps include investigating potential heterogeneity in associations between state-level policy factors and birth spacing by demographic characteristics and policy subtypes. For example, there is some evidence that expansions based on income may be more effective than more limited expansions based on duration.[21] Length of time that a state has had a waiver may also influence its effectiveness.[2] Finally, we also plan to utilize a quasi-experimental design (e.g., differences-in-differences or interrupted time series analysis) to identify causal effects of these state-level policy factors.

Tables and Figures

Table 1. Unadjusted and adjusted odds of birth within <6m inter-pregnancy interval among Medicaid-covered second- or higher-order births to US resident women delivering singletons, National Vital Statistics System Birth Record Data, 2015 (N=970,633)*

	Unadjusted Odds				Adjusted Odds: Model 1[a]				Adjusted Odds: Model 2[b]				Adjusted Odds: Model 3[c]			
	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p
STATE-LEVEL POLICY CHARACTERISTICS																
State Medicaid expansion																
No	Ref				Ref				-	-	-		-	-	-	
Yes	.82	.81	.83	<.0001	1.01	.98	1.04	.62	-	-	-		-	-	-	
State Medicaid family planning waiver																
No	Ref				-	-	-		Ref				-	-	-	
Yes	.85	.84	.86	<.0001	-	-	-		.90	.88	.93	<.0001	-	-	-	
State restriction on abortion																
Less restrictive	Ref				-	-	-		-	-	-		Ref			
More restrictive	1.35	1.33	1.38	<.0001	-	-	-		-	-	-		1.04	1.01	1.07	.02
URBAN-RURAL STATUS INTERACTIONS																
Urban-rural category *x* **Medicaid expansion**	-	-	-	-				.52				-				-
Urban-rural category *x* **Medicaid family planning waiver**[d]	-	-	-	-				-				.005				-
Urban-rural category *x* **State abortion restriction**[e]	-	-	-	-				-				-				.0497

*p-values refer to Wald tests of overall significance of model term • [a]Includes state Medicaid expansion, state Medicaid expansion x urban rural category, plus covariates (age, race, nativity, marital status, educational attainment, region, and urban-rural category) • [b]Includes state Medicaid family planning waiver, family planning waiver x urban rural category, plus covariates • [c]Includes state restriction on abortion, state restriction on abortion x urban rural category, plus covariates • [d]see Figure 1 • [e]see Figure 2

Figure 1. Predicted probabilities of <6 month inter-pregnancy interval by Medicaid family planning waiver and county urban-rural category, from Model 2

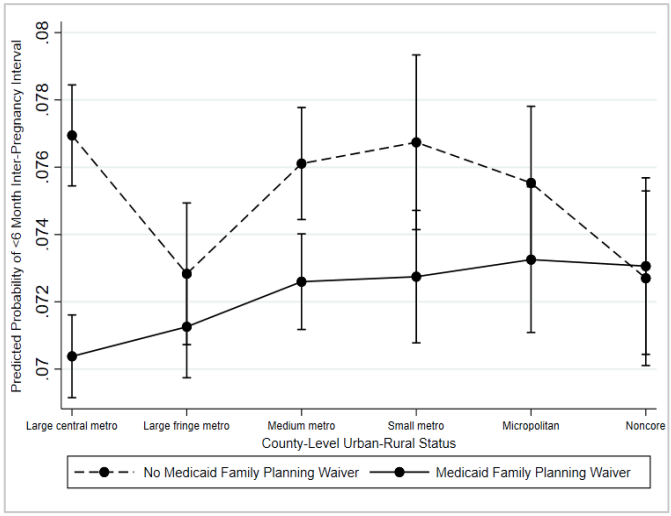
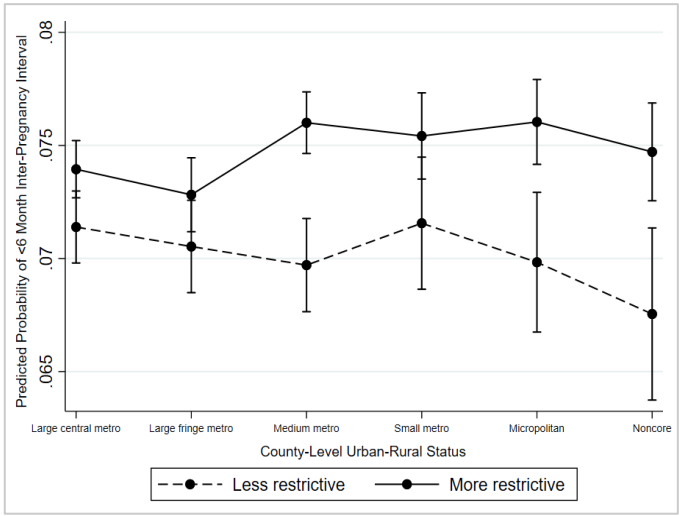


Figure 2. Predicted probabilities of <6 month inter-pregnancy interval by state restriction of abortion and county-level urban rural category, from Model 3



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