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Title of Project: Linked Dataset Analysis of Disparities in Cesarean Delivery Rates on the U.S. - Mexican Border

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To avoid violating publication agreements and jeopardizing publication of the paper which is currently under review, the three paragraphs included under "Paper 3" on pages 4 and 5 should not be disseminated until publication of the paper.

Introduction

Research problem

The US-Mexico border region has exceptionally high Hispanic cesarean delivery (CD) rates. In 2009, the rate was 37.9% as compared to 31.6% in the US and 30.9% in the border states. Even among women with no prior live births, the CD rate was 35.9% in the border region and 29.1% in the border states.¹ Rates for low risk primary and repeat CD in the border region have not been previously studied, but there is evidence that they might be high.¹ CDs can prevent birth complications for mother and baby, but they come with considerable risks and costs: premature birth, maternal bleeding, infection, disruption of breastfeeding, and complications in subsequent pregnancies such as placenta previa.² At the time this project was proposed in 2016, interventions to reduce CD rates ranging from maternal education to policy and legislative reforms had been tried in other US populations, but had had minimal impact.³⁻⁵ Indeed, recent birth data show that US CD rates increased between 2016 and 2017.⁶

Purpose, scope and methods

This project had three aims. The first was to conduct a descriptive analysis of CD in the border region that would build on earlier work that documented disparities in overall CD rates in the Hispanic border population through 2009.¹ The upward trend in CDs nationally began to decline in 2010 for non-Hispanic white (NHW) women and in 2013 for Hispanic women⁷. Our aim 1 analysis, based on birth certificate data in the US-Mexico border states (AZ, CA, NM, and TX) through 2015⁸, sought to compare the trends in low risk primary CDs; low-risk repeat CDs; nulliparous, term, singleton, vertex (NTSV) CDs; and overall CDs in Hispanic and NHW women in the border and nonborder counties of border states during 2000 – 2015. We also wanted to determine whether the declines seen nationally would also be evident in the border region.

Our second aim was to explain the CD geographic disparities between the border and nonborder Hispanic populations in the four border states and the racial/ethnic disparities between Hispanic and NHW women within the border using the most current National Vital Statistics System US Standard Certificate of Live Birth file⁸, Health Resources and Services Administration Area Health Resources Files (AHRF)⁹, American Hospital Association (AHA) Annual Survey Database¹⁰, and the Healthcare Cost and Utilization Project.net (HCUPnet) data¹¹. This analysis focused on low-risk primary and low-risk repeat CD outcomes. The contributions of the distributions of individual and county-level variables to the disparities were assessed with Oaxaca-Blinder regression techniques.

Aim 3 sought to explain the variation in rates of low-risk primary, repeat, NTSV, and overall CD among all counties in the four border states using the birth certificate⁸, AHRF⁹, AHA¹⁰ and HCUPnet¹¹ data files. We examined the contribution of single variables and groups of variables to the county-to-county variation in CD rates and the extent to which demographic, hospital, labor and delivery and medical risk environmental factors contributed to variation in county rates.

Study Design and Methods

Paper 1 (Aim 1)

Methods. In our first paper¹², “Trends in Hispanic and non-Hispanic white cesarean delivery rates on the US-Mexico border, 2000-2015”, we set out to compare cesarean delivery rates and trends in Hispanic and non-Hispanic white women residing in border and nonborder counties of the four US border states before and after 2009. We used data from birth certificates to calculate percentages of cesarean deliveries among all births and births to low-risk nulliparous women during 2000-2015, and among births to low-risk women with and without a previous cesarean during 2009-2015. We calculated 95% confidence intervals around rates and used regular and piecewise linear regression to estimate trends for four ethnic-geographic subpopulations defined by combinations of Hispanic ethnicity and border-nonborder status.

Findings. Among the four subpopulations studied, border Hispanic rates were highest every year for all cesarean outcomes. In 2015 they were 38.3% overall, 31.4% among low-risk nulliparous women, and 21.1% and 94.6% among low-risk women without and with a previous cesarean, respectively. Nonborder Hispanic rates in 2015 were lowest for all outcomes but repeat cesarean. Rates for all four subpopulations rose steadily during 2000-2009. Unlike non-Hispanic white rates, border and nonborder Hispanic rates did not decline post-2009. Most of the border Hispanic excess could be attributed to higher cesarean rates in Texas and a failure to reduce rates of low-risk repeat CD. Rates of low-risk repeat CD decreased in all study groups through 2015, but the decline in border Hispanic women was only 0.8% of the 2009 rate compared to 2.7%, 4.1% and 6.2% in nonborder Hispanic, nonborder NHW, and border NHW women, respectively.

Discussion and conclusions. Our findings show that no progress has been made in reducing the CD disparity among Hispanic women living along the US-Mexico border since 2009. Through 2015, CD rates among border Hispanic women remained higher than those of other Hispanic and non-Hispanic white women in border states and higher than those of US Hispanic, black and non-Hispanic white women. Results point to a need for analysis of the drivers of CD disparities among border Hispanics. Future research should consider state of residence and other contextual factors, including hospital factors, as well as individual factors to help target prevention measures.

Paper 2 (Aim 3)

Methods. We addressed Aim 3 before Aim 2 because we wanted to consider an exhaustive set of county-level variables and identify those that were most important before we also considered individual-level variables. This second paper¹³, “In states that border Mexico, cesarean rates were highest for Hispanic women living in border counties in 2015”, sought to determine how much variation in Hispanic CD rates existed among counties in border states in 2015; how much of that variation could be explained

by medical, demographic, hospital, health care, and geographic factors at the county level; and how much these variables contributed to the disparity between border and nonborder rates of Hispanic CD. Using data from birth certificates, AHRF, AHA, and HCUPnet, we compared cesarean rates among Hispanic women living in US border counties with rates among other Hispanic women in border states during 2015. Using linear regression, we also determined which medical, hospital, and sociodemographic characteristics accounted for intercounty variations in rates.

Findings. In nonborder counties, Hispanic CD rates were considerably lower than rates in border counties (30.9%, 24.4%, 15.1%, and 90.5% for total, NTSV, low-risk primary, and low-risk repeat CD, respectively). Maternal medical characteristics, like the percent of women giving birth in the county with a history of previous CD or the percent delivering a live early term infant, explained over 50 percent of the county-level variation for all cesarean outcomes. Other characteristics that were major contributors to higher cesarean rates included larger percentages of for-profit hospital beds, deliveries by a physician as opposed to a midwife, and Hispanic concentration in residence counties.

Discussion and conclusions. Using only county-level variables, our analysis explains at least 76 percent of the variation in county Hispanic CD rates within border states. We can only speculate about the factors that explain the remaining variation among counties and the disparity between border and nonborder counties. Factors such as social and cultural norms that can contribute to variation are one possible explanation, but they are difficult to quantify and are absent from systematically collected administrative data sets. Addressing potentially unnecessary cesareans among Hispanic women on the border will likely require a multicomponent strategy.

Paper 3 (Aim 2)

Methods. The third paper we completed as part of this project (Aim 2 of our original proposal), “Multi-level drivers of disparities in Hispanic cesarean delivery rates in US-Mexico border states”, is currently under review. The objective of this analysis was to identify the primary individual and county-level determinants of disparities in 2015 border Hispanic CD rates. Using birth certificate, AHRF, and AHA data we examined the determinants of low-risk primary and repeat cesarean rates in three groups: Hispanic and non-Hispanic white women residing in the US-Mexico border counties and Hispanic women residing in nonborder counties of border states. We assessed 29 individual- and county-level demographic, medical and hospital characteristics of the study populations. We performed a two-fold Oaxaca-Blinder decomposition analysis to estimate the contribution of the distribution of these characteristics to the border Hispanic population CD disparities.

Findings. Border Hispanic women had a rate of low-risk primary CD of 21.1%, while the rate among nonborder Hispanic women was 15.0%. Higher Hispanic concentration in county of residence accounted for 24.7% of the difference, a larger proportion of for-profit hospital beds accounted for 22.1%, and greater poverty accounted for 11.1%. No

other individual or county-level demographic, medical, or hospital variable explained more than 5% of the difference between border Hispanic and nonborder Hispanic women. Border Hispanic women had a rate of low-risk primary cesarean that was 4.6 percentage points higher than border non-Hispanic white women. Higher Hispanic concentration, more for-profit beds, less attendance by a MD or DO, higher BMI, and more families living in poverty contributed to the disparity (60.6%, 42.4%, 42.4%, 27.4%, and 21.3%, respectively), while lower education, more Medicaid births, and fewer obstetricians per 10,000 births (-34.4%, -28.2%, and -23.4%, respectively) worked to diminish the disparity. Study characteristics accounted for the entire disparity in the primary cesarean rate between Hispanic and NHW women in the border region. In other words, if study characteristics had been distributed similarly in the Hispanic and non-Hispanic white border populations, there would have been no disparity in CD rates. Hispanic concentration and percent for-profit beds were also important county-level explanatory variables for the low-risk repeat cesarean disparity.

Discussion and conclusions. Contextual variables were more important than medical history and other individual variables in explaining the border cesarean disparities. Hispanic women on the border live in communities that differ from the communities of NHW women on the border and Hispanic women elsewhere in border states. They are predominantly poor and are served largely by for-profit hospitals. Efforts to address potentially unnecessary cesareans among Hispanic women on the border will need to recognize that community demographic and health delivery system characteristics are more influential than maternal medical risk factors.

Overall Project Limitations

Inherent in secondary data sources used in this study, measures of social and cultural norms are limited. In addition, other variables, such as the medico-legal climate, are not available at the county or individual level and are difficult to track over time. Despite the volume of validated data it collects, the birth certificate is not a perfect substitute for talking to mothers and doctors. Primary data collection may be necessary to address some of these gaps.

The US-Mexico Border Region is a heterogeneous mix of urban areas and small, rural communities and cuts across the policies and insurance differences among four states. It includes a large, relatively affluent urban area in San Diego and a large, relatively poor urban area in El Paso. In addition, some of the 44 border counties had too few births in a single calendar year to include them in the analysis. This could have biased our results, although we found little evidence that CD risk in nonmetro counties differed from that in metro counties overall.

The results of these studies are probably most applicable to the US Hispanic population that is of Mexican descent, which represents the vast majority of border Hispanic residents. They might apply less well to Hispanic persons of Puerto Rican or Cuban descent, for example.

Overall Project Conclusions and Implications

Judging from the four border states that are home to over half the US Hispanic population, high Hispanic CD rates remain an unresolved—and possibly worsening problem. Between 2009 and 2015, the border Hispanic rate rose faster than the US Hispanic rate (38.1% to 38.3%¹² versus 31.6% to 31.7%.⁷ Most recently released US data show that US Hispanic rates have continued to rise⁶ (31.8% in 2017). Presumably, border Hispanic CD rates are also continuing to rise. Given these trends, the higher fertility rates among Hispanic women, and the growing number of Hispanic residents in the US, information on factors that cause higher CD rates among Hispanic women is likely to become increasingly important to insurers and policy makers.

The combined results suggest the importance of medical culture and the economics of health care. County overall CD rates for Hispanic women in the border states varied widely, reaching a high of 57% in one border county.¹³ Such wide variation in CD rates reflects medically inappropriate use of CD.¹⁴ On a broader level, it also suggests that commercial, for-profit medical care has costs that public care does not, costs resulting from overuse of services. The fact that greater Medicaid coverage was a significant factor protecting Hispanic women from even-higher CD rates illustrates the danger of curtailing Medicaid and increasing privatization of public health care.

More attention needs to be paid to contextual rather than individual factors that contribute to high CD rates. Most of the county variation in all Hispanic CD outcomes we studied is explained by contextual factors like the percent of birth mothers with a previous CD, the percent of for-profit hospital beds, and the Hispanic concentration of the birth and residence county populations. These results are consistent with findings in previous studies.¹⁴⁻²¹ After all county characteristics are considered, border status remains an important predictor of Hispanic CD rates in Aims 2 and 3. When we considered individual factors as well as the most important contextual factors in relation to border Hispanic disparities in low-risk primary and repeat CD, contextual factors remained the most important explanatory variables.

Finally, cultural factors must be reckoned with in any analysis of Hispanic reproductive health. The fact that we could not explain all the county variation in Hispanic CD rates nor all the border Hispanic–nonborder Hispanic disparity in primary and repeat CD and border Hispanic–border NHW disparity in repeat CD suggests that difficult-to-measure factors, such as cultural norms and acculturation indicators, are important. The importance of high Hispanic concentration also points to a need to better understand how cultural or social norms unique to the border region may be impacting CD rates. For example, close proximity to Mexico, where CD rates are higher than in the US, may work to increase border Hispanic rates through lower acculturation²² or increased cross-border family and provider interaction. Future studies might examine social norms related to communication, respect for authority and gender roles. Other studies might focus on medical culture in border hospitals.

Project Recommendations

All three project papers indicate that additional public health efforts to reduce CD rates are needed in the US-Mexico border region, especially since the border is often the first stop for Hispanic immigrants. Existing national efforts to this end since 2009 are not working well in the region. Border states might need to tailor their public health efforts so that they are appropriate for Hispanic persons in general and poorly-aculturated Hispanic persons in particular. Given the risks of unnecessary CDs to mothers and infants, border states need to also recognize that this is a public health problem as well as a medical care problem. State health departments and state legislatures can play an important role in trying to address this problem.

List of products (*peer reviewed articles, books, chapters in books, conference presentations, etc.*).

a. Peer-reviewed, published articles

- McDonald JA, Amatya A, Gard CC, Sigala J*. In states that border Mexico, cesarean rates were highest for Hispanic women living in border counties. *Health Aff (Millwood)*. 2019;38(2):276-286. doi: 10.1377/hlthaff.2018.05369
- McDonald JA, Amatya A, Gard CC, Sigala J*. Trends in Hispanic and non-Hispanic white cesarean delivery rates on the US-Mexico border, 2000-2015. *Plos One*, Sept 5, 2018. doi.org/10.1371/journal.pone.0203550

b. Articles currently under peer-review

- McDonald JA, Amatya A, Gard CC. Multi-level drivers of disparities in Hispanic cesarean delivery rates in the US-Mexico border states, 2015; Under review at *American Journal of Obstetrics and Gynecology*

c. Possible future analyses

- McDonald JA, Amatya A, Gard CC, others.
 - i. Trends and risk factors associated with non-low-risk CD in the border region
 - ii. Trial of labor trends and variation in Hispanic women in US-MX border counties
 - iii. Applying the Robson classification: what else can be learned about the cesarean delivery disparity in the border region?
 - iv. Cesarean delivery knowledge, attitudes, and belief among Hispanic college women in the border region
 - v. Cross-border knowledge of the risks and benefits of cesarean delivery: a qualitative study

d. Conference presentations

- Segmented regression analysis of the trends of cesarean delivery in the US-Mexico border states (#5006.0). Paper presented at the American Public Health Association 2018 Annual Meeting and Expo; San Diego, CA; November 10-14, 2018
- Explaining county-level variation in cesarean delivery rates in U.S.-Mexico border states (#0994-000403). Paper presented at the 2018 CityMatCH Leadership and MCH Epidemiology Conference; Portland, OR; September 12-14, 2018
- Trends in cesarean delivery on the US-Mexico border, 2000-2015. Poster presentation at the 31st Annual Meeting of the Society for Pediatric and Perinatal Epidemiologic Research; Baltimore, MD; June 18-19, 2018
- Trends in trial of labor and repeat cesarean delivery in the border region. Paper presented at the New Mexico Public Health Association 2018 Annual Conference; Albuquerque, NM; April 4-5, 2018
- Trends in cesarean delivery in the US-Mexico border states. Poster presented at the New Mexico Public Health Association 2018 Annual Conference; Albuquerque, NM; April 4-5, 2018

Dissemination activities and plans beyond peer-reviewed publications

a. Local and regional presentations

- Health Care Disparities among Ethnic and Racial Minorities; Osteopathic Health Policy Fellowship Seminar: Advancing Health Equity; Burrell College of Osteopathic Medicine, Las Cruces, NM, Jan 25-27, 2019
- Cesarean Delivery in the Border Region: Peeling the Onion; Southwest Institute for Health Disparities Research, Faculty Journal Club; November 28, 2018
- Disparities in cesarean delivery rates in the border region; Border Bunch Breakfast, New Mexico Department of Health, Office of Border Health; Las Cruces, NM; Nov 7, 2018
- Research Bytes - Southwest Health Disparities: Women and Children; NMSU RISE to the Postdoctorate STARTUP Workshop; Las Cruces, NM; May 25, 2018
- Public health issues facing the border region; Roundtable held at the first Electronic Caregiver Health Summit. Las Cruces, NM; May 10, 2018
- US and Mexican Reproductive Health Outcomes in the Border Region; Women in Medicine and Science (WIMS); Texas Tech University Health Sciences Center; El Paso, TX; March 28, 2018

b. News media and website coverage

- *Hispanic women in borderlands have more cesareans.* Eye on Research. Carlos A. Lopez interview with McDonald JA and Gard CC. Las Cruces Sun News, Feb 9, 2019
- *Linked Dataset Analysis of Disparities in Cesarean Delivery Rates on the US-Mexico Border. Trends in Cesarean Delivery on the US-Mexico Border.* Project and paper are featured on the website for the Southwest Institute for Health Disparities Research: <https://swihdr.nmsu.edu/home/project-overview/hrsa/>

Describe plans to continue this line or program of research through additional external funding

- We are considering the NSF Innovations in Graduate Education (IGE) Program as a possible source of funding to build on this HRSA-funded research. The NSF program is attractive because it would support development of health disparity research skills in students and junior faculty to study birth outcomes and chronic disease disparities in the US-Mexico border region.
- We are also monitoring NICHD R25 funding announcements that would align with our research program in cesarean delivery and other birth outcomes.

Research Grants Impact Analysis

MCHB is working to demonstrate the impact of funded research grants to a variety of stakeholders. Using the table below, provide some information on the impact of your research grant:

No. of Research Sites ¹	Total No. of Studies ¹	Total No. of Participants ever Enrolled	No. of Peer-Reviewed Publications ²	No. of Non-Peer Reviewed Publications ³	Total No. of Researchers Involved in Research ⁴	Total No. of Trainees Mentored ⁵	No. of External Funding Apps Submitted	No. of External Funding Apps Received
1	3	13,361,214 ^a	2	13	4	4 ^b	0	0

Footnotes: ¹Limit data report from study inception to date; ²Includes only published papers; ³Includes conferences workshops, webinars, community dissemination products; ⁴Includes all Investigators, Co-Investigators, Affiliates, and Researchers; ⁵includes pre and postdoctoral mentees, if available, include demographic information.

^aSecondary analysis of 13,361,214 birth records among NHW and Hispanic women in AZ, CA, NM and TX 2000-2015; ^b 2 NHW females, 1 Hispanic female, and 1 Hispanic male; 1 trainee is also included as one of the 4 investigators

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