HHS Public Access

Author manuscript

Med Care. Author manuscript; available in PMC 2024 July 24.

Published in final edited form as:

Med Care. 2015 August ; 53(8): 700–707. doi:10.1097/MLR.0000000000000385.

First Trimester Initiation of Prenatal Care in the US-Mexico Border Region

Jill A. McDonald, MS, PhD[*,†], **Brittany Argotsinger, MPH**[‡], **Octavio Mojarro, MS**[§], **Roger Rochat, MD**[‡], **Anup Amatya, PhD**[*]

[*]College of Health and Social Services, New Mexico State University, Las Cruces, NM

[†]Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, El Paso, TX

[‡]Rollins School of Public Health, Emory University, Atlanta, GA

[§]CECOFIN, S.C., Guadalajara, Mexico.

Abstract

Objectives: To systematically examine prevalence of first trimester prenatal care (FTPNC) in the 44 US counties and 80 Mexican municipios of the binational border region; and to describe disparities between border and nonborder areas within states, border states, and countries.

Methods: We combined 2009 records of singleton live births from the 10 US-Mexico border states (N = 1,370,206) into a single file. We included FTPNC; county/municipio, state, and country of maternal residence; and demographic variables common to all records. We computed prevalence of FTPNC for border and nonborder residents by state and country. Using multivariable regression, we computed adjusted prevalence ratios (aPR) for FTPNC in border relative to nonborder residents, states relative to one another, and the US relative to Mexico.

Results: In 2009, 68.8% of US-Mexico border mothers and 72.9% of nonborder mothers received FTPNC. After adjustment, nonborder residents had higher prevalence of FTPNC than border residents in Sonora, New Mexico, Arizona, Coahuila, and Chihuahua (aPR = 1.09–124). In US states, prevalence was 13%–36% higher in New Mexico, Arizona, and California than Texas. In Mexico, when compared with Coahuila, adjusted prevalence was 12%–20% higher in neighboring states. Between countries, FTPNC prevalence in border counties/municipios was higher in Mexico among women with low parity/low education and in the United States among women with high parity/high education.

Reprints: Jill A. McDonald, MS, PhD, College of Health and Social Services, MSC 3446, New Mexico State University, P.O. Box 30001, Las Cruces, NM 88003-0136. jillmcd@nmsu.edu.

The authors declare no conflict of interest.

Abstract (see Supplemental Digital Content 1 for Spanish-language version, http://links.lww.com/MLR/A944).

An abstract that featured some of the findings in this manuscript was presented by one of the authors, B.A., at the 18th Annual Maternal and Child Health Epidemiology Conference, December 12, 2012, San Antonio, TX.

The findings and conclusions in this report are those of the authors and do not necessarily reflect the official position of the Centers for Disease Control and Prevention.

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Website, www.lww-medicalcare.com.

Conclusions: In the US and Mexico, women in border counties/municipios receive less timely prenatal care than their nonborder counterparts, but the magnitude of the disparity varies by state. Lack of a consistent, binational approach to birth data collection requires cautious interpretation of findings.

Keywords

prenatal care; birth certificates; Mexico; Southwestern United States; health status disparities

The US-Mexico border region is defined as the area 100 km (62.5 miles) north and south of the binational boundary.[1] It is an interdependent, mobile region, home to >1.5 million women of reproductive age (15–44y).[2] The region includes 124 local jurisdictions: 44 counties in the US states of California, Arizona, New Mexico, and Texas, and 80 municipios in the Mexican states of Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas. Herein, “border resident” refers to a woman living in one of the 124 counties/municipios of the border region; “nonborder resident” refers to a women living in a border state, but outside of the designated border region.

Increasing first trimester entry into prenatal care (FTPNC) in the United States is a goal of the Healthy People 2020 program.[3] In 2010, the rate of FTPNC in the United States was 73.1%[4]; US Hispanic women and women residing in the US-Mexico border region have lower rates.[5,6] Prenatal care supports management of prepregnancy health conditions or pregnancy-related risk factors[7]; its delay or absence has been associated with higher rates of prematurity, still birth, and infant death.[8] Growing evidence also suggests that risk factors that are modifiable in the mother may influence a child’s risk for obesity, diabetes, and other chronic diseases later in life if not properly managed during the intrauterine period.[9,10] *Healthy Border 2010/2020* established benchmarks for first trimester prenatal care (FTPNC) in both the US and Mexico.[1] However, current patterns of FTPNC along the border are not well established, limiting stakeholder capacity to target interventions and monitor progress toward objectives.

This study uniformly characterizes rates of FTPNC for border state populations. Our primary objectives are to examine the prevalence of FTPNC for the entire border region, for US and Mexican sections separately, and for states and border regions within each section. We also assess whether border region disparities in FTPNC exist between states, border and nonborder areas within border states, and countries. We also seek to know whether available demographic factors can explain differences observed. No prior study has combined US and Mexican natality files to systematically examine the prevalence of FTPNC.

METHODS

We obtained 2009 Mexican birth data from the Sistema Nacional de Informacion en Salud (SINAIS) containing municipio-level identifiers.[11] We obtained 2009 US special use files with county-level identifiers from the National Center for Health Statistics’ National Vital Statistics System (NVSS).[12] We restricted analysis to women with singleton live births, residing in the 10 border states of California, Arizona, New Mexico, and Texas in the United States, and Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas

in Mexico. We excluded all records for US and Mexican residents for whom county or municipio of residence was unknown (n = 6556). Most exclusions were births belonging to Mexican residents that occurred in the United States (n = 5899); US certificates do not capture details of residence outside the United States. The remainder of the exclusions included 639 Mexican records with missing maternal residence information and 18 Mexican records indicating US residency; like US certificates, Mexican certificates do not capture details of residence outside Mexico. The final dataset contained 1,369,567 birth records, including 351,699 Mexican resident births and 1,017,868 US resident births.

Data from the states of Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas derive from the Mexican national birth certificate.[13] Among US border states, Arizona was the only one to use the 1989 standard US certificate of live birth in 2009; data from the states of California, New Mexico, and Texas derive from the 2003 revised version of this form.[14] The 2003 US version documents date of first prenatal visit as recorded in patient medical records, from which NCHS derives month of entry; the 1989 US form records the month gestation prenatal care began, as reported by the mother; and the Mexican standard form records the self-reported trimester of first prenatal visit for women receiving any prenatal care. To create a more comparable measure across the 3 certificates,[15] date or month of prenatal care initiation was collapsed into 4 categories: first trimester (months 1 to 3), second trimester (months 4 to 6), third trimester (months 7 or later), and no care. From this, we developed a binary dependent variable for FTPNC. Limitations of the decision to combine prenatal care and other variables collected across different versions of the birth certificate are addressed within the discussion.

Primary explanatory variables included country and state of maternal residence and residence within or outside the border region, as determined by county/municipio of residence. In adjusted models, we also included maternal nativity, age, education, marital status, parity, and birth location. We classified maternal nativity as US-born, Mexican-born, other Latin American, or other foreign non-Latin. For Mexican births, we derived maternal age using the mother's date of birth. To accommodate differences in classification of maternal education data across the 3 certificates, we collapsed this variable into 3 categories: <12 completed years of education in the United States and less than preparatoria (high school equivalent) completion in Mexico; 12 completed years of education or the equivalent in the United States and preparatoria completion in Mexico; and any postsecondary (US) or post-preparatoria (Mexico) education or professional training. Marital status in Mexico was collapsed to a dichotomous variable consistent with US data, with "nonmarried" inclusive of those reportedly single, divorced, widowed, and cohabitating. Birth location was same as residence if the mother reported residence in the county/municipio of delivery. Although unavailable in Mexican birth files, maternal ethnicity was retained for all births to US residents for inclusion in US-specific models. We classified mothers as Hispanic if they reported Mexican, Cuban, Puerto Rican, Central or South American, or other/unknown Hispanic heritage.

We constructed 12 regression models to estimate the crude and adjusted effects of country, state, and border residence on rates of FTPNC. We evaluated state and border effects in country-specific (stratified) models. We used the SAS 9.3 statistical package[16] to merge

and analyze all natality files. In US border counties, collectively, <1% of data were missing for each demographic variable except maternal education (4.2%). In Mexican border municipios, collectively, we observed the highest levels of missing data for maternal education (1.9%) and marital status (1.7%). Missing data were more prevalent for FTPNC, exceeding 2% of records in border counties in Sonora (2.8%), Tamaulipas (2.7%), Coahuila (3.0%), and New Mexico (4.6%), and nonborder counties in Chihuahua (2.1%), Sonora (3.7%), California (3.9%), and New Mexico (13.5%). When modeling, we addressed missing data using list-wise deletion, whereby we omitted records for women with missing data for any variables included in the model.[17]

We created dummy variables for all categorical indicators and assessed multicollinearity (interdependence of terms) using analysis of covariance, with an established variance inflation factor threshold of 10 for variables included in adjusted models.[17] We estimated prevalence ratios using a modified Poisson regression model with robust error variance to prevent artificially wide confidence intervals.[18] We tested for interaction between country of residence and demographic covariates. When possible, we calculated the weighted average of strata-specific prevalence ratios estimated from the regression model which included the interaction terms; inverse variances of the strata-specific prevalence ratios were used as the weights in the calculation. We report all crude and adjusted measures of association with 95% confidence intervals.

RESULTS

Of 1,369,567 total records included in the 10-state birth file, 1,017,868 (74.0%) belonged to US residents (Table 1). Overall, 1 in 10 US mothers lived in a border county (120,024, or 11.8%), whereas 4 in 10 Mexican mothers lived in a border municipio (142,224, or 40.4%). As a result, despite larger total populations in US states, the majority of mothers living in the designated border region were Mexican residents (54.2%).

Roughly two thirds of US border women were Hispanic and born in the United States; among US nonborder women, only half were Hispanic. In Mexico, border residents were younger than those in the United States, on average by 2 years (24.8±0.3 and 26.8±0.4, respectively), and a larger percentage were under the age of 19 years. Mexican border residents were also less educated and less likely to be married.

In 2009, 68.8% of women residing in the combined US-Mexico border region received FTPNC (Table 2). FTPNC rates were 68.4% and 69.2%, respectively, in US and Mexican sections of the border region. In each of the 9 states with border and nonborder regions, a larger proportion of women received FTPNC in nonborder than in border counties/municipios (Table 2 and Fig. 1). The contrast between border and nonborder counties was greatest in Arizona, Sonora, Chihuahua, and Coahuila and smallest in Texas and California. For all maternal characteristics, more women in nonborder than in border counties/municipios received FTPNC (Fig. 2). For all maternal characteristics, prevalence of FTPNC in Mexico exceeded rates in the United States.

The crude prevalence ratio (cPR) for FTPNC was 1.01 for Mexican border residents compared with US border residents (Table 3). Statistically significant interactions between mother's country of residence and other demographic variables (data not shown) prevented computation of a single adjusted prevalence ratio (aPR) for the entire Mexican border region as compared with the United States. Further examination of the model with interaction terms revealed that among women with less than high school education and parity ≤2, a demographic subgroup that comprises 32.5% of the binational border region (data not shown), FTPNC prevalence was 5%–20% higher in Mexican border residents than in their US counterparts. The exact measure depends on the age and marital status of the women, with higher age and married status producing the largest disparity. We calculated a weighted average of age-specific and marital status–specific aPRs for this subgroup; the cPR and aPR for FTPNC in Mexico relative to the US are 1.14 (1.12–1.16) and 1.12 (1.03–1.22), respectively.

In contrast, a second subgroup of women comprising 5.5% of border residents was also observed (data not shown). This subgroup was characterized as having greater than high school education and parity >2. In this smaller subgroup, US women had a FTPNC prevalence 5%–20% higher than Mexican women. Again, the exact measure depends on the age and marital status of the women, with lower age and unmarried status producing the largest disparity. Among women with other combinations of demographic characteristics, interactions were more complex and meaningful comparisons between the 2 countries could not be made.

Remaining associations were considered in models stratified by country. We first considered the association between FTPNC and state of residence, including border and nonborder counties in each state. In the United States, the crude prevalence was 12%–37% higher in New Mexico, Arizona, and California as compared with Texas; prevalence ratios changed little after controlling for demographic differences in the states. Among Mexican states, Coahuila had the lowest FTPNC prevalence. When compared with Coahuila, other states had crude rates 4%–25% higher and adjusted rates 12%–20% higher.

When comparing FTPNC in nonborder relative to border counties within each US state, cPRs ranged from 1.01 in Texas to 1.18 in Arizona. Ratios were modified only slightly in models adjusted for maternal characteristics, with prevalence of FTPNC in nonborder counties remaining 4%–19% higher in California, New Mexico, and Arizona as compared with border counties in those states. In Texas, prevalence of FTPNC was 8% lower in nonborder counties than in border counties after adjustment for covariates.

When comparing FTPNC in nonborder relative to border municipios within each Mexican state, cPRs ranged from 1.06 in Nuevo Leon to 1.31 in Chihuahua. However, disparities between border and nonborder municipios in Mexico diminished in adjusted models. When compared with border municipios, the adjusted FTPNC prevalence in nonborder municipios was 9%–24% higher in Sonora, Coahuila, and Chihuahua with marginal or no differences in Nuevo Leon and Tamaulipas.

DISCUSSION

Public health professionals and providers along both sides of the US-Mexico border have identified timely use of prenatal care as a priority.[1] Overall, 68% of mothers in the border region received FTPNC in 2009, leaving nearly a third—38,000 mothers in the United States and 43,000 mothers in Mexico—without timely care. Interstate disparities in crude prevalence of FTPNC are most conspicuous between US states, with a striking difference observed between large state populations in California and Texas. In Mexico, too, an absolute 15-point prevalence difference between Nuevo Leon and the interior states of Coahuila and Chihuahua are notable. These findings are consistent with the higher rates of preterm birth, low birth weight, and infant mortality in Texas as compared with California,[6] and estimates of infant mortality rates in Mexican border states which are highest in Chihuahua and lowest in Nuevo Leon.[19] In both countries, crude disparities in rates of FTPNC between nonborder and border residents varied greatly by state. Texas, California, Nuevo Leon, and Tamaulipas reflect relatively low levels of disparities in crude prevalence between border and nonborder counties/municipios. These contrast with Chihuahua and Coahuila, where crude prevalence of FTPNC is >30% higher in nonborder than in border municipios. It is possible that the FTPNC disparity in Chihuahua's border municipios could be related to the larger disparity in poverty seen in border municipios as compared with the disparity in other Mexican border states.[20] In Coahuila, preterm birth rates are higher in border than nonborder municipios, a disparity not seen elsewhere along the Mexican border[5] and one that is associated with late prenatal care.[8]

Beyond crude rates, we explored the extent to which demographic factors influence such disparities. The impact of social factors on health care access and outcomes has been well established in United States and regional literature.[21–23] A 2011 meta-analysis identified low maternal age, low educational attainment, nonmarital status, ethnic minority, and high parity as individual determinants of prenatal care utilization.[24] For this analysis, we also anticipated a relationship between FTPNC and demographic characteristics of the population; however, in US states, cPRs and aPRs were very similar. The same was true for nonborder to border comparisons within US states, with the exception of Texas, where demographic factors had a slightly greater effect. In some Mexican states, prevalence ratios comparing nonborder to border residents were more diminished in adjusted models. Yet, in nearly all states we found that demographic factors explain only a portion of the observed disparities. Comparison between the crude and adjusted Mexico-US FTPNC prevalence ratios in the border region was not possible due to complex interactions between country of residence and the demographic variables. However, in the 1 large subgroup where we could make a meaningful comparison, demographic differences had no effect on the disparity in FTPNC between the 2 countries.

Because differences in prevalence of FTPNC generally persisted—or increased—after adjusting for covariates in US and Mexican multivariable models, underlying disparities between states and between border and nonborder areas within states likely result from factors not measured in this study. Some of the disparity in the United States might be due to poverty or lack of access to care among undocumented immigrants.[24,25] Regional variation in prenatal care rates might be related to different state health care policies. In

2009, pregnant women in California, for example, had a lower threshold for public health insurance than those in Texas.[26] Availability of health care also might vary by state.[27] Almost the entire Texas border is medically underserved, but the communities of Tucson, Arizona and San Diego, California are not and these areas account for a large fraction of the births in those states. Mexico shows less variation among states, perhaps because health care policy is set at the federal rather than the local level.[28] Differences between border and nonborder FTPNC prevalence in Mexico may also result from inadequate services in border communities.[20] Expanding Medicaid/CHIP coverage in Texas[29,30] and providing insurance for undocumented pregnant immigrants[25,31] might reduce disparities in US states.[32] Improvement on the Mexico side might depend on making services more widely available. Both countries will need to develop policies and programs that specifically target the underserved populations in their border regions.

This study has numerous strengths. Perhaps most importantly, no previous study has combined US and Mexican birth files to support a systematic, binational analysis of prenatal care timing. Birth surveillance reports published by the US NVSS do not combine prenatal care or education information collected on different versions of the US standard form; nor do they combine US data with similar variables collected in other countries.[14] We acknowledge, as they do, that substantive differences in wording and source guidance between versions of the certificates may introduce bias in a combined dataset. However, because early entry into prenatal care is a binational priority in the US-Mexico border region,[1] it would be inappropriate to wait until a common data collection instrument is adopted by all US border states and Mexico to initiate a border-wide dialog around prenatal care. Combining previously independent datasets has allowed us to look across the border to consider FTPNC prevalence and disparities not as a US issue or a Mexican issue, but as an issue for public health professionals and their constituents in the interdependent, transnational border region.

More rigorous documentation criteria implemented with the 2003 US standard birth certificate relative to the 1989 version has been shown to reduce reported rates of FTPNC by as much as 10% in some states.[14] If this is true, the calculated prevalence of FTPNC in Arizona could represent an inflated rate and fall below 80.2% once data from the revised form, adopted in 2014, become available. Furthermore, as prenatal care timing in Mexico is recorded by trimester of initiation as well as through self-report, the Mexican prevalence rates may also be somewhat inflated relative to California, New Mexico, and Texas, which have adopted the 2003 US version. To assess the effect of non-comparable Arizona data, we temporarily removed Arizona from multivariable models and found that relative prevalence of FTPNC across other US states and between the US and Mexico remained the same.

Our use of vital records data presents a few additional limitations. First, while rates of missing data were low and relatively uniform across states, we observed a high level of missing data in several nonborder counties of New Mexico (3141 records, or 13.5%). The missing data in New Mexico records is likely associated with the rural nature of nonborder counties; this may have artificially inflated the prevalence of FTPNC in nonborder counties if rural women were disproportionately excluded and also less likely to access timely care. However, the distributions of demographic variables among women

with and without missing FTPNC information were virtually identical except for nativity which differed slightly. As New Mexico births account for just 3% of all US births, this limitation is unlikely to have affected the overall results in any major way. Indeed, when we removed New Mexico records from the analysis, the overall results for US states remained unchanged. Second, we had to dichotomize certain variables even though more detailed categories were potentially important. For example, the need to collapse marital status on the Mexican certificate into a binary variable consistent with the US may have introduced bias if unmarried Mexican women living in "unión libre," or cohabitating with a partner, were more likely to receive timely prenatal care than other unmarried women. Similarly, we could not include variables presently captured on only 1 form, such as maternal insurance status (Mexico) or behavioral risk factors, such as tobacco use or prepregnancy body mass index (US). Third, the tendency of US and Mexican women to cross the border for reproductive health services may have influenced our findings.[33,34] Delivery attendants may not have access to early (or any) prenatal records from physicians across the border. This could result in an underreporting of visits among women crossing the border to receive pregnancy care.

Progress toward more consistent data collection practices in the US and Mexico would strengthen future surveillance and examination of prenatal care utilization in the region, as would integrating a more comprehensive measure of adequate prenatal care that acknowledges divergent standards of prenatal care practice in the US and Mexico.[35,36] Standard indices used in the United States, such as the Adequacy of Prenatal Care Utilization Index or the Revised Graduated Prenatal Care Index, define adequacy according to American College of Obstetricians and Gynecologists' standards for satisfactory timing and numbers of visits.[37,38] ACOG could collaborate with peers from the Mexican Health Ministry to adapt guidelines for recommended timing and number of visits in both countries, or in the border region. Such an adaptation is feasible based on evidence which supports a reduced-visit prenatal package for low-risk women.[39,40] We believe that the periodic assembling of data on the border is important in driving policy and programs. Perhaps these and other coordinated efforts to monitor prenatal care in the region can be leveraged to increase binational collaboration around maternal and child health services and ultimately improve health outcomes of the border population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

REFERENCES

1. United States-Mexico Border Health Commission. Healthy Border 2010/2020 Strategic Framework Report. El Paso, TX: United States-Mexico Border Health Commission; 2010. Available at: http://www.borderhealth.org/files/res_1728.pdf. Accessed February 9, 2015.
2. US Department of Health and Human Services, Health Resources and Services Administration. Women's Health USA 2009: Border Health Supplement. Rockville, MD: US Department of Health and Human Services, Health Resources and Services Administration; 2009. Available at: http://mchb.hrsa.gov/whusa09/bh/pages/400bh.html. Accessed February 9, 2015.
3. US Department of Health and Human Services. Office of Disease Prevention and Health Promotion Healthy People 2020. Washington, DC: US Department of Health and Human Services.

Available at: https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives. Accessed February 9, 2015. Last updated May 14, 2015.

4. US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Child Health USA 2012. Rockville, MD: US Department of Health and Human Services; 2013.
5. McDonald JA, Mojarro O, Sutton PD, et al. A binational overview of reproductive health outcomes among US Hispanic and Mexican women in the border region. Prev Chronic Dis. 2013;10:E137. [PubMed: 23948338]
6. National Center for Health Statistics, final natality data and linked birth/infant death data. Available at: http://www.marchofdimes.org/peristats/Peristats.aspx. Accessed February 9, 2015.
7. Carroli G, Rooney C, Villar J. How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. Paediatr Perinatal Epidemiol. 2001;15(suppl 1): 1–42.
8. Partridge S, Balayla J, Holcroft CA, et al. Inadequate prenatal care utilization and risk of infant mortality and poor birth outcomes: a retrospective analysis of 28,729,765 US deliveries over 8 years. Am J Perinatol. 2012;29:787–794. [PubMed: 22836820]
9. Dixon B, Peña MM, Taveras EM. Lifecourse approach to racial/ethnic disparities in childhood obesity. Adv Nutr. 2012;3:73–82. [PubMed: 22332105]
10. Fall CHD. Evidence for the intra-uterine programming of adiposity inlater life. Ann Hum Biol. 2011;38:410–428. [PubMed: 21682572]
11. Base de datos sobre nacimientos [database]. Mexico City, Mexico: Sistema Nacional de Información en Salud. 2009. Available at: http://www.sinais.salud.gob.mx/basesdedatos/std_nacimientos.html. Accessed February 9, 2015.
12. National Center for Health Statistics. Natality Special Use File: All-Counties Identified. Hyattsville, MD: National Center for Health Statistics; 2009. Available at: http://www.cdc.gov/nchs/data_access/VitalStatsOnline.htm#Births.
13. Certificado de Nacimiento [Dirección General de Información en SaludWeb site]. 2014. Available at: http://www.sinais.salud.gob.mx/descargas/pdf/CN_ManualLlenado.pdf. Accessed May 14, 2015.
14. National Center for Health Statistics. User Guide to the 2009 Natality Public Use File. Hyattsville, MD: National Center for Health Statistics;2011. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/DVS/natality/UserGuide2009.pdf.
15. Martin JA, Wilson EC, Osterman MJ, et al. Assessing the quality of medical and health data from the 2003 birth certificate revision: results from two states. Natl Vital Stat Rep. 2013;62:1–19.
16. SAS Institute Inc. SAS 93 [computer program]. Cary, NC: SAS Institute Inc; 2012.
17. Hazard Munro B Statistical Methods for Health Care Research, 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2005.
18. Zou G A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol. 2004;159:702–706. [PubMed: 15033648]
19. Consejo de Población Nacional, México. Estimación de la mortalidad infantil para México, las entidades federativas y los municipios 2005. Base de datos. Mexico en cifras. Available at: http://www.conapo.gob.mx/en/CONAPO/Base_de_datos. Accessed February 9, 2015.
20. Consejo Nacional de Evaluación de Política de Desarrollo Social (CONEVAL). Medición de la pobreza. Available at: http://www.coneval.gob.mx/cmsconeval/rw/pages/medicion/index.es.do. Accessed January 10, 2013.
21. Rettenmaier AJ, Wang Z. What determines health: a causal analysis using county level data. Eur J Health Econ. 2013;14:821–834. [PubMed: 22961232]
22. Bengiamin MI, Capitman JA, Ruwe MB. Disparities in initiation and adherence to prenatal care: impact of insurance, race-ethnicity and nativity. Matern Child Health J. 2010;14:618–624. [PubMed: 19557508]
23. Sunil TS, Spears WD, Hook L, et al. Initiation of and barriers to prenatal care use among low-income women in San Antonio, Texas. Matern Child Health J. 2010;14:133–140. [PubMed: 18843529]

24. Feijen-de Jong EI, Jansen DE, Baarveld F, et al. Determinants of late and/or inadequate use of prenatal healthcare in high-income countries: a systematic review. Eur J Public Health. 2012;22:904–913. [PubMed: 22109988]
25. Spetz J, Baker L, Phibbs C, et al. The effect of passing an "anti-immigrant" ballot proposition on the use of prenatal care by foreign-born mothers in California. J Immigr Health. 2000;2:203–212. [PubMed: 16228741]
26. The Kaiser Commission on Medicaid and the Uninsured. A Foundation for Health Reform: Findings of a 50 State Survey of Eligibility Rules, Enrollment and Renewal Procedures, and Cost-Sharing Practices in Medicaid and CHIP for Children and Parents During 2009 Data Tables. Washington, DC: The Kaiser Family Foundation; 2009. Available at: https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8028_t.pdf. Accessed February 9, 2015.
27. US Department of Health and Human Services, Health Resources and Health Services Administration. Data warehouse; Map tool. 2009. Available at: http://datawarehouse.hrsa.gov/tools/MapTool.aspx. Accessed February 9, 2015.
28. Knaul FM, González-Pier E, Gómez-Dantés O, et al. The quest for universal health coverage: achieving social protection for all in Mexico. Lancet. 2012;380:1259–1279. [PubMed: 22901864]
29. Rosenberg D, Handler A, Rankin KM, et al. Prenatal care initiation among very low-income women in the aftermath of welfare reform: does pre-pregnancy Medicaid coverage make a difference? Matern Child Health J. 2007;11:11–17. [PubMed: 16763773]
30. Gavin NI, Adams EK, Manning WG, et al. The impact of welfare reform on insurance coverage before pregnancy and the timing of prenatal care initiation. Health Serv Res. 2007;42:1564–1588. [PubMed: 17610438]
31. Preston J Texas hospitals reflect debate on immigration. 2006. Available at: http://www.nytimes.com/2006/07/18/us/18immig.html. Accessed February 9, 2015.
32. Rittenhouse DR, Braveman P, Marchi K. Improvements in prenatal insurance coverage and utilization of care in California: an unsung public health victory. Matern Child Health J. 2003;7:75–86. [PubMed: 12870623]
33. Lapeyrouse LM, Morera O, Heyman JM, et al. A profile of US-Mexico border mobility among a stratified random sample of Hispanics living in the El Paso-Juarez area. J Immigr Minor Health. 2012;14:264–271. [PubMed: 21336846]
34. Macias EP, Morales LS. Crossing the border for health care. J Health Care Poor Underserved. 2001;12:77–87. [PubMed: 11217230]
35. American Academy of Pediatrics, American College of Obstetricians and Gynecologists. Guidelines for Perinatal Care, 7th ed. Elk Grove Village, IL; Washington, DC: American Academy of Pediatrics and American College of Obstetricians and Gynecologists; 2012.
36. Mexican Ministry of Health. Norma Oficial Mexicana NOM-007-SSA2–1993. 1995. Available at: http://www.salud.gob.mx/unidades/cdi/nom/007ssa23.html. Accessed February 9, 2015.
37. Kotelchuck M An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization Index. Am J Public Health. 1994;84:1414–1420. [PubMed: 8092364]
38. Alexander GR, Kotelchuck M. Quantifying the adequacy of prenatal care: a comparison of indices. Public Health Rep. 1996;111:408–418. [PubMed: 8837629]
39. Dowswell T, Carroli G, Duley L, et al. Alternative versus standard packages of antenatal care for low-risk pregnancy. Cochrane Database Syst Rev. 2010;CD000934. [PubMed: 20927721]
40. Villar J, Carroli G, Khan-Neelofur D, et al. Patterns of routine antenatal care for low-risk pregnancy. Cochrane Database Syst Rev. 2004;CD000934.

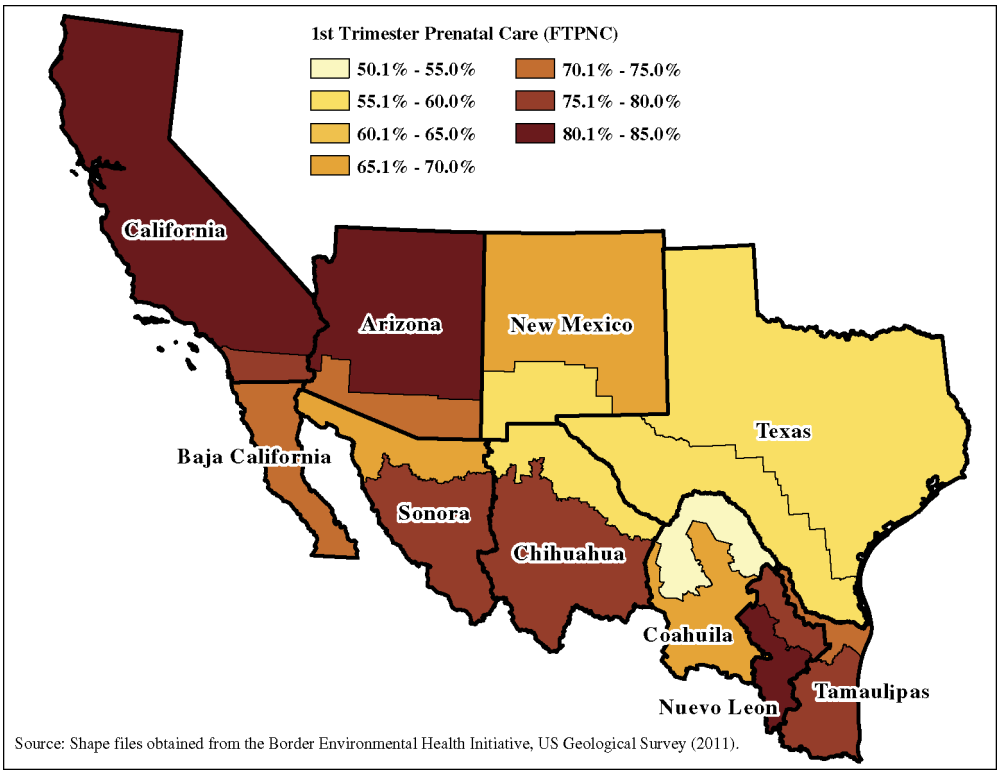

FIGURE 1.

Prevalence of first trimester prenatal care (FTPNC) among border state residents with a singleton birth, by state and border/nonborder region of residence, 2009.

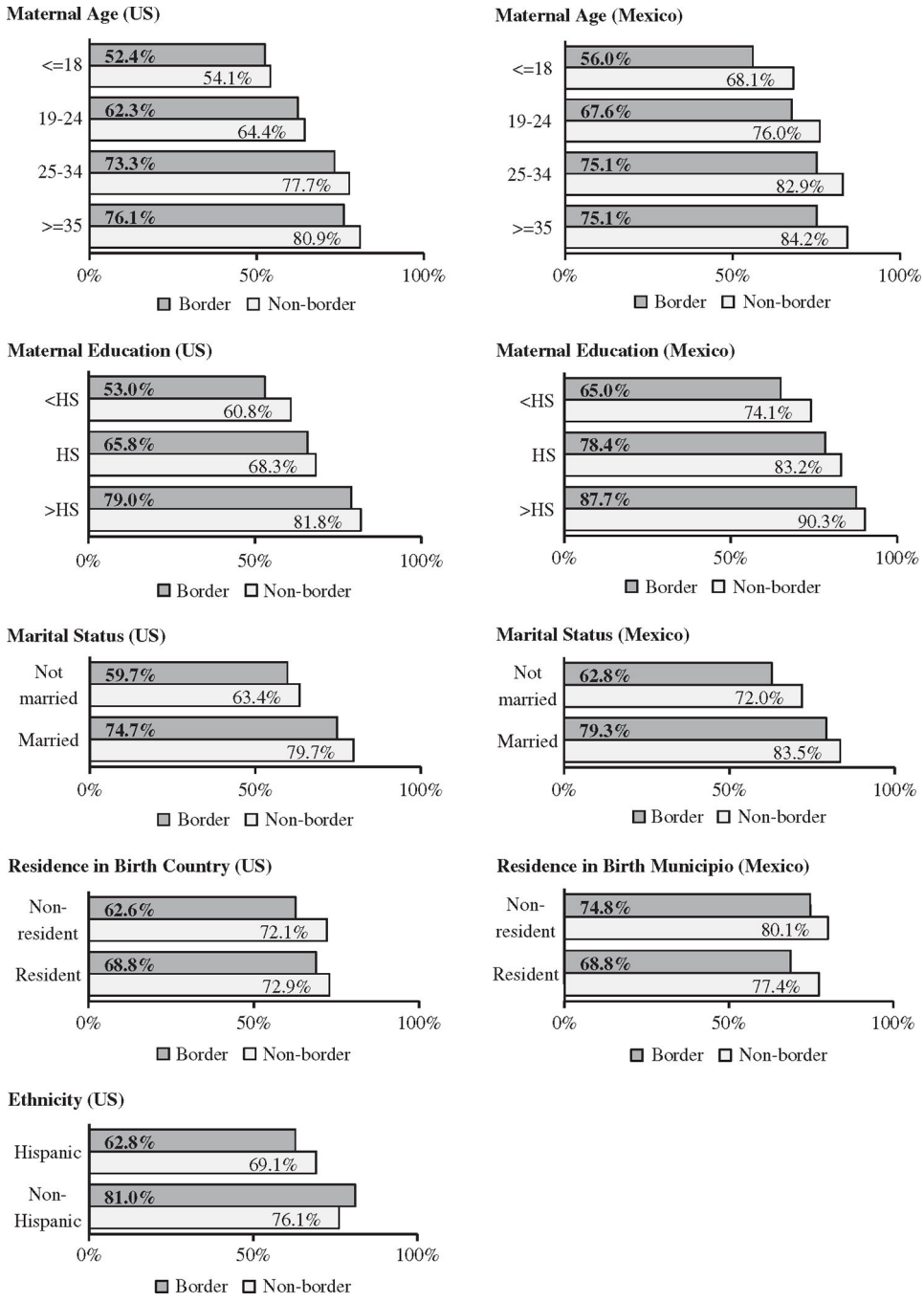

FIGURE 2.

Stratified rates of first trimester prenatal care (FTPNC) in border and nonborder areas according to select demographic variables, 2009.

TABLE 1.

Percent of Singleton Births to US and Mexico Border State Residents According to Maternal Characteristics, by Country and Border/Nonborder Region of Residence, 2009

Demographic Variables	US Border (n = 120,024)	US Nonborder (n = 897,844)	MX Border (n = 142,224)	MX Nonborder (n = 209,475)
State of maternal residence				
California	38.7	51.7	—	—
Arizona	15.2	8.0	—	—
New Mexico	4.2	2.6	—	—
Texas	41.9	37.7	—	—
Baja California	—	—	39.8	0.0
Sonora	—	—	9.3	15.5
Chihuahua	—	—	18.3	15.4
Coahuila	—	—	6.2	21.2
Nuevo Leon	—	—	1.2	34.3
Tamaulipas	—	—	25.1	13.5
Maternal nativity *				
US	62.7	64.3	0.2	0.1
MX	29.9	21.0	99.2	99.3
Other	6.5	14.0	0.2	0.1
Ethnicity *				
Hispanic	68.7	48.2	—	—
Non-Hispanic	28.4	51.1	—	—
Age (y) *				
≤ 18	8.6	6.9	16.3	14.7
19–24	31.2	28.4	37.1	33.4
25–34	47.3	49.9	38.0	42.3
≥ 35	12.9	14.8	8.0	9.0
Education *†				
Less than HS/preparatoria	27.3	25.3	73.3	62.6
HS/preparatoria complete	26.5	27.3	15.4	18.6

Demographic Variables	US Border (n = 120,024)	US Nonborder (n = 897,844)	MX Border (n = 142,224)	MX Nonborder (n = 209,475)
More than HS/preparatoria	42.1	45.8	9.4	16.8
Marital status *				
Married	58.4	57.5	39.2	55.6
Unmarried	41.6	42.5	59.2	42.5
Parity *				
1	39.2	39.5	37.0	39.7
2	30.0	30.7	30.6	31.2
3	17.7	17.2	19.9	19.6
4+	13.0	12.4	12.2	9.4
Location of birth *‡				
Same as residence	93.9	83.4	93.0	60.5
Other	6.1	16.6	7.0	39.4

*Missing values exist where proportions do not sum to 100.

†HS is high school; preparatoria is the Mexican equivalent of US high school (grades 10–12).

‡Location of birth is same as residence if the mother lives within the county/municipio of delivery; and other if she traveled outside her county/ municipio of residence to deliver.

MX indicates Mexico; US, the United States.

TABLE 2.

Prevalence of First Trimester Prenatal Care in Border, Nonborder, and Combined Regions by Place of Maternal Residence for Singleton Births to Residents of US and Mexico Border States, 2009

Place of Residence	Border Region (%)*†	Nonborder Region (%)*‡	Combined Region (%)*§
All border states	68.8	73.9	72.9
US border states	68.4	72.8	72.3
Mexico border states	69.2	78.5	74.7
US state			
California	79.4	81.4	81.3
Arizona	70.1	82.8	80.2
New Mexico	59.3	68.0	66.3
Texas	58.5	59.4	59.2
Mexican state			
Baja California‖	73.6	—	73.6
Sonora	68.3	79.2	76.0
Chihuahua	59.8	78.2	69.9
Coahuila	54.6	69.6	67.1
Nuevo Leon	79.5	84.2	84.1
Tamaulipas	72.5	77.6	74.8

*Prevalence rates exclude records with missing data on trimester of prenatal care entry.

†Prevalence rates in counties/municipios comprising the border region.

‡Prevalence rates in counties/municipios external to the border region.

§Prevalence rates for combined border and nonborder regions.

‖All municipios in the state of Baja California, Mexico, are within the border region.

TABLE 3.

Crude and Adjusted Prevalence Ratios for the Associations Between First Trimester Prenatal Care and Country, State, or Border Area Residence Among Singleton Births to Residents of US and Mexico Border States, 2009

Place of Residence	cPR (95% CI)	aPR (95% CI)*
US border vs. Mexico border		
All US	Reference	NA
All Mexico	1.01 (1.01–1.02)	NA
Selected subgroup: US†	Reference	Reference
Selected subgroup: Mexico†	1.14 (1.12–1.16)	1.12 (1.03–1.22)
US state		
California	1.37 (1.37–1.38)	1.35 (1.35–1.36)
Arizona	1.35 (1.35–1.36)	1.36 (1.36–1.37)
New Mexico	1.12 (1.11–1.13)	1.13 (1.12–1.14)
Texas	Reference	Reference
Mexican state		
Baja California	1.10 (1.09–1.10)	1.14 (1.13–1.15)
Sonora	1.13 (1.12–1.14)	1.16 (1.15–1.17)
Chihuahua	1.04 (1.03–1.05)	1.16 (1.14–1.19)
Coahuila	Reference	Reference
Nuevo Leon	1.25 (1.24–1.26)	1.20 (1.19–1.21)
Tamaulipas	1.11 (1.11–1.12)	1.12 (1.11–1.13)
US border vs. nonborder‡		
California nonborder	1.03 (1.02–1.03)	1.04 (1.04–1.05)
Arizona nonborder	1.18 (1.17–1.19)	1.19 (1.18–1.20)
New Mexico nonborder	1.15 (1.12–1.18)	1.13 (1.11–1.16)
Texas nonborder	1.01 (1.01–1.02)	0.92 (0.92–0.93)
Mexico border vs. nonborder‡§		
Sonora nonborder	1.16 (1.14–1.17)	1.09 (1.08–1.11)
Chihuahua nonborder	1.31 (1.29–1.32)	1.24 (1.22–1.25)
Coahuila nonborder	1.27 (1.25–1.30)	1.21 (1.19–1.24)
Nuevo Leon nonborder	1.06 (1.03–1.09)	1.03 (1.00–1.05)
Tamaulipas nonborder	1.07 (1.06–1.08)	1.04 (1.03–1.06)

*All models adjust for maternal nativity, age, education, marital status, parity, and residence in the county/municipio of the birth event. US-only models also adjust for maternal ethnicity.

†Comparison between US and Mexican women who were born in the same country in which they reside, have less than a high school education, are parity ≤ 2, and reside in the county/municipio of the birth event. Reported aPR is an inverse variance weighted average of 16 strata-specific aPRs, where strata are formed by a combination of age categories and marital status.

‡Residents of border areas in the state comprise the reference group for state- specific models.

§All municipios in the state of Baja California, Mexico, are within the border area.

aPR indicates adjusted prevalence ratio; CI, confidence interval; cPR, crude prevalence ratio; NA, not applicable; reference, reference group.