

Utilization of hospital-based second-trimester abortion in Mexico, 2007-2015

Lily T Alexander

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Committee:

Bernardo Hernández-Prado

Blair Darney

Alison Drake

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Lily T Alexander

University of Washington

**Abstract**

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Lily T Alexander

Chair of the Supervisory Committee:

Bernardo Hernández-Prado

Department of Global Health

Data on the incidence of in-facility second trimester abortions are sparse. We used 2007-2015 hospital discharge data from Mexico's Automated Hospital Discharge System (SAEH) to assess the frequency of second-trimester abortion in public sector hospitals across Mexico's 32 states. We identified 145,956 second-trimester abortions from 2007 to 2015. Overall, second-trimester abortions made up 13.4% of the total documented abortions at any gestational age (including those missing gestational age). The annual utilization rate of second-trimester abortion was relatively constant over the time period, fluctuating between 0.5 to 0.6 per 1,000 women. Young, marginalized women were more likely to seek late-term abortion services. Living in a state with a health or fetal anomaly exception was not associated with utilization of second-trimester services. The current state-level legal exceptions do not appear to be increasing utilization to second-trimester abortion services and must be more widely implemented in order to provide access to needed services and ultimately reduce morbidity and mortality from unsafe abortion.

## I. INTRODUCTION

Between 2010 and 2014, there were an estimated 25.1 million unsafe abortions annually; 97% of these occur in developing countries (Ganatra et al, 2017). Unsafe abortion<sup>1</sup> is estimated to account for 8% of total maternal deaths globally, although this is an underestimation due to known under-reporting of both abortion incidence and as cause of death (Say et al, 2014). While only 10-15% of all incident abortions are in the second trimester, they account for a disproportional amount of maternal deaths (Mulat, 2015; Harris & Grossman, 2011; Boland, 2010). Women seek second-trimester abortions for a variety of reasons: late recognition of pregnancy; difficulty deciding what to do about the pregnancy; delays associated with time to find funds to pay for abortions, locate a provider, multiple referrals, or travel; or fear and stigma (Boland, 2011; Drey et al, 2006). In addition, many tests to detect fetal anomalies cannot be performed until well into the second trimester. Thus, access to safe second-trimester abortion is a crucial part of efforts to reduce maternal morbidity and mortality worldwide (Harris & Grossman, 2011).

Despite some progress in expanding access to first-trimester services globally, access to safe and legal abortion at later gestational ages remains unchanged across much of the world. Two-thirds of countries with laws regulating second-trimester abortion allow it *only* to save the woman's life (Boland, 2010). While some countries where abortion is entirely illegal do have exceptions permitting second-trimester abortion, such as the woman's physical or mental

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<sup>1</sup> The WHO defines unsafe abortion as “a procedure for terminating an unwanted pregnancy either by persons lacking the necessary skills or in an environment lacking minimal medical standards or both” (WHO, 2014).

health, rape, fetal anomalies, or socio-economic reasons, they are implemented with varying degrees of success (Prada et al, 2011; Kim et al, 2018; Küng et al, 2018). Finally, data on the incidence of in-facility second-trimester abortions remain sparse, especially in settings where abortion is legally restricted.

In Mexico, abortion laws are determined at the state level. In Mexico City, one of Mexico's 32 states, women have had access to first-trimester abortion in the private and public sectors since 2007 (Becker, 2013). In Mexico's 31 other states, abortion at all gestational ages continues to remain restricted (Küng et al, 2018). Rape is the only circumstance for which abortion is legally permitted at the federal level, across all states (GIRE, 2011). Other grounds for legal access vary by state. For example, 27 states permit abortion when the life of the woman is at risk, but only 14 states permit abortion when the health of a woman is at risk, and 16 for fetal anomalies (GIRE, n.d.).

Previous estimates of abortion incidence in Mexico rely on the Abortion Incidence Complications Method (AICM) to account for known under-reporting of abortion (Juarez & Singh, 2012) (see **Technical Appendix** for more information). While it is critical to adjust for this undercounting, it is also important to know what the health system is reporting and how this differs across the country. No previous estimates have characterized in-facility second-trimester abortion incidence in Mexico. We measured geographical and temporal trends in second-trimester abortion rates in public hospitals in Mexico to provide an idea of the landscape of utilization throughout the country.

## II. METHODS

### *2.1 Data sources*

We used 2007-2015 hospital discharge data from Mexico's hospital discharge system, (Subsistema Automatizado de Egresos Hospitalarios – SAEH – in Spanish) (Secretaría de Salud, 2016). Data are provided by the National System for Health Information (SINAIS), directed by the Ministry of Health. All facilities included in this dataset are operated by national and state ministries of health (Secretaría de Salud, SSA). These facilities largely serve individuals without insurance or covered by Seguro Popular, a public insurance program for the unemployed, self-employed, or those without access to employment-based social security. These government facilities accounted for 76% of the country's total inpatient post-abortion cases in 2009 (Juarez & Singh, 2012).

The SAEH data is publicly available and can be downloaded for years 2000 to 2015. All hospital discharges are defined as the exit of a patient from inpatient services (thus outpatient clinics are not included). The dataset includes over 20 fields of information for each discharge, including: woman's age, municipality and state of origin, parity, hospital of admission, and length of hospital stay. In order to calculate utilization rates of second-trimester abortion, we used Consejo Nacional de Población's (CONAPO) population estimates of women ages 15-44 at the state and national level. In addition, we used the 2010 municipality-level marginalization index as a measure of community level socioeconomic status (CONAPO, n.d.). The index was constructed through principal component analysis, using variables related to education, housing, income, and population density (Bustos, 2011). Municipalities were categorized into five groups: very low, low, medium, high, and very high marginalization. The marginalization index was merged into the individual-level SAEH data based on the residence municipality of the woman. We also categorized states into four groups based on the percentage of poverty in

2014 as reported by the by The National Council for the Evaluation of Social Development Policy (Consejo Nacional de Evaluación de la Política de Desarrollo Social – CONEVAL – in Spanish) (Juarez et al, 2018). Mexico City was treated as a region apart due to its density of services, education, and infrastructure. Region 2 included states with less than 40% of the population in poverty, Region 3 with between 40-65% of the population in poverty, and Region 4 with 65% or more of state residents living in poverty (Juarez et al, 2018). Data on state-level legal exceptions were extracted from Grupo de Información en Reproducción Elegida (GIRE) and categorized as a binary variable based on whether a state had the health or fetal anomaly exception in their penal code (GIRE, n.d.). Finally, we downloaded facility-level characteristics, such as specialization of the hospital, from the Ministry of Health’s catalog of health facilities (Secretaría de Salud, 2018). All of the aforementioned data sources were publicly-available and downloadable (**Table 1**).

## *2.2 Sample Selection*

The SAEH dataset we included only obstetric events (births and abortions) using International Classification of Diagnosis Codes Version 10 (ICD-10 codes). Abortions were defined as cases of pregnancy with abortive outcomes (ICD10 O02-O08) (**Table 2**) and excluded ectopic and molar pregnancies with an abortive outcome, ICD O00 and O01. In order to comprehensively capture second-trimester abortions, we also included women whose abortions were listed in the up to six additional discharge diagnosis codes (N=894). For these cases, we reviewed and vetted the principal diagnosis codes to ensure that were related to second-trimester abortion procedures. Nine diagnosis codes comprised over 50% of these cases, with the leading code being O200, or “Threatened Abortion” (**Table 3**). Threatened

abortion, vaginal bleeding without dilation during the first 20 weeks of pregnancy, is often the precursor to a spontaneous abortion and was included as an abortive-related outcome. The other codes included trisomy 13, maternal care for intrauterine death, and severe pre-eclampsia, which also make intuitive sense. Additional abortions that may not have been flagged using ICD-10 diagnostic codes were identified using a “type of treatment” checkbox in the SAEH records, which indicates whether an abortion or a delivery was performed.

Gestational age, which measures in weeks and days the age of a pregnancy, usually dated from the first day of the last menstrual period and corroborated with ultrasound imaging when possible, was not routinely recorded prior to the legalization of first trimester abortion in Mexico City in 2007 (personal communication Raffaella Schiavon). Due to unavailability of gestational age before 2007, the dataset was restricted to 2007-2015 (see **Technical Appendix** for more information). Of total records, 238,972 were missing gestational age (22%). Although there were a few abortions identified after 20 weeks, per Mexican law, spontaneous or induced abortions after 20 weeks generate a fetal death certificate and are classified as stillbirths. In 2016, the gestational age threshold for stillbirths was increased to 22 weeks (Norma Oficial Mexicana).

## *2.3 Analytical methods*

### **2.3.1 Temporal trends in utilization**

Utilization rates of second-trimester abortions were calculated per year per 1,000 women of reproductive age, ages 15-44<sup>2</sup>, between 2007-2015 at the national, state, and

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<sup>2</sup> We defined reproductive age as women ages 15-44 to make our results comparable with other studies, even though we acknowledge that pregnancy can occur outside this range.

municipal level using CONAPO's population estimates (CONAPO, 2017). We also used linear regression models to test for temporal trends over time for second-trimester abortion frequencies and rates during this time period. We mapped these second-trimester abortion utilization rates across Mexico by state (32 states), socioeconomic region (4 regions), and by the presence of a state-level health or fetal anomaly exception laws (GIRE, n.d.).

### **2.3.2 Trends in gestational age**

We also tested for changes in mean and median gestational age of second-trimester abortions over time, clustering on hospital identifier to account for non-independence of observations as above. In addition to looking at these trends nationally, we examined GA trends in Mexico City versus the rest of the country. Given that Mexico City has legal first-trimester abortion services, we might imagine the trends in second-trimester gestational age to be distinct from the rest of the country due to earlier entry to care and fewer financial and geographic barriers to access.

### **2.3.3 Associated cofactors**

Finally, we identified cofactors associated with utilization of second-trimester abortion using logistic regression models. Through iterative testing of different covariates to ensure model robustness, we developed two final models (see **Technical Appendix** for equations). In model 1, we compared first versus second-trimester abortion patients. The dependent variable represented whether a woman sought an abortion in the first or second trimester, and independent variables included age group, parity, municipality-level marginalization, state-level health and fetal anomaly exceptions, and type of hospital where the woman sought care. Model 2 included the same specifications, except that the dependent variable represented

gestational age categories within the second-trimester period (13-16 weeks versus 17 and above). We estimated robust standard errors to account for non-independence of observations within hospitals using the “cluster” option in STATA (UCLA IDRE, n.d.).

### III. RESULTS

Of the 1,083,803 total abortions documented in the SAEH hospitalization records from 2007 to 2015, we identified 145,956 (13.4%) second-trimester abortions. The majority (70%) were classified as ICD-10 code O06 (“unspecified”) (**Table 2**).

Nearly 60 percent of second-trimester abortions were among women under 25 years old, 45.4% between 18-25, and only 2.4% were among women over 40 (**Table 4**). Most (70%) women who had a second-trimester abortion were hospitalized for one day. Over 50% of reported second-trimester abortions occurred in the least marginalized municipalities (**Table 4**). Overall, 24% of second-trimester abortions were performed in specialized hospitals, while 68% took place in general hospitals. However, in Mexico City, 56.4% of second-trimester abortions were performed in specialized hospitals, while in Guerrero, Oaxaca and Chiapas, only 1.6% of second-trimester abortions were performed in specialized hospitals (**Table 5**).

The annual utilization rate of second-trimester abortion was steady since 2007, fluctuating between 0.5 to 0.6 per 1,000 women of reproductive age (15-44) (**Figure 1**). When we examine the spatial pattern of second-trimester abortion utilization, there appears to be clustering of higher rates of utilization in the central and southern parts of the country (**Figure 2**). Zacatecas and Durango have the highest rates of utilization of second-trimester abortion services in the country, with 1.1 and 0.89 per 1,000 women respectively. These are followed by predominantly south states, including Tlaxcala, Guerrero, and San Luis de Potosí. The

northeastern states, including Coahuila, Nuevo León and Tamaulipas, boast some of the lowest rates of utilization of second-trimester abortion services.

Among states with legal exceptions in their penal code, utilization of second-trimester abortion varies. For states that permit women to have an abortion if the health of the woman is at risk (**Figure 3**), utilization rates of second-trimester abortion vary between 0.30 and 1.10 per 1,000 women, with no clear relationship between existence of this exception and utilization. Among states with fetal anomaly exceptions, the utilization rate varies between 0.21 and 0.77 per 1,000 women, with a similar lack of spatial pattern (**Figure 4**). It is notable, however, that the majority of states that have passed the fetal anomaly exception are clustered in the south.

The majority (62%) of second-trimester abortions were between 13-16 weeks, 38% occurred between 17-20 weeks, and < 1% from 21-24 weeks. Mean gestational age of second-trimester abortion patients in Mexico City was significantly higher than the rest of Mexico in 2007, but precipitously declined from 2007-2009, and then plateaued (**Figure 5**). However, mean gestational age remained slightly higher in Mexico City than in the rest of Mexico over the entire study period.

In multivariate analyses, adolescents were more likely than older women to have a second-trimester abortion in comparison to a first-trimester abortion (OR 1.07; 95% CI 1.04-1.11) (**Figure 6**). Women living in municipalities with high levels of marginalization also had higher odds of utilizing abortion services in their second trimester compared to women living in municipalities with lower marginalization (OR 1.43; 95% CI 1.18-1.73). Women utilizing second-trimester abortion services were more likely receive services in a specialized hospital (OR 1.19;

95% 1.02-1.39) than a general or community hospital. Living in a state with a health or fetal anomaly exception was not associated with utilization of second-trimester services.

In the multivariate model of utilizing second-trimester abortion between 13-16 weeks' verses >16 weeks, we found women using second-trimester services >16 weeks were more likely to live in states with a fetal anomaly exception (OR 1.26; 95% CI 1.05-1.52) (**Figure 7**). Women using later term second-trimester services were also less likely to live in highly marginalized municipalities (OR 0.78; 95% 0.60-0.99). There was no significant difference in timing of utilization of second-trimester abortion by age or hospital type.

#### **IV. DISCUSSION**

In summary, we found that poor, adolescent women living in more marginalized settings throughout Mexico were more likely to utilize second-trimester abortion services, and that they were often doing so in general hospitals without OBGYN specialty. Most of these women were presenting between 13-16 weeks gestational age, which has remained constant over time. And despite the stated purpose to expand access, the health and fetal anomaly exceptions do not appear to be increasing utilization of second-trimester abortion.

Data on abortions often focuses on first-trimester abortion, since abortions in the first 12 weeks are more common than second-trimester abortions. Yet in our study, we found that the average utilization rate of second-trimester abortions over the period was 0.57 per 1,000 women, and that 13.4% of total abortions over the period occurred in the second-trimester. This highlights that, albeit rare, there is need for safe, second-trimester abortion care. Although second-trimester abortion is largely illegal throughout Mexico and punishable by imprisonment, some women are able to access abortion services under the available exceptions, or present for

post-abortion care and receive care. These utilization rates vary across the country, ranging from 0.21 per 1,000 of reproductive age in the Yucatán, to 1.1 per 1,000 in Zacatecas. Using Juarez's estimates of an annual abortion rate of 38 per 1,000 women in Mexico, and the assumption that second-trimester hovers around 10% of total abortions, we would expect the utilization of second-trimester abortion to be more like 3.8 per 1,000 women (Juarez & Singh, 2012).

This under-utilization of second-trimester abortion services is likely due to poor implementation of the legal exceptions (Kung, 2018). For example, while Jalisco passed a law in 2009 that mandated institutions to provide abortion in cases of rape, the first case was not until 2016 (Olvera, 2018). Since then, there have been only 16 cases of abortions performed under this exception in Jalisco (Olvera, 2018). This was reflected in our study; women living in states with legal exceptions for health or fetal anomaly were no more likely to utilize second-trimester services than women living in states without these exceptions. The only exception to this was in comparing use of abortion at 13-16 weeks versus over 16 weeks, where we found that women have a higher likelihood of utilizing second-trimester services after 16 weeks if they live in states with the fetal anomaly exception. Given that fetal anomalies are often not detected until late in a women's pregnancy, it makes sense that women who live in states with the fetal anomaly exception are more likely to be able to access an abortion in these late-term circumstances. Yet, in general, there is widespread under-utilization of these exceptions, likely due to lack of guidelines for providers, poor dissemination of information about the legal exceptions to women, and a continued environment of criminalization of women for seeking abortion (Küng et al, 2018; Tames, 2015).

Our results support other evidence that Mexico's most vulnerable women are often disproportionately affected by obstacles to care. This finding has been reflected in other contexts as well, such as the U.S. and Colombia, where younger, poorer, and more disenfranchised women were more likely to seek second trimester abortions (Zurbriggen et al, 2018; Jones & Finer, 2012; Saavedra-Avendano et al, 2018). These same women also face disparities in access to obstetric and prenatal care (Saavedra-Avendano et al, 2018). In our study, odds of presenting for second-trimester abortion service (vs. first) were higher among adolescents and women living in highly marginalized municipalities. Our results showed that many women in poorer, more rural areas were seeking care in general or community hospitals, which raises the issue of how to ensure that general hospitals have the expertise and supplies to provide safe second-trimester abortions.

We found consistent utilization of second-trimester abortion services in Mexico over time, despite passage of the legal first-trimester abortion program in Mexico City. The mean gestational age among second-trimester abortion patients in Mexico has been on the decline but has stabilized around 16 weeks in recent years, demonstrating that the need for these late-term services is not going to disappear, even with expansion of first-trimester abortion services.

There were some key limitations to our study. First, gestational age is often poorly recorded in the SAEH hospitalization data, especially before 2007. Although we were able to restrict our analysis to data collected on or after 2007, gestational age continued to be missing in some areas after this date. However, we do not expect this missingness to be related to having a first or second-trimester abortion and thus would not greatly bias our results. We were also not able to differentiate between spontaneous and induced abortions, since the majority

were coded as “unspecified”. In addition, there were few socio-demographic variables included in the SAEH dataset, which limited our ability to evaluate other individual characteristics that may impact utilization of second-trimester abortions. We used other data sources with facility, municipality, and state-level characteristics to complement the SAEH information.

In addition, the SAEH dataset was limited to Ministry of Health hospitals. Thus, we did not capture women seeking second-trimester abortions in other domains of the public sector, such as IMSS or ISSTE, or the private sector. We were also unable to capture women who self-induced and did not seek care since our study only captured abortions reported in facilities. However, the Ministry of Health boasts the largest hospital system in Mexico and covers more than 75% of the country’s inpatient post-abortion care (Juarez & Singh, 2012). Thus, although we were unable to calculate the true *incidence* of second-trimester abortion, we were able to capture a high proportion of utilization.

## **V. CONCLUSION**

This is one of the first studies to leverage robust health information systems and use clinical data to report on in-facility second-trimester abortion in Mexico. Access to comprehensive, safe abortion services must go beyond the reaches of the legal first trimester program in Mexico City. These services must also encompass second-trimester care and be available to women throughout the rest of Mexico in order to reduce morbidity and mortality from unsafe abortion and provide all women the right to dictate their futures.

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**Figure 8.** Proportion of missing gestational age in SAEH data, 2000-2015

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**Figure 10.** Missingness in gestational age by SES Region

**Figure 11.** Missingness over time by SES Region

**Table 1. Data Sources and Relevant Variables**

DATA SOURCE	VARIABLES
Subsistema Automatizado de Egresos Hospitalarios (SAEH)	<ul style="list-style-type: none"><li>• Parity of the woman</li><li>• Age</li><li>• Hospital of treatment</li><li>• Length of stay</li></ul>
Grupo de Información en Reproducción Elegida (GIRE)	<ul style="list-style-type: none"><li>• Legal exceptions (health and fetal anomaly) in penal codes by state.</li></ul>
Consejo Nacional de Población (CONAPO)	<ul style="list-style-type: none"><li>• State population numbers by year</li><li>• Social marginalization index</li></ul>
Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL)	<ul style="list-style-type: none"><li>• Percentage of the state living in poverty</li></ul>
Secretaría de Salud (SSA)	<ul style="list-style-type: none"><li>• Facility-level characteristics including type of hospital and bed size for all Ministry of Health hospitals</li></ul>

**Table 2. ICD-10 codes for second trimester hospital-based abortions, 2007-2015**

ABORTION DIAGNOSIS CODES	FREQUENCY	PERCENT
	N = 145,956	
<b>002</b> Other abnormal products of conception	19,932	13.66%
<b>003</b> Spontaneous abortion	16,972	11.63%
<b>004</b> Medical abortion	353	0.24%
<b>005</b> Other abortion	2,642	1.81%
<b>006</b> Unspecified abortion	101,696	69.68%
<b>007</b> Failed attempted abortion	19	0.01%
<b>008</b> Complications following abortion and ectopic and molar pregnancy	368	0.25%
“Type of Attention” checkbox	3,974	2.72%

**Table 3. Primary ICD-10 diagnosis codes of women whose abortions were “hidden” in additional diagnosis codes**

<b>ICD-10 Diagnosis Code</b>	<b>Description</b>	<b>Freq. (N=894)</b>
O200	Threatened Abortion	146
O429	Trisomy 13, unspecified	76
Z348	Supervision of other normal pregnancy	57
O364	Maternal care for intrauterine death	45
O410	Oligohydramnios	41
O300	Twin Pregnancy	35
N939	Abnormal uterine and vaginal bleeding, unspecified	30
Z340	Supervision of normal first pregnancy	27
O141	Severe pre-eclampsia	19

**Table 4. Characteristics of women receiving in-hospital second-trimester abortions, Mexico 2007-2015**

<b>Characteristic</b>	<b>Frequency N = 145,956</b>	<b>Percent</b>
<b>Age Group</b>		
< 18 yr	18,397	12.60%
18-25 yr	66,924	45.42%
26-30 yr	27,626	18.93%
31-40 yr	30,208	20.70%
> 40 yr	3,421	2.35%
<b>Length of hospital stay</b>		
0 days	2,576	1.76%
1 day	102,609	70.30%
2 days	27,124	18.58%
3 or more days	13,647	9.35%
<b>Municipality-Level Marginalization</b>		
Very low <sup>1</sup>	73,660	50.55%
Low	23,719	16.28%
Medium	33,250	22.82%
High	8,139	5.59%
Very High	6,947	4.77%

<sup>1</sup> Marginalization index is based on 9 different indicators that cover four main domains: education, housing, income, and population distribution. Index is calculated for years 1990, 1995, 2000, 2005, 2010, and 2015. We used the 2010 ranking for modelling.

**Table 5. Type of facility where second-trimester abortions are performed, by region**

<b>Hospital Type</b>	<b>States grouped by percentage of population in poverty</b>			
	Mexico City (Region 1)	Low levels of poverty (Region 2)	Moderate levels of poverty (Region 3)	High levels of poverty (Region 4)
Specialized Hospital	<b>5,433</b> (56.35%)	<b>10,485</b> (23.41%)	<b>18,545</b> (23.05%)	<b>179</b> (1.62%)
General Hospital	<b>4,182</b> (43.29%)	<b>32,403</b> (72.36%)	<b>61,296</b> (76.20%)	<b>10,772</b> (97.69%)
Other Facility	<b>27</b> (0.28%)	<b>1,895</b> (4.23%)	<b>604</b> (0.75%)	<b>76</b> (0.69%)

Figure 1. Second-Trimester Utilization Rate per 1,000 women 15-44 in Mexico, 2007-2015

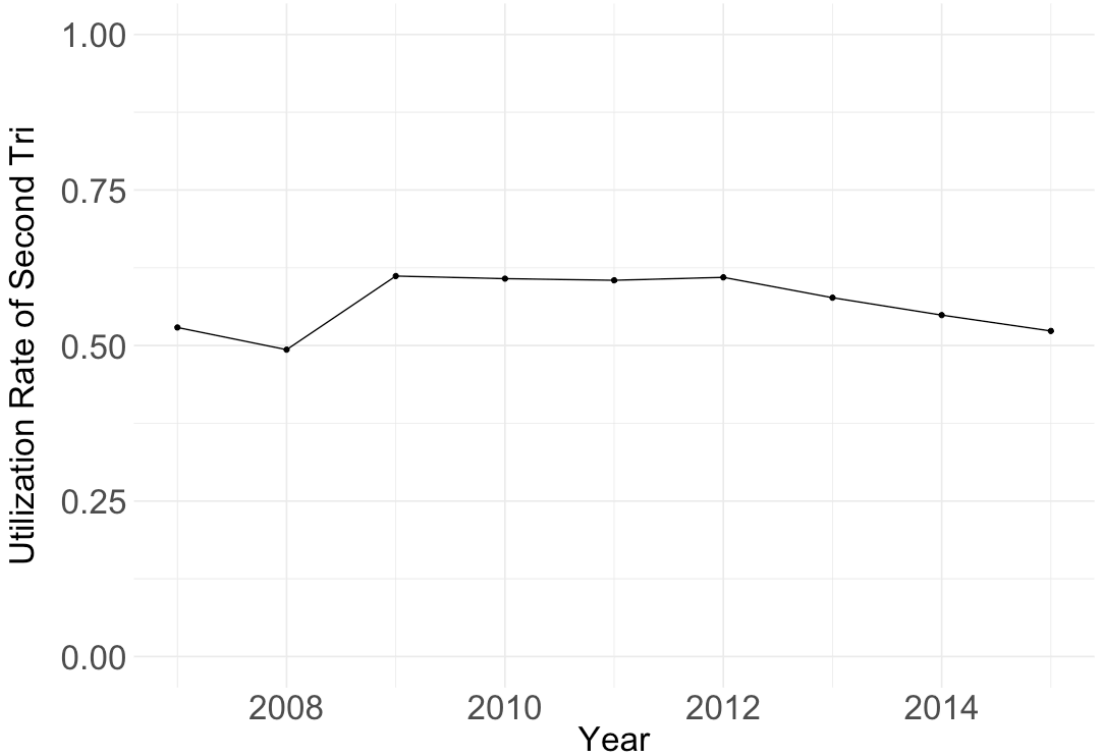


Figure 2. Second-Trimester Utilization Rate per 1,000 women 15-44 in 2015



Figure 3. Second-Trimester Utilization Rate in States with Health Exceptions

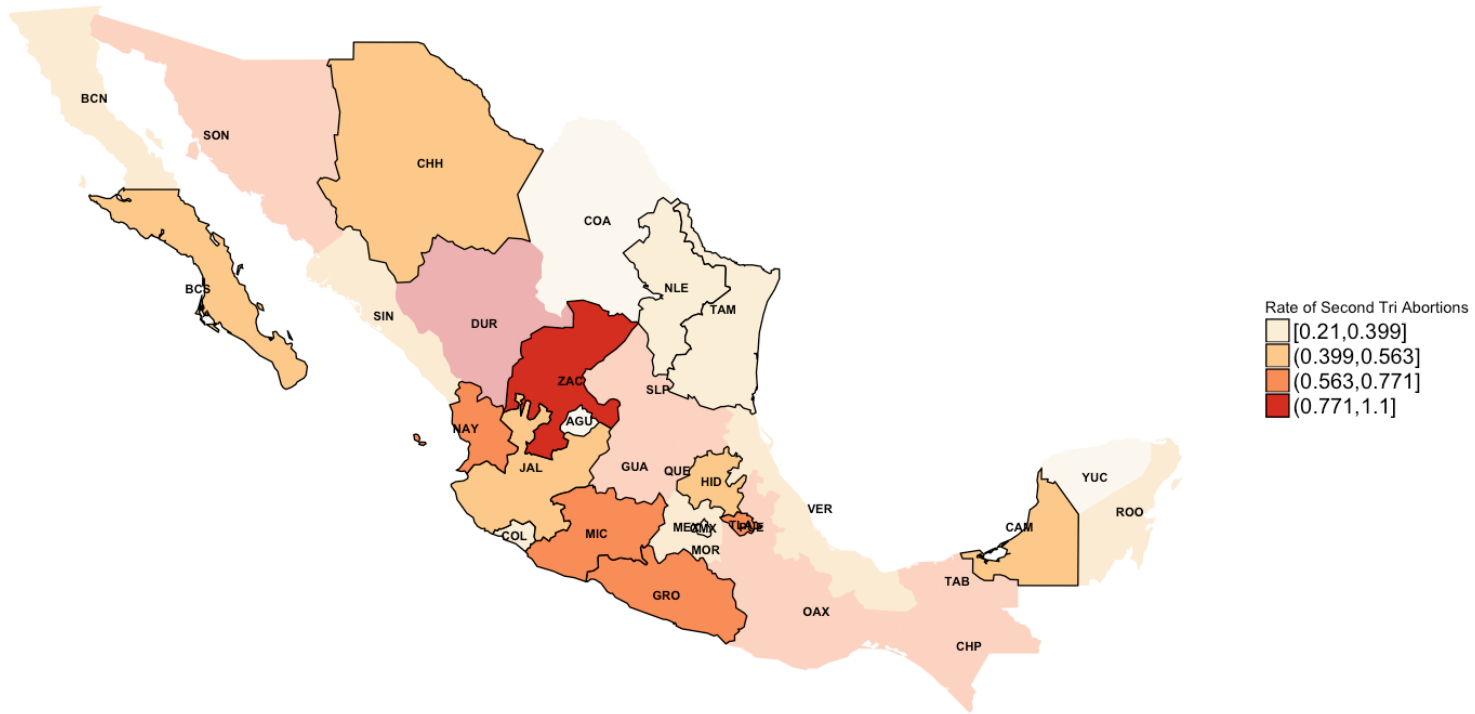


Figure 4. Second-Trimester Utilization Rate in States with Fetal Anomaly Exceptions

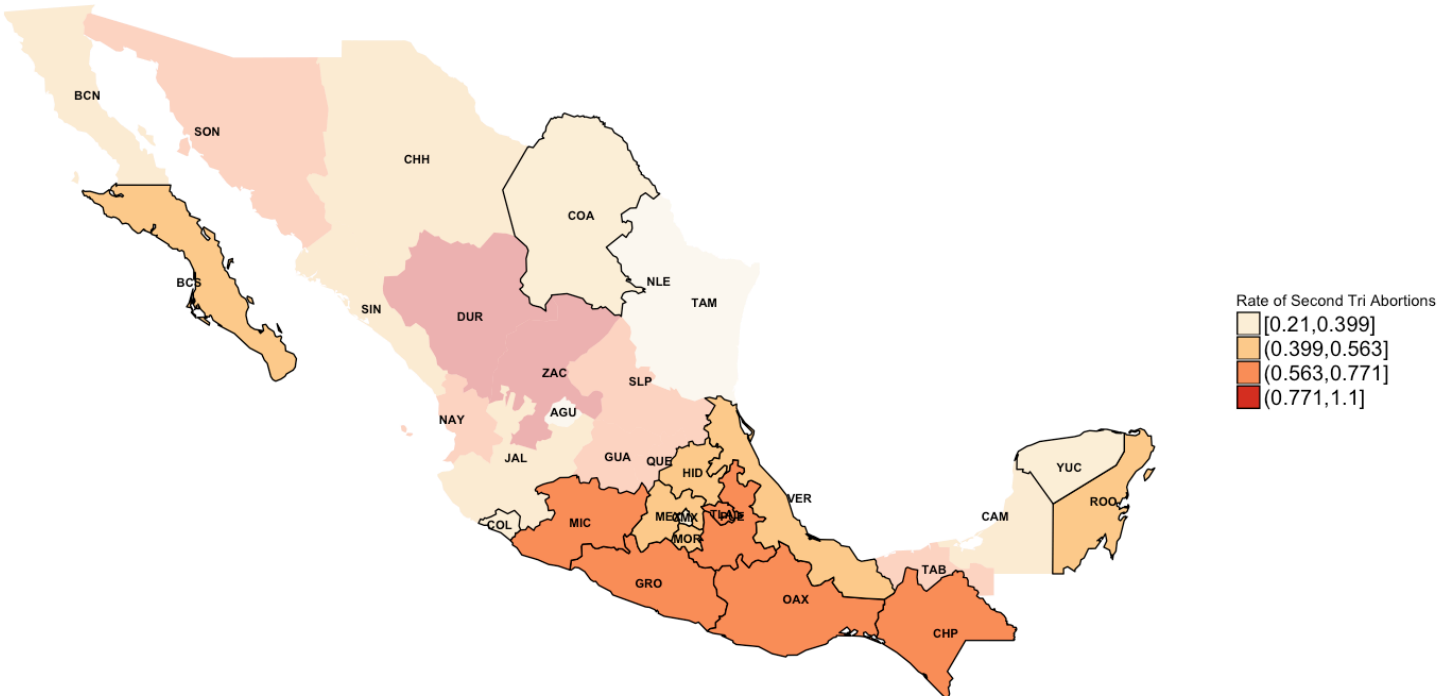


Figure 5. Trends in gestational age of second-trimester abortions over time

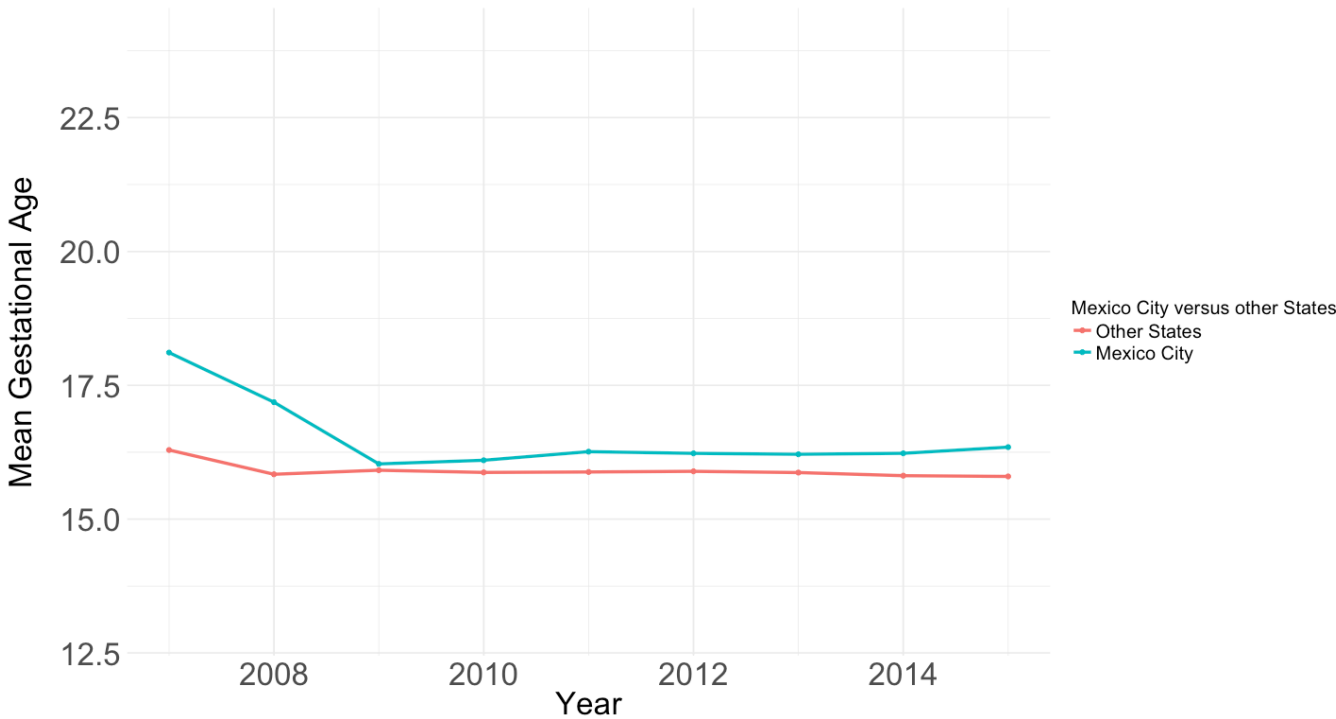
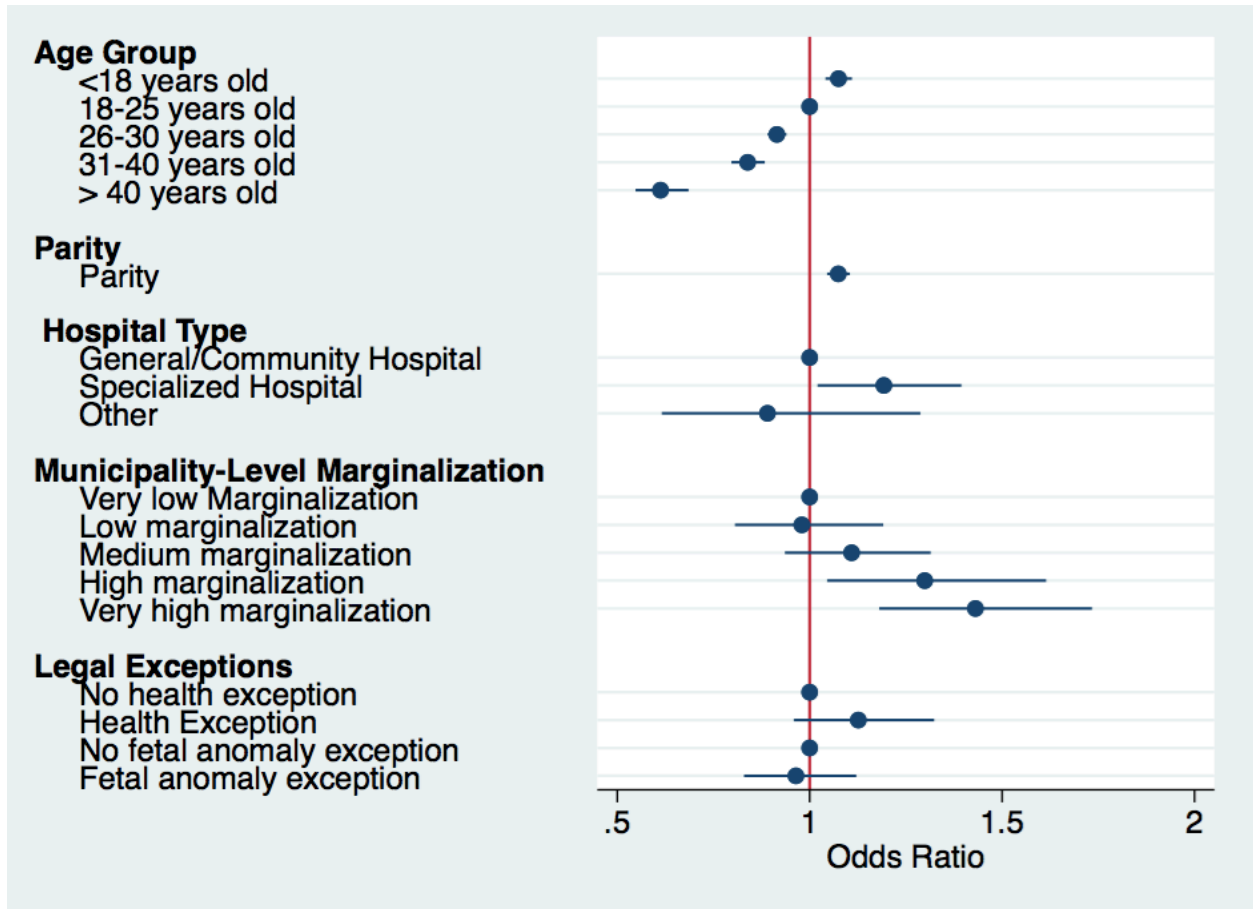
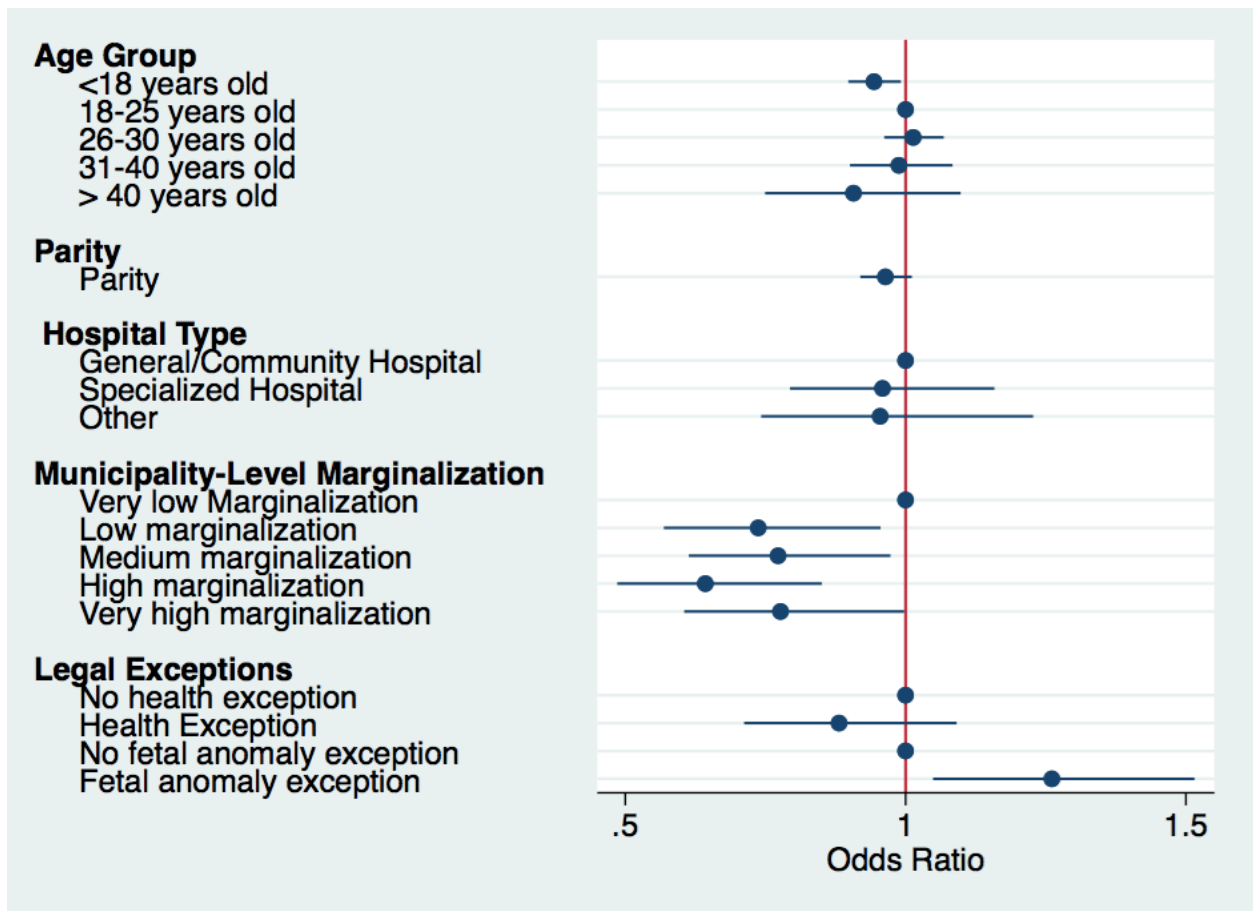


Figure 6. Factors associated with second-trimester abortion versus first trimester abortion



<sup>1</sup>The reference category for each variable is represented by the dot on the line where OR = 1.

Figure 7. Factors associated with second-trimester abortion after 16 weeks versus 13-16 weeks



## Technical Appendix

### I. AICM method

The Abortion Incidence Complications Method (AICM) is a technique to estimate the incidence of abortion in settings where abortion is highly restricted or unsafe. The method was first developed in the 1990s and has since been applied in settings throughout the world (Singh et al, 2010).

The method relies on two key pieces of data: (1) the number of women who receive in-facility treatment for post-abortion complications; and (2) the proportion of all women having abortions who receive in-facility treatment for complications (Singh et al, 2010). The first input is based off of official health statistics and nationally representative surveys of health facilities. The second input is based off of a Health Professionals Survey (HPS), which surveys abortion experts in the study country to estimate the proportion of women who likely experience complications and receive treatment. This is used to calculate a multiplier to account for the women who do not seek or obtain care in order to yield the overall incidence of induced abortions. There is also an adjustment made to isolate induced from spontaneous abortions.

The AICM has been applied to Mexico in three previous studies in 1990 and 2006. The most recent estimates of abortion incidence from 2009 in Mexico employ the AICM method as well (Juarez et al, 2012).

While the AICM represents an important and long-standing method to estimate the true incidence of induced abortion, the results from the HPS are known to vary widely based on the respondent, particularly in Latin America (Singh et al, 2010). In addition, this method relies on aggregate-level data of in-facility abortions, preventing any potential exploration of individual-level characteristics. Thus, we also believe there is value in reporting the documented utilization of abortion, even if this is a known under-estimation of the true incidence.

### II. Missingness in gestational age

After 2007, we see a general decline in missingness in reporting of gestational age (**Figure 8**). Although these trends differ by state, we see that this downward trend in missingness in gestational age after 2007 holds true across the country (**Figure 9**). Perhaps counterintuitively, Mexico City, with some of the highest access to education, health care, and infrastructure, boasted the highest rates of missingness in gestational age when compared to other regions with an average of 40.3% missingness in the gestational age variable across the time period (**Figure 10**).

When we look over time by socioeconomic region, we see that Mexico City's reporting of gestational age did improve markedly between 2008 and 2009, likely in response to the passage of the legal first-trimester abortion program in 2007 (**Figure 11**). However, one-third of all abortion records still contain missing gestational age information in Mexico City, and this level of missingness remains higher than the other socioeconomic groupings of states.

Figure 8. Proportion of missing gestational age in SAEH data, 2000-2015

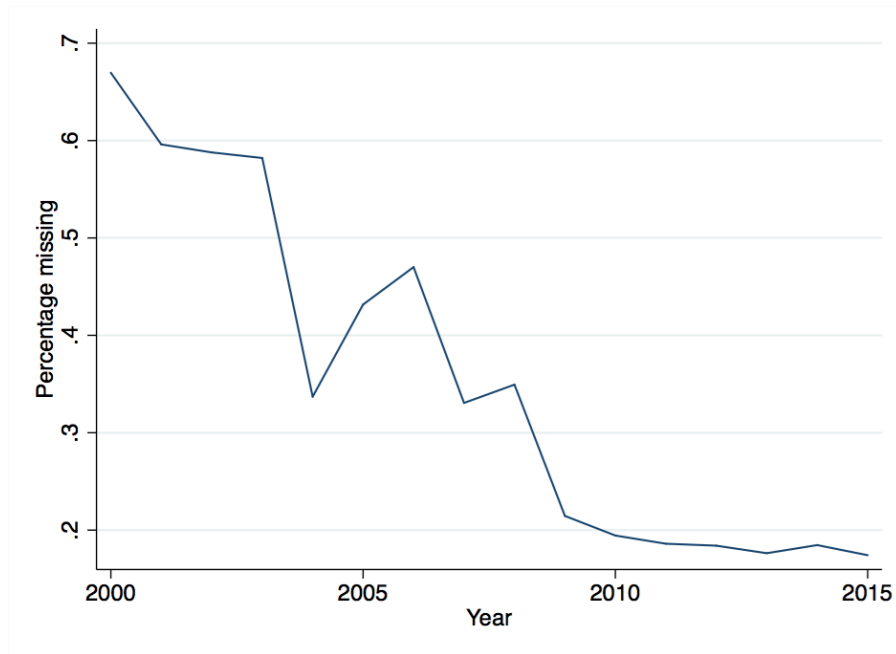


Figure 9. State-level trends in missingness in gestational age variable

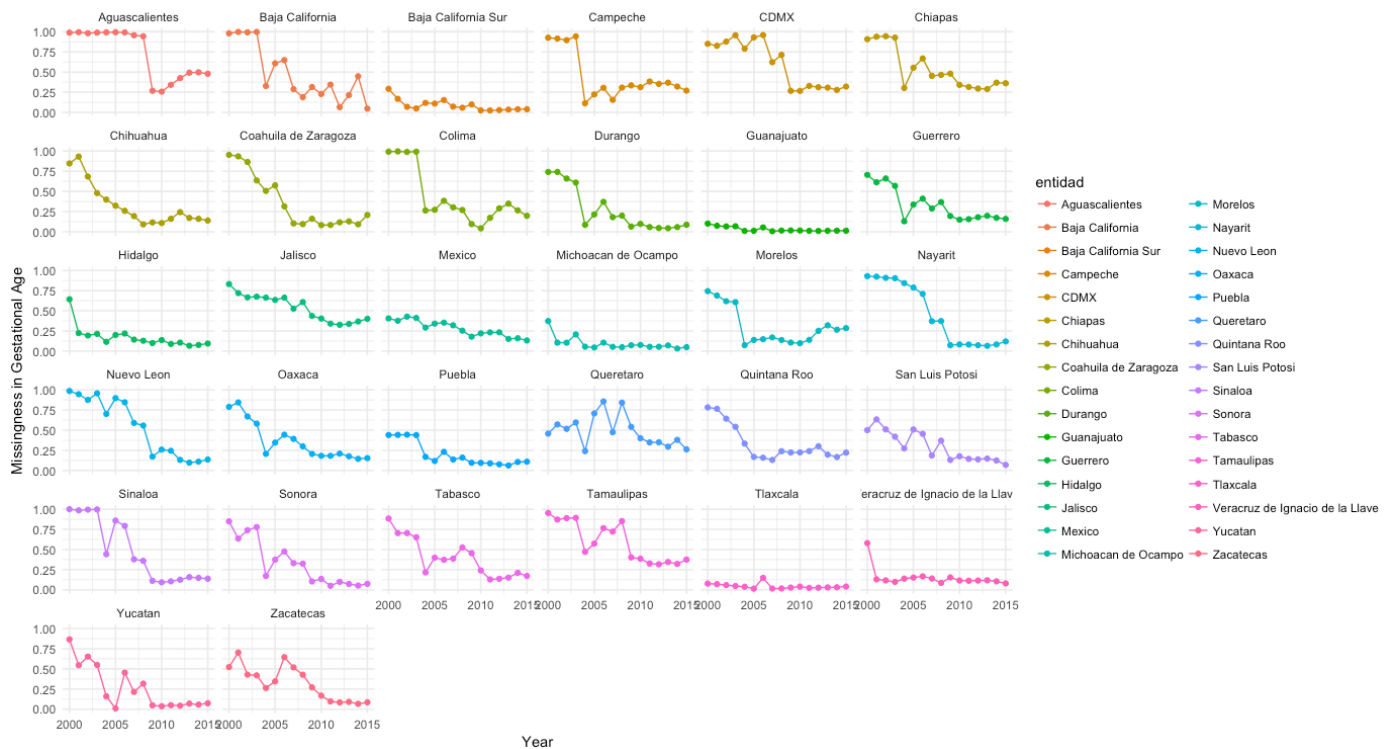
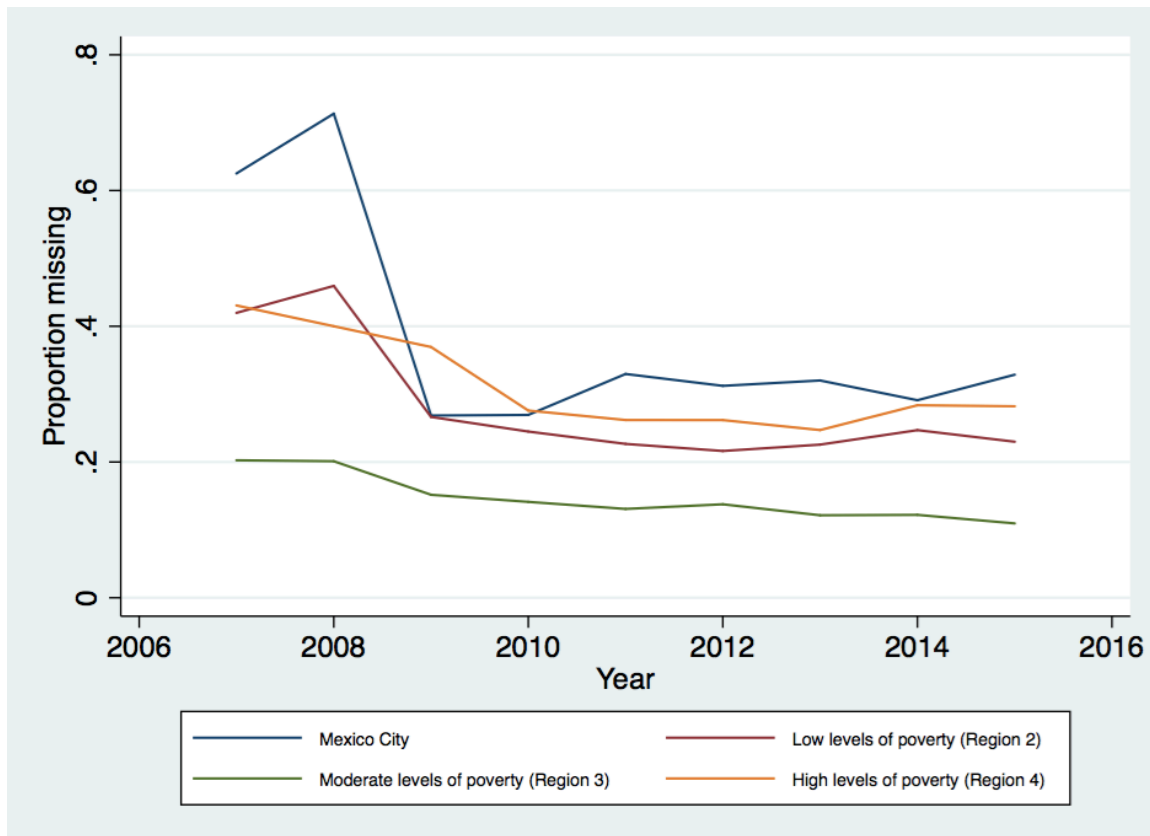


Figure 10. Missingness in gestational age by SES Region

	States grouped by percentage of population in poverty			
	Mexico City (Region 1)	Low levels of poverty (Region 2)	Moderate levels of poverty (Region 3)	High levels of poverty (Region 4)
Total reported abortions	79,093	352,968	561,882	89,313
Total reported abortions with missing gestational age	31,844	98,111	81,473	27,319
Percentage missingness	<b>40.3%</b>	<b>27.8%</b>	<b>14.5%</b>	<b>30.6%</b>

Figure 11. Missingness over time by SES Region



### III. Multivariate logistic regression models

#### Model 1

$$\begin{aligned} \text{logit}(\text{SecondTri}) &= \beta + \beta_1(\text{AgeGroup}) + \beta_2(\text{Parity}) + \beta_3(\text{Marginalization}) \\ &+ \beta_4(\text{Health Exception}) + \beta_5(\text{Fetal Anomaly Exception}) \\ &+ \beta_6(\text{Hospital Type}) + \beta_7(\text{Hospital}) + \varepsilon \end{aligned}$$

#### Model 2

$$\begin{aligned} \text{logit}(\text{SecondTri\_Cat}) &= \beta + \beta_1(\text{AgeGroup}) + \beta_2(\text{Parity}) + \beta_3(\text{Marginalization}) \\ &+ \beta_4(\text{Health Exception}) + \beta_5(\text{Fetal Anomaly Exception}) \\ &+ \beta_6(\text{Hospital Type}) + \beta_7(\text{Hospital}) + \varepsilon \end{aligned}$$

We performed iterative model testing to arrive at these final models. Other covariates that we tried in the models but did not have a significant effect on whether a woman utilized first trimester vs. second trimester abortion included:

- **Contraceptive coverage (CONAPO)**
  - Percentage of women of reproductive age (15-49) who are sexually active and use contraceptive methods, 2009 and 2014
  - Percentage of women of reproductive age who use contraceptive methods, 2009 and 2014
- **Unmet contraceptive need (CONAPO)**
  - Percentage of women of reproductive age (15-49) who referred to their desire to limit or space out their pregnancy but didn't use a contraceptive method
- **Maternal death data for women ages 10-54 (INEGI)**
  - MMR by state: # of maternal deaths per live births
  - # Maternal deaths / Women of reproductive age 10-54
- **Women's education (INEGI)**
  - Percentage of the population who have completed a primary education, by state
- **State-level female diabetes prevalence in Mexico (IHME)**
  - State-level diabetes prevalence among women by state
  - Diabetes and other chronic health conditions can often lead to higher rates of abortion