Rates, Trends and Determinants of Cesarean Section Deliveries in El Salvador: 1998 to 2008

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Abstract

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Background: Rates of cesarean section births have been rising since the 1990s in virtually all developed countries and increasingly in middle-income countries as well. In over 50% of countries worldwide, rates now exceed the World Health Organization's recommended upper limit of 15% of births by cesarean section. Just as the cesarean section birth rate varies between countries, it also varies between sub-populations within countries. Excessively high rates of cesarean section births do not increase health benefits and actually increase maternal and infant morbidity and mortality. They also divert health care resources from other medical priorities in resource-poor countries.

Objectives: The objectives of this study are to evaluate the over-all rate and change over time of cesarean section deliveries in El Salvador from 1998 to 2008, to identify and describe cesarean

section rates among sub-populations within El Salvador, and to examine factors and determinants related to cesarean section deliveries and their change over time.

Methods: This study is a retrospective analysis of observational, cross-sectional, population-based survey data collected in 1998, 2003 and 2008 in El Salvador. We investigated associations between sociodemographic and reproductive characteristics using bivariate and logistic regression analyses and calculated odds ratios, examined associations for confounding and evaluated interactions between age, area, socioeconomic status, number of children and religion and their effects on cesarean section birth rates.

Results: The over-all cesarean section birth rate increased from 15.7% to 24.9% between 1998 and 2008 respectively. During this time, women became more educated and their socioeconomic status improved. Women living in urban areas, of high socioeconomic status, more educated and delivering in private facilities had higher rates of cesarean deliveries, approaching 50% among this sub-population of women.

Conclusion: Although there were multiple statistically significant determinants related to the changes in cesarean section birth rates between 1998 and 2008, the shift from births taking place in private homes to births occurring in medical facilities was the major factor accounting for the increase in cesarean section birth rates among Salvadoran women.

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I. Introduction

Rates of cesarean section deliveries have been rising worldwide in the past few decades and are of concern in both developed and developing countries. To address this concern the World Health Organization (WHO) issued a consensus statement in 1985, stating there is no justification or additional health benefits to be gained by any region having cesarean section rates below 10% or higher than 15%.[1] These percentages were based on a review of estimates of national cesarean section rates and perinatal and maternal mortality rates from various countries. More than twenty years later Marsden Wagner, M.D., M.S., former director of Women's and Children's Health, WHO, confirmed that good, hard data continue to clearly demonstrate that the WHO recommendations of 1985 are still absolutely valid and "not out of date."[2] With rates of cesarean section deliveries exceeding 30% in some countries, including Brazil (45.9% cesarean section rate), Dominican Republic (41.9%), Argentina (35.2%), Paraguay (32.2%) and Uruguay (31.8%) there appears to be legitimate cause for concern.[3] The data show that as the cesarean section rate rises above 15%, maternal mortality rises as well.[4] In the United States, at least 45% of all maternal death is associated with a cesarean section delivery.[2] In the last three decades, cesarean section delivery rates have increased dramatically over the recommended 15% in virtually all developed countries and are increasing in less developed countries as well.[5]

At the other end of the spectrum, a rate of less than 5% of births by cesarean section delivery may signify a lack of access to appropriate obstetrical care.[5] In low-income developing countries, cesarean section delivery rates and other essential obstetric care have remained at critically low levels. This, too, is cause for concern.

While such between-country differences are well documented, within-country differences also exist. Generally, cesarean section rates tend to be significantly higher in urban areas, among wealthy women who deliver in private facilities.[6] This major surgical procedure is potentially life saving when performed for appropriate maternal or fetal complications. However, it is also associated with significant adverse health risks[7, 8] and has implications for how a woman delivers in subsequent pregnancies (once a woman delivers by cesarean section, quite often all subsequent deliveries are by cesarean section as well).[9] Additionally, when compared to vaginal deliveries, cesarean section deliveries utilize significantly more health care resources.[10] Therefore, it is the stance of the WHO that deliveries by cesarean section should be employed only in medically necessary situations when the advantages clearly outweigh the risks.

II. Specific Aims

The objective of this study was to evaluate rates and trends of cesarean section deliveries using nationally representative, population-based surveys conducted with women of child-bearing age in El Salvador between 1998 and 2008. We also examined maternal factors associated with those changes. Specifically, we investigated the temporal changes in socioeconomic, demographic and reproductive factors as they relate to proportion of cesarean section deliveries.

III. Background and Significance

The WHO's 1985 published guidelines on appropriate technology for birth were based on cesarean section data from developed countries. These data indicate that when cesarean section rates exceed the recommended 15%, over-reliance on cesarean sections as the appropriate method of delivery may be occurring.[11] In 1994, the WHO amended their earlier guidelines with the following:

> *It has been suggested this national cesarean section rate should lie between 5% and 15% of births. A figure falling below 5% indicates that a substantial proportion of women do not have access to surgical obstetric care and probably die as a result. A rate higher than 15% indicates over-utilization of the procedure for other than life-saving reasons. This is also dangerous for women's lives because of the unnecessary risk associated with any major surgical operation.*[12]

Almost twenty years after the publication of these WHO guidelines there is still much controversy about the optimal cesarean section delivery rate. This rate is important because it is thought to be a proxy indicator for access, availability and appropriateness of maternal obstetric care.[9]

The rate of cesarean section deliveries worldwide is estimated to be about 15%.[9] This estimate obscures the large variation in cesarean section delivery rates between countries and regions. Cesarean section rates in sub-Saharan African countries are estimated to be very low and stable, with at least 23 countries reporting rates of less than 5%.[11] This very low rate is alarming because it signifies that women may not be receiving life-saving obstetric care. It is

also alarming because the rate is static; it is not increasing. In more developed regions of the world, including Eastern Asia, Europe and North America, the cesarean section delivery rate far exceeds the WHO recommendations, reaching 31% in Central America and more than 40% in Eastern Asia.[9] These high rates are also cause for concern.

Rates of cesarean section delivery also vary within countries, between urban and rural areas, higher and lower socioeconomic groups, and between those who have access to private health care versus those who rely on public health care.[8, 9, 13, 14] Across all countries for which national data are available, cesarean section delivery rates in urban areas are four times greater than those in rural areas.[13] In Brazil, the cesarean section delivery rate reaches 80% among those women who pay by private sources and deliver in private facilities.[8, 14] This is in contrast to Brazil's over-all cesarean section delivery rate of 43% in 2006.[15] Because of this within-country variation of cesarean section birth rates, using a nation's overall rate as a proxy indicator for availability of essential maternity care for all women may be inaccurate. Differences in rates between sub-populations may mean that a substantial portion of women are not receiving cesarean sections when medically indicated (too few being done in some sub-population) or are receiving them even when not medically indicated (too many being done), while at the same time the overall rate appears to be in the acceptable range.

Available evidence challenges the widely held perception that cesarean section deliveries are safe.[16] Significant maternal and neonatal morbidity and mortality are associated with cesarean section deliveries.[7] It is estimated that women delivering by elective cesarean section (that is, no emergency exists) have a 2.84 times greater chance of maternal death than women delivering vaginally.[9] Other possible adverse maternal outcomes include bleeding, infection, damage to pelvic organs, admission to an intensive care unit, prolonged recovery

and uterine rupture in future pregnancies.[7, 8] Adverse neonatal outcomes include asphyxic and traumatic birth injury, infection, respiratory complications and stillbirth.[7] There is also evidence from more developed countries that cesarean section delivery is associated with adverse psychosocial outcomes such as distress, dissatisfaction and problems with maternal-infant bonding.[17] Another factor contributing to concern about the persistent increase in rates of cesarean section delivery is that this surgical procedure diverts scarce health care resources from other medical priorities in resource-poor, developing countries such as El Salvador.[10] When all related costs are considered, the cost of a cesarean section delivery is about twice as much as a spontaneous vaginal delivery. In addition to a drain on health care resources, these costs also may strain individual patient resources for out-of-pocket expenses such as medications, hospitalization and physician fees.

The objective of this study is to evaluate the rate and change over time of cesarean section deliveries between 1998 and 2008 in El Salvador. Are there sub-populations for whom the cesarean section delivery rate is critically low or excessively high? What socioeconomic, demographic and maternal health-related determinants are associated with cesarean section delivery rates? Is there adequate access to cesarean section deliveries for those patients in whom it is medically indicated? This information will help elucidate health care policy and guide the provision of health services as El Salvador progresses.

IV. Methods

Study Design

This study is an analysis of secondary observational cross sectional survey data collected in 1998, 2003 and 2008. These Reproductive Health Surveys are the most recent in a series of nine surveys, begun in 1973. They were conducted to provide essential information for implementing policies, strategies, programs and projects to improve the quality of life and health of the Salvadoran population. The Reproductive Health Surveys were conducted by the Salvadoran Demographic Association with active participation by the Interinstitutional Consultative Committee, composed of the United Nations Fund for Children, the Pan American Health Organization, the United Nations Fund for Population Activities, the Ministry of Public Health and Social Assistance, the Ministry of Foreign Relations, the Salvadoran Social Security Institute, the General Directorate of Statistics and Censuses, the Project for Maternal and Child Health and the United States Agency for International Development. Technical assistance for all phases of the survey was provided by the Division of Reproductive Health of the Centers for Disease Control and Prevention. The Institute for Health Metrics and Evaluation at the University of Washington is the coordinating center and holder of the Reproductive Health Survey data utilized in our study.

Human subjects review was not required as the University of Washington Institutional Review Board deemed this secondary data analysis project “non-human subjects research” because the data are publicly available and do not include any information that could potentially identify any individual.

Study Population and Sample Selection

The study population consisted of a random sample of women aged 15 and 49 years. The sample was designed to be representative of Salvadoran women of childbearing age in El Salvador. Sample selection was a three-stage process. In the first stage, urban and rural segments from each department were randomly selected. ("departments" are the primary administrative divisions in El Salvador, similar to a "state" in the United States. "Segments" are similar to census tracts in the United States: they are geographic and statistical subdivisions of a county with population averaging 4,000, used for the purpose of taking a census. There are 14 departments in El Salvador and roughly 700 segments.) In the second stage, 30 to 35 households (depending on the survey year) were randomly selected from each census segment. In the third stage, one woman aged 15 and 49 years was randomly selected from each household to be interviewed. Trained interviewers visited each selected household to verbally administer the questionnaire to the designated woman. Weighting factors generally used in representative population-based surveys of this nature were applied in the data analysis process to compensate for unequal probabilities of selection at each stage.

The 1998 survey sample included 20,760 households distributed across 692 census sectors with fieldwork conducted from April 27, 1998 to November 15, 1998. The 2003 survey sample included 18,450 households distributed across 610 census tracts with fieldwork conducted from November 4, 2002 to April 15, 2003. The most recent survey was in 2008 and included 21,595 households distributed across 617 census tracts with fieldwork conducted from April 7, 2008 to September 21, 2008.

Data Collection and Quality

The survey utilized two questionnaires to collect data: the household questionnaire, which included a section to select the woman in the household to be interviewed as well as administrative information, and an individual questionnaire which was administered to the selected woman. The questionnaires were administered in Spanish which is the dominant language spoken in El Salvador. A pilot test was carried out before commencing the official survey to ensure validity, logical sequence of questions and comprehension, and to establish a suitable amount of time for the interview. Interviewers and other field personnel were trained on standardizing criteria and procedures during a 15-day workshop. Data entry took place concurrently with data collection. This allowed for necessary corrections and clarifications, further ensuring data accuracy and quality. In conducting the individual interview, every effort was made to maintain privacy and guarantee confidentiality of the information, thus encouraging honest and forthright responses.

Research Hypotheses

The rate of cesarean section deliveries in El Salvador will show an increasing temporal trend and will differ among various sub-populations. We hypothesize that older age, better education, residing in metropolitan/urban areas, having higher socioeconomic status, having a greater number of prenatal care visits and delivering in private institutions will be associated with higher rates of women delivering by cesarean section.

Key Variables

The binary dependent variable, or outcome of interest, is type of delivery, i.e., cesarean section delivery versus vaginal delivery. The various explanatory or independent variables available in this data set are primarily socio-demographic including age, area of residence,

education, religion, employment status, socioeconomic status and marital status. Limited maternal reproductive details include parity, history of pregnancy outcomes, institution of prenatal care, institution of birth and, in the case of cesarean deliveries, whether the delivery was planned or emergent and the reason for cesarean delivery.

Sample Size/Power

The sample of women eligible to complete the Reproductive Health Survey was taken from approximately 20,000 randomly selected households in each of the three years of the survey. From these households, there were between 3,100 and 4,100 women each year that met the age qualification, reported having a live birth within the two years previous to the survey and who completed the survey. These randomly selected women were asked whether their last live birth was cesarean or vaginal. In 1998 there were 525 (unweighted) women reporting delivery by cesarean section for their last live birth, 604 in 2003, and 804 in 2008. With the above sample size information, using Raosoft Sample Size Calculator (available online at www.raosoft.com/samplesize.html), we calculated that the study would have over 90% power to detect a 5% difference in independent variable for each survey year.

Data Analysis Plan

Data analysis was completed using the Complex Sample Module within IBM SPSS Statistics Version 21. The Complex Sample Module allowed for more accurate representation of the target population by computing and assigning weights during the analysis stage to adjust for the survey sampling methods. The sampling methods compensated for by the Complex Sample Module included stratification, clustering, multistage sampling, and unequal selection probabilities. More detailed information about calculation of weights and

the sampling method can be found in the final reports of each survey, available at http://ghdx.healthmetricsandevaluation.org/geography/el-salvador.

Data analysis consisted of descriptive methods for all variables considered and tests of hypotheses for particular relationships. Categorical variables were summarized with frequencies and percentages. Quantitative variables were summarized with the mean and standard error (standard deviations are not available within the Complex Sample Module). Chi-square tests (labeled “test of independence of rows and columns” within the Complex Sample Module) were performed to compare demographic, socioeconomic and reproductive characteristics from the three survey years and to calculate p-values. We then conducted logistic regression analyses to calculate odds ratios for various demographic, socioeconomic and reproductive characteristics comparing women delivering vaginally with those delivering by cesarean section. Data for these analyses were obtained from women reporting a live birth within the two-year period previous to each respective survey. We further explored the relationship between age, number of children, socioeconomic status, education, religion and area and their effect on cesarean section birth rates. We evaluated these effects for confounding and interactions using cross tabs analyses, linear regression and logistic regression. Finally, we computed a hypothetical cesarean section birth rate for 2008 which reflected what the rate would be if the only change from 1998 to 2008 was the shift from home births to institutional births. This produced a percentage change that could be attributed to this shift in location of birth.

V. Results

An unweighted sample size summary for all survey years is presented in Table 1 with weighted sample sizes presented in Tables 2 through 6. The unweighted sample sizes of eligible women (aged 15 to 49 years) who completed an individual questionnaire in 1998, 2003 and 2008 were 12,634, 10,689 and 12,008 respectively, while the corresponding weighted sample sizes were 18,054, 15,139 and 17,051 respectively. Table 2 presents weighted information about the prevalence of cesarean section deliveries organized by department. In 1998, the overall cesarean section rate was 15.7% (95% CI 14.1%-17.5%). With the exception of San Salvador, Santa Ana and San Miguel, all departments had cesarean section rates that were within the WHO guidelines of 5% to 15%. By 2003 the overall cesarean section rate had risen to 22.0% (95% CI 19.0%-25.4%) and by 2008 it was 24.9% (95% CI 23.2%-26.7%) with several departments reporting rates over 30%. The total increase in the cesarean section rate from 1998 to 2008 was 58.6%.

Tables 4 through 6 include data from women who reported a live birth within a two year period preceding each survey. Table 4 presents weighted values and significance level (χ^2 tests) of maternal demographic characteristics. In this table, two variables with particularly large changes from 1998 to 2008 are education and socioeconomic status. Level of maternal education rose overall. Women who reported 7-9 years of education increased 31.0%, from 18.7% (95% CI 16.9%-20.6%) in 1998 to 24.5% (95% CI 22.7%-26.4%) in 2008; and women who reported 10+ years of education increased 53.1% from 19.2% (95% CI 17.2%-21.4%) in 1998 to 29.4% (95% CI 26.9%-32.1%) in 2008. Women who reported no formal education decreased over 50% from 18.7% (95% CI16.8%-20.7%) in 1998 to only 9.1%

(95% CI 7.9-10.6%) in 2008. Similarly, socioeconomic status improved overall. Women who reported low socioeconomic status decreased by 57.9% from 55.4% (95% CI 52.2%-58.5%) in 1998 to 23.3% (95% CI 20.8%-26.0%) in 2008. At the same time, women who reported high socioeconomic status nearly doubled from 15.1% (95% CI 12.8% to 17.7%) in 1998 to 29.9% (95% CI 27.1%-32.8%) in 2008.

Table 5 presents pregnancy and birth characteristics for women reporting a live birth in the two years preceding each survey. Women who reported receiving any prenatal care increased from 78.3% (95% CI 76.2%-80.2%) in 1998 to 95.0% (95% CI 93.8%-96.0%) in 2008, a 21.3% increase. This trend was also reflected in total prenatal care visits with women reporting an increased number of visits. Women who reported only one to three prenatal care visits decreased 58.8%, from 14.1% (95% CI 12.5%-15.7%) in 1998 to 5.8% (95% CI 4.9%-6.9%) in 2008, while women who reported seven to nine prenatal care visits increased 36.4%, from 36.5% (95% CI 34.1%-38.9%) to 49.8% (95% CI 47.6% to 51.9%). Another notable trend is the increasing prevalence of births in medical facilities rather than in homes. The percentage of births in a medical facility increased 41.5%, from 62.4% (95% CI 57.6%-67.6%) in 1998 to 88.3% (95% CI 83.7%-93.3%) in 2008. Births occurring in the home decreased 70.4% from 37.5% (95% CI 33.8%-39.3%) to only 10.8% (95% CI 9.2%-12.7%).

Table 6 presents differences in cesarean section rates by self-reported demographic, socioeconomic, pregnancy and birth-related characteristics. It compares women who delivered by cesarean section with women who delivered vaginally for their last live birth in the two years preceding each survey. With the dependent variable being cesarean section birth, characteristics found to be not statistically significant were age, marital status and religion in 1998 and 2003; and age and any prenatal care (yes/no) in 2008. In 1998 women

residing in urban areas had over twice the odds of delivering by cesarean section (OR 2.218, 95% CI 1.709-2.876) versus women residing in rural areas. This differential decreased 32.6% to about 1.5 (OR 1.494, 95% CI 1.241-1.799) in 2008. Level of education also was significantly associated with cesarean section births. In 1998 women with 10 or more years of education had more than four times the odds of delivering by cesarean section compared to women with no education (OR 4.286, 95% CI 2.788-6.588). As with the urban/rural odds, this differential also decreased by 2008 to about three times the odds over women with no education (OR 3.191, 95% CI 2.167-4.700). This was a 25.5% decrease in odds. Employment status also showed a similar decrease in differential between employed/not employed from 1998 to 2008. In 1998, employed women had over 1.5 times the odds of delivering by cesarean section (OR 1.671, 95% CI 1.286-2.172) over unemployed women. By 2008, those odds had decreased about 30% with employed women having about 1.2 times the odds of delivering by cesarean section (OR 1.284, 95% CI 1.052-1.567). Socioeconomic status also showed the same trend from 1998 to 2008. In 1998, women with high socioeconomic status had more than three times the odds of delivering by cesarean section (OR 3.344, 95% CI 2.398-4.664) versus women with low socioeconomic status. By 2008 that differential had decreased to only twice the odds (OR 2.156, 95% CI 1.677-2.771), a 35.5% decrease in odds.

For pregnancy related characteristics, whether a woman received prenatal care was associated with cesarean section in 1998 and 2003, but not in 2008. In 1998 women who reported that they received prenatal care during their pregnancy were more than twice as likely to deliver by cesarean section (OR 2.313, 95% CI 1.575-3.398) than women who did not receive any prenatal care. In 2003 the odds of cesarean section delivery among women

receiving prenatal care increased slightly (OR 2.590, 95% CI 1.636-4.102): an increase of 12.0%. Location of prenatal care was significant and fairly stable across all three survey years. In 1998, women receiving their prenatal care in private facilities had almost 3 times the odds of delivering by cesarean section (OR 2.808, 95% CI 1.895-4.160) versus women receiving prenatal care in MSPAS[1] facility. By 2008, that number had decreased 19.9%, with women receiving prenatal care in private facilities having slightly over twice the odds of delivering by cesarean section (OR 2.248, 95% CI 1.608-3.141). Trimester of a woman's first prenatal care visit was also significantly associated with cesarean section delivery. The earlier in pregnancy the first prenatal visit occurred the higher the odds of delivering by cesarean section. In 1998, women having their first prenatal care visit during their first trimester had twice the odds of delivering by cesarean section (OR 2.097, 95% CI .801-5.489) versus women having their first prenatal care visit during their third trimester. Similarly in 2008, women having their first prenatal care visit in their first trimester had three times the odds of delivering by cesarean section (OR 3.021, 95% CI 1.258-7.256) versus women having their first prenatal care visit in their third trimester: an increase of 44.1%. Women having a greater number of prenatal care visits also had higher odds of delivering by cesarean section. In 1998, women having a total of seven to nine prenatal care visits and 10 to 20 prenatal care visits had 1.8 (OR 1.861, 95% CI 1.221-2.837) and 4.2 (OR 4.211, 95% CI 1.876-9.452) times the odds of delivering by cesarean section respectively. In 2008,

[1] The Salvadoran health system is composed of two sectors, the public and the private. The main entities of the public sector are the Ministry of Public Health and Social Assistance (MSPAS) and the Salvadoran Social Security Institute (ISSS). Formally the MSPAS covers 80% of the population, but in reality it only provides services to about 40% of the population. About 40% of the population lives in extreme poverty and has no access to ongoing medical care. ISSS provides medical services to workers and families of the formal economy, about 13.6% of the population. Private sector hospitals and clinics are concentrated in the larger cities and are often for-profit institutions that sell services to the ISSS. Private not-for-profit hospitals are usually located the rural countryside. The private sector provides services to about 4.6% of the population.

women having seven to nine prenatal care visits and 10 to 20 prenatal care visits had 2.3 (OR 2.361, 95% CI 1.473-3.786) and 3.6 (OR 3.586, 95% CI 1.998-6.436) times the odds of delivering by cesarean section respectively. Women delivering in private facilities had over twice the odds of delivering by cesarean section (OR 2.290, 95% CI 1.282-4.098) versus women delivering in either MSPAS or ISSS facilities in 1998. In 2008, the odds again were about double (OR 2.074, 95% CI 1.292-3.328) in a private facility versus MSPAS or ISSS for delivering by cesarean section.

Women having low socioeconomic status and living in rural areas had the lowest incidence of cesarean section deliveries. In 1998, the cesarean section rate among this population was 8.2% (95% CI 6.8%-10.0%); in 2003, it was 12.4% (95% CI 10.1%-15.2%); and in 2008, it was 17.3% (95% CI 14.7%-20.3%). This represents an increase in the cesarean section rate of 111.0% over the 10-year period. At the same time, women of high socioeconomic status living in urban areas and delivering in private facilities had cesarean section rates of 47.5% (95% CI 29.9%-65.6%) in 1998; 26.8% (95% CI 14.7%-43.9%) in 2003; and 50.4% (95% CI 37.4%-63.3%) in 2008. This represents an increase in cesarean section rate of only 6.1%.

VI. Discussion

The burgeoning rate of cesarean section deliveries is a major public health problem now recognized worldwide. Well documented in most developed countries, the phenomenon is now solidly ensconced in middle income countries as well. This study confirms that the problem also affects El Salvador where, by WHO recommendations, the cesarean section delivery rate has risen to an unacceptably high level. It is unclear exactly what factors are responsible for this; it is likely multifactorial with clinical, institutional, legal, psychological, socioeconomic, and demographic factors all playing a role.[6] The Reproductive Health Survey data-sets used in these analyses fail to encompass all possible factors. However, we do examine temporal changes in socioeconomic, demographic and available clinical characteristics in an attempt to understand the factors driving the cesarean section delivery rate increase in El Salvador. It is important to understand the driving factors behind the rate increase because of its significant adverse effects on both maternal and infant health as well as its cost implications for an already fragmented and inadequate health care delivery system.

The WHO recommended upper limit for cesarean section delivery rate remains at 15% despite the fact that this rate is exceeded in over 50% of countries worldwide.[3] This recommended maximum rate continues to be supported by current and ongoing research that documents cesarean section rates above 15% are associated with increased morbidity and mortality in mothers and infants but are not associated with better perinatal outcomes.[18, 19] This study found that El Salvador's 2008 overall cesarean section rate of 24.9% was well above the WHO maximum recommended rate of 15%. Although there were various sub-populations within El Salvador in which the cesarean section rate was within the WHO

recommended guidelines in earlier years (8.2% and 12.4% for women with low socioeconomic status living in rural areas in 1998 and 2003 respectively), the rate now exceeds 17% even within this aforementioned subpopulation for a rate increase of over 110%. As the cesarean section rate acts as a proxy indicator for essential reproductive health services, with the above numbers it appears that Salvadoran women do have adequate access to essential obstetric services even among identified sub-populations.

At the other end of the spectrum and more concerning is the cesarean section rate overall and that of certain other sub-populations. The overall rate is 25%, well above WHO recommendations, and among women with high socioeconomic status, living in urban areas, and giving birth in private institutions the cesarean section rate is over 50%. While this is an alarming rate, the percentage of women receiving care and delivering in private institutions is less than 5%. Additionally, this cesarean section delivery rate of 50% has remained fairly stable from 1998 to 2008, showing an increase of only 6.0% (47.5% in 1998; 50.4% in 2008). However, even though this high rate affects relatively few women, the maternal and infant adverse events associated with cesarean deliveries cannot be ignored. Such women are ten times more likely to be admitted to an intensive care unit and up to six times more likely to die than women who deliver vaginally.[6, 19, 20]

We did not find maternal age on its own to be a significant factor associated with cesarean section delivery in this study. We find this rather puzzling because in the literature, age is often cited as a risk factor associated with cesarean section delivery. However, in at least one other study in the international literature it was found that the correlation between cesarean section delivery and age was not significant.[6]

Area of residence (urban vs. rural), education level, employment status and socioeconomic status all were found to be positively associated with cesarean section delivery. Naturally, medical facilities capable of accommodating cesarean surgeries are more prevalent in urban areas. Educational and employment opportunities are also more prevalent in urban areas. Women with higher educational attainment are more likely to be employed at higher paying jobs and have higher socioeconomic status resulting in better ability to afford cesarean section delivery. As El Salvador's economic development progresses, it may experience even greater increase in the cesarean section rate.

Pregnancy and birth-related characteristics remain fairly stable across survey years, thus not providing a plausible explanation for the increase in cesarean section rates. The one characteristic that changed substantially from 1998 to 2008 is institution of birth. In 1998 over 35% of births occurred in the home while just over 60% occurred in either public or private medical facilities. By 2008, the number of home births had decreased to just 10.8%, representing a 70.3% decrease in home births. Meanwhile, births occurring in medical facilities (both public and private) had increased to 88.5%, an increase of 41.8%. From 1998 to 2008 births occurring in private facilities remained stable at about 3% of total births. Could this shift from home births to medical facility births explain the increase in the cesarean section birth rate? Tables 7 and 8 illustrate how much the shift from home births to medical facility births explains the increase in cesarean section delivery rates. More births are occurring in medical facilities where it is possible to accommodate cesarean section deliveries. This shift from home births to medical facility births accounts for two-thirds of the change in cesarean section rates and appears to be the main drive behind the increase in cesarean section birth rates in El Salvador.

In an effort to further understand other potential factors influencing the increase in cesarean section birth rates we also designed a conceptual model including the variables age, area, socioeconomic status, education, number of children, religion and their effect, if any, on cesarean birth rates. We noted some interesting relationships:

- within area, rural area was associated with a greater number of children and fewer cesarean section births
- low socioeconomic status (SES) was associated with greater number of children and fewer cesarean section births
- urban residence was strongly associated with higher SES and increased number of cesarean section births
- age alone was not statistically significant but became significant when model was adjusted for area and education

We suspected confounding among the above variables but were unable to assess the specific relationships that could help us understand the increasing cesarean birth rate.

There are many strengths to this cross-sectional research study. Perhaps most notably is its large sample size. The unweighted sample size of households selected to participate in the Reproductive Health Survey was, on average, 20,000 households at each of the three survey time points. Additionally, the response rate (the number of eligible women who completed questionnaires) was above 90% to 95% at each time point. Another strength is the sampling scheme. The sampling features that enhanced the studies representativeness of the Salvadoran population include stratification, multistage sampling, cluster sampling, random selection of both households and of the designated woman within the household and finally,

the weighting factors applied during the analysis stage to adjust for the unequal probability of being selected.

The survey questionnaires were verbally administered by a limited number of extensively trained teams of interviewers. Other team members included a nurse or nutritionist, data entry personnel, a driver and a supervisor. Because data entry occurred in the field, discrepancies were identified and then clarified with interviewees and subsequently corrected in the database. All of these features contributed to the completeness and quality of the data.

An attempt was made during the interviews to provide privacy and confidentiality to encourage honesty and forthrightness of responses. Anonymity was an important feature. Another strength of the study was the opportunity to gather data from the same population at three different time points, thus revealing a cross sectional view as well as changes occurring over time.

There are also some limitations to this study. A fundamental difficulty is the fact that the survey was written, conducted and subsequently reported on in Spanish. This required translation of the questionnaire into English and meanings or nuances of the local Spanish dialect may have been slightly distorted. It may also have impeded the understanding of vital information in reports such as sampling scheme. Another limitation is that the information obtained in the survey was by retrospective maternal self-report and therefore subject to the woman's understanding and recall of her medical condition as well as to reporting bias. While having an interviewer verbally administer the questionnaire to the women was a strength in many ways, it may also have resulted in some degree of social desirability in the women's responses. There was no corroborating data from birth institutions that could

confirm relevant clinical details such as reason for cesarean delivery and other medical information. There also was not a question in the survey asking if the women had a history of previous cesarean section delivery. Not having this piece of information limited our analyses by having no way to distinguish primary cesarean sections from repeat procedures. Another limitation is that data were obtained only on deliveries occurring within a two-year period prior to each survey. Thus data from deliveries occurring outside of this two-year window were not captured. This may have resulted in over-representation of younger women of child-bearing age. Finally, survey modules and response choices changed somewhat between the three survey years making it difficult to compare results across years for some variables.

To better understand the factors influencing cesarean section rate increases an important goal for future research is to collect relevant, prospective clinical indicators at the hospital and even the individual level. This could serve to substantiate and validate data collected by self-report and household surveys. Reporting details of births, stillbirths, maternal morbidity and mortality and various types of obstetric care that is provided would be valuable. Further research is also needed in low and lower-middle income countries to determine if the reasons for increases in cesarean delivery rates are similar to those in more developed countries. To help stem the progression of cesarean delivery rates in the future, studies in Europe and the United States suggest an effective strategy is to provide feedback on a hospital's cesarean delivery rate relative to other hospitals serving a similar patient population.[9]

In conclusion, using nationally representative, population based Reproductive Health Survey data we evaluated rates, trends and determinants of cesarean section deliveries between 1998 and 2008 in El Salvador. There are multiple demographic, pregnancy and birth related characteristics that were associated with the increase of cesarean section deliveries

but the main determinant appears to be the shift from home births to institutional births. Although the rate of cesarean section births has increased over time, the rate of increase has been slower and the increase itself is lower than in many neighboring Latin American countries. Brazil, Chile and Paraguay all have cesarean section rates in the 30% to 45% range. It would be beneficial if lower-middle income countries such as El Salvador could learn from the experience of more developed countries with respect to cesarean section delivery rates.

Table 1: Sample Size Summary (unweighted)

	1998	2003	2008
Total number of households selected	20,760	18,450	21,595
Number of households with a woman age 15-49	13,425	11,723	13,329
Number of eligible women who completed questionnaires	12,634 94.1%	10,689 91.0%	12,008 90.0%
Number of women who completed questionnaires with a history of a previous completed pregnancy	9,682 76.6%	8,076 75.5%	9,182 76.5%
Number of women who completed questionnaire who had a previous live birth	9,615 76.1%	8,019 75.0%	9,085 75.6%
Number of women who completed a questionnaire who had a previous live birth in previous 5 years	5,991 47.4%	4,496 42.1%	4,434 36.9%
Number of women who completed a questionnaire who had a previous live birth in previous 2 years	4,101 32.5%	3,134 29.3%	3,397 28.3%
Number of women who completed a questionnaire and had a birth within the past 2 years who delivered by CS for their last birth	525 4.2%	604 5.7%	804 6.7%

Table 2. Cesarean deliveries by department (weighted)

Department	1998		2003		2008		p-value
Ahuachapan	30	11.3%	34	17.3%	54	21.1%	<.001
Santa Ana	64	16.0%	58	19.7%	87	23.1%	
Sonsonate	30	9.5%	57	16.1%	82	24.6%	
Chalatenango	17	10.2%	21	15.6%	28	20.8%	
La Libertad	33	8.8%	48	13.7%	93	18.7%	
San Salvador	332	24.8%	351	32.4%	278	30.9%	
Cuscatlan	13	7.8%	25	15.3%	38	25.8%	
La Paz	26	9.0%	37	13.9%	72	31.0%	
Cabanas	9	7.1%	19	15.8%	30	24.0%	
San Vicente	12	9.9%	24	16.4%	30	30.9%	
Usulutan	37	13.8%	47	27.4%	54	19.0%[2]	
San Miguel	84	19.5%	51	24.0%	75	22.2%[2]	
Morazan	16	11.6%	18	17.0%	32	24.6%	
La Union	24	12.0%	35	23.6%	49	28.9%	
Total	735	15.7%	829	22.0%	1007	24.9%	

[2] We were unable to explain the decrease in cesarean section birth rate from 2003 to 2008 in Usulutan and San Miguel.

Table 3. Self-reported reproductive history of all women who completed a questionnaire (weighted)

	1998		2003		2008		p-value χ^2 test
Sample size of women who completed a questionnaire	18,054		15,139		17,051		
Total number of completed pregnancies[3]	42,100		34,475		35,741		<.001
Mean (SE)	2.33 (.035)		2.27 (.043)		2.10 (.029)		
Number of pregnancies resulting in:							
Live birth, currently living	37,039	87.9%	29,726	86.2%	31,444	87.9%	<.001
Live birth, subsequently died	2,476	5.9%	2,286	6.6%	1,722	4.8%	.230
Stillbirth	542	1.3%	508	1.5%	543	1.5%	.710
Miscarriage	2043	4.8%	1,955	5.7%	2,032	5.7%	.700
Total number of women who had a live birth	12,504		10,448		11,822		<.001
Total number of women who had a live birth in the previous 2 years	4,823		3,907		4,185		<.001
Total number of women who had a cesarean delivery in their last live birth	735		829		1007		

[3] Completed pregnancy includes stillbirths (born dead after the 6th month of pregnancy), miscarriages (born dead before the 6th month of pregnancy), and live births.

Table 4. Self-reported demographic characteristics of women with a live birth in the previous 2 years (weighted)

	1998		2003		2008		
Demographic Characteristic	Number	% of total	Number	% of total	Number	% of total	p-value (χ^2 test)
Area							.527
Urban	2,235	45.6%	1,962	49.5%	2,068	48.4%	
Rural	2,667	54.4%	2,003	50.5%	2,202	51.6%	
Age							.004
15-19	784	16.0%	604	15.3%	613	14.4%	
20-24	1,577	32.2%	1,242	31.3%	1,154	27.0%	
25-29	1,222	24.9%	972	24.5%	1,090	25.5%	
30-34	703	14.4%	596	15.1%	775	18.2%	
35-39	406	8.3%	327	8.3%	408	9.6%	
40-44	178	3.6%	195	4.9%	181	4.2%	
45-49	29	0.6%	27	0.6%	47	1.1%	
Religion							<.001
Catholic	2,536	51.8%	1,957	49.4%	1,898	44.4%	
Protestant	1,075	22.0%	1,070	27.0%	1,469	34.4%	
Not religious	1,285	26.2%	920	23.2%	902	21.2%	
Other	---	---	17	0.4%	1	0.0%	
Maternal Education							<.001
No education	915	18.7%	538	13.6%	390	9.1%	
1-3 years	996	20.3%	663	16.7%	632	14.9%	
4-6 years	1,131	23.1%	918	23.2%	944	22.1%	
7-9 years	917	18.7%	916	23.1%	1,047	24.5%	
10 or more years	942	19.2%	928	23.4%	1,256	29.4%	
Employment Status							.027
Not employed	3,697	75.4%	2,910	73.4%	2,984	77.2%	
Working inside the home	290	5.9%	275	7.0%	296	6.9%	
Working outside home	914	18.7%	780	19.6%	989	23.2%	
Marital Status							<.001
Married	3,889	79.3%	3,220	81.2%	3,300	77.2%	
Separated/Divorced/Widow	714	14.6%	400	10.1%	630	14.8%	
Single	298	6.1%	344	8.7%	340	8.0%	
Socioeconomic Status							<.001
Low	2,714	55.4%	1,756	44.3%	995	23.3%	
Medium	1,447	29.5%	1,334	33.6%	1,998	46.8%	
High	740	15.1%	875	22.1%	1,276	29.9%	

Table 5. Self-reported pregnancy and birth characteristics of last live birth in the previous two years (weighted)

	1998		2003		2008		p-value (χ^2 test)
Any prenatal care							
Yes	3,721	78.3%	3,363	87.7%	3,868	95.0%	<.001
No	1,032	21.7%	471	12.3%	202	5.0%	
Total prenatal care visits[4]							
1-3 visits	523	14.1%	310	9.2%	218	5.8%	<.001
4-6 visits	1,732	46.6%	1,432	42.6%	1,486	39.5%	
7-9 visits	1,356	36.5%	1,481	44.1%	1,874	49.8%	
10-20 visits	88	2.4%	137	4.1%	185	4.9%	
> 20 visits	20	0.6%	2	0.1%	---	---	
Trimester of first prenatal care visit[5]							
1st trimester	2,689	72.3%	2,501	74.4%	3,104	80.3%	<.001
2nd trimester	918	24.7%	799	23.8%	672	17.4%	
3rd trimester	103	2.8%	62	1.9%	53	1.4%	
Institution at which prenatal care was received							
MSPAS	2,706	72.7%	2,438	72.5%	2,786	72.0%	.485
ISSS	603	16.2%	634	18.9%	716	18.5%	
Private	347	9.3%	240	7.2%	306	7.9%	
Other	63	1.7%	49	1.5%	53	1.4%	
Tetanus vaccination received during pregnancy							
Yes	4,211	93.0%	---[6]	---	3,625	89.1%	<.001
No	316	7.0%	---	---	444	10.9%	
Institution of birth							
MSPAS	2,216	46.6%	2,224	58.0%	2,699	66.3%	<.001
ISSS	608	12.8%	518	13.5%	775	19.0%	
Private	143	3.0%	138	3.6%	123	3.0%	
Home	1,736	36.5%	951	24.9%	439	10.8%	
Other	48	1.0%	---	---	30	0.8%	

[4] Total prenatal care visits for those women reporting they received prenatal care.

[5] Trimester of first prenatal care visit of those women reporting they received prenatal care.

[6] Information about tetanus vaccinations given during pregnancy was not collected in 2003 survey.

Table 5 continued

	1998		2003		2008		p-value
Gestational age							
# of weeks premature	568	12.7%	612	16.0%	697	17.2%	<.001
Mean (weeks)	3.9		3.7		3.3		.045
Standard Deviation	2.61		2.92		2.32		
Minimum (weeks)	1		0		0		
Maximum (weeks)	16		16		12		
Term	3,912	87.3%	2,987	78.0%	3,070	75.5%	
More than 9 months	---	---	230	6.0%	298	7.3%	
Type of delivery for most recent birth in past 2 years							
Vaginal	3,955	84.3%	2,943	78.0%	3,035	75.1%	<.001
Cesarean	735	15.7%	829	22.0%	1007	24.9%	
Emergent vs planned CS							
Emergent CS	406	8.7%	542	14.4%	649	16.1%	.009
Planned CS	329	7.0%	286	7.6%	357	8.8%	
Reason for cesarean delivery[7]							
Severe bleeding	25	3.8%	13	1.7%	5	0.5%	<.001
Abnormal position	241	36.2%	238	30.9%	202	20.1%	
Long labor	56	8.5%	137	17.8%	103	10.3%	
Delayed birth	32	4.9%	27	3.5%	35	3.5%	
Previous birth problems	39	5.9%	14	1.8%	---	---	
Previous cesarean birth	211	31.7%	204	26.6%	260	25.8%	
Cephalopelvic disprop	---	---	76	9.9%	99	9.9%	
Pre-eclampsia/eclampsia	43	6.5%	35	4.6%	52	5.2%	
Fetal suffering	---	---	---	---	204	20.3%	
Personal preference	---	---	---	---	---	---	
Other	16	2.5%	24	3.2%	44	4.4%	
Number of previous live births							
0	78	1.6%	58	1.5%	86	2.0%	.004
1	1425	29.1%	1351	34.1%	1604	37.6%	
2	1293	26.4%	1038	26.2%	1141	26.7%	
3	839	17.1%	605	15.3%	661	15.5%	
4	500	10.2%	349	8.8%	292	6.9%	
5	267	5.4%	183	4.6%	198	4.7%	
6 or more	500	10.2%	382	9.5%	289	6.6%	

[7] As with all information, the reason for cesarean delivery was by maternal report; there was no corroborating medical information.

Table 6. Self-reported demographic, socioeconomic, pregnancy and birth characteristics comparing women who delivered by cesarean section with women who delivered vaginally for their last live birth in the two years preceding the respective survey (weighted)

	1998			2003			2008		
Characteristic	Vaginal	C-Section	OR & 95% CI	Vaginal	C-Section	OR & 95% CI	Vaginal	C-Section	OR & 95% CI
Area									
Urban	1,658	453 21.5%		1,296	542		1,380	559 28.8%	
Rural	2,297	283 11.0%	.451 (.348, .585)	1,647	287	.416 (.295, .588)	1,656	448 21.3%	.669 (.556, .806)
Age									
15-24	1,942	347 15.2%		1,404	365 20.6%		1,303	402 23.6%	
25-34	1,533	305 16.6%	1.112 (.860, 1.439)	1,148	354 23.6%	1.184 (.919, 1.524)	1,307	467 26.3%	1.157 (.951, 1.408)
35-49	480	84 14.9%	.979 (.676, 1.420)	390	111 22.2%	1.089 (.703, 1.689)	426	138 24.5%	1.052 (.804, 1.376)
Religion									
Catholic	2,055	370 15.3%		1,464	417 22.2%		1,330	471 26.2%	
Protestant	843	175 17.2%	1.155 (.881, .512)	758	242 24.2%	1.123 (.822, 1.535)	1,009	368 26.7%	1.031 (.839, 1.267)
No Religion	1,054	188 15.1%	.993 (.744, 1.326)	707	168 19.2%	.835 (.544, 1.280)	697	168 19.4%	.681 (.533, .871)
Education									
No education	798	78 8.9%		454	67 12.9%		312	54 14.7%	
1-3 years	876	95 9.8%	1.108 (.659, 1.864)	544	86 13.6%	1.071 (.596, 1.924)	501	101 16.8%	1.175 (.756, 1.825)
4-6 years	949	143 13.1%	1.548 (.961, 2.492)	739	151 17.0%	1.379 (.783, 2.428)	706	190 21.2%	1.563 (1.040, 2.349)
7-9 years	711	161 18.5%	2.332 (1.479, 3.676)	632	235 27.1%	2.518 (1.281, 4.952)	751	243 24.4%	1.881 (1.265, 2.795)
10 or more years	621	259 29.4%	4.286 (2.783, 6.602)	575	291 33.6%	3.426 (1.978, 5.935)	765	420 35.4%	3.191 (2.166, 4.703)
Employment Status									
Not Employed	3,081	499 36.4%		222	555 20.0%		2,182	670 23.5%	
Employed	874	237 21.3%	1.671 (1.284, 2.174)	721	274 27.5%	1.522 (1.101, 2.104)	852	336 28.3%	1.284 (1.052, 1.567)
Marital Status									
Married	3,104	601 16.2%		2,366	670 22.1%		2,373	741 23.8%	
Separated, divorced widowed	607	85 12.3%	.720 (.479, 1.081)	312	83 21.0%	.935 (.602, 1.452)	448	156 25.8%	1.112 (.840, 1.472)
Single	244	50 17.0%	1.069 (.656, 1.742)	266	76 22.2%	1.010 (.528, 1.934)	214	111 34.2%	1.660 (1.152, 2.394)
Socioeconomic Status									
Low	2,360	253 9.7%		1,454	241 14.2%		789	166 17.4%	
Medium	1,092	300 21.6%	2.559 (1.928, 3.398)	987	299 23.3%	1.827 (1.312, 2.543)	1,435	472 24.8%	1.563 (1.247, 1.959)
High	503	181 26.5%	3.344 (2.395, 4.669)	502	289 36.5%	3.470 (2.457, 4.899)	812	369 31.2%	2.156 (1.676, 2.773)
Any prenatal care?									
Yes	2,998	646 17.7%		2,508	778 23.7%		2,855	973 25.4%	
No	934	87 8.5%	.432 (.294, .636)	417	50 10.7%	.386 (.244, .610)	163	33 16.8%	.598 (.342, 1.045)

	Vaginal	C-Section	OR & 95% CI	Vaginal	C-Section	OR & 95% CI	Vaginal	C-Section	OR & 95% CI
Institution of prenatal care									
MSPAS	2,270	378 14.3%		1,872	496 20.9%		2,125	636 23.0%	
ISSS	442	152 25.6%	2.066 (1.492, 2.861)	435	196 31.1%	1.705 (1.213, 2.396)	516	192 27.1%	1.242 (.980, 1.575)
Private	229	107 31.8%	2.808 (1.902, 4.144)	165	73 30.7%	1.669 (1.039, 2.681)	179	121 40.3%	2.248 (1.608, 3.142)
Other	56	7 11.1%	.789 (.191, 3.260)	37	13 26.0%	1.310 (.494, 3.472)	30	23 43.4%	2.584 (1.241, 5.383)
Trimester at first prenatal care visit									
1st trimester	2,117	504 19.2%		1,805	632 25.9%		2,251	818 26.7%	
2nd trimester	781	129 14.2%	.696 (.521, .929)	646	140 17.8%	.619 (.439, .875)	528	139 20.8%	.724 (.551, .952)
3rd trimester	92	10 9.8%	.477 (.182, 1.247)	57	6 9.4%	.294 (.107, .809)	47	6 11.3%	.331 (.138, .796)
Total number of pre-natal care visits									
1-3 visits	449	62 12.1%		274	33 10.7%		186	29 13.5%	
4-6 visits	1,427	279 16.4%	1.409 (.966, 2.056)	1,107	281 20.2%	2.130 (1.244, 3.647)	1,127	345 33.7%	1.980 (1.231, 3.182)
7-9 visits	1,051	271 15.9%	1.861 (1.219, 2.842)	1,049	405 27.9%	3.238 (1.943, 5.396)	1,361	496 26.7%	2.361, (1.473, 3.785)
10-20 visits	54	31 36.5%	4.211 (1.872, 9.472)	77	58 43.0%	6.346 (2.421, 16.633	117	65 35.7%	3.586 (2.003, 6.421)
> 20 visits	17	2 10.5%	1.035 (.217, 4.933)	1	1 100%	10.109 (.856, 19.328)	---	---	---
Institution of birth									
MSPAS	1,665	516 23.7%		1,538	634 29.2%	Data not available	1949	724 27.1%	
ISSS	448	151 25.2%	1.089 (.804, 1.474)	350	167 32.3%		549	216 28.2%	1.061 (.843, 1.336)
Private	79	56 41.5%	2.290 (1.278, 4.103)	112	26 18.8%		69	53 43.4%	2.074 (1.292, 3.327)
Home	1,698	4 0.2%	.008 (.002, .036)	925	---		433	---	---
Other	48	5 10.4%	.409 (.120, 1.394)	---	---		16	12 42.9%	1.967 (.842, 4.594)

Table 7. 1998 proportion of births within institutions and cesarean section rate

Institution of birth	Proportion of births occurring within institution	Cesarean section rate within institution
MSPAS	0.466	23.7%
ISSS	0.128	25.2%
Private	0.030	41.5%
Home	0.365	0.2%
Other	0.010	10.4%
Overall cesarean section birth rate in 1998 = 15.7%		

Table 8. 2008 proportion of births within institutions

Institution of birth	Proportion of births occurring within institution
MSPAS	0.663
ISSS	0.190
Private	0.030
Home	0.108
Other	0.008
Overall cesarean section birth rate in 2008 = 24.9%	

If the only change from 1998 to 2008 was the change in where births occurred, then we would expect the cesarean birth rate in 2008 to be the sum of the (2008 proportion of births within institution times the 1998 cesarean section rate within institution):

0.663 X 23.7 = 15.7
0.190 X 25.2 = 4.8
0.030 X 41.5 = 1.2
0.108 X 0.2 = .02
0.008 X 10.4 = .08
sum = **21.8**

Actual change in overall cesarean birth rate from 1998 to 2008:
24.9 – 15.7 = **9.2**

Hypothetical change if only change from 1998 to 2008 was change in where birth occurred:
21.8 – 15.7 = **6.1**

Hypothetical change (6.1) divided by actual change (9.2) equals 6.1 ÷ 9.2 = **66.3%** of the change in cesarean section birth rate from 1998 to 2008 can be accounted for by the change in location of births from home births (in 1998) to predominantly institutional births in (2008).

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