Cesarean Section Deliveries

In Paraguay:

A comparison of trends between 1995 and 2008

Jiasong Yuen

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington
2012

Committee:

Donna Denno
Ian Painter

Program Authorized to Offer Degree:

School of Public Health

University of Washington

Abstract

Cesarean Section Deliveries In Paraguay: A comparison of trends between 1995 and 2008

Jiasong Yuen

Chair of the Supervisory Committee:

Donna M. Denno
Associate Professor, Pediatrics, Joint Global Health, Adjunct Health Services

Background: Cesarean section (CS) can be a life saving intervention and is an important component of Emergency Obstetric and Newborn Care. However, unnecessary CS represents a resource drain on health care systems and is associated with increased maternal and neonatal morbidity and mortality.

Objective: To identify maternal factors associated with an increase in cesarean section (CS) rates from 16.7% in 1995 to 35.6% in 2008 in Paraguay.

Study Design: Retrospective analysis of 1995 and 2008 Paraguay Demographic and Sexual and Reproductive Health Survey data.

Main outcome measures: The change in CS rates between 1995 and 2008.

Results: The proportion of CS births is higher in 2008 (35.6%, 95% CI 32.9-38.4%) than in 1995 (16.7%, 95%CI 14.9-18.6%). The home birth rate in 2008 decreased by 72.9%. This decrease accounted for approximately 33.3% of the change in CS rate. Despite an only slight increase in the proportion of women delivering in private facilities in 1995 (16.7%, 95%CI 14.7-18.9%) compared to 2008 (20.6%, 95%CI 18.0-23.3%), there was a 53.8% increase in delivery by CS in public facilities, and a 71% increase in private institutions from 1995 to 2008. This higher rate of increase in private institution CS delivery accounted for approximately 32.8% of the change in CS rate between 1995 and 2008. Of the women who had a live birth in the 5 years preceding the survey, 72.6% and 86.3% of those who had a previous CS delivery ended up having a repeat CS delivery in 1995 and 2008, respectively. Other important factors that were associated with CS delivery included living in Asuncion and in urban areas more generally, higher socioeconomic and education levels, increasing frequency of prenatal care visits, pre-term delivery and having health insurance.

Conclusion:

A change in where births occurred was a contributor to the increase in CS rates, but did not account for all of the change, as CS rates increased regardless of institution of birth. The combination of overall increasing CS rates regardless of institution, a shift away from home births and from public to private institutions (which in general have higher CS rates) means that the observed overall rates increased more than the within institution rates.

Efforts to increase skilled birth attendance at deliveries must be balanced by informed, patient-centered delivery decision-making. Expectant mothers and health care providers in Paraguay need to be better informed about the risks and benefits of both vaginal and CS delivery. This could help dispel misconceptions that CS delivery is a superior standard of care, especially among the wealthy. Community-based education approaches that allow women to exchange

reproductive health information with family and friends have been shown to be particularly effective. Nurse-led relaxation classes, birth preparation classes, and implementing guidelines with mandatory second opinion can lead to a small reduction in CS rates. Seeking local opinion leaders' endorsement of VBAC guidelines may increase the proportion of women with previous CS being offered TOL in appropriate settings. Policy makers must attempt to regulate and prevent unnecessary procedures in the short term, but also look to address any underlying issues in the healthcare system that encourage institutions and professionals to misuse and overuse CS procedures for institutional and personal financial gains, especially in private institutions.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

I am grateful to Donna Denno and Ian Painter, faculty members at the University of Washington School of Public Health. Donna's maternal and child health experience and practical knowledge helped to guide the research process. Her sharp, critical mind pushed me to think deeply and challenged me to go beyond what I thought was possible. Ian's expertise in biostatistics was indispensible for this research. I am forever indebted to Ian for his kindness, patience and the countless number of hours he has helped me with the analysis.

Thank you also to Linta Abraham, my fellow classmate, who had the courage to initiate research on these datasets and generously provided a lot of background information.

I wish to acknowledge Mark Oberle from the University of Washington; Paul Stupp and Howard Goldberg from the CDC; Mercedes Melian, survey director at CEPEP. Mary Lou Shefsky and Karen Hays answered important questions along the way. Also a special thank you to Peter Speyer from IHME who made the datasets available to us ahead of their official release to the IHME repository, and Michelle Darbous at IHME who set up the access to the datasets for us.

A special thank you also to Roberta Deboard who helped me translate parts of the survey final reports from Spanish to English.

Last but not least, I could not have undertaken this research without the support and encouragement of my family, Frank James, my husband, and Taiming YuenJames, my son, thank you for your unyielding love, support, and understanding.

Introduction

Cesarean section, or surgical delivery of a baby, is recommended when vaginal delivery might pose a risk to the mother or baby. A cesarean section, or C-section (CS), may be planned in advance if the baby is in a breech or transverse position, there are multiple gestations, an unusually large fetus, the mother has an active infection such as with HIV, or potentially if the mother has had a previous CS (1). Vaginal birth after cesarean (VBAC) refers to the birthing of a baby vaginally after a previous CS. Once believed to be high-risk, there is now emerging evidence that VBAC is a safe and reasonable choice for the majority of women with prior cesarean and that repeated cesareans may in fact be harmful (2). An emergency (unplanned) CS may be indicated when a complication arises for the mother or baby during labor such as a failure for labor to progress, fetal distress or umbilical cord prolapse (1).

CS is sometimes performed for reasons other than medical necessity. Planned "elective cesarean" due to "maternal request" or physician preference is such an example. Pregnant women may desire a planned CS over vaginal delivery for reasons including knowing the exact time when the baby will be born, avoiding perceived possible complications and risks to baby, avoiding post-term pregnancy, obstetrician availability, and minimization of injury to pelvic floor tissues. Physicians may prefer to deliver by CS because of financial incentive and better control over scheduling. While CS can be a life-saving procedure, it is not without risks which include higher rates of abdominal or pelvic organ injury, infection of the incision or the uterus, hemorrhage, maternal blot clots in the legs or lungs, complications from anesthesia, and uterine rupture in future pregnancies (1). A review of 79 studies comparing outcomes of elective CS deliveries with vaginal deliveries, including both observational studies and randomized trials, suggests that CS may have substantially greater risks of maternal mortality, hysterectomy, ureteral tract and vesical injury, abdominal pain, neonatal respiratory morbidity, fetal death, as

well as placenta previa and uterine rupture in future pregnancies, compared to vaginal deliveries (3). Unnecessary CS not only poses medical risks but also is costlier than natural births and consumes scarce resources, especially in resource-constrained countries.

CS birth rates have been rising rapidly worldwide. UNICEF, WHO, and UNFPA guidelines indicate that, as a general rule, a minimum of 5% prevalence of deliveries are likely to require a CS in order to preserve the life and health of mother or infant. Rates below 5% indicate poor access to Emergency Obstetric and Newborn Care, whereas rates higher than 15% likely indicate inappropriate use of the procedure (4, 5). In 2002, the proportion of cesarean births was 21.1% in developed countries, whereas in least developed countries only 2% of deliveries were by CS (6). The U.S. cesarean delivery rate has increased for 12 consecutive years, and has risen 48% since 1996, rising to 32.9% in 2009 (7). The 2004 – 2008 World Health Organization (WHO) global survey on maternal and perinatal health examined data from 286,565 deliveries in 24 countries in Asia, Africa and Latin America, and found 25.7% of all deliveries were done by CS, ranging from 2.3% in Angolan health facilities to 46.2% in Chinese facilities (8). It concluded that CS prevalence increased in these settings and is associated with an intrinsic risk of increased short-term severe maternal outcomes such as death, admission to ICU, blood transfusion and hysterectomy (8).

For the 2005 WHO global survey on maternal and perinatal health, 24 geographic regions in eight Latin American countries were studied to see how cesarean delivery rates affect pregnancy outcomes. Rate of cesarean delivery was positively associated with postpartum antibiotic treatment and severe maternal morbidity and mortality, even after adjustment for risk factors (9). Increase in the rate of cesarean delivery was associated with an increase in fetal mortality rates and higher numbers of babies admitted to intensive care for 7 days or longer even after adjustment for preterm delivery (9). This is contrary to many women's belief in Latin

America, such as in Brazil, where CS rates were 50% in 2012, up from 37% in 1996 (6, 10) and fear of substandard care underlies many poor women's preferences for a CS (11). There has been a steady increase in the number of cesarean deliveries in many developing countries, especially in Latin America and Asia (8). Paraguay reported 33% of deliveries by CS in 2008, a significant increase from 15.3% in 1995 (12, 13).

It is important to understand the factors driving the rapid increase in CS rates, especially in Latin America where the rates have been rising at alarming levels. The objective of this study is to investigate and identify maternal factors associated with an increase in CS rates from 16.7% to 35.6% over a 13-year time frame in Paraguay using data from national surveys of women of reproductive age conducted in 1995 and 2008.

I. Materials and Methods

Study Design: We analyzed data collected in the 1995 and 2008 National Survey of Demography and Reproductive and Sexual Health by the Paraguayan Center of Population Studies (CEPEP), with the cooperation of the United States Agency of International Development (USAID), the United Nations Children's Fund (UNICEF), and the International Planned Parenthood Federation (IPPF), and with the technical assistance of the Division of Reproductive Health of the Centers for Disease Control and Prevention (CDC) (12, 13). The objective of these surveys is to maintain periodic evaluation of maternal and child health topics principal programmatic indicators (12). We examined data from the 1995 and 2008 surveys, as they are the most recent two with the full sets of survey data collected at the national level. Analysis was of secondary data without identifying information. The University of Washington Institutional Review Board approved a human subjects exemption.

Study Population: Both surveys were conducted in the Eastern Region of the country, and excluded the Western region (Chaco) due to its low density and widely dispersed population. About 98% of the population in Paraguay is concentrated in the Eastern Region (Figure 1). Women of childbearing age between ages 15-49 years were randomly selected from randomly selected households to participate in the survey in 1995. The same sampling strategy was applied to women between 15-44 years in 2008. We analyzed data from the subset of women who reported having ever had a live birth. Survey questions were examined a priori for variables that could plausibly be related to CS delivery including demographic, prenatal and birth history characteristics that were asked in both surveys. The variables that we found to be significantly associated with CS delivery in both 1995 and 2008 were further analyzed to determine if changes in these variables are associated with the increase in CS rates in 2008 in Paraguay.

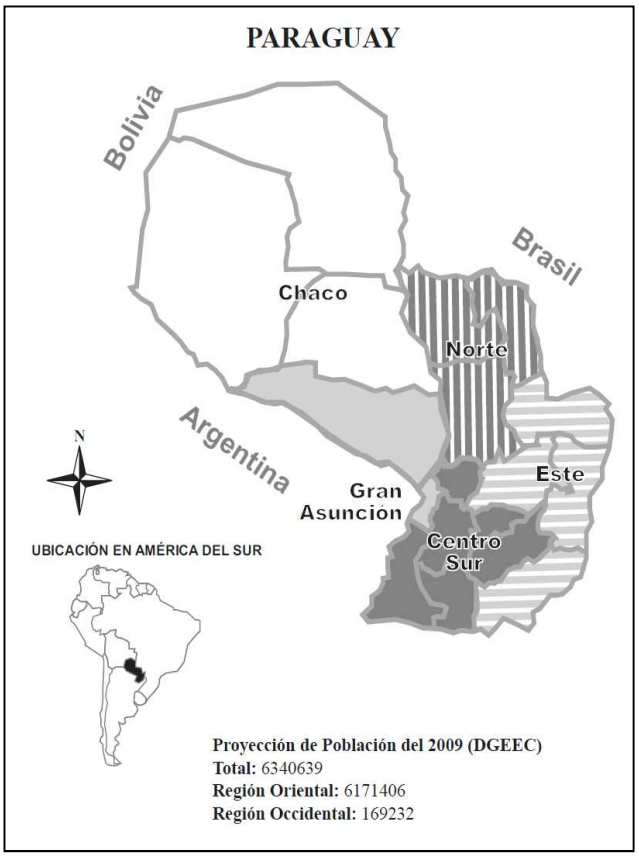

Figure 1: Map of Paraguay adopted from CEPEP's National survey on demographic and sexual & reproductive health 2008 report.

Sample Design: The sampling design included a three-stage probability sample selection self-weighted at the level of four regions of Eastern Paraguay (Figure 1):

Metropolitan Asuncion

North

South Central, excluding districts that are part of Metropolitan Asuncion

East

This design allowed estimates to be representative at the national level, urban and rural areas and the four regions (12, 13).

Data Collection Methods:

Both surveys used a master sampling frame from the CEPEP. There were 348 clusters of households in the sample. The fieldwork took place between September 1995 and January 1996 (13) and from February to April, 2008 (12).

Data Analysis:

The data were collected using stratification by region and cluster sampling within region. We analyzed the data using the complex samples module for SPSS to appropriately weight observations and take into account correlations caused by clustering. Sampling schemes as described in CEPEP's 2008 Final Report (12) were used. As the age structure of mothers within the population changed from 1995 to 2008 and because age is a known risk factor for CS, age was adjusted for in the final regression models.

We used the complex samples module for SPSS to calculate frequencies for the demographic, pregnancy and birth characteristics of interest and conducted Chi-Square Tests (complex samples crosstabs test of independence of rows and columns) to compare data from the two years. We only analyzed demographic characteristics data for women who had a previous live birth because this was the subset of women for whom further information regarding type of delivery was obtained. The weighted sample size for this subset was 5,980 women in 1995 and 5,027 women in 2008. For pregnancy and birth characteristics, we only analyzed data for women who had a live birth in the previous 5 years, as they were the only ones who were asked these questions. This yielded 4,055 and 3,053 women in 1995 and 2008, respectively. We only included data related to the most recent delivery if the respondent had more than one live birth in the last 5 years. We performed cross tabs analysis for each of the variables of interest to calculate

relative risk (RR) of CS (versus vaginal delivery) for both survey years, as well as change in RR from 1995 to 2009. We excluded those with a previous CS delivery from this analysis.

Because of large differences in CS rates between public and private facilities, we sought to further examine the association between type of birth facility and CS rate using multivariate logistic regression. We excluded those with a previous CS delivery, home births and births at other unidentified facilities. The model was built adjusting for age (because the age structure changed between 1995 and 2008, and age is a known risk factor for CS. Age weights were available for the 2008 dataset but not for the 1995 dataset, and so could not be used to normalize the age structure), and included institution of birth, year and an interaction term between institution of birth and year.

We next examined the association between insurance status and type of birth facility by running a cross tabs analysis. Percentages of having insurance were calculated for those who delivered in private institutions versus public institutions.

II. Results

Table 1 presents the unweighted sample size summary for both survey years. Table 2 presents a summary of the pregnancy history of all survey participants for both survey years. Among women who had a live birth in the five years preceding the individual survey years, the CS rates were 16.7% (95% CI 14.9-18.6%) in 1995 and 35.6% (95% CI 32.9-38.4%) in 2008, representing a more than two-fold increase between survey years.

Demographic characteristics are presented in Table 3, prenatal and delivery variables are presented in Table 4. Prevalence rates of demographic, prenatal and delivery variables examined significantly changed between 1995 and 2008 except for region of residence, urban/rural status and spousal employment.

Of the women who had a live birth in the 5 years preceding the survey, 72.6% and 86.3% of those who had a previous CS delivery ended up having a repeat CS delivery in 1995 and 2008, respectively. Therefore, we excluded those births that were preceded by a previous CS delivery in the rest of the analysis because it is such a strong predictor of CS birth.

Characteristics associated with CS delivery are presented in Table 5. Demographic factors associated with the biggest risk of CS in both 1995 and 2008 included region of residence and urban/rural status, language, employment status, SES, and maternal education. CS rate for those living in Gran Asuncion was three times the rate of the region North in 1995 (RR 3.23, 95% CI 2.33-4.35), and two times the rate of North in 2008 (RR 2.17, 95% CI 1.75-2.63). Those living in urban areas had a CS rate that is almost 3 times the rate of rural residents in 1995 (RR 2.63, 95% CI 2.13-3.23), and one and a half times the rate of rural residents in 2008 (RR 1.59, 95% CI 1.33-1.89). Guarani-only speaking women had a CS rate that is 72% lower than the rate of Spanish-only speaking women in 1995 (RR 0.28, 95% CI 0.22-0.36), and 67% lower than the rate of Spanish-only speaking women in 2008 (RR 0.33, 95% CI 0.27-0.40). Those employed

had a CS rate that is 1.4 times the rate of those not employed in 1995 (RR 1.43, 95% CI 1.19-1.69), and 1.56 times the rate of those not employed in 2008 (RR 1.56, 95% CI 1.37-1.79). Those with a high SES had a CS rate that is over 4 times the rate of those with low SES in 1995 (RR 4.67, 95% CI 3.65-5.95) and over 3 times the rate of those with low SES in 2008 (RR 3.68, 95% CI 2.92-4.63). Those with 6 years of secondary education or more had a CS rate that is over 5 times the rate of those with 0-2 years of primary education in 1995 (RR 5.13, 95% CI 3.41-7.75), and over 2 times the rate of those with 0-2 years of primary education in 2008 (RR 2.48, 95% CI 1.64-3.73) (Table 5).

Increasing maternal age, especially for those older than 35 years, was associated with CS delivery (RR 1.35, 95% CI 1.11-1.64 and RR 1.37, 95% CI 1.18-1.57) comparing women $\geq$ 35 years to those under 35 years in 1995 and 2008, respectively. Those reporting having received 10-20 prenatal care visits had a CS rate over 4.5 times (RR 4.59, 95% CI 3.27-6.41 and RR 5.00, 95% CI 2.57-9.71) those who received 1-3 visits in 1995 and 2008, respectively. Those who received prenatal care in private facilities were over 2 times (RR 2.88, 95% CI 2.42-3.44 and RR 2.31, 95% CI 2.06-2.59) more likely to deliver by CS in 1995 and 2008, respectively. Those who did not receive tetanus vaccine during pregnancy had a 78% lower CS rate in 1995 (RR 0.22, 95% CI 0.12-0.42), but only 29% lower CS rate in 2008 (RR 0.71, 95% CI 0.48-1.05). Those with IPS insurance had a CS rate that is over 2 times those without insurance[1] (RR 2.38, 95% CI 1.96-2.86) in 1995 and 1.67 times (RR 1.67, 95% CI 1.41-1.96) in 2008. Furthermore, in 2008, those with any insurance had a CS rate that is over 2 times those without insurance (RR 2.08, 95% CI 1.85-2.38), and those with private insurance had a CS rate that is 2.78 times those

[1] The "not insured" category for 1995 is technically "not insured by IPS" since that was the question asked. We are making the assumption that private insurance coverage was non-existent among respondents in 1995, since private insurance was not introduced to any extent until 2006. However this number may include some respondents who were covered by police/military insurance but the proportion is likely to be very small.

without insurance (data not shown; RR 2.78, 95% CI 2.44-3.18). Those who delivered in private facilities had a CS rate 1.94 times (RR 1.94, 95% CI 1.64-2.30) and 2.16 times (RR 2.16, 95% CI 1.92-2.43) of those who delivered in public facilities in 1995 and 2008 respectively. Those who gave birth to premature babies had up to a three times CS rate than those with term pregnancies (RR 3.16, 95% CI 2.57-3.91 and RR 1.90, 95% CI 1.63-2.21) in 1995 and 2008, respectively. Primiparous women had more than a three times CS rate than those with a previous live birth (RR 3.70, 95% CI 2.78-4.76 and RR 3.77, 95% CI 2.70-5.26) in 1995 and 2008, respectively (Table 5).

Despite the increase in CS birth rate from 1995 to 2008, the magnitude of association with CS birth decreased for most of the demographic, prenatal and delivery variables over the two time periods (Table 5). Exceptions included rates among women residing in rural locations or in the North, South Central and East regions. The relative risk also increased for women with 4-20 prenatal care visits, and especially for those who did not receive tetanus vaccination during pregnancy (Table 5).

Table 1: Sample size summary (unweighted)

	1995 survey	2008 survey
Total number of households selected	9,462	12,208
Number of household questionnaires completed	9,339 (98.7%)	12,013 (98.4%)
Number of eligible women surveyed	6,751 (aged 15-49 y.o.)	6,877 (aged 15-44 y.o.)
Number of eligible women who completed individual questionnaires	6,465 (95.8%)	6,540 (95.1%)
Number of women who completed individual questionnaires with a history of a previous completed pregnancy[2]	4,978 (77.0%)	4,237 (64.8%)
Number of women who completed individual questionnaires who had a previous live birth	4,894 (75.7%)	4,155 (63.5%)
Number of women who completed individual questionnaires who had a previous live birth in the previous 5 years	3,463 (53.6%)	2,607 (39.9%)

[2] Completed pregnancy includes stillbirth, miscarriage and live birth.

Table 2: Self-reported pregnancy history of all survey participants, comparing 1995 and 2008 responses (weighted)

	1995	2008	p-value (χ^2 test)
Weighted sample size of women who completed individual questionnaires	8,729	8,946	
Total number of completed pregnancies[3]	23,843	14,776	<0.001
Mean (SD)	4.0 (6.5)	3.0 (4.6)	
Median (IQR)	3 (1.5-5)	2 (1-3.5)	
Range	1-18	1-14	
Number of pregnancies resulting in:			
Live birth, currently living	20,541 86.2%	13,062 88.4%	<0.001
Live birth, subsequently died	1,209 5.1%	423 2.9%	<0.001
Stillbirth	469 1.9%	214 1.4%	<0.001
Miscarriage	1,624 6.8%	1,077 7.3%	0.022
Total number of women who had a live birth	5,980	5,027	<0.001
Total number of women who had a live birth in the previous 5 years	4,055	3,053	<0.001
Number who had a CS delivery in last live birth	781 19.3%	1,094 35.8%	

Number (%) reported unless otherwise noted.

[3] Completed pregnancy includes stillbirth, miscarriage and live birth.

Table 3: Self-reported demographic characteristics of women with a live birth history, comparing 1995 and 2008 responses (weighted)

	1995		2008		
Demographic Characteristic	**Number**	**% of total**	**Number**	**% of total**	**p-value (χ^2 test)**
Region					0.616
Gran Asuncion	1,610	26.9%	1,558	31.0%	
North	822	13.8%	545	10.8%	
South Central	1,616	27.0%	1,352	26.9%	
East	1,932	32.3%	1,572	31.3%	
Area					0.072
Urban	3,057	51.1%	2,987	59.4%	
Rural	2,923	48.9%	2,040	40.6%	
Language					0.001
Spanish	1,173	19.6%	1,326	26.4%	
Guarani	2,666	44.6%	1,559	31.0%	
Spanish & Guarani	1,875	31.4%	1,923	38.3%	
Other	266	4.4%	219	4.4%	
Marital Status					<0.001
Married	3,551	59.4%	2,295	45.6%	
Living together, not married	1,458	24.4%	1,806	35.9%	
Widowed/Separated/Divorced	253	4.3%	240	4.7%	
Single	718	12.0%	686	13.7%	
Employment Status					<0.001
Not employed	3,403	56.9%	2,528	50.3%	
Work inside home	1,175	19.7%	532	10.6%	
Work outside home	1,402	23.4%	1,967	39.1%	
Spousal Employment Status					0.804
Yes	4,870	97.2%	4,003	97.6%	
No	114	2.3%	98	2.4%	
Don't know/no response	25	0.5%			

Table 3 continued

SES[4]					<0.001
Low	2,194	36.7%	928	18.5%	
Medium	1,820	30.4%	1,749	34.8%	
High	1,966	32.9%	2,350	46.8%	
Maternal education					<0.001
Primary 0-2 yrs	678	11.3%	218	4.3%	
Primary 3-5 yrs	1,865	31.2%	746	14.8%	
Primary 6 yrs/ completed	1,679	28.1%	1,470	29.2%	
Secondary <6 yrs	953	15.9%	1,055	21.0%	
Secondary 6 yrs/ completed	805	13.5%	1,539	30.6%	
Spousal education					<0.001
Primary 0-2 yrs	462	9.2%	140	3.4%	
Primary 3-5 yrs	1,276	25.5%	500	12.2%	
Primary 6 yrs/ completed	1,411	28.2%	1,034	25.2%	
Secondary <6 yrs	959	19.2%	854	20.8%	
Secondary 6 yrs/ completed	813	16.2%	1464	35.7%	
Don't know/No Response	85	1.7%	109	2.7%	
Age (years)					<0.001
15-19	265	4.4%	210	4.2%	
20-24	865	14.5%	737	14.7%	
25-29	1,153	19.3%	1,073	21.3%	
30-34	1,169	19.6%	1,037	20.6%	
35-39	1,037	17.3%	999	19.9%	
40-44	827	13.8%	971	19.3%	
45-49	664	11.1%			

[4] SES was assessed as low, medium or high and was based on type of dwelling, type of utilities, and asset ownership

Table 4: Self-reported pregnancy and birth characteristics of last live birth in the previous 5 years, comparing 1995 and 2008 (weighted)

	1995		2008		
Pregnancy & birth characteristics	**Number**	**% of total**	**Number**	**% of total**	**p-value (χ^2 test)**
Prenatal care					
Yes	3,675	90.6%	2,983	97.7%	<0.001
Number of prenatal visits					<0.001
1-3	754	20.5%	144	4.8%	
4-9	2,146	58.4%	1,484	49.7%	
10-20	659	17.9%	1,272	42.7%	
>20	115	3.2%	81	2.7%	
Months gestation at first prenatal visit					<0.001
<=3	2,528	68.8%	2461	82.5%	
4-6	994	27.1%	486	16.3%	
>=7	153	4.2%	36	1.2%	
Prenatal Care Location					<0.001
Public facility	2,975	81.0%	2,234	74.9%	
Private facility	700	19.0%	657	22.0%	
Other	0		92	3.1%	
Vaccinated against tetanus during pregnancy					<0.001
Yes	3,729	92.0%	2,920	95.7%	
No	310	7.6%	128	4.2%	
Don't know/no response	16	0.4%	5	0.2%	

Table 4 continued

Insurance status[5]					--
IPS[6]	485	11.9%	437	14.3%	
Private	--	--	259	8.5%	
Both IPS & Private	--	--	62	2.0%	
Police/Military	--	--	32	1.0%	
Not insured[7]	3,564	87.9%	2,259	74.0%	
Other	--	--	3	0.1%	
Don't know/no response	6	0.2%	1	0.0%	
Institution of Birth					<0.001
Public facility	1,872	46.2%	2,026	66.4%	
Private facility	678	16.7%	627	20.6%	
Home	1,364	33.6%	279	9.1%	
Other	141	3.5%	120	3.9%	
Type of birth attendant at institutions[8]					<0.001
Doctor	1,487	55.3%	1,709	64.4%	
Obstetrical Nurse[9]	1,045	38.8%	817	30.8%	
Nurse	121	4.5%	38	1.4%	
Nursing aid	2	0.1%	1	0.0%	
Other	15	0.6%			
Don't know	20	0.7%	89	3.4%	
Gestational Age[10]					<0.001
Term	3,809	93.9%	2,631	86.2%	
Premature	242	6.0%	350	11.5%	
More than 9 mos.	0		72	2.4%	
Don't know	4	0.1%			

[5] The 1995 survey only asked respondents about whether they had IPS insurance coverage. The 2008 survey asked whether the respondents had any type of insurance and included responses about IPS and other types of insurance coverage as well. No p-value is computed because the insurance status variable is not generally comparable between the two years.

[6] Instituto de Previsión Social (IPS) is a public social security insurance.

[7] The "not insured" category for 1995 is technically "not insured by IPS" since that was the question asked. We are making the assumption that private insurance coverage was non-existent among respondents in 1995, since private insurance was not introduced to any extent until 2006. However this number may include some respondents who were covered by police/military insurance but the proportion is likely to be very small.

[8] Type of birth attendant represents only those at institution births (excludes home births).

[9] Nurse with specific training in obstetrics.

[10] As with all data, gestational age is per maternal self-report. Responses were categorized into the given responses within the survey data.

Table 4 continued

Weight					<0.001
<=2.50 Kg	397	11.6%	334	11.2%	
2.51-3.99 Kg	2,250	65.7%	2,222	74.9%	
>3.99 Kg	780	22.8%	388	13.1%	
Don't know	45		22	0.7%	
No Response	1				
No Information	582		87		
Previous CS Delivery					<0.001
Yes	185	4.6%	163	5.6%	
No	3,869	95.4%	2,759	94.4%	
No Information			131		
Type of Delivery for last live birth					<0.001
Vaginal	3,273	80.7%	1,759	60.0%	
Cesarean	781	19.3%	1,094	37.3%	
No information			80	2.7%	
Number of Previous Live Births					<0.001
0	2,210	54.5%	2,284	74.8%	
1	1,212	29.9%	655	21.5%	
2	503	12.4%	112	3.7%	
3	130	3.2%	2	0.1%	

Table 5: Self-reported characteristics associated with Cesarean Delivery (excluding the births that were preceded by a previous CS delivery) in 1995 and 2008 (weighted)[11]

	1995			2008			
Demographic characteristic	**Vaginal**	**C Section**	**RR & 95% CI**	**Vaginal**	**C Section**	**RR & 95% CI**	**Change in RR**
Total	3,222	646 (16.7%)		1,727	955 (35.6%)		
Region							
Gran Asuncion	628	272 (30.2%)		463	351 (43.1%)		
North	526	55 (9.5%)	0.31 (0.23, 0.43)	263	66 (20.0%)	0.46 (0.38, 0.57)	+48.4%
South Central	911	140 (13.3%)	0.44 (0.34, 0.57)	502	261 (34.2%)	0.79 (0.66, 0.95)	+79.5%
East	1,157	179 (13.4%)	0.44 (0.34, 0.57)	499	277 (35.6%)	0.83 (0.67, 1.02)	+88.6%
Area							
Urban	1,368	452 (24.9%)		886	648 (42.2%)		
Rural	1,854	194 (9.5%)	0.38 (0.31, 0.47)	841	307 (26.7%)	0.63 (0.53, 0.75)	+65.8%
Language							
Spanish	516	201 (28.1%)		302	364 (54.6%)		
Guarani	1,745	149 (7.9%)	0.28 (0.22, 0.36)	755	167 (18.1%)	0.33 (0.27, 0.40)	+17.9%
Spanish & Guarani	841	261 (23.7%)	0.84 (0.69, 1.03)	639	399 (38.4%)	0.70 (0.61, 0.81)	-16.7%
Other	120	35 (22.8%)	0.81 (0.48, 1.39)	31	25 (44.9%)	0.82 (0.51, 1.32)	-1.2%
Marital Status							
Married	1,786	426 (19.2%)		574	495 (46.3%)		
Living together, not married	977	125 (11.4%)	0.59 (0.48, 0.73)	796	300 (27.3%)	0.59 (0.51, 0.68)	0%
Widowed/Separat-ed/Divorced	60	28 (32.1%)	1.67 (1.12, 2.49)	58	20 (25.9%)	0.56 (0.35, 0.90)	-66.5%
Single	399	67 (14.3%)	0.74 (0.55, 1.01)	299	140 (31.9%)	0.69 (0.55, 0.86)	-6.8%
Employment Status							
Employed	1,176	303 (20.5%)		687	543 (44.1%)		
Not employed	2,046	343 (14.4%)	0.70 (0.59, 0.84)	1,040	412 (28.4%)	0.64 (0.56, 0.73)	-8.6%
Spousal Employment Status							
Employed	2,696	541 (16.7%)		1,334	781 (36.9%)		
Not employed	50	9 (14.9%)	0.89 (0.43, 1.87)	36	13 (26.6%)	0.72 (0.43, 1.22)	-19.1%
Don't know/no response	17	1 (7.2%)					
SES							
Low	1,510	109 (6.7%)		521	90 (14.7%)		
Medium	974	199 (17.0%)	2.52 (1.95, 3.26)	696	263 (27.4%)	1.86 (1.44, 2.42)	-26.2%
High	738	338 (31.4%)	4.67 (3.65, 5.95)	510	602 (54.1%)	3.68 (2.92, 4.63)	-21.2%
Maternal education (years)							
Primary 0-2 yrs	385	35 (8.3%)		80	23 (22.2%)		
Primary 3-5 yrs	1,090	106 (8.9%)	1.08 (0.69, 1.66)	308	62 (16.8%)	0.75 (0.48, 1.19)	-30.6%
Primary 6 yrs/completed	965	147 (13.2%)	1.60 (1.03, 2.48)	581	203 (25.9%)	1.16 (0.76, 1.79)	-27.5%
Secondary <6 yrs	498	149 (23.0%)	2.78 (1.82, 4.27)	389	214 (35.5%)	1.59 (1.06, 2.41)	-42.8%
Secondary 6 yrs/ completed	284	209 (42.4%)	5.13 (3.41, 7.75)	369	453 (55.1%)	2.48 (1.64, 3.73)	-51.7%

[11] For the last live birth in the preceding 5 years.

Table 5 continued

Spousal education (years)							
Primary 0-2 yrs	290	21 (6.8%)		59	12 (17.4%)		
Primary 3-5 yrs	774	67 (8.0%)	1.17 (0.70, 1.96)	208	49 (19.1%)	1.09 (0.60, 1.99)	-6.8%
Primary 6 yrs/completed	811	119 (12.8%)	1.87 (1.11, 3.16)	402	128 (24.2%)	1.39 (0.77, 2.51)	-25.7%
Secondary <6 yrs	514	145 (22.0%)	3.23 (1.95, 5.32)	272	164 (37.6%)	2.16 (1.17, 3.97)	-33.1%
Secondary 6 yrs/ completed	311	192 (38.2%)	5.59 (3.44, 9.09)	378	429 (53.2%)	3.05 (1.71, 5.46)	-45.4%
Don't know/no response	60	7 (9.9%)		51	13 (20.3%)		
Age (years)							
< 35	2,392	430 (15.2%)		1,379	672 (32.8%)		
>= 35	833	216 (20.6%)	1.35 (1.11, 1.64)	348	282 (44.8%)	1.37 (1.18, 1.57)	+1.5%
Prenatal care							
Yes	2,860	633 (18.1%)		1,661	954 (36.5%)		
No	362	13 (3.5%)	0.19 (0.10, 0.39)	66	1 (1.9%)	0.05 (0.01, 0.36)	-73.7%
Number of prenatal visits							
1-3	678	51 (7.0%)		122	13 (9.8%)		
4-9	1,698	343 (16.8%)	2.40 (1.73, 3.32)	940	371 (28.3%)	2.90 (1.46, 5.78)	+20.8%
10-20	415	197 (32.3%)	4.59 (3.27, 6.41)	560	535 (48.8%)	5.00 (2.57, 9.71)	+8.9%
>20	69	42 (37.8%)	5.38 (3.46, 8.33)	38	35 (47.3%)	4.85 (2.29, 10.31)	-9.9%
Months gestation at first prenatal visit							
<=3	1,876	524 (21.8%)		1,272	879 (40.9%)		
4-6	847	99 (10.5%)	0.48 (0.38, 0.61)	361	72 (16.6%)	0.41 (0.31, 0.54)	-14.6%
>=7	137	10 (6.9%)	0.32 (0.16, 0.62)	28	3 (8.3%)	0.20 (0.05, 0.78)	-37.5%
Prenatal Care Location							
Public facility	2,458	380 (13.4%)		1,478	597 (28.8%)		
Private facility	402	253 (38.6%)	2.88 (2.42, 3.44)	176	349 (66.4%)	2.31 (2.06, 2.59)	
Other				7	8 (54.1%)	1.88 (1.04, 3.41)	-19.8%
Vaccinated against tetanus during pregnancy							
Yes	2,923	629 (17.7%)		1,644	925 (36.0%)		
No	289	12 (3.9%)	0.22 (0.12, 0.42)	83	28 (25.4%)	0.71 (0.48, 1.05)	+222.7%
Don't know/no response	10	5 (33.8%)		1	4 (80.0%)		
Insurance status[12]							
IPS[13]	297	152 (34.0%)		212	180 (46.0%)		
Private	--			48	163 (77.3%)	1.68 (1.42, 1.98)	
Both IPS & Private	--			10	40 (80.2%)	1.74 (1.39, 2.19)	
Police/Military	--			16	15 (48.4%)	1.04 (0.59, 1.85)	
Not insured[14]	2,921	492 (14.4%)	0.42 (0.35, 0.51)	1,442	554 (27.8%)	0.60 (0.51, 0.71)	+42.9%
Other	--				2 (100.0%)	--	
Don't know/no response	4	2 (27.4%)		1			

[12] The 1995 survey only asked respondents about whether they had IPS insurance coverage. The 2008 survey asked whether the respondents had any type of insurance and included responses about IPS and other types of insurance coverage as well.

[13] Instituto de Previsión Social (IPS) is a public social security insurance.

[14] The "not insured" category for 1995 is technically "not insured by IPS" since that was the question asked. We are making the assumption that private insurance coverage was non-existent among respondents in 1995, since private insurance was not introduced to any extent until 2006. However this number may include some respondents who were covered by police/military insurance but the proportion is likely to be very small.

Table 5 continued

Institution of Birth							
Public facility	1,391	364 (20.8%)		1,298	612 (32.0%)		
Private facility	379	257 (40.4%)	1.94 (1.64, 2.30)	153	343 (69.1%)	2.16 (1.92, 2.43)	+11.3%
Home	1,352	0		276	0		
Other	100	25 (20.1%)	0.97 (0.61, 1.55)				
Type of birth attendant at institutions[15]							
Doctor	750	591 (44.1%)		623	936 (60.0%)		
Obstetrical Nurse[16]	973	48 (4.7%)	0.11 (0.08, 0.15)	782	18 (2.2%)	0.04 (0.02, 0.06)	-63.6%
Nurse	116	3 (2.8%)	0.06 (0.02, 0.20)	38			
Nursing aid	1	1 (53.5%)	1.21 (0.33, 4.41)	1			
Other	15						
Don't know/No info	15	3 (17.4%)		8	1 (11.1%)		
Gestational Age[17]							
Term	3,104	544 (14.9%)		1,615	775 (32.4%)		
Premature	114	102 (47.3%)	3.16 (2.57, 3.91)	112	180 (61.5%)	1.90 (1.63, 2.21)	-39.9%
Don't know	4						
Weight							
2.51-3.99 Kg	1,684	441 (20.7%)		1,221	719 (37.1%)		
<=2.50 Kg	303	69 (18.5%)	0.89 (0.67, 1.18)	183	105 (36.3%)	0.98 (0.80, 1.20)	+10.1%
>3.99 Kg	634	120 (15.9%)	0.77 (0.61, 0.96)	225	126 (35.8%)	0.97 (0.81, 1.16)	+26.0%
Don't know	34	11 (24.5%)		18	3 (14.3%)		
No response	1						
No Information	566	5		80	2		
Number of Previous Live Births							
0	1,660	549 (24.9%)		1,226	897 (42.2%)		
1	991	72 (6.8%)	0.27 (0.21, 0.36)	422	53 (11.2%)	0.27 (0.19, 0.37)	0%
2	459	17 (3.6%)	0.14 (0.08, 0.26)	77	5 (5.9%)	0.14 (0.06, 0.34)	0%
3	113	7 (6.2%)	0.25 (0.12, 0.50)	2	0		

[15] Type of birth attendant represents only those at institution births (excludes home births).

[16] Nurse with specific training in obstetrics.

[17] Gestational age is per maternal self-report. Responses were categorized into the given responses within the survey data.

The prevalence of home births decreased from 33.6% (95% CI 30.6%-36.7%) in 1995 to 9.1% (95% CI 7.3%-11.3%) in 2008 (Table 4). In order to examine the impact of this trend on CS rates, we further calculated the amount this decline in home births contributed to the increase in CS rates (Appendix A). Assuming the only variable that changed was home birth, if home birth rate were the same as the 2008 rate (9.1%) and assuming all home births to be by vaginal delivery, then the CS rate in 1995 would have been 23.9% assuming the same public:private facility ratio of deliveries as for non-home deliveries and facility-type specific CS rates in 1995. In a second scenario assuming all home births in 1995 were delivered at public facilities and applying the public facilities CS rate, the CS rate would have been 22.1%. We calculated the contribution of the decline in home births and found that it accounted for 33.3% of the increase in the CS rate.

In order to determine how much of the overall increase in CS rates related to increased CS rates at private facilities is driven by insurance status, we examined the relationship between CS, institution of delivery and insurance coverage. CS deliveries were more common for those with IPS insurance in 1995 (RR 2.38, 95% CI 1.96-2.86) and 2008 (RR 1.67, 95% CI 1.41-1.96). Furthermore, in 2008, those with any insurance had a CS rate that is over 2 times those without insurance (RR 2.08, 95% CI 1.85-2.38), and those with private insurance had a CS rate that is 2.78 times those without insurance (data not shown; RR 2.78, 95% CI 2.44-3.18). Among those with IPS insurance coverage, the percentage who delivered at public institutions increased by 18.1% from 1995 to 2008, whereas the percentage who delivered at private institutions decreased by 43.2%. Among those with no insurance, the percentage that delivered in public institutions increased by 12% whereas the percentage who delivered in private institutions decreased by 34.2% (Table 6). While having IPS insurance was not associated with delivering in private institutions over public institutions in 1995 (data not shown; RR 1.14, 95% CI 0.9-1.44), those

with private insurance in the 2008 survey were four times as likely to have delivered in a private facility (data not shown; RR 4.28, 95% CI 3.47-5.29).

Results from the multivariate logistic regression model controlling for age, and including institution of birth, year and an interaction term between institution of birth and year show that the odds of having a CS in a public institution in 2008 was 1.9 times (OR 1.9, 95% CI 1.54, 2.35) the odds of having a CS in a public institution in 1995, whereas the odds of having a CS in a private institution in 2008 was 3.43 times (OR 3.43, 95% CI 2.46, 4.78) the odds of having a CS in a private institution in 1995.

CS deliveries were more common in private compared to public facilities in 1995 (RR 2.88, 95% CI 2.42-3.44) and 2008 (RR 2.31, 95% CI 2.06-2.59). CS deliveries in private facilities increased by 71% (CI) compared to 53.8% (CI) in public institutions (Table 5). Assuming the only factor that changed were the proportion of public to private institution births, if the public facility birth rate were the same as the 2008 rate (66.4%) and private facility birth rate were the same as the 2008 rate (20.6%), then the CS rate in 1995 would have been 22.9%.

Although there was a 36.1% increase in doctors performing CS deliveries in institutions between the two survey years (Table 5), there are very few countries where health providers with less training than doctors are allowed to do CS. Therefore, doctors as a type of skilled birth attendant (SBA) is expected to be associated with CS and further analyses were not performed.

Table 6: Insurance status and institution of birth in 1995 and 2008 (weighted)[18]

Year	Insurance Status	Public Institution	Private Institution
1995	IPS	274 (70.4%)	115 (29.6%)
	Not insured[19]	1,479 (74.0%)	520 (26.0%)
2008	IPS	327 (83.2%)	66 (16.8%)
	Private	58 (26.9%)	156 (73.1%)
	Both IPS & Private	15 (28.3%)	39 (71.7%)
	Police/Military	24 (78.4%)	7 (21.6%)
	Not insured	1,484 (82.9%)	305 (17.1%)

[18] Home births and births at other sites were excluded from this analysis.

[19] The "not insured" category for 1995 is technically "not insured by IPS" since that was the question asked. We are making the assumption that private insurance coverage was non-existent among respondents in 1995, since private insurance was not introduced to any extent until 2006. However this number may include some respondents who were covered by police/military insurance but the proportion is likely to be very small.

III. Discussion

Our study has several limitations. First, we do not have data on the decisions related to the delivery. We do not know the extent to which the C-sections were medically indicated or were elective and for the latter how much maternal request vs. physician preference played a role. Secondly, we do not have data on the number of women who started with home birth and/or with a trial of vaginal delivery and were transferred to a hospital and/or subsequently delivered by CS because of medical necessity. Finally, all birth data was per maternal self-report, which is subject to recall and reporting bias. Despite these limitations, our study reveals important findings about factors related to cesarean delivery.

A change in where births occurred was an important contributor to the increase in CS rates. Even though CS rates increased regardless of institution of birth, the proportion of CS deliveries at private facilities increased more than at public facilities. The combination of overall increasing CS rates regardless of institution and a dramatic shift away from home births means that the observed overall rates increased more than the within institution rates.

Concern has been raised internationally over the increasing medicalization of childbirth, which includes cesarean section and other obstetric interventions (14). Our study showed that CS birth rate increased from 16.7% in 1995 to 35.6% in 2008 in Paraguay and represent the C-section rate for the most recent live birth in the five years preceding the individual survey years. CS rates in neighboring Latin American countries have also been on the rise. Brazil's CS rate increased from 36.7% in 1996 to 50% in 2012, Ecuador's rate increased from 19.9% in 1999 to 26% in 2010, El Salvador's rate increased from 16% in 1998 to 25% in 2010, Mexico's rate increased from 25.4% in 1997 to 43% in 2010, Uruguay's rate increased from 23.8% in 2000 to 34% in 2010, (6, 10).

We found that rates of home birth (which are primarily attended by traditional birth

attendants) between 1995 and 2008 fell from 33.6% to 9.1% and that this decline accounted for approximately one-third of the increase in CS rate during the same period under the assumption that other variables are held constant and that all home births are by vaginal delivery. Delivery assistance by SBAs is crucial to reducing maternal and neonatal mortality (Figure 4.2, (15)) and in order to meet the United Nations Millennium Development Goals (MDG) 4[20] and 5[21]. In fact skilled birth attendance is a target indicator for MDG5. Because the vast majority of home births in resource limited countries are not attended by SBAs and because of the human resource crisis contributing to a severe lack of sufficient numbers of SBAs, the focus on increasing skilled birth attendance has been on increasing the proportion of deliveries that occur in facilities. Our data demonstrate a concomitant and alarming increase in C-sections – above and beyond the rates of 5-15% that are expected in order to ensure safe access to necessary and life-saving emergency interventions. Efforts to move deliveries away from home-based should be accompanied by efforts to mitigate unnecessary and harmful delivery interventions, including and especially to ensure that surgical deliveries are appropriately utilized and not over-utilized.

Another finding was the rate of increase in CS birth was 1.3 fold higher in private facilities than in public facilities. Our calculations suggest that the higher rate of increase in private institution delivery accounted for approximately one-third of the change in CS rate between 1995 and 2008. Taljaard et al found that characteristics of institutions explained 48% of the variability among risk-adjusted CS rates in Latin America (16). These risk characteristics included private versus a public institution, having some financial incentive for CS versus no incentive, and having >= 50 maternity beds (16). Private institutions' median risk-adjusted CS rate was 46.5% compared to 29.1% for public institutions (OR=2.3, 95% CI 1.5-3.3), which is consistent with our finding of a 2-fold higher CS birth rate in private institutions for both years,

[20] MDG4: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.
[21] MDG5: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio.

and that a higher rate of increase in CS birth in private versus public institutions contributes to the increase in CS rates.

Taljaard et al also found that hospitals that provide some incentive for CS has significantly higher risk-adjusted CS rates (OR=1.84, 95% CI 1.29-2.61). The World Health Organization has pointed out that doctors creating CS demand for their own financial gain is contributing to the worldwide CS epidemic (15). This is supported by the findings by Parkhurst et al that the majority of women delivering in private facilities in Bangladesh did not prefer CS delivery, but were influenced by the physicians (17). Unnecessary CS procedures can increase women's mistrust of medical facilities, increase the chance of having higher medical expenses, and increase the chance of women having to break social taboos around childbirth (17). These factors can increase the delay in seeking care when problem arises, which place women at greater risk of adverse maternal and birth outcomes. It is plausible that there is more financial incentive in private hospitals in Paraguay, which might explain our finding of higher CS rates within private institutions.

Another study by Villar et al looked closely at CS delivery and pregnancy outcome at the institutional level in Latin America. The proportion of CS delivery was always higher in private hospitals (median rate 51%, 43-57) followed by hospitals belonging to the social-security system and public institutions (9). Higher CS delivery rates in private and social security institutions were mostly due to an increase in elective CS delivery. Cephalopelvic disproportion, dystocia or failure to progress were the most common indications for CS deliveries in all types of institutions. However, the second most common indication varied between public and private institutions: for public and social security institutions, it was fetal distress, whereas for private institutions, it was previous CS delivery without any complication in the current pregnancy (9). This is consistent with our finding that CS rates are higher in private institutions. A study by

Ronsmans that analyzed data from 42 developing countries from 1988 to 2002 found extremely low CS rates among the very poor: they were below 1% for the poorest 20% of the population in 20 countries (18). However, the difference between the rich and poor in developing countries where CS rates were 5% or more was much higher. Among the wealthiest 10% of women living in Brazil, 77% delivered by CS. A longstanding interventionist approach to vaginal births in Brazil that made them more painful and stressful than is necessary had given CS a reputation as being a safer, more predictable, painless and modern way to deliver (19). Private hospitals have capitalized on this fear and offer delivery "packages" like a weekend getaway in a birth-themed five-star hotel, complete with hairstyling, manicure, makeup sessions, and catering service (19). This further explains the preference for CS delivery among the rich in Brazil and is consistent with our findings from Paraguay, although to a lesser degree than what has been observed in Brazil. Notably, while CS rates overall were highest among urban, educated and wealthier women in both survey years, we found that the increases in CS rates were most profound among rural, poor, and less educated women.

Practice guidelines, regulation and oversight of facilities (including private institutions) to ensure safe use of interventions, as well as education and communication campaigns targeting women of different SES levels, and women's groups to advocate for safe delivery options are all strategies that could reduce over-utilization of CS. For example, Brazilian women's attitude towards CS is beginning to change. Women organized protest marches in 13 cities in response to a medical regulatory agency in Rio de Janeiro forbidding doctors from doing home births and doulas from helping out in hospitals in July 2012 (19). Brazil's federal government has allocated $3.36 billion over the last year and a half in a program called "The Stork Network," aimed at "humanizing" the birth experience and educating mothers and health care practitioners on the benefits of natural childbirth (19).

We found that although the percentage of women with IPS insurance only increased 2.4% between the 2 years, private insurance went from being non-existent in 1995 to 10.5% in 2008. This increasing presence of private insurance might explain our finding of increasing CS rates within private institutions. Paraguay has a national health care system that covers some 72% of the population. The Instituto de Prevision Social (IPS), which provides coverage for occupational illnesses, accidents and disability, covers 13% of the population, with the remaining 15% in the private sector (20). Insurance companies did not underwrite health insurance as of 2006, although there was a sizeable volume written by prepaid medicines companies. Therefore, those with no health insurance are not necessarily the poor, unlike in many other countries such as in the US. Among those with no insurance who may have opted to pay out-of-pocket, however, the percentage that delivered in public institutions increased, while the percentage that delivered in private institutions decreased. One possible explanation is that the number of public institutions has increased exponentially between the 2 survey years and private institutions have not kept up the pace of the public sector's growth. The quality of public institutions and the perception thereof has also improved, so those paying out-of-pocket would opt to deliver in a public hospital. The lower cost in public institutions would be another factor.

The risks of a VBAC include increased risk of uterine rupture and fetal death with uterine rupture. A study by Macones et al showed that uterine rupture, the most concerning complication of a VBAC, was as low as 0.7% to 0.98% in the US (21). A WHO systematic review showed that for developed countries, the prevalence of uterine rupture for women with previous CS is approximately 1% (22). Yet it is this small risk that draws much attention, while less information is shared with mothers about risks associated with surgical delivery, including complications with anesthesia, infection, blood loss, prolonged recovery time, hysterectomy, and placenta accreta (a condition in which the placenta grows into the uterus) in future pregnancies.

The WHO reviewed showed that for less and least developed countries, uterine rupture is a more prevalent and serious problem (22). However the data available lacks differentiation between uterine rupture with and without previous CS. Overall, most rates of uterine rupture range from 0.1% to 1%. Maternal mortality associated with uterine rupture ranged between 1% and 13%, and perinatal mortality between 74% and 92% (22). Efforts to reduce morbidity and mortality from uterine rupture should be focused on reducing primary CS rates and optimizing care for women with previous CS. As our analysis showed, 72.6% of the births that had a previous CS delivery ended up with a CS delivery in 1995, and 86.3% of the births with a previous CS delivery ended up with a CS delivery in 2008. Furthermore with CS rates highest among primips (42% in 2008 survey), CS rates are only bound to have increased with subsequent deliveries and will continue to do so if these trends continue. This indicates that VBAC is not the standard of care in Paraguay and that repeat CS is contributing to the increasing CS rate.

Community based participatory women's groups have been shown to reduce neonatal and maternal mortality in Nepal even when not accompanied by interventions targeting health care providers (23). This type of strategy can be applied to reduce CS rates as well. A systematic examination of factors influencing the recent increase in Cesarean rates in six developing countries in Latin America and South Asia analyzed data from over 20,000 births, and showed that women who exchange reproductive health information with friends and family are less likely to experience a Cesarean section than their counterparts (24). The study concludes that community-based approaches may help curb rising cesarean section rates in resource-poor settings.

Another systematic review showed that nurse-led relaxation classes and birth preparation classes may reduce CS rates in low-risk pregnancies (25). Implementing obstetrics guidelines with mandatory second opinion can lead to a small reduction in CS rates. Peer review,

including pre-CS consultation, mandatory second opinion, and post-CS monitoring can lead to a reduction in repeat CS rates. Finally seeking local opinion leaders' endorsement of VBAC guidelines may increase the proportion of women with previous CS being offered TOL in appropriate settings (25).

Under-five mortality rates have fallen from 54 per 1,000 live births in 1990 to 23 per 1,000 live births in 2010 in Latin America (26) and in Paraguay specifically the rates have fallen from 50 to 25 per 1,000 (10). While this has halved, it is not on track to meet the MDG4 of reducing by two thirds, between 1990 and 2015, the under-five mortality rate. Maternal mortality rates have decreased from 130 per 100,000 in 1990, to 96 per 100,000 in 2000, to 72 per 100,000 in 2010 in Latin America (26) and in Paraguay specifically the rates have fallen from 120 per 100,000 in 1990 to 99 per 100,000 in 2010 (27). This falls short of meeting MDG5, which is to reduce by three quarters, between 1990 and 2015, the maternal mortality ratio. The proportion of deliveries attended by SBA has increased from 75% in 1990, to 83% in 2000, to 92% in 2010 in Latin America (26) and in Paraguay specifically the proportion was 84.6% in 2008 (27). While the increased access to SBAs and institutional deliveries has definitely helped lower infant mortality and maternal mortality rates, it has also facilitated health care provider planned/recommended or maternal request CS. These changes together with other factors have directly or inadvertently contributed to the over-medicalization of childbirth and increasing CS rates.

IV. Conclusion

A change in where births occurred was a contributor to the increase in CS rates, but did not account for all of the change, as CS rates increased regardless of institution of birth. The combination of overall increasing CS rates regardless of institution, a shift away from home births and from public to private institutions (which in general have higher CS rates) means that the observed overall rates increased more than the within institution rates.

Efforts to increase skilled birth attendance at deliveries must be balanced by informed, patient-centered delivery decision-making. Expectant mothers and health care providers in Paraguay need to be better informed about the risks and benefits of both vaginal and CS delivery. This could help dispel misconceptions that CS delivery is a superior standard of care, especially among the wealthy. Community-based education approaches that allow women to exchange reproductive health information with family and friends have been shown to be particularly effective. Nurse-led relaxation classes, birth preparation classes, and implementing guidelines with mandatory second opinion can lead to a small reduction in CS rates. Seeking local opinion leaders' endorsement of VBAC guidelines may increase the proportion of women with previous CS being offered TOL in appropriate settings. Policy makers must attempt to regulate and prevent unnecessary procedures in the short term, but also look to address any underlying issues in the healthcare system that encourage institutions and professionals to misuse and overuse CS procedures for institutional and personal financial gains, especially in private institutions.

Bibliography

1. Williams. Williams Obstetrics, Twenty-Third Edition. Chapter 25-26. 2010.
2. NIH. NIH Consensus Development Conference Statement on Vaginal Birth After Cesarean: New Insights. Volume 27, Number 3. March 8-10, 2010. 2010.
3. Belizan JM, Althabe F, Cafferata ML. Health consequences of the increasing caesarean section rates. Epidemiology. 2007 Jul;18(4):485-6.
4. AbouZahr C, Wardlaw T. Maternal mortality at the end of a decade: signs of progress? Bull World Health Organ. 2001;79(6):561-8.
5. WHO. Appropriate technology for birth. Lancet. 1985 Aug 24;2(8452):436-7.
6. Betran AP, Merialdi M, Lauer JA, Bing-Shun W, Thomas J, Van Look P, et al. Rates of caesarean section: analysis of global, regional and national estimates. Paediatr Perinat Epidemiol. 2007 Mar;21(2):98-113.
7. CDC. Births: Final Data for 2009. National Vital Statistics Reports Volume 60, number 1. November 2011. 2011.
8. Souza JP, Gulmezoglu A, Lumbiganon P, Laopaiboon M, Carroli G, Fawole B, et al. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. BMC Med. 2010;8:71.
9. Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet. 2006 Jun 3;367(9525):1819-29.
10. UNICEF. Website: Info by country - Statistics. http://www.unicef.org/infobycountry/latinamerica.html . Nov 4, 2012.
11. Behague DP, Victora CG, Barros FC. Consumer demand for caesarean sections in Brazil: informed decision making, patient choice, or social inequality? A population based birth cohort study linking ethnographic and epidemiological methods. BMJ. 2002 Apr 20;324(7343):942-5.
12. CEPEP. Paraguayan population center for population studies. 2008 Survey Report. National survey on demographic and sexual & reproductive health. October, 2009. 2008.
13. CEPEP. Paraguayan population center for population studies. 1995-1996 Survey Report. National survey on demographic and sexual & reproductive health. October, 1997. 1995.
14. Johanson R, Newburn M, Macfarlane A. Has the medicalisation of childbirth gone too far? BMJ. 2002 Apr 13;324(7342):892-5.
15. WHO. The World Health Report 2005: Make every mother and child count. 2005.
16. Taljaard M, Donner A, Villar J, Wojdyla D, Faundes A, Zavaleta N, et al. Understanding the factors associated with differences in caesarean section rates at hospital level: the case of Latin America. Paediatr Perinat Epidemiol. 2009 Nov;23(6):574-81.
17. Parkhurst JO, Rahman SA. Life saving or money wasting? Perceptions of caesarean sections among users of services in rural Bangladesh. Health Policy. 2007 Mar;80(3):392-401.
18. Ronsmans C, Holtz S, Stanton C. Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. Lancet. 2006 Oct 28;368(9546):1516-23.
19. Barbassa J. Brazilian women rebel against cesarean births. Associated Press Healthy Newborn Network August 12, 2012.
20. Paraguay Info. Healthcare in Paraguay. http://www.alloexpat.com/paraguay_expat_forum/healthcare-in-paraguay-paraguay-hospital-guide-t3044.html . Dec 04, 2006. .

21. Macones GA, Peipert J, Nelson DB, Odibo A, Stevens EJ, Stamilio DM, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. Am J Obstet Gynecol. 2005 Nov;193(5):1656-62.
22. WHO. WHO systematic review of maternal mortality and morbidity: the prevalence of uterine rupture. BJOG: an International Journal of Obstetrics and Gynaecology. 2005;September 2005, Vol. 112, pp. 1221–1228.
23. Manandhar DS OD, Shrestha BP, Mesko N, Morrison J, Tumbahangphe KM, Tamang S, Thapa S, Shrestha D, Thapa B, Shrestha JR, Wade A, Borghi J, Standing H, Manandhar M, Costello AM; Members of the MIRA Makwanpur trial team. Effect of a participatory intervention with women's groups on birth outcomes in Nepal: cluster-randomised controlled trial. Lancet. 2004;Sep 11-17;364(9438):970-9.
24. Leone T, Padmadas SS, Matthews Z. Community factors affecting rising caesarean section rates in developing countries: an analysis of six countries. Soc Sci Med. 2008 Oct;67(8):1236-46.
25. Khunpradit S TE, Lumbiganon P, Laopaiboon M, Wasiak J, Gruen RL. Non-clinical interventions for reducing unnecessary caesarean section. The WHO Reproductive Health Library http://appswhoint/rhl/pregnancy_childbirth/childbirth/caesarean/cd005528/en/ 2011.
26. UN. The Millennium Development Goals Report. 2012.
27. WHO. Global Health Observatory Data Repository. http://apps.who.int/ghodata/?vid=240. Oct 10, 2012.

APPENDIX A: Calculation to determine how much the decrease in home birth rate explains the change in CS rate

If the only thing that changed were the number of home births, how much would CS rate change?

Original Data:

	1995	2008
	---	---
No. of Home Births:	1364 (33.6%)	279 (9.1%)
Total no. of births:	4055	3053

If home birth rate in 1995 was the same as 2008's home birth rate, i.e. 9.1%:

4055 x 9.1% = 369

1364 – 369 = 995

There would be 995 fewer home births in 1995.

<u>Scenario 1: The 995 births all went to public institutions</u>

Number of births:

Public = 1872 + 995 =	2867
Private	678
Home	369
Other	141
Total:	4055

CS rates (using current 1995 CS birth rates, excluding those births preceded by a previous CS delivery):

Public: 2867 x 20.8% =	596
Private: 678 x 40.4% =	274
Home	
Other: 141 x 20.1 %	28
Total CS births:	898

CS rate would be: 898/4055 = **22.1%**

Scenario 2: Distribute the 995 births to public & private institutions according to the same ratio in 1995

Original data:

Public	1872
Private	678
Ratio (private/public) = 0.36	

Number of births:

Public:	1872 + (995 x 0.64) =	2509
Private:	678 + (995 x 0.36) =	1036
Home:		369
Other:		141
Total:		4055

CS rates (using current 1995 CS birth rates, excluding those births preceded by a previous CS delivery):

Public:	2509 x 20.8% =	522
Private:	1036 x 40.4% =	419
Home:		
Other:	141 x 20.1% =	28
Total CS births:		969

CS rate would be: 969/4055 = **23.9%**

Average between the 2 CS rates in these 2 scenarios: (22.1 + 23.9) / 2 = 23%

Based on these calculations, CS rate in 1995 would increase approx. 23-16.7% = 6.3%

Actual increase between 1995 and 2008 = 35.6 – 16.7% = 18.9%

6.3/ 18.9 = 33.3%

So the decrease in home birth rate in 2008 accounted for approximately 33.3% of the change in CS rate.

APPENDIX B: Calculation of how much the rate of increase in private institution delivery in 2008 explains the change in CS rate

If the only thing that changed were the proportion of public to private institution births, how much would CS rate change?

Original Data:

	1995	2008
	------	------
No. of public institution births:	1,872 (46.2%)	2,026 (66.4%)
No. of private institution births:	678 (16.7%)	628 (20.6%)
No. of home births:	1,364 (33.6%)	279 (9.1%)
No. of other births:	141 (3.5%)	120 (3.9%)
Total no. of births:	4,055	3,053

If all birth rates in 1995 were the same as 2008's birth rates:

No. of public institution births:	4,055 x 66.4% = 2,693
No. of private institution births:	4,055 x 20.6% = 835
No. of home births:	4,055 x 9.1% = 369
No. of other births:	4,055 x 3.9% = 158

CS rates (using current 1995 CS birth rates, excluding those births preceded by a previous CS delivery):

Public:	2,693 x 20.8% =	560
Private:	835 x 40.4% =	337
Home:	369 x 0%	0
Other:	158 x 20.1% =	32
Total CS births:		929

CS rate would be: 929/4055 = **22.9%**

Based on these calculations, CS rate in 1995 would increase by 22.9-16.7% = 6.2%

Actual increase between 1995 and 2008 = 35.6 – 16.7% = 18.9%

6.2/ 18.9 = 32.8%

So the higher rate of increase in private institution delivery in 2008 accounted for approximately **32.8%** of the change in CS rate.