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Publicly insured caesarean sections in private hospitals: a repeated cross-sectional analysis in Chile

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ABSTRACT

Objective To measure the likelihood of delivery by caesarean section (C-section) for publicly insured births as compared with privately insured births, across all hospitals and within private hospitals.

Design Repeated cross-sectional analysis.

Setting The universe of hospital births in 15 regions of Chile.

Participants 2 405 082 singleton births between 2001 and 2014.

Outcome measures C-section rates by type of hospital and type of insurance; contribution to overall C-section rates of subgroups by type of insurance and type of hospital; adjusted OR of privately insured births delivered by C-section compared with publicly insured births, across all hospitals and within private hospitals; percentage of discharges related to maternal morbidity and mortality across groups; length of stay after delivery.

Results An increasing percentage of publicly insured births occur in private facilities each year. Approximately three out of four publicly insured births in private hospitals are delivered by C-section. The adjusted odd of C-section delivery in a private maternity unit is lower for those privately insured than for those with public insurance: OR 0.6, 95% CI 0.56 to 0.64. There is no evidence that these women would have been more likely to have a C-section out of medical necessity.

Conclusions We find an association between high C-section rates and publicly insured women delivering at private institutions in Chile, and show that this group is driving the overall high and growing rates. There is a need for a more informed surveillance on the part of the public insurance system of its private providers' C-section practices.

Strengths and limitations of this study

► Uses a large dataset (2 405 082 observations) to analyse the universe of singleton births in all hospitals in Chile for the period 2001–2014.

► The dataset does not allow to identify either the parity of birth, women with prior caesarean sections (C-sections), nor other risk factors for a C-section.

► There is also a lack of socioeconomic measures at the individual level (other than type of insurance) that limits the ability to characterise mothers more accurately.

Moreover, the cost of C-section overutilisation in 2008 is estimated to have amounted to US$2.32 billion worldwide.[4]

C-sections represented 45% of all births in Chile in 2014. The country has a much higher C-section rate relative to other countries: it is the second highest among OECD countries and higher than that of many other Latin American countries.[7] Between 2001 and 2014, the C-section rate in Chile rose dramatically from 26% to 45%, while the average C-section rate among OECD countries increased from 20% to 27%.[8 9] This makes Chile a particularly interesting case study given both its higher than average levels and rapid increase in caesarean delivery rates. Figure 1 in the online supplementary appendix presents a comparison of C-section rates in Chile with a selection of OECD countries for the period 2001–2014.

The success of efforts to contain steadily increasing C-section rates crucially depends on understanding the driving forces behind them. Some common causes include: advanced maternal age, multiple births, patient socioeconomic characteristics, patient preferences, practice style, malpractice liability and local provider capacity.[5 7 10 11] Evidence also suggests that financial incentives for physicians, hospitals and insurance companies play a key role in determining the odds of a C-section. Moreover, private

INTRODUCTION

A rise in caesarean section (C-section) rates to unprecedented levels has become a global concern. In some areas, the rates are alarmingly high. In Latin America and the Caribbean, C-sections account for 40.5% of all births, a rate that is much higher than the recommendations of 10%–19% of all deliveries.[1–3] This raises concerns about potentially medically unnecessary interventions and consequent negative effects on maternal and neonatal morbidity and mortality.[4–6]

sector health providers are increasingly present around the world, and the provision of care for pregnancies and deliveries are not exempt from this trend.[12–14] C-sections are more frequently performed among women with private insurance compared with those with public insurance.[15 16] Further, C-sections rates are higher in for-profit hospitals than in non-profit hospitals.[17] This is also the case in Chile.[18 19] In what follows, we push the analysis of private sector health provision a step further by analysing how the latter interacts with the public insurance system in Chile.

Chile's healthcare system has two non-complementary health insurance providers: individuals decide between public or a private health insurance. Affiliates of the public system pay 7% of their income as premium and copayments. They can then receive treatment from public providers or selected private providers. In 2014, public insurance covered 75.2% of Chile's population, while private insurance covered 18.5%. The remaining 6.3% was either not insured or belonged to the police or armed forces.[20] Privately insured individuals are mostly adults between the ages of 21 and 45, and are on average wealthier than those with public health insurance.[21]

We focus on an important feature of the Chilean system: publicly insured individuals can opt to receive healthcare at a selected group of private facilities through a copayment for each service (prices are set each year by the Ministry of Health).[22 23] In the particular case of births (and also for a selected set of conditions), patients have access to a voucher system or diagnosis-related group (DRG)-based payment that covers all the costs related to the delivery. The patient is responsible for a copayment of a fixed and known in advance sum. The copayment is 25% in the case of births, and the sum is independent of the mode of delivery.

Almost all births occurring in private hospitals under public insurance are financed through this voucher system. The key characteristic is that only women with a singleton pregnancy can opt into this scheme, by physician prescription at week 37, under the condition that they are free of obstetric and specific medical complications. The voucher does not cover other complications due to mother's health, prematurity-related complications nor multiple births (these are covered through the regular public insurance scheme).[24]

The main objective of this paper is to measure the likelihood of birth by C-section at private hospitals for publicly insured women as compared with privately insured women. Our analysis contains three parts. First, we show the variation in C-section rates across hospital types and insurance types over time, and we analyse the contribution of each of these groups into the overall C-section rate. Second, we measure the likelihood of birth by C-section for privately insured women as compared with those publicly insured, and at private hospitals, as compared with public ones. Third, we focus on the sample of births in private hospitals, and analyse the likelihood of C-section delivery for privately insured women as compared

with publicly insured ones. We also analyse whether there is evidence suggesting that these differences are driven by medical necessity.

METHODS

Data

The main source of data is the administrative records of the universe of all hospital discharges in Chile collected by the Ministry of Health.[25] The database contains information on all inpatient stays in Chile, for all types of medical care institutions, for the period 2001–2014. The sample includes information on the age of the patient, diagnosis code, length of stay, insurance, type of institution and county of residence. The dataset does not, however, allow to identify either the parity of birth or women with prior C-sections. We identify C-sections and vaginal births using ICD-10CM codes.[26] For each birth in the data, we create a variable that is equal to 1 if it is a C-section and 0 if it is a vaginal birth.

There are 2 630 593 births in the dataset, and we apply the following restrictions to produce the working sample: singleton birth (99.44% of all cases), covered by either public or private insurance (94.09% of all cases), at either a private or public hospital (91.93% of all cases). The final sample includes 2 405 082 observations, with an average of approximately 172 000 observations per year.

We also build a secondary sample, consisting of all hospital discharges related to maternal morbidity and mortality based on diagnosis codes (1 740 640 discharges), which may occur during pregnancy but cannot be linked to the actual delivery in all cases. The 'Sample selection' section in the online supplementary appendix provides further details on the construction of these samples.

Analysis of the data

We begin by comparing the C-section rates of four different groups, defined by type of insurance and type of hospital. To test the significance of the difference in C-section rates between two selected groups, we perform a t-test and report the corresponding p value using a bilateral alternative hypothesis, and assuming that unpaired data have equal variances in both groups. We then proceed with the analysis of the contribution of each group to the overall C-section rate, using weights computed as the number of C-sections in each group divided by the total number of C-sections, for each year.

We perform regression analyses of the probability of delivering by C-section on a series of explanatory variables, including an indicator variable for private insurance, an indicator for private hospital and maternal age categories (less than 19 years old, between 19 and 25 years old, between 26 and 34 years old and 35 years old or more). To control for time-invariant geographical and socioeconomic characteristics and time trends, we also include mothers' county of residence fixed effects and year fixed effects. Additionally, we estimate the models using socioeconomic information on the mother's county

of residence as controls (ie, income, level of education, population density and percentage of individuals below the poverty line; obtained from the Chilean household survey Encuesta de Caracterización Socioeconómica Nacional) and results are very similar.[27] We prefer the specification with county fixed effects both because it allows to control for other unobserved characteristics of the mother's county of residence (eg, cultural factors related to mode of delivery), and because there is low temporal variation in the socioeconomic measures in the period under study.

We perform unadjusted regressions on the probability of delivering by C-sections that include only one covariate (private insurance, private hospital and mother's age categories), and adjusted regressions that include the former set of covariates and fixed effects. The regressions are performed assuming a logit model for the probability of interest. To compute ORs, we estimate logistic models. We use the coefficients of logit regressions to obtain individual marginal effects (computed as the sample average of the individual effects). SEs of unadjusted regressions are computed under the assumption of homoscedasticity, while those for adjusted regressions are robust to both heteroscedasticity and cluster at the county level.

To further analyse variation in C-section rates across insurance status even within private hospitals, we replicate the above regression analysis in the sample of deliveries at private hospitals. The regression equations for the above estimations are presented in the online technical supplementary appendix.

We also explore the possibility that there are high rates of C-section among publicly insured women in private facilities because of medical necessity. We analyse the incidence of maternal morbidity and mortality, across the four groups defined by insurance and type of hospital, using the secondary sample described above. Under the assumption that worse outcomes require longer periods of care, we compute average length of stay after delivery at public and private hospitals across type of insurance.[28]

Patient and public involvement
Neither patients nor the public were involved in this study.

RESULTS
Public hospitals accounted for 77% of all births throughout the period 2001–2014, and 88% of all births were covered by public insurance. Table 1 provides a complete report of the number of deliveries and percentage of C-sections each year by type of insurance and hospital. Online supplementary appendix table 1 reports descriptive statistics on the working sample. The prevalence of births in private facilities covered by public insurance increased from just 1.6% in 2001 to 20.6% in 2014. Births financed by private insurance at private hospitals also increased, from 10.1% to 14.7%. There simultaneously occurred a decline in the number of deliveries in public hospitals covered by public insurance. Births in public hospitals under private insurance are rare.

Table 1 Births and C-sections by type of insurance and hospital

Year	Total Births (#)	C-sections (%)	Public insurance Public hospital Births (%)	C-sections (%)	Private hospital Births (%)	C-sections (%)	Private insurance Public hospital Births (%)	C-sections (%)	Private hospital Births (%)	C-sections (%)
2001	168 919	24.4	85.3	20.2	1.6	61.8	3.0	47.5	10.1	47.6
2002	167 194	24.8	84.2	20.3	2.5	61.9	2.3	47.4	11.0	46.5
2003	162 897	25.8	83.2	21.4	4.9	59.8	2.2	42.2	9.7	42.8
2004	164 589	28.5	81.5	23.6	7.9	59.1	1.6	50.2	9.0	42.7
2005	161 838	29.2	81.3	24.1	8.6	59.7	1.4	54.6	8.7	43.3
2006	161 194	30.9	79.4	25.0	10.2	60.6	1.2	54.9	9.2	46.0
2007	163 521	34.1	79.5	28.3	9.5	62.0	1.4	54.6	9.6	51.5
2008	171 739	34.5	76.7	26.8	12.2	68.3	1.6	51.7	9.5	50.5
2009	185 415	37.1	73.1	26.8	15.3	72.4	1.6	52.1	10.0	55.4
2010	182 656	37.6	73.8	27.6	14.3	74.4	1.5	52.4	10.4	55.3
2011	178 594	39.6	71.8	28.8	16.2	75.3	1.4	55.3	10.6	55.6
2012	177 072	42.7	65.4	29.6	20.0	75.4	2.1	46.3	12.5	58.2
2013	174 667	44.3	64.8	30.8	20.5	76.4	1.5	56.2	13.2	59.1
2014	184 787	44.7	63.4	30.9	20.6	77.2	1.3	56.6	14.7	57.3
Total	2 405 082	34.4	75.7	25.8	12.0	71.0	1.7	50.7	10.6	51.8

Authors' analysis of hospital discharge data, 2001–2014.

Table 2 Contributions to overall C-section rates by type of insurance and hospital, in %

| Year | Public insurance | | Private insurance | | Overall (weighted) |
	Public hospital	Private hospital	Public hospital	Private hospital	C-section rate
2001	49.1	8.7	9.7	32.4	28.9
2002	47.3	13.0	7.2	32.5	29.5
2003	49.2	22.7	5.1	23.0	30.0
2004	48.6	29.7	4.3	17.5	32.7
2005	47.9	31.2	4.3	16.6	33.6
2006	45.1	33.9	3.4	17.6	35.6
2007	49.0	28.3	3.2	19.6	38.1
2008	39.3	40.4	3.1	17.2	40.7
2009	31.4	47.7	2.6	18.3	45.3
2010	32.8	46.2	2.4	18.6	45.7
2011	31.5	48.9	2.2	17.4	47.7
2012	26.3	52.2	2.1	19.4	51.0
2013	26.5	51.6	2.0	19.8	52.4
2014	25.7	52.0	1.8	20.5	52.8

Authors' analysis of hospital discharge data, 2001–2014.

As expected, C-section rates in public hospitals for deliveries covered by public insurance are the lowest throughout the entire period. Surprisingly, however, we find that the highest C-section rates are found among deliveries in private facilities covered by public insurance; higher even than those for births covered by private insurance (differences in all years analysed are statistically significant at the 1% level). This has been the case since 2001, and by 2014, the C-section rate for births in private hospitals covered by public insurance rose as high as 77.2%.

To further understand the extent to which publicly insured deliveries in private hospitals have added to the increase in C-sections rates in Chile, in table 2 we report the contribution of four different groups, defined by type of insurance and hospital, to the overall C-section rate. Online supplementary appendix table 2 details the weights used in the computations. Since 2008, C-sections among publicly insured women who delivered in private maternity units have been the greatest contributor to the overall C-section rate in Chile. By 2014, the 'private hospital under public insurance' group contributed 52% to the overall weighted C-section rate, while the 'private insurance' group, including C-sections performed in public and private hospitals, contributed only 22.3%. The remaining 25.7% was generated by publicly covered C-sections performed in public hospitals.

Table 3 presents results of unadjusted and adjusted ORs of C-section delivery. Using all deliveries between 2001 and 2014 (column 1), the unadjusted ORs for a woman covered by private insurance and of delivering at a private hospital are both above 1 (2.27 and 4.55, respectively). Surprisingly, we find that the adjusted likelihood of having a C-section (column 2) is lower for those privately insured than for those with public insurance (OR 0.71, 95% CI 0.63 to 0.79), while the adjusted likelihood of having a C-section at a private hospital is similar to the unadjusted one (OR 5.29, 95% CI 4.42 to 6.32).

We present the same regressions using only the deliveries that occurred in 2001 and separately, only the deliveries that occurred in 2014, in columns 3–6 of table 3. We find that the adjusted probability of having a C-section among privately insured women relative to that of publicly insured women declined during the period

Table 3 ORs of having private health insurance on the probability of having a C-section. Full Sample

	2001–2014		2001		2014	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	OR	OR (95% CI)	OR	OR (95% CI)	OR	OR (95% CI)
	(1)	(2)	(3)	(4)	(5)	(6)
Private insurance	2.27	0.71 (0.63 to 0.79)	3.43	1.89 (1.6 to 2.23)	1.82	0.56 (0.48 to 0.64)
Private hospital	4.55	5.29 (4.42 to 6.32)	3.67	2.35 (1.93 to 2.86)	4.82	8.01 (6.58 to 9.74)
Mother's age						
<19	0.36	0.46 (0.44 to 0.48)	0.38	0.45 (0.41 to 0.48)	0.34	0.47 (0.44 to 0.5)
19–25	0.55	0.64 (0.62 to 0.65)	0.55	0.62 (0.59 to 0.65)	0.57	0.68 (0.66 to 0.7)
26–34	1.00	1.00	1.00	1.00	1.00	1.00
35+	1.44	1.56 (1.53 to 1.59)	1.48	1.56 (1.5 to 1.62)	1.35	1.45 (1.4 to 1.51)
N	2 405 082	2 398 729	168 919	166 660	184 787	183 063

Authors' analysis of hospital discharge data, 2001–2014.
ORs are computed using logistic regressions. In the adjusted regressions, we include as covariates a set of indicators for the age of the mother, dummies that identify county of residence of the mother and year dummies. SEs in the adjusted regression are clustered at the county level.

Table 4 ORs of having private health insurance on the probability of having a C-section. Sample of deliveries in private hospitals

	2001–2014		2001		2014	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	OR	OR (95% CI)	OR	OR (95% CI)	OR	OR (95% CI)
	(1)	(2)	(3)	(4)	(5)	(6)
Private insurance	0.44	0.6 (0.56 to 0.65)	0.56	0.64 (0.59 to 0.7)	0.40	0.56 (0.5 to 0.62)
Mother's age						
<19	1.04	0.76 (0.73 to 0.79)	0.92	0.77 (0.64 to 0.92)	1.12	0.78 (0.7 to 0.87)
19–25	1.05	0.8 (0.78 to 0.83)	0.96	0.8 (0.73 to 0.87)	1.10	0.82 (0.78 to 0.87)
26–34	1.00	1.00	1.00	1.00	1.00	1.00
35+	1.47	1.62 (1.57 to 1.67)	1.71	1.73 (1.6 to 1.86)	1.18	1.4 (1.33 to 1.48)
N	543 066	541 371	19 775	19 614	65 251	64 223

Authors' analysis of hospital discharge data, 2001–2014.
ORs are computed using logistic regressions. In the adjusted regressions, we include as covariates a set of indicators for the age of the mother, dummies that identify county of residence of the mother and year dummies. SEs in the adjusted regression are clustered at the county level.

under analysis (OR in 2001 is 1.89, 95% CI 1.6 to 2.23; OR in 2014 is 0.56, 95%, CI 0.48 to 0.64).

We turn our focus to the sample of births in private hospitals and present the odds of C-section for publicly insured women as compared with privately insured women in table 4. Pooling all years under analysis (column 2), among women who delivered in a private hospital, we find that the adjusted likelihood of having a C-section is lower for those privately insured than for those with public insurance: the OR is 0.6 (95% CI 0.56 to 0.65).

We also find a small reduction in the adjusted likelihood of a C-section between 2001 and 2014 (columns 4 and 6), among privately insured women relative to that of publicly insured women (OR in 2001: 0.64, 95% CI 0.59 to 0.7; OR in 2014: 0.56, 95% CI 0.5 to 0.62).

A report of the marginal effects is presented in online technical supplementary appendix table 1.

Table 5 presents the analysis on hospital discharges related to maternal morbidity and mortality. We find no evidence of higher rates of maternal morbidity, miscarriages, labour or delivery complications, nor greater

maternal mortality among women with public insurance at private institutions. On the contrary, the bulk of discharges for these conditions (81.4%, 80.1% and 69.2%, respectively) and deaths (87.1%) take place at public hospitals and are covered by public insurance.

We also find that the longest length of stay after delivery among the four groups analysed is that for women at public hospitals covered by public insurance. For deliveries in private hospitals, patients with public insurance have a shorter length of stay than those covered by private insurance (2.5 vs 2.9, p value of the difference <0.0001). A report of the marginal effects is presented in online technical supplementary appendix table 2.

DISCUSSION

We analyse C-section rates using the universe of births in Chile for the period 2001–2014. Our results show that the odds of a C-section delivery at private hospitals for publicly insured women are higher than that for women covered by private insurance.

Table 5 Hospital discharges for maternal morbidity and mortality, and length of stay after delivery

	Total	Public insurance		Private insurance	
		Public hospital	Private hospital	Public hospital	Private hospital
	(#)	(%)	(%)	(%)	(%)
Maternal morbidity	1 066 503	81.4	5.6	1.5	11.6
Pregnancy with abortive outcome	414 155	80.1	4.9	2.5	12.5
Complications of labour and delivery	259 695	69.2	13.9	1.6	15.3
Maternal mortality	287	87.1	3.8	1.1	8.0
Mean length of stay after delivery	2 405 082	3.2	2.5	2.5	2.9

Authors' analysis of hospital discharge data, 2001–2014.
All analysis based on secondary sample, except for length of stay after delivery, which comes from the main sample. Section 'Sample selection' in the online supplementary appendix provides details on the ICD-10CM codes used to classify discharges.

This pattern holds for the entire period of analysis, but is particularly high in recent years. By 2014, the C-section rate for births in private hospitals covered by public insurance rose as high as 77.2%. As dramatic as this figure seems, it is consistent with previous findings for the Chilean healthcare system.[29]

We evaluate whether the relationship between publicly insured deliveries at private hospitals and high C-section rates is driven by riskier patients seeking care at private institutions, for whom high C-section rates would be medically appropriate.[30] We analyse hospital discharges related to maternal morbidity and mortality, and find no evidence that this is the case. Further, there is also no evidence from the average length of stay after delivery that suggests that outcomes are worse for mothers with public insurance delivering at private institutions.

Context

In line with what is now a worldwide phenomenon, the private sector plays an increasingly relevant role in deliveries in Chile.[12 31] We find that women with private insurance are more likely to undergo C-sections, consistent with other findings for Chile.[19] We also find higher rates of C-sections at private hospitals, as found in other studies.[18 32] Our analysis shows the importance of considering both dimensions simultaneously when studying the incidence of C-sections, since our key finding is the high odds of a C-section delivery for publicly insured women at private hospitals.

C-section rates are higher, and the magnitude is increasing: since 2004, the number of C-sections performed in private hospitals covered by public health insurance has surpassed the number of C-sections covered by private insurance. In 2014, public health insurance financed 29 388 C-sections in private hospitals while the number of C-sections performed in the same type of hospital but paid by private health insurance was only 15 571.

Strengths and limitations

A major strength of this paper is the long period of study and the large number of cases evaluated.

The requirement that only women with a healthy singleton term pregnancy can purchase the voucher through public insurance to deliver at a private hospital is a crucial point in our analysis. This group should have a relatively low risk of caesarean delivery and, nonetheless, it is for this group that the highest C-section rates are observed.

The main limitation of this study is the absence of information on either parity of birth or women who had prior C-sections. Other variables missing from our data include: gestational age, breech presentation, other risk factors for C-section and socioeconomic measures at the individual level that would allow to characterise mothers more accurately. We do include age as a control variable, as well as county of residence fixed effects in our estimations. We also rely on the type of insurance, used as a proxy for socioeconomic status.

Mechanisms

Why are C-sections rates among women with public insurance in private hospitals so high?

Previous literature emphasises the importance of maternal characteristics (including preferences, cultural background and social class).[13 33] High C-section rates in Chile may be related to cultural issues and obstetric violence, such as emotional or physical abuse, mistreatment or unnecessary procedures, which can translate into unwanted C-sections. Further, elevated C-section rates could be related to inequity in access to appropriate healthcare. Efforts are being made to investigate these aspects in the Chilean context.[34]

Other research suggests that financial incentives play a crucial role in determining C-section rates. A key argument in explaining high C-section rates is that providers generally receive a higher payment for C-sections than for vaginal births.[10 13 17 35 36]

However, in this particular setting (publicly insured births occurring at private institutions in Chile), there is no fee differential, as the cost of the voucher is independent of the mode of delivery.

A second argument refers to physician practice styles and their specialisation in high-tech procedures, which may be more prominent in private hospitals because they usually have more resources and better infrastructure.[17 37] To the best of our knowledge, there is no evidence on this for the case of Chile. Finally, various studies show that C-sections take less time and can be scheduled at advantageous moments for doctors and institutions, instead of waiting longer for a vaginal birth, thus maximising income and convenience.[17 38 39] This is consistent with our findings, because women with public insurance have access to a specific and limited set of private providers through the voucher system. Even though fee differentials between C-sections and vaginal births were eliminated through the voucher system, the fee-for-service payment scheme can imply an overprovision of C-sections.[17] Further, it may be that the combination of financial incentives and practice styles ultimately produces high C-section rates among publicly insured women in these private hospitals. Disentangling between these two hypotheses will be the subject of future research.

CONCLUSIONS AND IMPLICATIONS

C-sections are resource intensive and a policy-relevant procedure. While an unprecedented increase in C-sections has heightened public awareness, measures to limit their use have not always been successful. This paper provides important insight relative to the interaction between public insurance and its private providers, and resultant C-section rates, at a time when private sector health providers play an increasingly relevant role in offering care around the world.[12]

We show that there is an association between high C-section rates and publicly insured women delivering at private institutions, and that it is this group that is driving the overall high and increasing rates of caesareans in Chile. Roughly, three out of four publicly insured women who opt to give

birth in a private hospital will have a C-section, even though there is no evidence that these women would have been more likely to have a C-section out of medical necessity. Our findings indicate that there are potentially great health and financial benefits to be reaped from a more informed surveillance on the part of the public insurance system of its private providers' C-section practices.

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