Demand for obstetric care and density of health resources for childbearing age Mexican women

Javier Valdés-Hernández,¹ Aldelmo E. Reyes-Pablo,² Eduardo Navarrete-Hernández³ and Sonia Canún-Serrano⁴

¹Secretaría de Salud, National Homeopathic Hospital, Epidemiology Department; ²Secretaría de Salud, Hospital General "Dr. Manuel Gea González", Obstetrics & Gynecology Division; ³Instituto Mexicano del Seguro Social, Epidemiological Surveillance Coordination, Hospital Epidemiology Division; ⁴Secretaría de Salud, Hospital General "Dr. Manuel Gea González", Medical Genetics Division. Mexico City, Mexico

Abstract

Introduction: In Mexico, there is an increase recorded in the number of C-sections, as well as inequity and inequality in the distribution of resources for obstetric care. **Objective:** To identify the states and municipalities in Mexico that concentrate the demand for obstetric care and the C-section rates and their relationship with health resources and women of childbearing age (WCBA). **Method:** Births of the 2008-2017 period were recorded, grouped into five municipal strata, as well as 2017 health resources and WCBA. **Results:** The 2008-2017 national rate of C-sections was 45.3/100 births; 95 and 97 % of births and C-sections were concentrated in the "very high" stratum, where 80 % or more of health resources were used, with overuse standing out. The density of health resources assigned to WCBAs reflected inequity and inequality. **Conclusions:** The high concentration of obstetric demand and health resources supply could entail a higher recurrence of C-sections. Policies for C-section reduction should consider proper organization and administration of health resources.

KEY WORDS: Maternal health services. Cesarean sections. Health resources. Woman of childbearing age.

Demanda de atención obstétrica, cesáreas y densidad de recursos en salud para la población femenina en edad fértil de México

Resumen

Introducción: México registra aumento de las cesáreas e inequidad y desigualdad en la distribución de recursos para la atención obstétrica. **Objetivo:** Identificar las entidades y municipios en México que concentran la demanda de atención obstétrica y tasas de cesáreas y su relación con los recursos en salud y mujeres en edad fértil (MEF). **Método:** Se registraron los nacimientos del periodo 2008-2017, agrupados en cinco estratos municipales, y los recursos en salud y MEF de 2017. **Resultados:** La tasa nacional de cesáreas 2008-2017 fue de 45.3/100 nacimientos; 95 y 97 % de los nacimientos y cesáreas se concentraron en el estrato "muy alto", en el cual se utilizó 80 % o más de los recursos en salud y destacó la sobreutilización. La densidad de recursos en salud destinados a las MEF reflejó inequidad y desigualdad. **Conclusiones:** La alta concentración de la demanda obstétrica y oferta de los recursos en salud pudiera conllevar mayor recurrencia a la cesárea. En las políticas de reducción de cesáreas es necesario considerar la organización y administración adecuadas de los recursos en salud.

PALABRAS CLAVE: Servicios de salud materna. Cesáreas. Recursos en salud. Mujeres en edad fértil.

Correspondence:

*Javier Valdés-Hernández

E-mail: javiervah@ yahoo.com.mx

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Introduction

There are two routes whereby a delivery is solved: vaginal delivery or cesarean section (C-section). Regardless of the route, there is a natural risk for the mother and the fetus, and the obstetrician must therefore judge case by case which option is best for both.^{1,2}

C-section is an incision in the abdominal and uterine walls that is intended to extract the living or dead fetus of 22 or more weeks of gestation, as well as the placenta and its annexes. It is the most common surgical procedure in obstetrics departments and its indication is the responsibility of the specialist in that area in daily practice.^{3,4}

The indications for C-section are precise and its only purpose is to ensure the mother-child binomial health, and thus this surgical procedure should only be used in women with high-risk deliveries.^{2,5,6} When it is carried out without the precise indications being complied with, the risks outweigh the benefits, which generates complications for women, violations of their reproductive rights and additional costs for the health system.^{7,8}

The cesarean section rate (CSR) is a multidimensional indicator of hospital performance that assesses adequate medical care, mother-child safety and efficiency in the use of resources. According to the World Health Organization, the rate of necessary C-sections is estimated to range between 10 and 15 % of deliveries, while the CSR to reduce maternal-neonatal health risks ranges from 15 to 20 %.

Since 2000, an increase in CSR and its related factors has been reported in Mexico.⁹⁻¹² With regard to clinical factors, in a review of 3232 medical records from the Mexican Institute of Social Security for the 1997-1999 period, 434 diagnostic expressions were noted, a heterogeneity that contrasted with institutional regulations in force, which established 59 specific indications.¹³

Differential CSRs have been referred when comparing different states of the country according to their degree of marginalization; the highest rates show a positive association with socioeconomic development: the lower the marginalization, the higher the CSR and vice versa.¹⁴

Studies on the organization of health services have found that CSRs are higher in the private than in the public sector, and that, in the latter, the CSR is higher in social security institutions than in those that look after unaffiliated population.^{10,14}

In Mexico, iniquity and inequality in the distribution of health resources in general and specifically for obstetric care have been pointed out.¹⁴⁻¹⁶

Regarding the size of hospitals, Campero et al. identified that the probability of C-section in a woman who requires obstetric care increases according to the size of the hospital from 10 beds on.¹⁷

Since 1983, several constitutional reforms have been carried out in Mexico in order to achieve the right to health protection and universal health coverage; however, inequality gaps persist. One of the causes is the supply of health resources, which is governed by social demand for medical care rather than by demographic and health requirements,¹⁸ which results in divergences in their use or efficiency, estimated as the volume of actions per unit of available health resources and the density of health resources (DHR), which refers to the ratio between the resources available to meet health needs and the target population they are directed to, even when they are not necessarily available at a given moment for that population.¹⁵

Objectives

- To identify the states and municipalities where the highest demand for obstetric care is concentrated, considered on the basis of the births recorded in the 2008-2017 period and the highest C-section rates, through stratification and mapping of information.
- To analyze the statistical relationship between the municipal strata according to the demand for obstetric care and C-sections and the efficiency of health resources in the municipalities.
- To identify the municipalities where the highest number of women of childbearing age (WCBA) aged 15 to 44 years is concentrated through municipal stratification and its statistical and geospatial relationship with the demand for obstetric care and C-sections and DHR per municipality.

Method

CSRs were calculated by states and municipalities according to the natality databases of the National Institute of Statistics and Geography (INEGI – *Instituto Nacional de Estadística y Geografía*) and the Ministry of Health (SSa – *Secretaría de Salud*) for the 2008-2017 period. Births of 22 or more weeks of gestation and ≥ 500 g weight were taken into account.

For the calculation of the CSR, the state and municipality of birth, the place where pregnant women

requested and received the delivery care were taken into account.

The analysis by state of birth and annual CSR showed no significant differences, and the information for the period was therefore accumulated; the same procedure was used in the analysis by municipalities with the purpose to stabilize the CSRs.

For the summary and analysis of data by states and municipalities, births and CSRs were grouped by strata: very low (VL), low (L), middle (M), high (H) and very high (VH). The stratification method was by percentiles. Stratification according to the number of births was used as the basis of the analysis for the grouping of the remaining data.

A concordance study between strata by birth and C-section was performed separately for both the states and municipalities in order to identify the relationship between both variables.

For better representation of some data, mapping was used. For the generation of maps, the Digital Map of Mexico program, version 6.3.0, was used, as well as the map layers of all 32 states of the country and their 2458 municipalities developed by INEGI.

The 2017 Health Resources data were acquired from the SSa General Directorate of Health Information and those for WCBA, from the 2017 projections of the National Population Council.

In order to analyze the statistical significance of differences, CSR mean comparisons were performed by strata using error plots and single-factor analysis of variance (ANOVA). The chi-square test was also used for the comparison of CSRs by strata.

Results

The number of births with state of birth records was 20,179,539 (Fig. 1). The VH and H strata concentrated 67.9 % of births, as well as 69.5 % of 9,141,552 C-sections performed during the period.

A national CSR of 45.3/100 births was estimated. By states, the CSR ranged from 31.2 to 52.2/100 births. The five states with the highest CSRs were Nuevo León, Yucatán, Sinaloa, Mexico City and Tamaulipas, while those with the lowest CSRs were San Luis Potosí, Zacatecas, Nayarit, Chiapas and Durango.

By strata, no differences in rates were identified, which ranged from 42.5 to 47.6/100 births, not statistically significant according to the mean contrast plot and the ANOVA. The error plot shows CSR wide intervals for each stratum, which overlap with the

opposites. The chi-square test for CSRs showed no significant differences between strata.

Geospatial contrast of births and CSR data shows that stratifications barely reached a concordance of 6.3 % (Fig. 1).

Births with a municipal registry were 20,176,197 (Fig. 2). There were 109 municipalities (4.43 %) with no data.

According to stratification, births and C-sections were concentrated in the VH stratum, which comprised 470 municipalities, with 95 and 97 %, respectively. Furthermore, CSR in that stratum was the highest: 46.3/100 births. CSR mean differences by strata are statistically significant, particularly when the VH stratum is compared with the others, according to the error plot and the ANOVA results. The narrow confidence intervals in the error plot for each stratum indicate stable figures inside. VH versus H stratum rate ratio is 1.58 and 5.1 in comparison with the VL stratum.

Concordance between municipalities of birth and CSR was 55.3 %; however, the analysis for each stratum showed a concordance of 93 % between the VH strata of both groups. There was an almost perfect spatial correlation between the municipalities localized in the VH stratum of births and those of the CSR VH stratum, which increased the reliability of the trend towards concentrating the demand for obstetric care and C-sections in these municipalities.

Table 1 describes the use of health resources by municipal strata according to the demand for obstetric care. In the majority of them, an upward trend was found that ran parallel to birth stratification: from lower to higher number of births, lower to higher use of health resources. With the exception of 11 items, the VH stratum concentrated 80 % or more of resources. In those that had percentages lower than this limit, concentration was equal to or greater than 70 % when the immediately lower stratum was added, with a predominance of the VH stratum, which confirms the trend towards a concentration of resources.

Table 2 shows the efficiency of health resources. Except for three items within births and two in C-sections, an ascending number of births or C-sections was found per unit that ran parallel to birth stratification: from lower to higher birth stratification, lower to higher number of births or C-sections per unit of health resources, which indicates overuse in the VH and underuse in the VL strata.

As for the distribution of WCBA by strata according to the number of births (Fig. 3), nearly 75 % of WCBA were at the VH stratum, followed by the H

Figure 1. Obstetric demand (number of births) and C-section rates, nation-wide and by states. Mexico, 2008-2017.

Figure 2. Obstetric demand and C-section rates distribution according to municipal strata and their geospatial coincidence. Mexico, 2008-2017. Source: Bases de datos abiertas de nacimientos, INEGI/SSA, 2008-2017.

stratum, which together accounted for approximately 88 %. This distribution is geospatially illustrated on the map: it exceeds the territorial extension of the 470 municipalities where 95 % of births are concentrated.

Women in the VH stratum who migrated for their care were 41.1 %, while 34.5 % in the H stratum and 29.6 % in the VL stratum did the same. The DHR figures for WCBA have a random behavior, since some of them reflect iniquity and inequality in the provision of resources, while there are also similar figures that would indicate equity and equality.

Discussion

Currently, ecological studies at the level of small areas are more convenient because they are more enlightening.¹⁹ With this approach, in our analysis we identified a high concentration in the demand for obstetric care and C-sections in 470 municipalities associated with the clustering of health resources. However, inequalities were observed in the use of health resources in the H and VH strata, with overuse due to the excessive demand for obstetric care. Regarding human resources for health, this relationship can be considered as an indicator of

Table 1. Health resources distribution by municipal strata according to the number of births or obstetric demand. Mexico, 2008-2017

Health resources	Strata according to the number of births										Total
	Very low		Low		Middle		High		Very high		
	n	%	n	%	n	%	n	%	n	%	
Primary care units	1228	5.9	1887	9.1	2969	14.4	4702	22.7	9883	47.8	20669
Secondary care units	2	0.2	6	0.5	20	1.5	232	17.7	1050	80.2	1310
Hospitalization area	2	0.1	9	0.5	29	1.7	260	14.8	1455	82.9	1755
Surgical unit	0	0.0	1	0.1	12	1.0	208	17.7	951	81.1	1172
NICU	0	0.0	0	0.0	1	0.3	8	2.3	333	97.4	342
Obstetrics and obstetric surgery area	56	3.6	67	4.3	86	5.5	327	21.0	1021	65.6	1557
Neonatology and nursery area	1	0.1	5	0.6	13	1.6	105	12.7	701	85.0	825
Operating rooms	2	0.0	3	0.1	19	0.5	314	7.7	3714	91.7	4052
Delivery rooms	100	3.8	169	6.4	214	8.1	528	20.0	1632	61.7	2643
Cribs for healthy newborns	31	0.4	49	0.7	71	1.0	480	6.6	6599	91.3	7230
Total offices	1864	2.5	2832	3.8	4410	5.9	9016	12.2	56036	75.6	74158
General medicine	1508	3.9	2274	5.9	3457	8.9	6184	15.9	25355	65.4	38778
Obstetrics & gynecology	2	0.1	6	0.3	27	1.3	229	11.4	1746	86.9	2010
Pediatrics	3	0.2	4	0.2	26	1.5	186	10.7	1527	87.5	1746
Total beds hospitalization area	15	0.0	250	0.3	570	0.7	4074	4.7	82014	94.4	86923
General medicine	3	0.2	6	0.4	42	2.9	540	36.9	874	59.7	1465
Obstetrics & gynecology	1	0.0	15	0.1	48	0.3	983	5.9	15533	93.7	16580
General and reconstructive surgery	0	0.0	6	0.0	32	0.2	643	4.6	13347	95.1	14028
Pediatrics	4	0.0	14	0.1	105	1.0	683	6.2	10131	92.6	10937
Labor area	199	4.0	327	6.5	442	8.8	631	12.5	3438	68.3	5037
Postpartum recovery area	0	0.0	8	7.8	14	13.6	4	3.9	77	74.8	103
Total physicians	1078	2.1	1984	3.8	3528	6.7	8178	15.6	37605	71.8	52373
General practitioners	189	1.0	210	1.1	261	1.4	824	4.3	17716	92.3	19200
Pediatricians	19	0.2	6	0.1	26	0.2	398	3.7	10356	95.8	10805
Obstetrician-gynecologists	14	0.2	3	0.0	31	0.3	408	4.5	8525	94.9	8981
Surgeons	14	0.2	3	0.0	7	0.1	128	1.8	6986	97.9	7138
Anesthesiologists	2	0.1	18	1.1	10	0.6	12	0.8	1531	97.3	1573
On training	759	5.9	978	7.6	1235	9.6	2047	15.9	7854	61.0	12873
Residents	96	0.6	127	0.8	264	1.7	794	5.1	14339	91.8	15620
Interns	96	2.7	185	5.2	269	7.5	353	9.9	2673	74.7	3576
Undergraduate interns	0	0.0	1	0.0	9	0.0	232	0.9	24287	99.0	24529
Total nurses	740	0.5	1228	0.8	2682	1.8	7664	5.2	133671	91.6	145985
General nurses	75	0.2	86	0.2	224	0.6	781	2.2	34647	96.7	35813
Obstetrics nurses	1012	0.5	1354	0.7	2936	1.4	11220	5.4	191723	92.1	208245

Source: *Bases de datos abiertas de nacimientos INEGI/SSa, 2008-2017* and *SSa 2017 health resources*. NICU = Neonatal intensive care unit.

Table 2. Use of health resources by municipal strata according to obstetric demand or number of births. México, 2008-2017

Health resources	Strata according to the number of births					
	Very low	Low	Middle	High	Very high	Total
	HR/B or C ratio	HR/B or C ratio	HR/B or C ratio	HR/B or C ratio	HR/B or C ratio	HR/B or C ratio
Number of births	1 991	13 965	91 544	910 593	19 158 104	20 176 197
Obstetrics and obstetric surgery area	36	208	1064	2785	18764	12958
Delivery rooms	20	83	428	1725	11739	7634
General medicine offices	1	6	26	147	756	520
Obstetrics & gynecology offices	996	2328	3391	3976	10973	10038
Obstetrics & gynecology beds	1991	931	1907	926	1233	1217
Labor area beds	10	43	207	1443	5572	4006
Postpartum recovery beds	0	1746	6539	227648	248807	195885
General practitioners	11	67	351	1105	1081	1051
Obstetrician-gynecologists	142	4655	2953	2232	2247	2247
Anesthesiologist physicians	996	776	9154	75883	12513	12827
Medical interns	21	75	340	2580	7167	5642
Undergraduate interns	0	13965	10172	3925	789	823
Nurses	3	11	34	119	143	138
General nurses	27	162	409	1166	553	563
Obstetrics nurses	2	10	31	81	100	97
Number of C-sections	180	678	8 864	26 5964	8 864 862	9 140 548
Obstetrics and obstetric surgery area	3	10	103	813	8683	5871
Delivery rooms	2	4	41	504	5432	3458
General medicine offices	0	0	3	43	350	236
Obstetrics & gynecology offices	90	113	328	1161	5077	4548
Obstetrics & gynecology beds	180	45	185	271	571	551
Labor area beds	1	2	20	421	2578	1815
Postpartum recovery beds	0	85	633	66491	115128	88743
General practitioners	1	3	34	323	500	476
Obstetrician-gynecologists	13	226	286	652	1040	1018
Anesthesiologist physicians	90	38	886	22164	5790	5811
Medical interns	2	4	33	753	3316	2556
Undergraduate interns	0	678	985	1146	365	373
Nurses	0	1	3	35	66	63
General nurses	2	8	40	341	256	255
Obstetrics nurses	0	1	3	24	46	44

Source: Bases de datos abiertas de nacimientos INEGI/SSA 2008-2017 and SSA 2017 health resources. HR = health resources. B = births, C = C-sections.

Indicator	Strata according to the number of births					
	Very low	Low	Middle	High	Very high	Total
Women aged 15 to 44 years	620,148	1,122,688	1,883,577	3,900,111	22,350,537	29,877,062
Percentage	2.1	3.8	6.3	13.1	74.8	100.0
Percentage of births with usual residence other than the municipality of care	29.6	20.6	18.3	34.5	41.1	40.7
2017 health resources						
Density of health resources use by women aged 15-44 years						
Obstetrics and ob-surgery area	11,074	16,757	21,902	11,927	21,891	19,189
Delivery rooms	6,201	6,643	8,802	7,387	13,695	11,304
General medicine offices	411	494	545	631	882	770
Obstetrics & gynecology offices	310,074	187,115	69,762	17,031	12,801	14,864
Obstetrics & gynecology beds	620,148	74,846	39,241	3,968	1,439	1,802
Beds in labor area	3,116	3,433	4,261	6,181	6,501	5,932
Beds in postpartum recovery	0	140,336	134,541	975,028	290,267	290,069
General practitioners	3,281	5,346	7,217	4,733	1,262	1,556
Obstetrician-gynecologists	44,296	374,229	60,761	9,559	2,622	3,327
Physician anesthesiologists	310,074	62,372	188,358	325,009	14,599	18,994
Medical interns	6,460	6,069	7,002	11,048	8,362	8,355
Undergraduate interns	0	1,122,688	209,286	16,811	920	1,218
Nurses	838	914	702	509	167	205
General nurses	8,269	13,055	8,409	4,994	645	834
Obstetrics nurses	613	829	642	348	117	143

Figure 3. Relationship between health resources and women aged 15 to 44 years by municipal strata according to obstetric demand or number of births. Mexico, 2008-2017. Source: Bases de datos abiertas de nacimientos, INEGI/SSA, 2008-2017. SSA 2017 health resources and National Population Council 2017 population estimates.

productivity. As for the results, supersaturation in obstetrics and gynecology departments might lead to a higher use of C-section as a strategy to free beds in the delivery rooms, considering the effective time of care required for a vaginal delivery in comparison with a C-section.

Since its creation in the 1950s, the Mexican medical model has focused on curative or problem-solving

care,²⁰ which places the delivery rooms in the hospital setting, privileging secondary and tertiary over primary care, thus transforming obstetric practice into a matter of “medical specialty” in parallel to the process of displacement of general medicine: there are 1.7 medical specialists for each general practitioner (Table 1).

During the study period, 98 % of births were attended to in hospitals; 63 % of the obstetrics and obstetric surgery areas, 93 % of neonatology and nursery areas, 95 % of operating rooms, 56 % of delivery rooms and 93 % of the cribs for healthy newborns are in secondary care facilities. In contrast, 92 % of general medicine offices, 83 % of general practitioners and 3 % of family medicine specialists are found in primary care units.

The results confirm the distributive health policy implemented in Mexico, which overlooks the criterion of the potential user population for the provision of services. This study highlighted the uneven DHR in relation to the number of WCBA, which might explain the high percentage of pregnant women inter-municipal migration for childbirth care to municipalities with more resources or that were available at the time they were required. Two out of every five childbirths were extraterritorial to the place of maternal usual residence. Although local density of resources in the L and VL birth strata was better, there was a high percentage of care in other municipalities, either because health resources were concentrated there or because local obstetric care services were not operating at the time they were required.

According to the results, inadequate planning of health resources for obstetric care and the medical care model are added to the known factors associated with high CSR and thus, considering these dimensions in the development of public policies aimed at reducing C-section rates is also required.

In this reengineering, designing primary care units with an acceptable area for the care of imminent or low-risk deliveries would be necessary, considering the distribution of the demanding population and the necessary health resources, in addition to strengthening primary care services, which also requires improving general practitioners capabilities and the quality of care.

Furthermore, estimating an adequate and rational CSR according to the context of the country is necessary, which will serve as a reference for further evaluations on C-sections, under the current regulations of delivery care. In addition, rational indicators of productivity and use of health resources are required.

Changes in the demographic and epidemiological profile of the Mexican population are foreseeable for the years to come. The health system needs to be adjusted to respond to these changes, especially including the composition of human resources, particularly towards vaginal route obstetric care.

The approach of this research report offers novel and important conclusions within the context the country is living in.

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