Is a Rising Cesarean Delivery Rate Inevitable? Trends in Industrialized Countries, 1987 to 2007

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ABSTRACT: Background: *Cesarean delivery rates have been rising rapidly in many countries in the last decade. The objective of this research is to examine cesarean rates in industrialized countries and assess patterns in the trends toward increasing rates.* **Methods:** *We examined cesarean delivery rates per 1,000 live births from 1987 to 2007 in 22 industrialized countries. To enhance comparability, the inclusion criteria were at least 50,000 births annually and a per capita gross domestic product of at least U.S.$10,000 in 2007. Poisson regression was selected to model the cesarean delivery rates of countries across time.* **Results:** *We examined overall cesarean delivery rates, absolute changes in these rates, and changes in trend lines for cesarean rates for the period from 1987 to 2007. In 2007, 11 of the 21 countries reported overall cesarean rates of more than 25 percent, led by Italy (39%), Portugal (35%), the United States (32%), and Switzerland (32%). Five countries, the Slovak Republic, Czech Republic, Ireland, Austria, and Hungary more than doubled their cesarean delivery rate between 1992 and 2007. Comparing changes in rates across time periods, 14 countries experienced a greater increase in rates in the period between 1998 and 2002 compared with the period between 1993 and 1997. Comparing trends from 2003–2007 to 1998–2002, eighteen countries experienced a slowing down of rate increases across these two periods.* **Conclusion:** *Although cesarean delivery rates continue to rise, the rate of increase appears to be slowing down in most industrialized countries. (BIRTH 38:2 June 2011)*

Key words: *cesarean delivery rates, cesarean trends, cross-national analysis, trend analysis*

Almost a century ago John Whitridge Williams questioned the overuse of cesarean section (1). Concern with rising cesarean delivery rates has once again emerged as rates in several industrialized countries (Italy, United States, Portugal, Australia, South Korea) (2) and selected Latin American and South American countries (Mexico, Brazil, Chile) (3) have exceeded 30 percent. Attempts to establish guidelines for appropriate cesarean delivery rates by the World Health Organization (WHO) (10–15%) (4) and the U.S. Public Health Service (15.5% primary cesarean rate for singleton, vertex, full gestation births) (5) have been questioned as not reflecting changing practices and attitudes among physicians and mothers (6–8).

Several changes in clinical practice would suggest that an increase in cesareans is inevitable, particularly in the industrialized world. These changes include the practice of routinely performing a cesarean section in

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the case of multiple births or breech presentations, an aging maternal population, and, in some countries (e.g., United States), limitations on the use of vaginal birth after a cesarean section (9). Some, in focusing on potential problems (prolapse, incontinence) that might be avoided by a policy of routine cesarean delivery, have questioned the wisdom of vaginal delivery (10–12). In addition, popular but unsubstantiated claims have suggested that a rising cesarean delivery rate is based on maternal request (13). One might argue that a rising cesarean rate is inevitable, as a substantial broadening of the indications for a primary cesarean section (14,15) combined with an increase in the practice of routine repeat cesareans would inexorably lead to a growing number of cesarean deliveries. As the number increases, hospitals develop staffing plans and policies to accommodate additional cesareans (16), and some worry that the cycle reinforces itself. But is this what is currently happening?

Methods

We examined cesarean delivery rates per 1,000 live births from 1987 to 2007 in 22 industrialized countries. To enhance comparability, the inclusion criteria were at least 50,000 births annually and a per capita gross domestic product of at least U.S.$10,000 in 2007. By design these criteria excluded both countries with a relatively small number of births (e.g., Albania and Iceland) and larger, but less wealthy countries (e.g., Turkey and Mexico). For context, the average annual number of births for all the countries studied here, excluding the 4.2 million in the United States, was 258,000 in 2007, and the average gross domestic product per capita in that year was $41,444 compared with $46,452 in the United States.

The data are drawn primarily from two sources: the WHO *European Health for All Database* for European countries (17) and the Organisation for Economic Co-operation and Development's (OECD) *OECD Health Data 2010* (2) for the United States, Canada, Australia, and New Zealand. Generally, the WHO and the OECD report comparable but very slightly different rates (e.g., <1 percentage point), and when data were available from both sources, we used the larger and more comprehensive WHO data set. In some cases (e.g., Canada and Sweden), data from individual countries were used to fill in rates for time periods when no data were available from the other sources (18,19).

Two countries that met both volume and gross domestic product standards, Greece and Japan, were excluded because consistent recent data on cesarean delivery rates were not published in international sources and could not be located from country sources. The case of Greece may be notable, as at the time of the last reported rate in the WHO Europe Database (1991), the country had the highest cesarean rate (24%) in Europe. As with any effort to compare national rates over time, cases of missing data occurred for individual countries for particular years. For example, Ireland, the Netherlands, and Slovak Republic all reported national cesarean delivery rates from 1990 onward, except for 1994. In Table 1, when a single year was missing, we chose the rate from a year before the reported rate, and these cases are noted in the table.

We examined overall cesarean delivery rates, absolute changes in these rates, and changes in trend lines for the rates for the period from 1987 to 2007. Poisson regression was selected to model the cesarean rates of countries across time. It was hypothesized that the cesarean rates would change over time; however, it was not expected that substantial changes in rates would occur in a single year. To model changes in rates over time, we used a piece-wise model assuming that 5-year increments from 1987 to 2007 would have similar annual changes in cesarean section rates. This assumption was supported by visual inspection of the cesarean rates for each country.

For the trend analysis, we evaluated whether the annual change in cesarean delivery rates differed in the time period 2003 to 2007 compared with 1998 to 2002 and in the time period 1998 to 2002 compared with 1993 to 1997 in each of the countries. The slope of the cesarean trend line for each country was compared using 5-year intervals by calculating an exponentiated change in rate (multiplicative scale), which is the ratio of the annual change in cesarean rate for a country during one period (e.g., 2003–2007) compared with another period (e.g., 1998–2002). The Poisson model was used to evaluate the equivalence of annual change in overall cesarean delivery rates for each country across two time periods. The 1993 to 1997 period was chosen as a baseline because it had fewer instances of missing data than the 1988 to 1992 period. All tests were performed at the 0.01 significance level.

Results

Current Rates

Table 1 presents the cesarean delivery rates at 5-year intervals from 1987 to 2007, an overall change in rate between 1992 and 2007, and two comparisons of trends in rate increases. In 2007, 17 of the 22 countries reported overall cesarean rates of more than 20 percent, led by Italy (39%), Portugal (35%), the United States (32%), and Switzerland (32%). Only the Netherlands (14%) reported a rate in the WHO-recommended range of 10 to 15 percent.

Table 1. Cesarean Rates (Per 1,000 Live Births) in Industrialized[a] Countries, 1987–2007

Country	*1987*	*1992*	*1997*	*2002*	*2007*	*Overall Change (1992–2007) %*	*Exponentiated Change in Rate (1998–2002 vs 1992–1997); Multiplicative Scale*	*Exponentiated Change in Rate (2003–2007 vs 1998–2002); Multiplicative Scale*
Australia	—	182	201	268	306	68.1	1.055[d]	0.966[d]
Austria	—	—	140	206	272	119.4[c]	1.033[d]	0.973[d]
Belgium	96	120	145	174	173	44.2	1.002	0.963[d]
Canada	196	177	184	234	266	50.3	1.058[d]	0.9716[d]
Czech Republic	70	88	118	141	196	122.7	0.970[d]	1.040[d]
Denmark	129	122	137	183	214	75.4	1.048[d]	0.971[d]
Finland	143	145	155	164	163	12.4	0.988[d]	0.993
France	—	145	160	187	199	37.2	1.019[d]	0.981[d]
Germany	—	159	181	237	284	78.6	1.031[d]	0.986[d]
Hungary	—	—	157	232	281	106.6[c]	1.007	0.961[d]
Ireland	89	120	153	225	266	121.7	1.031[d]	0.955[d]
Italy	175	232	270	362	398	71.6	1.035[d]	0.950[d]
The Netherlands	—	82	104	135	139	69.5	1.007[d]	0.951[d]
New Zealand	—	125	165	222	228	82.4	1.005	0.950[d]
Norway	129	126	129	161	169	34.1	1.043[d]	0.971[d]
Portugal	132	218	274	302	347[b]	59.2[c]	0.999	1.016[d]
Slovak Republic	73	99	130	177	223	125.3	1.020[d]	0.992
Spain	122	162	198	234	253	56.2	0.994[d]	0.990[d]
Sweden	108	107	125	156	176	64.4	1.014[d]	0.973[d]
Switzerland	192	—	—	254	316	78.5[c]	1.229[d]	0.899[d]
United Kingdom	—	—	167	217	230	62.0[c]	1.015[d]	0.955[d]
United States	237	223	208	261	318	42.6	1.073[d]	0.992[d]
Weighted average of all countries	201	186	193	244	277	48.9	1.048	0.978
Weighted average excluding United States	146	156	180	230	237	51.9	1.031	0.955

[a]*Countries with at least 50,000 births annually and a per capita gross domestic product of at least U.S.$10,000 in 2007.*
[b]*Rate for Portugal is for 2006 rather than 2007.*
[c]*Austria, Hungary, and UK comparison is for 1995–2007; Switzerland comparison is for 1991–2007; and Portugal is for 1992–2006.*
[d]$p < 0.01$.
Sources: From References (2), (17), and (19).

Changes in Absolute Rates

Of the 14 countries for which we have data in 1987, only one, the United States, had a cesarean delivery rate greater than 20 percent, and by 1992 only three (Italy, the United States, and Portugal) exceeded 20 percent, whereas four (Belgium, Czech Republic, the Netherlands, and Slovak Republic) reported rates of less than 10 percent. The weighted average of the increase in cesarean rate between 1992 and 2007 was 52 percent among all countries excluding the United States, while the United States experienced a 43 percent increase. Almost half the countries (10) experienced an increase of 70 percent or more between 1992 and 2007, led by the Czech Republic, Ireland, Austria, and Hungary, all of which more than doubled their cesarean delivery rates over the 15-year period. In absolute terms, Italy increased its cesarean rate by 15 percentage points and Ireland by 14.6, whereas two countries, Norway (4 percentage point increase) and Finland (2 percentage point increase), experienced minor changes.

Changes in Trends

A related question to absolute and relative changes in cesarean delivery rates is to ask whether or not *the rate of increase* in cesareans (i.e., the velocity of change) is slowing, and here the findings are more mixed. The slope of the cesarean trend line for each country from 2003 to 2007 was compared with the slope from 1998 to 2002, and the same comparison was performed for 1998 to 2002 compared with 1993 to 1997 based on the exponentiated change in rate. Comparing the 1998

to 2002 period with 1993 to 1997, 14 of 21 countries (Switzerland was excluded from this comparison because of missing data), led by the United States, Canada, and Australia, experienced significant increases (an acceleration in the rate of change indicated by an exponentiated change significantly greater than 1) in the growth of their cesarean delivery rate. Three of the countries experienced a significant slowing in the rate of change, and in four no difference was found. Comparing the two most recent periods (2003–2007 vs 1998–2002), only two countries (Czech Republic and Portugal) had a significant increase in their slope. Eighteen countries, led by Ireland and New Zealand, had a significant *decrease* in their slope, and two showed no difference. No countries saw significant acceleration or deceleration across both periods. The overall weighted average for all countries showed a rapid acceleration in rising cesarean rates from 1998 to 2002 compared with 1993 to 1997 and a distinct slowing in that growth in the period 2003 to 2007. To minimize the possibility that these rate changes may have been influenced unduly by the periods chosen for comparison, we also tested the model using other periods (e.g., 1996–2000 with 2001–2005) for comparison and found comparable results.

To illustrate the differences in patterns, the trends from 1985 to 2008 for the three industrialized countries with the highest current rate (Italy, Portugal, and the United States—all >30%) and three countries with the lowest current rates (Netherlands, Finland, and Norway—all <17%) are presented in Fig. 1. This figure illustrates that starting with lower rates was no guarantee of continuing with low rates. Italy and Portugal both began in 1985 with rates comparable with the three countries with current low rates, but then experienced consistent annual increases over the next two decades. The United States exhibits a unique pattern, starting with a 1985 rate of about 10 percentage points higher than other countries, *declining* in the early 1990s and then rapidly increasing between 1996 and 2008. The Netherlands and Norway had a cesarean delivery rate of less than 13 percent in 1985, gradually increasing until 2002, and then leveling off. Finland had a rate of 15 percent in 1985 and has since stayed within 2 percentage points of that figure.

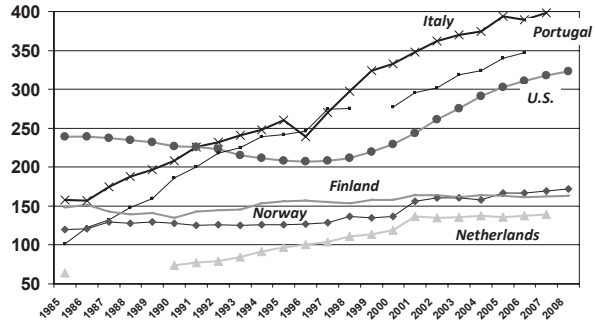

Fig. 1. Trends in cesarean delivery rates (per 1,000 births), selected countries, 1985–2008. Note: The selected countries include those with three highest and three lowest rates among the industrialized countries in 2007. Sources: References (2) and (17).

Discussion

Is a rising cesarean delivery rate inevitable? The simple answer is a tentative "no," but much depends on where one lives. For the last 20 years almost all industrialized countries have experienced a consistently rising cesarean rate, although in almost all these countries that growth is slowing down (i.e., analogous to continued forward motion in a car that is decelerating), and in several countries rates have leveled off. It may be that these more modest recent increases are a forerunner of a general leveling in national rates. Alternatively, this slowing in growth might be but a brief pause in a long-term upward trend.

Furthermore, and importantly for individual childbearing women, these national rates also mask considerable variability within many countries, particularly in those with high rates. In Italy, for example, cesarean rates in the southern region of the country (e.g., Campagnia at 59%) are more than twice those in the central and northern regions (e.g., 23% in Friuli Venezia Giulia) (20). In the United States, the rate (38%) of cesareans in New Jersey in 2007 was more than 70 percent higher than that in Utah (22%) (21), indicating that caution is warranted when generalizing about national trends.

We described the rationale for a continually rising rate in the introduction. Further research is needed to determine what factors are associated with the leveling of cesarean delivery rates in several countries. How have they avoided the steadier rise experienced by other countries? Can similarities be identified among these countries in terms of health care systems, populations, or clinical practice? What other relevant trends are associated with the different cesarean curves (e.g., maternal and neonatal morbidity or benefit)?

There are no simple answers to these important questions in published cross-national data. As quickly as potential explanations for cross-national differences in cesarean delivery rates are proposed, notable exceptions are discovered. For example, some have suggested that less reliance on obstetricians for care in uncomplicated births may reduce cesarean rates, and indeed the United States has more than double the proportion of obstetricians per birth than the Netherlands. However, in Sweden the proportion of obstetricians per birth is similar to that in the United States, and Sweden has only

slightly more than half the American cesarean delivery rate (2).

The *European Perinatal Health Report* provides some additional data from 2004 that can be suggestive in examining cross-national patterns (22). Vaginal birth after cesarean (VBAC) rates appear inversely related to overall cesarean rates in the 10 countries in the *Report* that provide such rates. The three countries with the lowest cesarean rates (the Netherlands, Norway, and Finland) all reported VBAC rates of greater than 50 percent. However, Germany, with a VBAC rate of 41 percent, still maintained an overall cesarean rate of 28 percent, whereas Belgium (Flanders) with a relatively low VBAC rate (32%) also maintained a cesarean rate of less than 20 percent. Likewise, rates for induction of labor (reported for 10 countries) range from a low of 11 percent for Sweden, with its cesarean rate of 18 percent, to an induction rate of more than 26 percent for Belgium, a country that reported a cesarean rate of 17 percent.

National differences in health care finance, the medical–legal system, and professional guidelines may also contribute to differences in cesarean delivery rates. In systems with more central funding of health care, the direct and indirect costs of cesarean births may create pressure to reduce their number. Differences in the legal climate in countries with lower rates may also affect decision making during difficult labors. Guidelines about decision making related to areas such as VBAC, vaginal breech birth, and maternal choice may both reflect the culture of practitioners in different countries and influence practice related to cesareans.

More subtle and difficult to measure may be international variations in attitudes toward cesarean birth. Is there a sense among practitioners, policymakers, and mothers in a given country that a rising cesarean rate is even a problem? Cross-national studies of obstetrician's attitudes toward cesarean birth suggest that wide differences exist (23). The few national studies of mothers' attitudes toward maternity care also find substantial cross-national differences (24,25). In terms of both mothers' and obstetricians' attitudes, however, the data are too limited to be applied directly to differences in cesarean rates.

An example from Finland may suggest how attitudinal differences can influence cesarean delivery rates. In some cases a minor factor suggested as contributing to the increase in cesareans is a fear of labor and delivery, so much so that the term *tokophobia* has now been added to the lexicon of conditions (26). One response to a mother's fear of labor and delivery is for a clinician to suggest or be open to elective cesarean birth as an option. The response in Finland has been to deal directly with the problem by establishing "fear clinics" to address the underlying cause of childbirth fear and identify means for mothers to cope with it, rather than opting for a cesarean section. It is not likely that establishing Finnish "fear of childbirth" clinics has significantly reduced the overall cesarean rate, but they may characterize an approach to childbirth that sees cesareans as a last option, rather than a first option, in addressing complications (27).

This brief study of cesarean delivery rates is limited primarily by the lack of complete cross-national data on key indicators of cesarean birth. As valuable as the *European Perinatal Health Report* is, it could provide data on VBACs and inductions for only 10 of the 22 countries examined here. Comprehensive cross-national analysis using a measure such as the Robson groups, which relies on additional data (induction, prior cesarean, breech presentation), is not currently possible with the available data (28). Consistency in reported national cesarean delivery rates is not even complete. As noted earlier, the rates reported by WHO and OECD, which are typically within a percentage point of each other, are not exactly the same and in a few cases differ by 2 to 3 percentage points, although the trends are comparable.

The general slowing of the rise in the cesarean delivery rate suggests that "inevitable" is too strong a description for the current trends and that national cesarean rates may be nearing a plateau. There are, of course, limits to both how high (100%) and how low (0%) cesarean delivery rates will go, and as rates approach these extremes the rate of change will inevitably lessen. The upper limit is likely less than 100 percent (some women will have vaginal deliveries even if universal cesarean delivery is planned), and the slowing may reflect rates approaching systemic limits in some countries. However, even if cesarean rates have begun to level off, they have done so at rates far higher than two decades ago. The ultimate question, of course, is whether these higher rates will result in improved population outcomes, and here the results are mixed (29,30). Although the evidence of benefit is clear when developing countries create an infrastructure that can support cesarean births, for industrialized countries the balance of risks and benefits resulting from increasingly high cesarean rates deserves careful and considered evaluation.

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