Relationship Between Malpractice Litigation Pressure and Rates of Cesarean Section and Vaginal Birth After Cesarean Section

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Background: Since the 1990s, nationwide rates of vaginal birth after cesarean section (VBAC) have decreased sharply and rates of cesarean section have increased sharply. Both trends are consistent with clinical behavior aimed at reducing obstetricians' exposure to malpractice litigation.

Objective: To estimate the effects of malpractice pressure on rates of VBAC and cesarean section.

Research Design, Subjects, Measures: We used state-level longitudinal mixed-effects regression models to examine data from the Natality Detail File on births in the United States (1991–2003). Malpractice pressure was measured by liability insurance premiums and tort reforms. Outcome measures were rates of VBAC, cesarean section, and primary cesarean section.

Results: Malpractice premiums were positively associated with rates of cesarean section ($\beta = 0.15$, $P = 0.02$) and primary cesarean section ($\beta = 0.16$, $P = 0.009$), and negatively associated with VBAC rates ($\beta = -0.35$, $P = 0.01$). These estimates imply that a $10,000 decrease in premiums for obstetrician-gynecologists would be associated with an increase of 0.35 percentage points (1.45%) in the VBAC rate and decreases of 0.15 and 0.16 percentage points (0.7% and 1.18%) in the rates of cesarean section and primary cesarean section, respectively; this would correspond to approximately 1600 more VBACs, 6000 fewer cesarean sections, and 3600 fewer primary cesarean sections nationwide in 2003. Two types of tort reform—caps on noneconomic damages and pretrial screening panels—were associated with lower rates of cesarean section and higher rates of VBAC.

Conclusions: The liability environment influences choice of delivery method in obstetrics. The effects are not large, but reduced litigation pressure would likely lead to decreases in the total number cesarean sections and total delivery costs.

Key Words: medical malpractice, tort reform, cesarean section, defensive medicine, liability

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The dictum, "once a cesarean, always a cesarean" governed obstetrical practice in the United States for most of the last century.[1] In the 1980s, concerns over rising rates of cesarean section and reports of safe experiences with vaginal birth after cesarean (VBAC)[2] led expert bodies to promote trial of labor for patients who had had previous cesarean deliveries.[3,4] With the spread of managed care in the 1990s, some hospitals and health insurers did the same, in part because they were attracted to the shorter hospital stays and less intensive use of medical services typically associated with VBACs. VBAC rates increased steadily through the 1990s, peaking in 1996, when 28.3% of women with a previous cesarean section delivered vaginally.[5] But the rise proved temporary: by 2004, the VBAC rate had dropped to 9.2%.[6] The old dictum had regained currency.

The reasons for the shift away from VBACs over the past decade are unclear, but safety concerns seem to have been influential. The American College of Obstetricians and Gynecologists narrowed its recommended eligibility criteria for VBACs in 1999, citing such concerns.[7] Failed VBACs may cause serious complications, including uterine rupture and neonatal morbidity.[8] However, the evidence evaluating their safety relative to cesarean section remains fluid, and does not counsel uniformly against them.[7,9–11]

Because patient safety problems can lead to malpractice claims, fear of medical malpractice litigation is also widely believed to have influenced the waning popularity of VBACs.[12,13] Obstetricians are sued more frequently than physicians in most other specialties, awards against them can

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be very large, and they pay more for liability insurance coverage than any other specialty except neurosurgeons. Cesarean sections are not risk free, but they are widely perceived to reduce risks of the kinds of catastrophic birth injuries that fuel expensive litigation.[14,15]

A number of previous studies have found a positive association between malpractice claims experience or malpractice insurance premiums and cesarean section rates[16–20]; others have found no such relationship.[21–23] There is little available information concerning the effect of tort reforms on cesarean section rates, and virtually none on the effect of malpractice pressure on VBAC rates. Using data on births in the United States between 1991 and 2003, we investigated the impact of states' liability environment on rates of VBAC and cesarean section in the state. We hypothesized that higher levels of malpractice pressure would lead obstetricians to favor cesarean section and disfavor VBAC.

METHODS

Conceptual Framework and Overview

Our analytical approach rests on the theory that obstetricians' decisions about delivery method are influenced by a mix of medical and nonmedical factors. The nonmedical factors include the degree of malpractice pressure in the obstetrician's practice environment, patient socioeconomic characteristics and insurance status, and hospital characteristics. High malpractice pressure, the variable of primary interest in this study, should lead obstetricians to prefer clinical choices that minimize the risk of serious birth injuries and the lawsuits that those injuries sometimes trigger. When such choices are not medically indicated for a particular patient, they can be considered "defensive medicine."

We use the average liability insurance premiums paid by obstetrician-gynecologists in each state as a marker of malpractice pressure. Premiums represent the insurer's estimate of the malpractice risk for a physician in a given specialty and market. To evaluate the potential for policy interventions to reduce defensive medical practice in obstetrics, we also test whether the presence of various liability-limiting tort reforms affected preferences for cesarean section and VBAC. Because previous research has demonstrated that these 2 measures of liability pressure are correlated,[24,25] we model them in separate regression analyses. We use states as the unit of analysis because our chief focus is state-level effects to inform state-level policy and decision making, and variations in the liability environment occur primarily at the state level.[26]

Data

We extracted data on approximately 52 million recorded births in the United States between January 1, 1991 and December 31, 2003 from the Natality Detail File (NDF).[27] NDF data come from birth certificate information collected by the states and transmitted to the National Center for Health Statistics. The dataset includes method of delivery, as well as demographic and lifestyle characteristics of the mother.

Delivery Method

For each state in each year ("state-year"), we calculated rates of VBAC, cesarean section, and primary cesarean section. The VBAC rate was calculated by dividing the number of vaginal deliveries among women with a previous cesarean section by the total number of deliveries among women with a previous cesarean section. The total cesarean rate was calculated by dividing the total number of cesarean sections by the total number of deliveries. Primary cesarean sections are of special interest because they create an increased risk of delivery by cesarean section in future births. The primary cesarean rate was calculated by dividing the number of first cesarean sections by the total number of deliveries to women who had not had a previous cesarean. Because our focus is clinical decision making regarding choice of delivery method, we assign one method to multiparous births, based on the first delivery, and count it once.

Liability Pressure

We obtained data on malpractice premiums for obstetricians from the Medical Liability Monitor Annual Rate Survey. The Medical Liability Monitor conducts an annual 50-state survey of liability insurance carriers to elicit information on premiums charged to physicians in obstetrics-gynecology, general surgery, and internal medicine. Companies provide average premiums by geographic region within each state they serve; premiums charged by government-run secondary-layer insurance schemes are also included. We weighted these data to account for the insurers' market share[28] and the geographic distribution of physicians within the state,[29] and then adjusted the figures to real 2003 dollars (the weighting method is described in detail in the technical appendix, which is available online at http://links.lww.com/A632).

Information on tort reforms was obtained from the National Conference of State Legislatures,[30] the American Tort Reform Association,[31] and an internet database maintained by a law firm.[32] We constructed binary variables to indicate the presence of the following tort reforms in each state-year: attorney fee limits, modification of the collateral-source rule, caps on damages, expert-witness restrictions, modifications to joint-and-several-liability rules, periodic payment of awards, shortening of statutes of limitations, and use of pretrial screening panels (procedures designed to weed out nonmeritorious claims at an early stage). We model damages caps using 4 dummy variables (1 punitive damages cap and 3 levels of noneconomic damages cap). Because tort reforms tend not to affect the malpractice climate instantaneously,[33] we lag each tort-reform variable by 1 year from the date of its implementation. If a tort reform was subsequently held unconstitutional, its value is set to zero beginning in the year after the holding.

We completed construction of these tort reform variables before publication of another comprehensive compilation of state tort reforms by Avraham.[34] We subsequently cross-checked our database of tort reforms with the Avraham database. The variables were essentially the same, except for 2 differences in the respective coding schemes. For damages caps, we coded 4 different levels whereas Avraham chose a

simple binomial indicating whether any cap existed. For periodic-payment reforms, Avraham coded 2 different levels, based on whether they were voluntary or mandatory; we used a binomial.

Control Variables

Provider Factors

Managed care penetration,[35] hospital ownership[36] and location,[37] and type of delivering clinician[38] are all provider-side factors that may influence obstetricians' choice of delivery method. Our model includes variables to control for each of these factors across states and time. Using Interstudy data,[39] we model HMO penetration rates for each state-year. Variables indicating the percentages of investor-owned hospitals, not-for-profit hospitals, and urban hospitals in each state-year are based on data from the American Hospital Association.[40] We also incorporate variables capturing the percentage of nonphysician-assisted births and out-of-hospital births in each state-year.

Patients' Medical Risk Factors

Obesity rates have been rising and obese women are more likely to deliver by cesarean section.[41,42] We calculated female obesity rates for the state-years using data on all females from the Behavioral Risk Factor Surveillance System (data on obesity rates among women of childbearing age were unavailable).[43] The probability of delivering by cesarean section is also higher for multiple births[44] and for women over 35 years of age.[17] Proportions of births in each state-year with these characteristics were calculated and are incorporated into the models.

We also sought to control for 14 clinical risk factors for delivery by cesarean section that are included in the NDF,[18] namely: abruptio placenta, breech birth, cephalopelvic disproportion, chronic hypertension, cord prolapse, diabetes, dysfunctional labor, eclampsia, excessive bleeding, fetal distress, incompetent cervix, placenta previa, pregnancy-associated hypertension, and prolonged labor. To address the high degree of collinearity that existed among some of these risk factors and gain statistical power, we used principal-component analysis to collapse them into 4 principal components which collectively explained 83% of the variation from all conditions.

Socioeconomic Factors

Previous research has identified lower rates of cesarean section among women without health insurance and higher rates among privately insured women, and rates for women with public insurance that fall in between.[45,46] We obtained data on the health insurance status (Medicaid, private, or uninsured) of women in each state-year from the US Census Bureau[47] (again, targeted information on women of childbearing age was unavailable). Race[48,49] and education[50,51] may independently predict delivery method.[52] We control for them using NDF data on births to minority mothers and mothers with a college education.

Analysis

The panel dataset consists of 13 repeated measures for each of the 50 states and the District of Columbia. To account for the possibility of spatial correlations among jurisdictions, we add a level of region based on the 9 census divisions. Thus, the analytical dataset has 3 levels: state, year, and region. The regression models uses simple polynomial trends to capture changes in the mean responses over time.

We use a mixed-effects model (also called a hierarchical or multilevel model), an extension of the traditional random-effects model.[53] The mixed model contains fixed and random components, and permits investigation of both within- and between-state variation over time. It is a further generalization of linear regression which allows for the inclusion of random variations other than those affiliated with the overall error term. The underlying premise of the mixed model is that some of the regression parameters vary randomly from one individual to another, whereas others do not. The distinctive feature of the model is that the mean response is modeled as a combination of population characteristics that are assumed to be shared by all individuals (fixed effects) as well as subject-specific (random) effects that are unique to a particular individual.

Using maximum likelihood variance component estimation, mixed models generate statistically efficient estimates of fixed regression coefficients. Specifically, mixed models adjust for autocorrelation and model heteroscedasticity via covariance structures, and allow a more appropriate and realistic specification of complex variance structures at each level. This model is well suited to analyses of hierarchical effects where the explanatory variables are measured at more than one level and to modeling repeated measures where observations are correlated rather than independent.

Several considerations support the use of a mixed model. First, tort reforms were largely time-invariant in many states over the study period, rendering a fixed-effects model less appropriate, and increasing risks of confounding. Fixed-effects models compare the average change in the outcome variable in the states that adopted (or abandoned) a tort reform with the average change in the rest of the states. But if only a handful of states adopted (or abandoned) a tort reform during the study period, the precision of the resulting estimates may be low, and there may be confounding by unobserved time-varying effects (personal communication with Dr. Joseph Newhouse, August 24, 2005).[33] Second, dummy variables created by fixed-effects models consume many degrees of freedom. Third, fixed-effects models eliminate opportunities to examine between-state variation, which was of great interest in our study. Finally, Hausman tests supported a random-effects specification ($P > 0.17$ for all versions of our model).

The technical appendix (http://links.lww.com/A632) provides further details regarding the specification of the mixed-effects model and the inclusion of regional effects; it also elaborates on our rationale for choosing this model over the type of fixed-effects models that have been used in some previous analyses.

RESULTS

National Trends in Delivery Method and Malpractice Premiums, 1991–2003

Cesarean section rates (both total and primary) decreased from 1991 until the mid-1990s and then steadily increased (Fig. 1). Conversely, VBAC rates had a curvilinear trend, rising through 1995 and then dropping sharply after 1997. Another curvilinear trend is evident in the average malpractice insurance premiums paid by obstetrician-gynecologists nationwide during the study period (Fig. 2). Premiums during the mid-1990s were slightly lower than those during the early 1990s and early 2000s. Both the median premium and the degree of variation in premium levels across states increased after 1999.

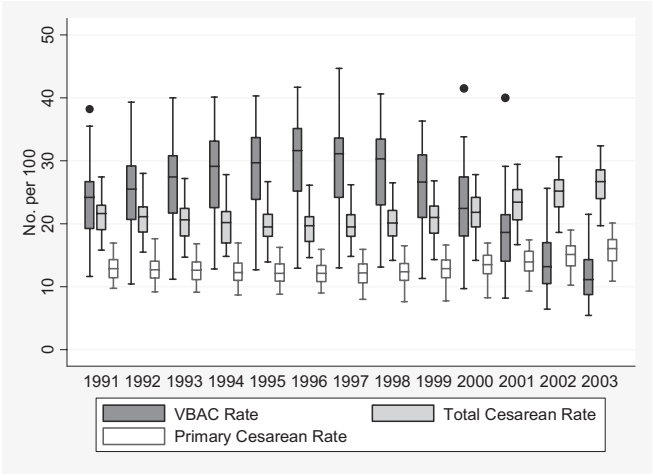

FIGURE 1. National rates of cesarean section and vaginal birth after cesarean section, 1991 to 2003.

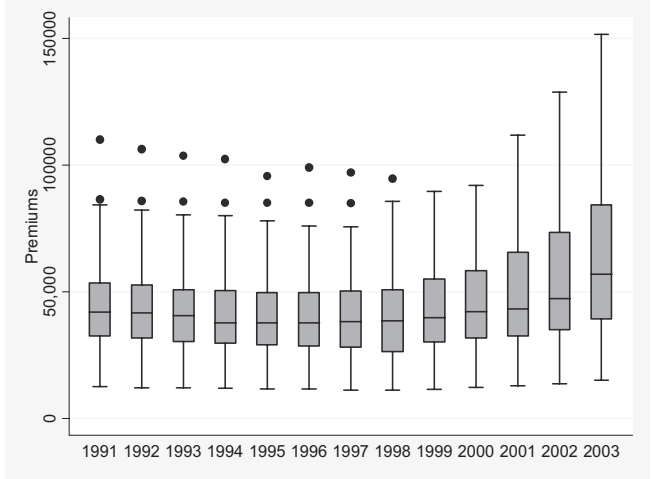

FIGURE 2. National average malpractice insurance premiums for obstetrician-gynecologists, 1991–2003. *, All values adjusted to 2003 dollars.

Study Sample

The study sample consisted of 663 state-year observations (Table 1). Across all state-years, the mean rate of cesarean sections was 21.3 per 100 births (SD = 3.6), the

TABLE 1. Characteristics of the Study Sample (n = 663*)

Variables	Mean	SD
Outcome variables		
Delivery method (per 100)		
VBAC	24.08	8.28
All cesarean sections	21.30	3.58
Primary cesarean sections	13.06	2.20
Other procedures (per 1000)		
Amniocentesis	2.81	1.59
Tocolysis	2.29	1.42
Explanatory variables		
Malpractice pressure		
Obstetrician-gynecologist insurance premiums ($2003)	$45,386	$21,237
Tort reforms	(Not shown)	
Provider factors (%)		
Nonphysician (midwife) births	7.34	4.93
Nonhospital births	1.11	0.88
Hospital type		
Urban	49.84	25.67
Investor-owned	11.88	11.71
Not-for-profit	62.42	24.73
HMO penetration	18.31	12.60
Maternal medical risk factors		
Before labor		
Obesity (per 100)	16.89	3.84
Multiple births (per 100)	2.81	0.51
Age >35 yr (per 100)	11.53	3.45
Chronic hypertension (per 1000)	0.78	0.26
Diabetes (per 1000)	2.74	0.79
Eclampsia (per 1000)	0.39	0.29
Incompetent cervix (per 1000)	0.26	0.12
Pregnancy-related hypertension (per 1000)	3.76	1.04
During labor (per 1000)		
Abruptio placenta	0.63	0.17
Breech/malpresentation	3.95	0.77
Cephalopelvic disproportion	2.60	1.02
Cord prolapse	0.21	0.11
Dysfunctional labor	2.87	1.52
Excessive bleeding	0.73	0.73
Fetal distress	4.09	1.49
Placenta previa	0.33	0.11
Prolonged labor (>20 h)	1.06	0.84
Socioeconomic factors (%)		
Insurance coverage		
Employment-based insurance	71.27	6.49
Medicaid	10.82	3.42
No insurance	14.02	4.03
Nonwhite births	20.06	14.77
College education or more	22.63	6.36

*Birth records with missing data (2%) were excluded.

average rate of primary cesarean sections was 13.1 per 100 (SD = 2.2), and the average rate of VBAC was 24.1 per 100 (SD = 8.3). The malpractice premium variable was specified as a continuous variable in $10,000 increments; hence, the figures shown in Table 1 denote an average premium of $45,386 and a standard deviation of $21,237.

Relationship Between Malpractice Insurance Premiums and Delivery Methods

Results from the multivariate regression analyses supported the study hypothesis that higher malpractice premiums for obstetrician-gynecologists stimulate greater use of cesarean section and reduced rates of VBAC. Average premiums were positively associated with rates of total cesarean section ($\beta = 0.15$, $P = 0.02$) and primary cesarean section ($\beta = 0.16$, $P = 0.009$), and negatively correlated with VBAC rates ($\beta = -0.35$, $P = 0.01$) (Table 2). The estimates imply that a $10,000 decrease in malpractice premiums (a reduction of 20% to 25% in the average premium for obstetrician-gynecologists during the study period) would lead to an increase of 0.35 percentage points (1.45% increase in the mean) in the VBAC rate and decreases of 0.16 and 0.15 percentage points (0.7% and 1.18%) in the primary and total cesarean section rates, respectively. At 2003 levels of these delivery methods, this would mean approximately 1600 more VBACs per year, 3600 fewer primary cesarean sections, and 6000 fewer cesarean sections overall.

Two or more of the components used to capture medical risk factors were significantly associated with the delivery method in all 3 models. The coefficients of these components are not directly interpretable, but their direction is appropriate: the presence of risk factors was associated with lower VBAC rates and higher cesarean section rates. Other significant predicators of delivery method were rates of multiple births, midwife births, and births to older women, as

TABLE 2. Multivariate Regression Results: Impact of Obstetrician-Gynecologist Malpractice Insurance Premiums on Rates of VBAC, Cesarean Section, and Primary Cesarean Section, 1991–2003 (n = 663)

	VBAC		Total Cesarean Section		Primary Cesarean Section	
	β	***P***	***β***	***P***	***β***	***P***
Insurance premiums ($10,000)	−0.35	0.01	0.15	0.02	0.16	0.009
Provider factors (%)						
Nonphysician (midwife) births	0.08	0.23	−0.06	0.01	−0.04	0.02
Nonhospital births	0.61	0.09	−0.28	0.08	−0.13	0.31
Hospital type						
Urban	−0.01	0.61	0.02	0.57	<0.01	0.69
Investor-owned	0.04	0.35	−0.01	0.17	−0.01	0.36
Not-for-profit	<0.01	0.85	<0.01	0.61	<0.01	0.78
HMO penetration	0.04	0.08	−0.02	0.009	−0.01	0.02
Maternal medical risk factors (per 100)						
Obesity	−0.15	0.42	<0.01	0.87	0.03	0.26
Multiple births	−0.45	0.41	0.64	0.008	0.69	0.007
Age >35 yr	−0.13	0.46	0.05	0.46	0.16	0.009
Medical conditions*						
Component 1	−0.64	<0.001	0.12	<0.001	0.09	<0.001
Component 2	−0.35	<0.001	0.05	<0.001	0.16	<0.001
Component 3	−0.29	0.01	0.04	0.63	0.02	0.64
Component 4	0.07	0.71	−0.01	0.81	−0.02	0.73
Socioeconomic factors (%)						
Insurance status						
Medicaid	−0.04	0.54	0.09	0.18	0.08	0.15
No insurance	−0.05	0.42	0.02	0.54	<0.01	0.77
Nonwhite births	−0.05	0.24	<0.01	0.82	0.01	0.55
College education or more	0.25	0.21	0.04	0.37	0.03	0.54
Time trend						
Linear time trend	−1.22	<0.001	0.20	<0.001	0.05	<0.001
Quadratic time trend	−0.27	<0.001	0.12	<0.001	0.06	<0.001

*The 4 principal components represent 14 conditions: abruptio placenta, breech birth, cephalopelvic disproportion, chronic hypertension, cord prolapse, diabetes, dysfunctional labor, eclampsia, excessive bleeding, fetal distress, incompetent cervix, placenta previa, pregnancy-associated hypertension, and prolonged labor.

TABLE 3. Multivariate Regression Results: Impact of Tort Reforms on Rates of VBAC, Cesarean Section, and Primary Cesarean Section, 1991–2003 (n = 663)

	VBAC		Total Cesarean Section		Primary Cesarean Section	
	β	*P*	*β*	*P*	*β*	*P*
Tort reforms*						
Damages reforms						
Attorney fee limits	1.22	0.17	−0.78	0.10	−0.48	0.11
Collateral source rule	−0.68	0.18	0.11	0.64	−0.04	0.80
Caps on damages						
Punitive damages only	0.74	0.09	0.12	0.43	0.18	0.21
Noneconomic damages, ≤$250,000	1.92	0.01	−0.32	0.04	−0.48	0.03
Noneconomic damages, $250,001–$500,000	1.37	0.02	−0.15	0.02	−0.22	0.04
Noneconomic or total damages, >$500,000	1.25	0.04	−0.47	0.62	−0.19	0.37
Periodic payment	0.85	0.13	−0.27	0.29	−0.05	0.84
Modifications of liability rules						
Expert witness rule	0.54	0.25	0.02	0.92	0.01	0.93
Joint-and-several liability rule modified	0.30	0.63	−0.38	0.19	−0.45	0.18
Limitations on access to court						
Pretrial screening	0.07	0.04	−0.28	0.009	−0.26	0.008

*The reforms models were separated from the premiums models, which were showed in previous table. Explanatory variables other than tort reforms used in the regression: nondoctor births (midwife births), nonhospital births, urban hospitals, investor-owned hospitals, not-for-profit hospital, HMO penetration, obesity, multiple births, births to women >35 years old, 4 medical risk components, Medicaid, no insurance, nonwhite births, college education or more, linear time trend, and quadratic time trend.

well as the degree of HMO penetration. State-years with relatively higher rates of multiple births had higher rates of delivery by both total and primary cesarean section. Larger proportions of births to women over 35 years were associated with significantly higher rates of primary cesarean section. Cesarean sections were less common among deliveries by nonphysicians and in states with relatively high HMO penetration. Finally, there were significant time trends for all 3 delivery methods.

Relationship Between Tort Reforms and Delivery Methods

Caps on noneconomic damages were the leading predictor of delivery method among the 10 types of tort reforms investigated (Table 3). VBAC rates were significantly higher and cesarean section rates were significantly lower in state-years in which caps on noneconomic damages were in force. The effect size increased with the stringency of the cap: caps of $250,000 or less were associated with a 1.92 percentage point (7.97%) higher VBAC rate, caps between $250,001 and $500,000 with a 1.37 percentage point (5.69%) higher rate, and caps above $500,000 with a 1.25 percentage point (5.19%) higher rate.

Noneconomic damages caps were inversely related to rates of cesarean section, although the effects were smaller and were statistically significant for only the lower cap levels. A cap of $250,000 or less was associated with a reduction of 0.48 percentage points (3.68%) in the primary cesarean section rate and a 0.32 percentage point (1.5%) reduction in the total cesarean section rate. Extrapolating to the national level, our estimates suggest that a nationwide cap on noneconomic damages at the $250,000 level would be associated with approximately 9000 more VBACs, 12,800 fewer cesarean sections, and 8000 fewer primary cesareans per year.

Pretrial screening panels had a modest but statistically significant, positive relationship with VBAC rates ($\beta = 0.07$, $P = 0.04$), and a stronger, inverse relationship with rates of total ($\beta = -0.28$, $P = 0.009$) and primary ($\beta = -0.26$, $P = 0.008$) cesarean section. No other tort reforms were significantly associated with rates of the delivery methods under investigation. The coefficients and *P* values for the other explanatory variables (provider, medical risk, socioeconomic) included in the model are not shown in Table 3, but are generally in line with the estimates from the premium models.

Sensitivity Analyses

We tested the robustness of our findings in 3 separate sensitivity analyses. First, to explore the possibility that the observed relationships between liability pressure and obstetric practice were not causal—for example, whether they might be an artifact of some unobserved styles or dimensions of obstetric practice that vary over time and across different liability environments for reasons unrelated to malpractice pressure—we reran the regression analyses substituting amniocentesis and tocolysis rates as the outcome variables. We

chose amniocentesis and tocolysis because obstetrician-gynecologists tend to have limited discretion about when to order them; therefore, they should be relatively insensitive to the liability environment. If the liability measures were statistically significant in the tocolysis and amniocentesis models, this would suggest either that these procedures are not truly unrelated to liability pressure, and are therefore poor benchmarks; or that the coefficients on liability variables are capturing some other unobservable effect and the model has an omitted-variable problem. We found that neither the premium variable nor any of the tort-reform variables were significant predictors of the rates of either procedure.

Second, to investigate possible aggregation bias in our analyses of state-level means and proportions, we reconstructed the models with individual births as the unit of analysis. We tested a random sample of 1% of the births from 1993, 1996, 1999, and 2002 (n = 160,742) using the same outcomes, explanatory variables, and mixed-effect approach, but employing logit estimation to model the probability of vaginal and cesarean delivery. After adjusting the coefficients for comparability (Technical Appendix, http://links.lww.com/A632), the estimates were very similar to those obtained in the state-level models. The standard errors in the birth-level model were smaller, but the signs and significance levels of the key coefficients were essentially unchanged.

Third, we tested an alternative specification of the medical risk factors, collapsing them into 6 components which explained 90.5% of the variance. The coefficients and significance levels for the liability pressure variables did not change in either the premium or tort-reform versions of the model.

DISCUSSION

This study found a statistically significant association between malpractice pressure and delivery method in obstetrical practice. States with relatively high malpractice insurance premiums had lower rates of delivery by VBAC and higher rates of cesarean section than states with lower premiums. Two kinds of tort reforms—damages caps and pretrial screening—predicted delivery method. Both reforms were associated with higher VBAC rates and lower cesarean section rates. The likelihood of a causal relationship between malpractice pressure and rates of these procedures is substantiated by the lack of any association between these variables and in rates of amniocentesis and tocolysis.

The effect sizes we observed, particularly in the premium models, are modest, and do not explain the overall decline in VBAC rates since 2000. However, in the context of approximately 4 million births per year, the impacts are not trivial. Based on estimated charges for uncomplicated vaginal delivery and uncomplicated cesarean delivery,[54] a $10,000 reduction in premiums nationwide would result in $32.6 million (in 2006 dollars) in reduced expenditures annually on obstetrical services, and a nationwide $250,000 cap on noneconomic damages would save $69.7 million. These estimates do not take into account additional expenses for cesarean complications (which would increase net savings) or the costs of litigation over VBACs with poor outcomes that a cesarean section may have avoided (which would decrease net savings).

Our findings concerning primary cesarean sections are of particular interest to clinicians and policymakers seeking to reduce the use of cesarean delivery. Although we observed similar percentage-point decreases in total and primary cesarean rates when malpractice premiums were lower, the effect on primary cesareans is actually more dramatic because the baseline rate of primary cesarean section is substantially lower (13.1% in our sample) than the total cesarean rate (21.3%). Moreover, avoiding cesarean section in a mother who has not previously had one will also decrease her chances of delivering by cesarean section in subsequent births.

To our knowledge, the only previous investigation of the effect of malpractice pressure on VBAC rates is a study of births in New York State in 1989.[51] It found no significant association between either physicians' malpractice premiums or hospitals' claims payments and patients' likelihood of delivering by VBAC. This single-state, cross-sectional study of a year in which the liability environment was quite favorable may not be indicative of the national situation or obstetric practice in more turbulent times.

We are aware of one previous study of the relationship between tort reforms and cesarean sections.[55] That analysis found that joint-and-several liability reform significantly reduced the probability that an individual would receive a cesarean section, but noneconomic damages caps increased it. The latter finding challenges previous research which has underlined caps as the tort reform with the greatest effect on claims costs and insurance premiums.[56] In addition, use of a fixed-effects modeling approach in the context of time-invariant covariates may be problematic (Technical Appendix, http://links.lww.com/A632).

The literature concerning the relationship between malpractice premiums or claims payments and use of cesarean section is much larger, but has yielded conflicting results. Physician surveys indicate that many obstetricians view cesarean sections as a way to minimize their exposure to litigation and may practice accordingly.[57,58] Some multivariate analyses of actual birth data have linked malpractice pressures to higher cesarean section rates[16–20]; others have found no such relationship.[21–23] The key limitations of these studies are cross-sectional design or a narrow institutional or geographic focus,[16–22] short time period for the analysis,[19,20,23] and omission of important control variables.[16,23] Our study innovates by examining a much longer window of time than previous investigations, including periods of both stability and instability in malpractice environments; controlling carefully for both patient risk factors and provider effects; and utilizing more accurate premium data (weighted by market share and physician distribution).

The study has limitations, however. First, characteristics of individual clinicians (eg, gender, malpractice history) that we could not include in our state-level models may influence choice of delivery method. Second, we assumed that tort reforms take one year to take full effect, which is simplistic; in reality, the lag time is likely to vary by reform type and state. Third, we could not account for the role of

patient demand for elective cesarean section in driving overall and primary cesarean section rates. Demand for cesarean section may be influenced by both patient desires and physician preferences, but it is the former that presents challenges for our analysis. National data on the prevalence of elective cesarean sections are currently unavailable, but patient demand is reportedly growing as women increasingly seek convenience, predictability, and avoidance of rare but catastrophic risks associated with normal childbirth.[59] If any of the above factors varied systematically across different liability environments, they may have biased our findings.

A further limitation is that our analytical approach did not involve judgments about the clinical appropriateness of cesarean section and VBAC in particular cases. This affects our ability to draw definitive conclusions about the extent of defensive medicine in high-liability states, because what is truly of interest is the marginal difference in clinically-inappropriate procedures across areas with different liability risk. Because we controlled for a range of clinical indicators for cesarean delivery, the analysis does isolate the influence of the liability environment on the method-of-delivery choices. It is therefore reasonable to interpret the higher rates of cesarean section in high-pressure states as defensive medicine. But not all behavioral responses to liability are socially undesirable. One possible challenge to the conclusion that our findings evidence defensive medicine is that cesarean sections may have been systematically underused, and VBACs attempted too often, in states with low malpractice pressure, in which case malpractice pressure may actually have pushed clinicians in high-liability states toward improved quality of care.

The evidence on the appropriateness of VBACs is currently too thin to reject or accept that conclusion,[10] but there is little support in the literature for the notion that cesarean section is underused. On the contrary, concerns in the United States and elsewhere center on the high and rising rates.[60] cesarean sections that are clinically unnecessary and unwanted by the patient are especially troubling because they deviate from sound medical practice, raise costs, undercut women's decision-making autonomy, and subject them to a surgical procedure that may unnecessarily complicate childbirth.[61]

This study suggests that tort reforms and other measures that constrain the growth of malpractice premiums over time may help to lower the incidence of cesarean sections. Caps on noneconomic damages and pretrial screening panels seem to be particularly impactful. The finding regarding screening panels, however, should be interpreted with caution in light of previous studies indicating that screening panels do not significantly affect malpractice premiums.[56] Notwithstanding this negligible effect, or perhaps because they are unaware of them, obstetricians may derive a degree of comfort from the existence of screening panels that influences their clinical decision-making. Damages caps are more efficacious, but also highly controversial. Among the concerns expressed about caps are that they disproportionately burden the severely injured[62] and draw policy makers' attention away from consideration of other reforms that may do more to address fundamental problems with the liability system, including problems that lead to defensive medicine.

Decisions about delivery methods, particularly VBAC, present a continuing challenge for obstetricians because of limited data on safety, shifting recommendations from professional societies, and changing patient expectations and demands. This is true in all liability environments. Reducing the disruptive effects of malpractice litigation on sound clinical decision making will not eliminate hard choices in obstetric practice, for physicians or patients. However, it should allow physicians to focus more sharply on factors that are consonant with high quality care.

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