

# The determinants of obstetricians' willingness to undertake delivery by vaginal birth after cesarean section in Taiwan

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**Background:** Babies are sometimes delivered by cesarean section (CS) to women eligible for trial of labor after a cesarean (TOLAC) due to a fear of complications during the delivery process. This view is especially widespread in Taiwan, as evidenced by the extremely low rate (<5%) of vaginal birth after cesarean section (VBAC). To improve the safety and quality of childbirth and the obstetrical practice environment, this study aimed to identify ways to contain the ever-increasing rate of CS by investigating the determinants for TOLAC from the viewpoint of obstetricians.

**Methods:** A specially designed questionnaire was employed that incorporated the perceived risk of VBAC, institutional managerial attitude, and obstetricians' personal characteristics. Face-to-face surveys were conducted with obstetricians from across Taiwan. Regression analysis was used as appropriate.

**Results:** Among the 231 recruited obstetricians, 86.7% were willing to undertake VBAC, but only 71.4% had actually done so. Obstetricians with a more risk-tolerant personality were more likely to undertake VBAC. Institutional characteristics, such as the time it takes to transfer a woman from the delivery table to the operating table (table to table) and the general facilities of the hospital to handle delivery complications resulting from VBAC were also key determinants for attempting VBAC.

**Conclusion:** In Taiwan, a country with a low birthrate, obstetricians need to be risk-tolerant to undertake VBAC. This phenomenon is probably due to underinvestment in facilities for vaginal delivery and thus a general perception that VBAC is risky. The study's results will potentially help medical institutions to adopt appropriate guidelines and build incentive structures to achieve a higher VBAC rate.

**Keywords:** physician traits, vaginal birth after cesarean section, willingness to undertake

## Introduction

The proportion of women giving birth by cesarean section (CS) has increased by more than 100% worldwide in the past several decades.<sup>1,2</sup> CS was introduced in clinical practice as a life-saving procedure for both the mother and baby. Other than pregnancy complications that make CS necessary, the reasons why women choose cesarean delivery include fears of pain or complications during labor and a more predictable delivery date (Landon 1998). Obstetricians might also discourage women who have had a previous CS from choosing vaginal birth to avoid risks. However, 60–80% of the women who attempt trial of labor after a cesarean (TOLAC) are successful,<sup>3–5</sup> and issues surrounding uterine rupture occur in <1%

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of all attempts.<sup>5–7</sup> Thus, TOLAC should be encouraged and emphasized because vaginal birth is more beneficial to both women and babies than CS.<sup>8</sup> Vaginal birth has a more rapid recovery, is preferred by many women,<sup>9,10</sup> and is associated with fewer hazards in future pregnancies.<sup>3,11</sup> By contrast, CS is associated with the development of many childhood diseases, such as diabetes and autoimmune diseases including asthma, obesity, allergic rhinitis, and food allergy.<sup>12,13</sup> As a result, the increasing rate of primary and repeat cesarean delivery is concerning to many physicians, midwives, and patients. In addition, CS is associated with higher medical costs, which is a concern for most countries' health authorities due to the high growth rate of health care expenditure.

To contain the ever-increasing rate of cesarean delivery, vaginal birth after cesarean section (VBAC) delivery has been promoted since the 1990s.<sup>14</sup> A National Institutes of Health consensus conference in 2010 and the most recent American College of Obstetricians and Gynecologists (ACOG) Practice Bulletin recognized the safety of TOLAC and recommended increased access.<sup>15–17</sup> However, due to the perceived risk of uterine rupture and other complications, obstetricians may be reluctant to undertake VBAC.<sup>18</sup> This situation is especially prominent in Taiwan, even though the Ministry of National Health Insurance (MNHI) in Taiwan enacted a policy.<sup>21</sup> (This policy raised the reimbursement rate by the Ministry of National Health Insurance (MNHI) in Taiwan for VBAC to the same as that for CS) to encourage VBAC in 2005. Given the low rate of VBAC in Taiwan of only 1.5–4.0% in recent decades<sup>19–21</sup> relative to the rates of 8.5–30% in the US<sup>22</sup> and 30–50% in European countries,<sup>23</sup> women and obstetricians in general view TOLAC as a relatively risky birthing practice. The very low rate of VBAC in Taiwan might be attributed to the low rate of birth in this country (the crude birth rate dropped from 2.46 in 1981 to 1.18 in 2015),<sup>24</sup> which has indirectly caused underinvestment in facilities for vaginal delivery and a general perception that VBAC is hazardous. The current study intended to investigate the determinants of VBAC in Taiwan from the viewpoint of obstetricians. The extent to which obstetricians' past experiences, risk tolerance, background information, and institutional settings influence the VBAC or elective repeat cesarean surgery (ERCS) decision will be explored.

Many factors determine whether an obstetrician is willing to undertake a planned VBAC. Among them, institutional factors such as hospital layout, including the

distance from the delivery room to the operating room as well as the availability of 24 hr anesthesia service, pediatric intensive care, and experienced staff in the delivery room are important.<sup>25</sup> The ACOG's guidelines advise that TOLAC is most safely undertaken in hospitals where staff can immediately perform an emergency cesarean delivery.<sup>17</sup> Experienced staff in a delivery room help obstetricians manage urgent situations. Without the help and service of such personnel, TOLAC is with greater hazard than ERCS. Finally, whether an obstetrician has previous VBAC experience is a potentially crucial factor. It is plausible to assume that successful previous experiences give obstetricians more confidence in conducting VBAC again.

Understanding the factors that influence the success of VBAC is important. The results of our study are pertinent for the amendment of relevant policies to facilitate complication-free deliveries. They are also of interest to an international interdisciplinary audience, as they provide insight into the appropriate choice of delivery method based on obstetricians' risk tolerance as well as institutional infrastructure and managerial attitude toward VBAC.

## Methods

### Design and sample

This study employed a specially designed questionnaire to interview obstetricians in Taiwan. Face-to-face surveys were conducted with the inclusion criteria (1) physicians who were board-certified specialists in obstetrics or who were in training for this specialty and (2) physicians with recent (in the past 3 years) experience in delivering babies. Pilot testing of the questionnaire was performed among 25 physicians differing in age, experience, and specialty (internal medicine, gynecologists) to verify the validity and clarity of the questionnaire prior to the formal survey. The responses from the pilot study were not included in the final analyses. To reduce potential sampling bias, the interview venues included professional obstetrician/gynecologist (OB/GYN) conference sites, various hospitals, and clinics from across Taiwan.

Several methods were used to identify the eligibility of our potential participants. For the obstetricians who were interviewed at the conference sites, only registered obstetricians who wore a badge or nametag were invited to participate. For those who were interviewed in hospitals or clinics, the human resource department released the names of the contracted or employed obstetricians for our interviewers to contact. Participants were first asked whether they had

experience in delivering babies in the past 3 years. If the answer was no, no further questions were asked.

The questionnaire had three parts. The first part included obstetricians' demographic background, such as age, gender, and personality preference toward risk and uncertainty. The second part involved their willingness to undertake (WTU) VBAC. The third part encompassed background information on the obstetricians' working environment, including hospital attributes and the availability of a supporting team in case of complications during delivery. Four tiers of physicians' working health facilities were characterized: medical center, regional teaching hospital, community hospital, and childbirth clinic. Health facilities in different tiers could be furnished with different grades of equipment, which in turn might influence obstetricians' WTU VBAC. The study protocol was reviewed and approved by the institutional review board of a medical center in Taiwan. Written informed consent was obtained from all participants before conducting the interviews. Detailed descriptions regarding risk tolerance preference and the willingness index are explained in the following paragraphs. The variables and their definitions are reported in Table 1.

## Risk tolerance index

Six items from the Jackson Personality Inventory – Revised (JPI-R)<sup>26</sup> were employed to understand the respondents' risk preferences. Originally adapted and validated by Pearson et al in 1995 to measure risk preference,<sup>27</sup> research suggests adequate structural equivalence of the JPI across clusters of countries, including Asian countries.<sup>28–30</sup> However, the major reason for adopting the JPI in this study is that it has been widely used in studies of medical decision making.<sup>31–34</sup> The items were translated into Chinese and then translated back into English twice to ensure correct language usage.

- I enjoy taking risks.
- I try to avoid situations that have uncertain outcomes.
- Taking risks does not bother me if the gains involved are high.
- I consider security an important element in every aspect of my life.
- People have told me that I seem to enjoy taking chances.
- I rarely, if ever, take risks when there is another alternative.

All items were scored on a 6-point Likert scale, and the scores were summed and rescaled to form an index with a

range from 0 (most risk-averse) to 1 (most risk-tolerant).<sup>35</sup> Respondents with missing values were excluded.

## Index of WTU

In the second part of our questionnaire, WTU VBAC was assessed by asking the following question: (Q1) Are you willing to undertake a planned VBAC when the situation allows it, considering patient safety and health care facility conditions? This question itself serves as an outcome measure for analysis. However, some respondents might tend to understate or overstate their response to this question due to cultural influences. Therefore, additional questions were asked:

Q2: At your current place of employment, have you ever undertaken a planned VBAC for a patient?

Q3: Is the managerial attitude of your current working environment supportive of undertaking a planned VBAC?

Q4: Have you ever had a failed VBAC experience?

Q5: Were you previously pro-VBAC but now are against it?

For a more rounded assessment, a composite WTU index was constructed to describe the responses to these questions.<sup>36</sup> Analysis of a composite index is superior to the analysis of answers to individual questions because it combines different aspects based on current and past experiences as well as workplace atmosphere. A variety of approaches can be used to build a composite index, and we chose the method of linear combination due to its simplicity and widespread use<sup>37</sup> and because the transformation of variables ensures that the weights used in the composite are valid across the observed range of answers.<sup>38</sup> For each question, a "yes" answer was given a score of 1 and a "no" answer was given a score of 0.

The WTU index was calculated as follows:

$$WTU\ Index = Normalization\ (Q1 + 4*Q2 + Q3 - Q4 - Q5).$$

As questions 4 and 5 convey adverse effects from past experiences, they were given a negative weight in the index. Question 2 carried more weight than the other questions because it directly reflected respondents' true actions. For example, consider two obstetricians, A and B, with responses for Q1 through Q5 as (1, 0, 1, 0, 0) and (1, 1, 0, -1, -1), respectively. If Q2 had equal weight as the other questions, A would have WTU=2, and B would have WTU=0. However, one would intuitively believe that B was more prone to undertake VBAC than A. To correctly reflect this phenomenon, the weight for Q2 had to be at least 4. The aggregate value was then normalized to

**Table 1** Description of variables

Variables	Definitions
WTU index and content	
WTU Index	An index ranging from 0 to 1 that indicates the likelihood of a respondent to undertake a VBAC childbirth plan.
Q1 (Willingness)	=1 if the respondent is willing to undertake a planned VBAC when the situation allows it, considering patient safety and hospital conditions; =0 otherwise
Q2 (Actual experience)	=1 if the respondent has experience in undertaking VBAC in the current workplace; =0 otherwise (actual experience)
Q3 (Managerial attitude)	=1 if the managerial attitude of the respondent's current workplace is supportive towards obstetricians undertaking a planned VBAC; =0 otherwise
Q4 (Past failure)	=1 if the respondent has previous failed VBAC experiences; =0 otherwise
Q5 (Opposition)	=1 if the respondent does not recommend VBAC for average obstetricians; =0 otherwise
Obstetrician background	
CS_Table	=1 if the respondent has experience in undertaking CS after a failed vaginal delivery; =0 otherwise
Tenure	Number of years the respondent has been an obstetrician
Risk Tolerance Index	Constructed from 6 questions with a 6-point Likert scale. Thus, the index ranged from 6 to 36 and was then rescaled to a range of 0–1. A higher value indicates a less risk-averse person, and a lower value suggests a more risk-averse person.
Legal	=1 if the respondent has previous experience with a malpractice legal lawsuit; =0 otherwise
Institutional status	
Category	=1 if the workplace of the respondent is a clinic; =2 if it is a community hospital; =3 if it is a regional teaching hospital; =4 if it is a medical center
Teach	=1 if the respondent works in a teaching hospital; =0 otherwise
Institutional characteristics	
NICU	=1 if the respondent's workplace has a newborn intensive care unit; =0 otherwise
Pediatrican_24	=1 if there are pediatricians on standby duty 24 hrs a day in the respondent's workplace; =0 otherwise
Anesth_24	=1 if there are anesthesiologists on standby duty 24 hrs a day in the respondent's workplace; =0 otherwise
Support	=1 if there are rotating support personnel in the labor and delivery room; =0 otherwise
Facility	=1 if the respondent thinks the supporting personnel in his/her workplace have sufficient professional ability to support VBAC; =0 otherwise
TtoT	The time that it takes to transfer a woman from the labor and delivery room to the operating room

between 0 and 1 to form an index. To test the validity of the index, Pearson correlation and linear regression were employed in this study.<sup>39</sup>

## Regression analysis of the determinants

With the WTU index, the dependent variables that indicated the likelihood of an obstetrician to undertake a planned VBAC, while holding the physician's personal

characteristics constant, and the extent to which the choice of VBAC was influenced by obstetricians' personal characteristics and by institutional characteristics could be ascertained. For comparison purposes, the dichotomy of the answers to questions 1–3 was also analyzed using a probit and logit model. Question 1, which is analogous to the WTU index, directly surveyed the willingness of the respondents. Question 2, which probed whether the

respondents had actual past VBAC experience provided insight into what factors increase the possibility of a VBAC actually taking place. Question 3, which assessed the managerial attitudes at the respondents' workplaces, gave information about what factors lead an institution to be considered a VBAC-friendly environment.

The ACOG's guidelines advise physicians that TOLAC is most safely undertaken in hospitals where staff can immediately perform an emergency cesarean delivery.<sup>17</sup> Thus, the final part of the questionnaire surveyed the characteristics of the obstetricians' workplaces, including the availability of neonatal care services, availability of anesthesia services, and capabilities of nurses and supporting teams. The architectural design of the operating room and the labor and delivery room was also surveyed to determine whether the interior setting might hinder the procedure and increase the potential risk when undertaking VBAC.

The linear regression model used takes the following general form:

$$WTU_i = \beta_0 + \beta_1 X_i + \beta_2 Y_i + \varepsilon_i,$$

where WTU is the index of willingness to undertake VBAC for the *i*th obstetrician; *X* is the obstetrician's personal characteristics, including risk tolerance index, tenure, and gender; and *Y* represents institutional characteristics, such as facility design, equipment, facility status, managerial attitude, and staff qualification. The probit or logit model used for regression analysis of questions 1 to 3 takes the following form:

$$Pr(Q_{1-3} = 1 | X_i, Y_i) = \Phi(\beta_0 + \beta_1 X_i + \beta_2 Y_i + \varepsilon_i),$$

where *Pr* denotes probability and  $\Phi$  is the cumulative distribution function of the standard normal distribution for the probit model and the logistic distribution for the logit model. The  $\beta$  parameters are estimated by maximum likelihood. The details of the variables are described in Table 1.

By comparing the linear regression results from WTU and the probit and logit regression results from Q1 to Q3, it will become clear whether WTU is valid and representative of reality. To validate the robustness of these methods, the sample was stratified into subgroups by types of prior experiences, tenures, and genders and analyzed using the same regression models. In this way, the impact of each determinant could be better understood based on the responses from obstetricians with various backgrounds.

## Results

### Statistics summaries

A total of 312 eligible obstetricians were contacted and 231 questionnaires were collected with complete responses (response rate: 74.68%). Table 2 reports the statistical summary of our survey results. The largest two sources of respondents were clinics and medical centers, making up approximately 34% and 33% of all responses, respectively. A total of 69.10% of the respondents were male, which is consistent with the normal gender ratio of obstetricians in Taiwan. One-way ANOVA was performed to test the differences in variables for obstetricians working at different levels of health institutes. Most of the variables displayed significant differences across institute levels, with the exceptions of gender ratio, malpractice legal experience, VBAC failure experience for obstetricians and table-to-table (TtoT) timespan of institutes. The average age ( $\pm$  SD) and risk tolerance index of our respondents were 40.4 ( $\pm$ 7.9) years and 0.37 ( $\pm$ 0.2), with younger and more risk-tolerant obstetricians being found in medical centers and older and less risk-tolerant counterparts being found in clinics. In terms of physician attitude toward VBAC, 86.7% of the respondents were willing to undertake VBAC when the situation allowed for it, while only 71.3% had actually performed the procedure. Only 71.7% of the respondents thought their workplace was supportive of VBAC. Based on the attitude ratings introduced in the previous section, the index of the likelihood for obstetricians to undertake VBAC averaged at 0.69 ( $\pm$ 0.29), with the lowest value (0.51 $\pm$ 0.29) in community hospitals and the highest value (0.84 $\pm$ 0.16) in medical centers. Regarding institutional factors, 54.7% of the respondents worked in institutions with a newborn intensive care unit (NICU). A total of 75.6% of the respondents thought their workplace was suitably equipped for a VBAC birth plan. Among the different institutional categories, medical centers had the highest approval rate (91.9%), while community hospitals had the lowest (54.6%).

### Validity test of WTU

To test the validity of the WTU index, Pearson correlation was used to assess the responses to the five survey questions that directly inquired about obstetricians' willingness and experiences regarding VBAC. The results are shown in Table 3. Unsurprisingly, WTU had the highest positive relationship with actual past experience (question 2), which had a correlation coefficient of 0.9; thus, this factor



**Table 2** Statistical summary by hospital category

	Whole sample	Clinic	Community	Regional	Medical center	
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	
Observation number	231	78	23	54	76	
Male (%)	69.10 (46.31)	69.62 (46.28)	77.27 (42.89)	67.92 (47.12)	67.11 (47.30)	
Age (years)	40.38 (7.86)	43.57 (6.08)	40.11 (7.35)	40.94 (7.00)	36.43 (8.66)	***
Tenure (years)	17.66 (10.96)	21.89 (10.65)	17.06 (12.01)	16.47 (8.55)	14.01 (11.19)	***
Risk tolerance index (0–1)	0.37 (0.19)	0.33 (0.21)	0.35 (0.21)	0.39 (0.18)	0.40 (0.17)	***
Legal (%)	31.63 (46.61)	36.99 (48.61)	35.00 (48.94)	35.29 (48.26)	22.54 (42.08)	
CS_Table (%)	38.30 (48.78)	36.36 (48.66)	25.00 (44.72)	15.79 (36.95)	65.12 (48.22)	***
Q1 (% willingness)	86.74 (31.79)	82.05 (38.62)	77.27 (42.89)	88.68 (31.99)	98.68 (11.47)	***
Q2 (% actual exp.)	71.33 (44.85)	56.96 (49.83)	50.00 (51.18)	73.58 (44.51)	93.51 (24.80)	***
Q3 (% managerial att.)	71.74 (38.69)	65.38 (43.62)	43.18 (41.67)	69.81 (38.40)	91.55 (20.52)	***
Q4 (% failure exp.)	59.50 (48.77)	56.58 (49.89)	52.38 (51.18)	65.38 (48.04)	66.23 (47.60)	
Q5 (% opposition)	35.44 (48.23)	58.11 (49.67)	45.45 (50.96)	24.53 (43.44)	21.05 (41.04)	***
WTU Index (0–1)	0.69 (0.28)	0.57 (0.30)	0.51 (0.29)	0.70 (0.31)	0.84 (0.16)	***
Teach (%)	47.90 (50.10)	0.00 (0.00)	9.09 (29.42)	64.15 (48.41)	97.40 (16.01)	***
NICU (%)	54.70 (49.56)	9.59 (29.65)	27.27 (45.58)	76.92 (42.54)	98.68 (11.47)	***
Pediatrican_24 (%)	72.20 (44.90)	32.88 (47.30)	77.27 (42.89)	86.54 (34.46)	98.68 (11.47)	***
Anesthesia_24 (%)	75.68 (43.00)	41.10 (49.54)	63.64 (49.24)	94.23 (23.54)	1.00 (0.00)	***
TtoT (min)	10.25 (11.23)	8.30 (15.79)	12.85 (11.88)	12.23 (8.57)	8.69 (8.88)	
Support (%)	72.85 (44.62)	28.89 (45.84)	76.47 (43.72)	92.68 (26.37)	95.83 (20.19)	***
Facility (%)	75.57 (43.07)	71.62 (45.39)	54.55 (50.96)	66.67 (47.61)	91.89 (27.48)	***

**Notes:** SD are in parentheses. TtoT represents transferring from labor and delivery table to operating table. Other definitions of each variable are in [Table 1](#). \*\*\*Denotes difference at 1% significance level across institutional levels.

**Table 3** Validity test for WTU index

	Pearson correlation coefficients						Regression
	WTU	Q1 Willing	Q2 Actual experience	Q3 Managerial attitude	Q4 Past failure	Q5 objection	WTU
WTU	1.00						
Q1: Willing	0.56*** (0.00)	1.00					0.24*** (17.6)
Q2: Actual experience	0.92*** (0.00)	0.39*** (0.00)	1.00				0.52*** (44.5)
Q3: Managerial attitude	0.61*** (0.00)	0.45*** (0.00)	0.44*** (0.00)	1.00			0.15*** (11.2)
Q4: Past failure	-0.04 (0.55)	0.06 (0.37)	0.18*** (0.01)	0.17*** (0.01)	1.00		-0.09*** (10.7)
Q5: Objection	-0.45*** (0.00)	-0.19*** (0.00)	-0.22*** (0.00)	-0.24*** (0.00)	0.03 (0.68)	1.00	-0.06*** (7.2)
Risk	0.21*** (0.00)	0.19*** (0.00)	0.14*** (0.02)	0.19*** (0.00)	0.04 (0.51)	-0.20*** (0.00)	0.14*** (6.34)
R <sup>2</sup>			—				0.99
N			231				231

**Notes:** \*\*\*Denotes difference at 1% significance level across institutional levels. WTU ranges from 0 to 1, while all other variables are binary with 0 (no) or 1 (yes) answer. N is observation number.

was given the highest weighting when constructing the index. The answers to question 1 (regarding the WTU VBAC) and question 3 (regarding the managerial attitude of the respondent's workplace) also highly correlated with the WTU index, both having correlation coefficients of approximately 0.6. The correlation between question 5 and WTU index is significantly negative, which is consistent with our prediction. This was expected, as question 5 allowed the respondents to directly express whether they were against the idea of VBAC. For respondents who had previously experienced failure performing a VBAC (question 4), there was no significant relationship to WTU.

To further confirm the validity of the WTU index, the answers to the five questions, as well as the risk tolerance index, were regressed on WTU. The results are reported in the last column of Table 3. Results consistent with the correlation table were produced, except for the experience of past failure, which became significant after the regression analysis, although it still maintained a negative relationship. All the aforementioned results regarding correlation coefficients suggest that our WTU index is consistent with the respondents' willingness to perform

VBAC as well as their prior experience. Thus, the index appropriately represents the actual WTU VBAC.

## Regression analysis

As reported in Column (1) of Table 4, the baseline WTU model submitted to regression analysis showed that most coefficients were significant with the expected signs. Specifically, older respondents were less willing to undertake VBAC: for every 1% increase in age, WTU decreased by 0.2. Additionally, obstetricians with higher risk tolerance scores were more likely to undertake VBAC: with each percentage point increase in risk measurement, the WTU increased by 0.2. Finally, obstetricians with prior experience performing CS after a failed VBAC were more willing to perform VBAC. All results were significant at the 5% or 1% level. Institutional factors such as the time required to transfer women from the labor and delivery table to the operating table (TtoT), the presence of a NICU at an institution, and the perception of an obstetrician that an institution is well-equipped to handle obstetric complications in case of emergency and failed VBAC (Facility)

**Table 4** Regression analysis of obstetricians' willingness to undertake VBAC<sup>a,b,c</sup>

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	WTU index	Q1 Willing – whole sample	Q1 Willing – sample w/ actual exp	Q2 Actual exp	Q3 Managerial attitude	WTU male	Female
Age	−0.21** (−2.23)	−0.50 (−0.58)	−0.38 (−0.34)	−0.68 (−1.07)	−0.92 (−1.24)	−0.12 (−0.99)	−0.4*** (−2.62)
Male	0.04 (0.97)	−0.20 (−0.57)	−0.76 (−1.44)	0.40 (1.54)	−0.23 (−0.78)	–	–
Risk	0.22*** (2.44)	2.04*** (2.75)	1.88** (2.15)	1.13** (1.90)	1.34** (2.10)	0.28*** (2.55)	−0.02 (−0.09)
TtoT	−0.1*** (−2.92)	−0.43*** (−2.51)	−0.14 (−0.68)	−0.47*** (−3.25)	−0.29** (−2.03)	−0.07*** (−2.63)	−0.05 (−1.14)
Support	−0.01 (−0.22)	0.22 (0.71)	0.30 (0.81)	0.11 (0.46)	−0.13 (−0.47)	−0.02 (−0.39)	−0.01 (−0.13)
NICU	0.14*** (2.82)	0.37 (0.97)	0.09 (0.20)	0.80*** (2.60)	0.58* (1.76)	0.12** (2.04)	0.26*** (2.53)
Facility	0.10** (2.43)	0.35 (1.12)	0.17 (0.46)	0.55** (2.20)	0.65*** (2.54)	0.10** (1.97)	0.17 (1.74)
Anesth_24	0.09 (1.60)	0.50 (1.23)	0.52 (1.14)	0.29 (0.95)	0.35 (1.05)	0.10 (1.55)	0.00 (0.02)
CS_table	0.14** (2.59)	0.78** (2.23)	0.06 (0.12)	0.51 (1.59)	0.03 (0.10)	0.16** (2.29)	0.12 (1.27)
Teach	−0.01 (−0.16)	−0.44 (−1.04)	−0.04 (−0.09)	0.01 (0.02)	−0.02 (−0.06)	0.02 (0.43)	−0.13 (−1.45)
Constant	1.15*** (3.28)	2.21 (0.68)	2.42 (0.58)	2.08 (0.87)	3.80 (1.35)	0.84 (1.75)	1.87*** (3.24)
(Pseudo) R <sup>2</sup>	0.33	0.23	0.18	0.25	0.21	0.34	0.45
N	231	231	200	231	231	159	72

**Notes:** <sup>a</sup>Column (1) uses WTU index as a dependent variable, and linear regression was performed in this model. Columns (2), (3), (4) and (5) are probit models for binary dependent variables from survey questions Q1–Q3. In these columns, pseudo R<sup>2</sup> values are reported. Age and TtoT are taken as the natural logarithm. Risk ranges from 0 to 1. All other variables take 0 or 1 binary values. <sup>b</sup>t-statistics are in parentheses. <sup>c</sup>1%, 5%, and 10% significance levels are denoted by \*\*\*, \*\*, and \*, respectively.

all significantly affected the likelihood of an obstetrician to undertake VBAC.

For comparison purposes, question 1, which directly enquired about the respondents' WTU VBAC, was analyzed using a probit and logit model. Both models generated similar results, so only the results from the probit model are reported (Column (2) of Table 4). In this model, age, presence of a NICU, and facility became insignificant. The pseudo R<sup>2</sup>, at 0.23, is also much lower than that shown in Column (1), indicating that the regression analysis of composite index is superior to analysis of single questions as the dependent variable. The same results were

produced following subgroup analysis including only respondents with past VBAC experience, as shown in Column (3). Column (4) analyzes what factors increase the likelihood of an obstetrician actually undertaking VBAC. Compared to Columns (2) and (3), this result is more comparable to the WTU index, except that age is still insignificant. Similar results were produced when the dependent variable was changed to managerial attitude at the workplace, as shown in Column (5). Overall, these results indicate that the composite index used in this research accurately reflects an obstetrician's WTU VBAC by incorporating both conceptual willingness and past



experience. Further cohort analysis should focus on base-line WTU regression to assess the impact of gender, prior experiences, and tenure.

## Regression analyses of cohorts

In the gender analysis results shown in Columns (6) and (7) of Table 4, it can be observed that male obstetricians are more driven by risk tolerance and place greater emphasis on their prior CS experience and an institution's general facilities for handling VBAC. Male obstetricians are

also less concerned about the time needed to transfer a woman from the delivery table to the operating table when a VBAC fails. Female obstetricians are less likely to undertake VBAC as they age.

The results of other cohort analyses are presented in Table 5. The left panel reflects the prior experiences of the respondents, and the right panel divides the respondents into three groups based on tenure years. Age and tenure are highly correlated (correlation coefficient 0.83); thus, age as a variable was dropped from the regression analysis

**Table 5** Regression analysis of obstetricians' WTU index<sup>a,b,c</sup>

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	<b>Actual past</b>		<b>Experience</b>		<b>Tenure year</b>		
	<b>Whole time</b>	<b>Current employment</b>	<b>Ever failure</b>	<b>No failure</b>	<b>&lt;10</b>	<b>10–30</b>	<b>&gt;30</b>
Age	−0.23** (−2.32)	−0.11*** (−2.74)	−0.12 (−0.99)	−0.24 (−1.34)	–	–	–
Male	0.00 (0.08)	0.00 (0.10)	0.01 (0.11)	0.01 (0.16)	0.00 (0.04)	0.03 (0.57)	0.13 (0.76)
Risk	0.19** (1.98)	0.13*** (3.05)	0.31** (2.28)	0.05 (0.30)	0.09 (0.56)	0.42*** (3.17)	0.20 (0.66)
TtoT	−0.05** (−1.98)	0.02 (1.43)	−0.09*** (−3.29)	−0.02 (−0.44)	−0.07* (−1.70)	−0.04 (−0.95)	−0.03 (−0.38)
Support	0.01 (0.17)	−0.01 (−0.75)	0.01 (0.28)	−0.02 (−0.25)	−0.01 (−0.25)	−0.03 (−0.52)	0.00 (0.03)
NICU	0.11** (2.09)	0.02 (0.87)	0.15** (2.22)	0.12 (1.25)	0.21** (2.12)	0.14** (2.19)	−0.24 (−1.05)
Facility	0.10** (2.28)	0.03* (1.72)	0.14** (2.63)	0.06 (0.73)	0.03 (0.34)	0.19*** (3.39)	−0.06 (−0.40)
Anesth_24	0.09 (1.60)	0.03 (1.18)	0.06 (0.75)	0.13 (1.29)	0.03 (0.32)	0.01 (0.16)	0.18 (1.21)
CS_table	0.09 (1.60)	−0.01 (−0.50)	0.19*** (2.89)	0.00 (0.04)	0.11 (1.20)	0.25*** (3.28)	−0.08 (−0.37)
Teach	0.01 (0.22)	0.01 (0.72)	−0.06 (−1.00)	0.09 (0.95)	−0.05 (−0.57)	0.02 (0.27)	0.37 (1.63)
Constant	1.28*** (3.43)	1.10*** (7.56)	0.82* (1.73)	1.43 (2.18)	0.65*** (3.97)	0.13 (0.96)	0.45** (2.26)
R <sup>2</sup>	0.31	0.25	0.31	0.44	0.20	0.45	0.36
N	200	165	138	62	76	112	43

**Notes:** <sup>a</sup>In all models, WTU was analyzed as a dependent variable. Age and TtoT are taken as natural logarithms. Other explanatory variables have binary values. Column (1) shows the subgroup analysis for obstetricians with actual VBAC experience anytime in the past. Column (2) shows the subgroup analysis for obstetricians with actual VBAC experience at the current workplace. Column (3) shows the subgroup analysis for obstetricians with failed VBAC experience. Column (4) shows the subgroup analysis for obstetricians without prior VBAC failure. <sup>b</sup>t-statistics are in parentheses. <sup>c</sup>1%, 5%, and 10% significance levels are denoted by \*\*\*, \*\*, and \*, respectively.

for the tenure breakdown. Notably, the results in Column (3), which correspond to the respondents with prior failed VBAC experience, show greater magnitudes in explanatory variables such as risk tolerance, TtoT, NICU presence, facility, and CS\_table, indicating that these determinants have greater importance for this cohort than general obstetricians. Younger obstetricians with a tenure of 10 years or less care more about the presence of a NICU at an institute and the time needed to transfer from TtoT. Risk tolerance was not found to play a role in determining WTU.

## Discussion

Planned ERCS and planned VBAC for women with a prior cesarean birth are associated with both benefits and harms. Evidence for these care practices is largely drawn from non-randomized studies that have potential bias.<sup>40</sup> The results and conclusions of these studies must, therefore, be interpreted with caution. However, given the low rate of VBAC in Taiwan relative to developed Western countries, it is plausible to assume that TOLAC is considered a risky practice in Taiwan. Importantly, obstetricians' and women's viewpoints toward TOLAC and VBAC have not yet been investigated following efforts made by Taiwanese health authorities to encourage VBAC and reduce CS procedures. To understand the determinants for undertaking VBAC, obstetricians' risk tolerance was considered in this study in addition to institutional infrastructure and managerial attitudes toward VBAC. The results suggest that obstetricians in Taiwan support the 2010 ACOG guidelines and are willing to undertake VBAC in general. However, more risk-tolerant obstetricians with prior experience performing CS are more likely to undertake VBAC than risk-averse obstetricians without prior experience. Institutional factors are also crucial in explaining variations in WTU VBAC. Managerial attitudes toward VBAC, the time needed to transfer a woman from the delivery table to the operating table in case of emergency, and the general facilities available at an institute to handle complications during VBAC are the factors with the most significant influence. After comparing across cohorts, it was found that older female obstetricians are the least willing to undertake VBAC. Younger obstetricians care more about institutional facilities, and risk preference is irrelevant among obstetricians with a few years of work experience.

There are two limitations to this study. First, under the current MNHI reimbursement plan, obstetricians receive the same compensation for vaginal birth and CS. Thus, the

questionnaire was conducted based on the presumption that the responding obstetricians were receiving the same overall remuneration. Given the higher risk of undertaking VBAC, total utility was not held constant between choices (not a fair consideration). Second, there are approximately 2550 obstetricians in Taiwan, 66% of whom are 46 years and older. Our survey encompassed a younger group of obstetricians and covered approximately 1/10 of obstetricians. As VBAC is a relatively new practice in Taiwan, older obstetricians might be more reluctant to accept it, which is most likely the reason why younger obstetricians showed more interest in participating in this study. Different survey results might have been obtained if an older obstetrician group was surveyed.

## Conclusion

Even though Taiwan is considered comparable to advanced Western countries in many ways, the low rate of VBAC in Taiwan is unusual. This low rate might be a result of underinvestment in hospital delivery rooms due to the declining vaginal birth rate in Taiwan. VBAC is generally deemed a hazardous procedure relatively to ERCS. Obstetricians need to be confident that their institutions have strong facilities available to conduct VBAC.

Our results show that age and degree of risk tolerance are the key personal determinants for WTU VBAC. Institutional characteristics, including the time needed to transfer a woman from the delivery table to the operating table, the availability of a NICU, and the obstetrician's perception of their institution's facilities for handling complications due to a failed VBAC, are also influential. Under current policy, the Taiwan MNHI provides the same remuneration to obstetricians for vaginal birth and CS. To encourage more obstetricians to perform VBAC, different health policies and incentive structures for institutions or obstetricians that promote VBAC should be considered by the government authorities. Relevant education should also be provided to obstetricians to help them understand the true risk of VBAC. More importantly, adequate investment in delivery room equipment is needed to improve the safety and quality of the birth environment.

## Abbreviations

ACOG, American College of Obstetricians and Gynecologists; MNHI, Ministry of National Health Insurance; CS, cesarean section; ERCS, elective repeat

cesarean surgery; NICU, newborn intensive care unit; JPI-R, Jackson Personality Inventory, Revised; OB/GYN, obstetrician/gynecologist; TtoT, table to table (from labor and delivery table to the operating table); TOLAC, trial of labor after a cesarean; VBAC, vaginal birth after cesarean section; WTU, willingness to undertake.

## Ethics approval and consent to participate

The study protocol was reviewed and approved by the institutional review board of Chen-Hsing Hospital, Taiwan; approval number (380)120-27. Written informed consent was obtained from all participants before conducting the interviews.

## Consent for publication

This manuscript does not contain any individual person's data. Thus, consent for publication is not applicable.

## Data sharing statement

Data are available from the authors upon reasonable request. Please email [kychang@mail.mcu.edu.tw](mailto:kychang@mail.mcu.edu.tw) for detailed information.

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## Author contributions

G Linn conceptualized the research topic and design and provided overall guidance and direction for the study. Y Ying helped develop the research question, conducted data analysis, and wrote the draft of the paper for submission. K Chang provided overall guidance and direction for the study, checked data analysis for accuracy and clarity, and assisted with writing the paper for submission. All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Savage W. The rising cesarean section rate: a loss of obstetric skill? *Obstet Gynaecol.* 2007;27:339–346. doi:10.1080/01443610701337916
2. Hamilton BE, Martin JA, Ventura SJ. Births: preliminary data for 2010. *Natl Vital Stat Rep.* 2011;60(2):1–25. Available from: [www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60/02.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60/02.pdf). Accessed July 24, 2019.
3. Mazzoni A, Althabe F, Liu NH, et al. Women's preference for cesarean section: a systematic review and meta-analysis of observational studies. *BJOG.* 2011;118:391–399. doi:10.1111/j.1471-0528.2010.02793.x
4. Mozurkewich EL, Hutton EK. Elective repeat cesarean delivery versus trial of labor: a meta-analysis of the literature from 1989 to 1999. *Am J Obstet Gynecol.* 2000;183:1187. doi:10.1067/mob.2000.108890
5. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple cesarean deliveries. *Obstet Gynecol.* 2006;107:1226–1232. doi:10.1097/01.AOG.0000219750.79480.84
6. Chazotte C, Cohen WR. Catastrophic complications of previous cesarean section. *Am J Obstet Gynecol.* 1990;163:738–742. doi:10.1016/0002-9378(90)91059-L
7. Flamm BL, Goings JR, Liu Y, Wolde-Tsadik G. Elective repeat cesarean delivery versus trial of labor: a prospective multicenter study. *Obstet Gynecol.* 1994;83:927–932. doi:10.1097/00006250-199406000-00005
8. National Institutes of Health Consensus Development Conference Panel. National Institutes of Health Consensus Development conference statement: vaginal birth after cesarean: new insights, March 8–10, 2010. *Obstet Gynecol.* 2010;115:1279–1295. doi:10.1097/AOG.0b013e3181e459e5
9. Kieser KE, Baskett TF. A 10-year population-based study of uterine rupture. *Obstet Gynecol.* 2002;100:749–753.
10. Landon MB. Vaginal birth after cesarean delivery. *Clin Perinatol.* 2008;35:491–504,ix–x. doi:10.1016/j.clp.2008.07.004
11. Little MO, Lyerly AD, Mitchell LM, et al. Mode of delivery: toward responsible inclusion of patient preferences. *Obstet Gynecol.* 2008;112:913–918. doi:10.1097/AOG.0b013e3181888fd8
12. Okada H, Kuhn C, Feillet H, et al. The 'hygiene hypothesis' for autoimmune and allergic diseases: an update. *Clin Exp Immunol.* 2010;160(1):1–9. doi:10.1111/j.1365-2249.2010.04139.x[PMC free article] [PubMed].
13. Bach JF. The effect of infections on susceptibility to autoimmune and allergic diseases. *N Engl J Med.* 2002;347(12):911–920. doi:10.1056/NEJMr020100
14. Grobman WA, Peaceman AM, Socol ML. Cost-effectiveness of elective cesarean delivery after one prior low transverse cesarean. *Obstet Gynecol.* 2000;95(5):745–751.
15. Graseck AS, Odibo AO, Tuuli M, Roehl KA, Macones GA, Cahill AG. Normal first stage of labor in women undergoing trial of labor after Cesarean delivery. *Obstet Gynecol.* 2012;119(4):732–737. doi:10.1097/AOG.0b013e31824c096c
16. Cahill AG, Macones GA. Vaginal birth after cesarean delivery: evidence-based practice. *Clin Obstet Gynecol.* 2007;50:518–525. doi:10.1097/GRF.0b013e31804bde7b
17. American College of Obstetricians and Gynecologists ACOG. Vaginal birth after previous cesarean delivery. ACOG practice bulletin no. 115. *Obstet Gynecol.* 2010;116:450–463. doi:10.1097/AOG.0b013e3181eeb251
18. Holmgren C, Scott JR, Porter TF, Esplin MS, Bardsley T. Uterine rupture with attempted vaginal birth after cesarean delivery. Decision-to-delivery time and neonatal outcome. *Obstet Gynecol.* 2012;119:725–731. doi:10.1097/AOG.0b013e318249a1d7
19. Fu J-C, Xirasagar S, Liu JH, Probst JC. Cesarean and VBAC rates among immigrant vs. native-born women: a retrospective observational study from Taiwan Cesarean delivery and VBAC among immigrant women in Taiwan. *BMC Public Health.* 2010;10:548. doi:10.1186/1471-2458-10-548

20. Hsu CY, Lo JC, Chang JH, Chen CP, Yu S, Huang FY. Cesarean births in Taiwan. *Int J Obstet Gynecol.* 2007;96(1):57–61. doi:10.1016/j.ijgo.2006.09.011.
21. Chang K. Analysis of vaginal birth after caesarean section: a population-based study from 1997–2010 in Taiwan, research project of Cheng-Hsin General Hospital, Taiwan; 2013 (in Chinese).
22. MacDorman M, Declercq E, Menacker F. Recent trends and patterns in cesarean and vaginal birth after cesarean (VBAC) deliveries in the United States. *Clin Perinatol.* 2011;38(2):179–192. doi:10.1016/j.clp.2011.03.007
23. Smith V. EU COST action, IS0907: childbirth cultures, concerns, and consequences: creating a dynamic EU framework for optimal maternity care. Report of the Short Term Scientific Mission (STSM), Vaginal Birth after Caesarean Section: Culture, Character and Concerns; January 2012
24. National Statistics. Department of registration, Ministry of Interior, Taiwan. Available from <http://eng.stat.gov.tw/mp.asp?mp=5>. Accessed January 03 2016.
25. Scott JR. Vaginal birth after cesarean delivery: a commonsense approach. *Obstet Gynecol.* 2011;118:342–50. doi:10.1097/AOG.0b013e3182245b39
26. Jackson DN. *Jackson Personality Inventory-Revised Manual [CD-ROM]*. Port Huron, MI: Sigma Assessment Systems Inc; 2004.
27. Pearson SD, Goldman L, Orav J, et al. Triage decisions for emergency department patients with chest pain: do physicians' risk attitudes make the difference? *J Gen Intern Med.* 1995;10:557–564. doi:10.1007/bf02640365
28. Güngör D, Bornstein MH, Leersnyder JD, Cote L, Ceulemans E, Mesquita B. Acculturation of personality: a three-culture study of Japanese, Japanese Americans, and European Americans. *J Cross Cult Psychol.* 2013;44(5):701–718. doi:10.1177/0022022112470749
29. Jackson DN. *Jackson Personality Inventory – Revised Manual*. Port Huron, MI: Sigma Assessment Systems, Inc; 1994.
30. Fetvadjeiev VH, Meiring D, Van de Vijver FJR. Measures of personality across cultural. In: Boyle GJ, Saklofske DH, Matthews G, editors. *Book Measures of Personality and Social Psychological Constructs*. Cambridge (MA): Academic Press; 2014:P765.
31. Baldwin RL, Green JW, Shaw JL, et al. Physicians risk attitudes and hospitalization of infants with bronchiolitis. *Acad Emerg Med.* 2005;12:142–146. doi:10.1197/j.aem.2004.10.002
32. Robinson G. Do general practitioners' risk-taking propensities and learning styles influence their continuing medical education preferences? *Med Teach.* 2002;24:71–78. doi:10.1080/01421590120091078
33. Fiscella K, Franks P, Zwanziger J, et al. Risk aversion and costs. A comparison of family physicians and general internists. *J Fam Prac.* 2007;49:7–12.
34. Franks P, Williams GC, Zwanziger J, Mooney C, Sorbero M. Why do physicians vary so widely in their referral rates? *J Gen Intern Med.* 1995;10:557–564. doi:10.1007/bf02640365
35. Fuglenes D, Oian P, Kristiansen IS. Obstetricians' choice of cesarean delivery in ambiguous cases: is it influenced by risk attitude or fear of complaints and litigation? *Am J Obstet Gynecol.* 2008;200(1):48. e1–8. doi:10.1016/j.ajog.2008.07.021
36. Jacobs R, Smith P, Goddard M. Measuring performance: an examination of composite performance indicators. University of York, Center for Health Economics, CHE Technical Paper Series 29; 2004. Available from: <https://www.york.ac.uk/che/pdf/tp29.pdf>. Accessed July 24, 2019.
37. Nardo M, Saisana M, Saltelli A, Tarantola S. Tools for composite indicators building. institute for the protection and security of the citizen econometrics and statistical support to antifraud unit I-21020 Ispra (VA) Italy; 2005. Available from: <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC31473/EUR%2021682%20EN.pdf>. Accessed July 24, 2019.
38. Smith P. Developing composite indicators for assessing health system efficiency. In: Smith PC, editor. *Measuring Up: Improving the Performance of Health Systems in OECD Countries*. Paris: OECD; 2002:6–10.
39. McIntire SA, Miller LA. *Foundations of Psychological Testing*. 2nd ed. New Jersey: John Wiley and Sons; 2005.
40. Dodd JM, Crowther CA, Huertas E, Guise JM, Horey D. Planned elective repeat caesarean section versus planned vaginal birth for women with a previous caesarean birth. *Cochrane Database Syst Rev.* 2013;12: Art. No.: CD004224. doi:10.1002/14651858.CD004224.pub3

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