


Hospital Variation and Associated Organizational Factors of Pregnancy-Related Venous Thromboembolism in China

Clinical and Applied
Thrombosis/Hemostasis
Volume 28: 1-9
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DOI: 10.1177/10760296221076148
journals.sagepub.com/home/cat



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Abstract

Objective: Identifying organizational factors affecting venous thromboembolism (VTE) incidence and variations between hospitals.

Methods: From a 2019 survey of VTE and live births in 113 hospitals, organizational factors: (hospital type, characteristics, live birth number), resource availability: (D-dimer, B-scan ultrasonography of lower extremity veins, computed tomographic pulmonary angiography [CTPA]), and competency: [risk assessment, use of anticoagulants and patient education], data were collected and the associations, weighted by live birth number, analyzed.

Results: Of 113 hospitals in China, 770,828 live births and 526 cases of VTE (68.2 per 100,000 live births) were reported. Nine hospitals lacked B-scan ultrasonography of lower extremity veins and 22 lacked CTPA. Prevalence rates of VTE rates were higher in general hospitals (Odds ratio [OR] = 4.251, 95% CI: 3.373-5.357), hospitals with live births < 10,000 (OR = 1.650-2.193), and hospitals without B-scan ultrasonography (OR = 1.661, 95% CI: 1.096-2.518). Hospitals implementing patient education, had a lower risk of VTE (OR = 0.296-0.374), and VTE rate decreased with the annual increase in live births.

Conclusions: Improved hospital resource availability and competency, especially patient education, is vital for reducing VTE-related maternal mortality and morbidity risk.

Keywords

vein thromboembolism, pregnancy, hospital, China

Date received: 10 November 2021; revised: 30 December 2021; accepted: 6 January 2022.

Introduction

Thromboembolism in pregnancy is one of the most common causes of maternal morbidity and mortality worldwide.^{1,2} In pregnant women, venous thromboembolism (VTE) presents as deep vein thrombosis (DVT) or pulmonary embolism (PE).^{3,4} In recent decades, VTE has become a leading cause of sudden death, which occurs in every 1600 pregnancies, and PE accounted for 9% of overall maternal deaths.^{5,6} It is well recognized that pregnancy increases the risk of thromboembolism under conditions of hypercoagulability, decreased mobility, and compression of the inferior vena cava and pelvic veins.^{3,4} Therefore, there is an urgent need to recognize risk factors of pregnancy-related VTE.

The incidence of VTE varies worldwide, which is accounted for by both individual and organizational factors. In the United

States and the United Kingdom, the incidence ranged from 0.5 to 2 and 0.85 per 1000 pregnancies, respectively.⁷⁻¹⁰ Among

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them, Asian women displayed a lower risk of VTE and death from VTE than black women.^{11,12} Besides individual heterogeneity, organizational factors in hospitals, including available D-dimer, B-scan ultrasonography, computed tomographic pulmonary angiography (CTPA), patient education, risk assessment and use of anticoagulants, are potentially key factors in pregnancy-related VTE. It has been reported that, with early detection and prophylactic managements, maternal death rate due to thromboembolic disease had declined from 14.8% in 2006 to 3.2% in 2014.^{13,14} Thus, these organizational factors may also play an important role in the varied incidence of VTE in pregnancy.

Here we hypothesized that the VTE rate differs in different hospital settings and that organizational factors, including resource availability and competency may have an impact on the incidence of thromboembolism in pregnancy. Considering the ethical issues of a prospective design or randomized controlled trial (RCT) on VTE prevention and management, an epidemiological investigation is a preferred alternative. Hence, we conducted a retrospective hospital-based point prevalence survey of 113 hospitals in mainland China. The purpose was identifying organizational factors and their roles affecting venous thromboembolism (VTE) incidence and variations between hospitals in the differing levels of maternal healthcare in hospital services.

Methods

Data Sources

We conducted a hospital-based point prevalence survey in 113 hospitals in 26 provinces throughout China. This cross-sectional survey collected registered data of thromboembolism during pregnancies from January 1st to December 31st, 2019. Participating hospitals included those across all levels that provided maternal healthcare services in mainland China. A survey request from the Chinese Women's and Children's Health Association was sent to the Chief of the Department of Obstetrics at each hospital. Hospitals that completed the survey and provided informed consent before February 29, 2020, were enrolled for the final analysis, and those with missing data of VTE were excluded. Trained staff members assigned for data quality control telephoned the point of contact in case of any queries. The Institutional Review Board of the Obstetrics and Gynecology Hospital of Fudan University approved the project (IRB 2020-147).

Data Collection

The participating hospitals completed the survey forms, and all data were uploaded to an e-questionnaire platform. This thromboembolism survey was designed to evaluate the hospital-related factors associated with VTE in accordance with Donabedian's framework.^{15,16} It covered the following aspects: organizational general information, resource availability and competency. The participating cases were all reported VTE cases in the puerperium period, covering before delivery and 42 days after delivery. DVT was diagnosed by the abnormal findings on B-scan

ultrasonography of the lower extremity veins, and PE was diagnosed by abnormal findings of CTPA.

First, organizational general information predominantly included general information (hospital type, characteristics and live birth number. Second, hospital resource availability included screening for VTE, using D-dimer for high risk screening, B-scan ultrasonography of the lower extremity veins and computed tomographic pulmonary angiography [CTPA] for diagnosis. Risk assessment referred to the evaluation of VTE risk for the women during pregnancy and postpartum, based on the current clinical guidelines used in each hospital. Anticoagulant use was defined as therapeutic dosing. If the woman had no contraindication to anticoagulants, she would be prescribed these by obstetricians; if the woman had a contraindication, she would be transferred to a hematology specialist. Emergency transfer was medical transfer of critical patients to specialized hospitals or secondary hospitals, or for patients with suspicious symptoms, to those hospitals without use of further diagnostic methods. Patient education included the importance of early mobilization, use of stockings, risk classification, prophylactic and therapeutic anticoagulant use, and identifying early typical symptoms of VTE.

Statistical Analysis

We used numbers and percentages to describe the actual number and prevalence of VTE. Hospital related factors including hospital type, characteristics, and live birth numbers were analyzed as covariates. Patient individual information was unavailable in this questionnaire and thus not included. A multilevel regression was applied analyzing the association of organizational factors with the prevalence of VTE. "Hospital" was treated as a cluster and live birth number in each hospital was weighted. Poisson regression was conducted with hospital-level covariates to predict VTE event counts. Crude odds ratio (OR) and multivariable analyses after adjusting for hospital types, characteristics, region, live birth number, availability of B-scan ultrasonography of lower extremity veins and CTPA, risk assessment, anticoagulants' use, patient education, are presented. Residual error was calculated by the variation between actual and adjusted prevalence of VTE. After adjusting the organizational factors, the variation of VTE prevalence was accounted for by individual factors. Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY).

Results

Among the total of 124 hospitals completing our survey, 113 hospitals were included in the final analysis after excluding eleven hospitals with missing data (Supplemental Table 1). Of the total 770,828 deliveries in 113 enrolled hospitals, 526 VTE cases (68.2 per 100,000 live births) were reported. The number of VTE cases was 423, and the prevalence was 54.9 per 100,000 live births (95% CI: 54.6-55.1). For PE, the number of cases was 103, and the prevalence was 13.4 per 100,000 live births (95% CI: 13.3-13.4).

The majority of the enrolled hospitals were tertiary hospitals (79%) and located in the eastern region (75%). The proportion of general and specialized hospitals was 63% vs 37%, respectively. The number of live births varied from 600 to 373,00 per year, with median of 3500. Besides eight cases with missing information about maternal mortality (comprising two cases in tertiary hospitals and six cases in secondary hospitals due to lost follow-ups), there was one case of maternal mortality in a tertiary hospital and in the rest, 104 live cases were recorded. Of the physicians who responded, 80% were older than 40 years, 75% were at the position of an Associate Physician or above, and 53% had a Master's degree or more.

The general information of hospital-related factors with VTE rate is shown in Table 1. Besides availability of the D-dimer assessment, 9 (8%) of the hospitals lacked B-scan ultrasonography of the lower extremity veins and 22 (19.5%) lacked the CTPA. D-dimer test was available in 112 of our 113 hospitals. A small portion of hospitals reported insufficient competency, including lacking risk assessment (24.8%), anticoagulant use (18.6%), emergency transfer (3.5%), or patient education (4.4%).

Association of organizational factors with the prevalence of VTE is reported in Table 2.

Of the general factors, a higher rate was observed in general hospitals than that of specialized hospitals (OR = 4.079, 95% CI: 3.380-4.922). A relatively lower prevalence in the eastern regions (OR = 0.740, 95% CI: 0.593-0.924) was noted. A higher prevalence of VTE was observed in hospitals with live birth numbers less than 10,000 (OR = 2.885-3.204). Availability of B-scan ultrasonography of lower extremity veins, CTPA and anticoagulants' use was not associated with the prevalence of VTE. Hospitals implementing patient education showed lower VTE prevalence (OR = 0.331-0.592) compared to those hospitals without patient education. In multivariate analyses, the association between organizational factors and VTE prevalence was confirmed. In addition, hospitals with available B-scan ultrasonography of the lower extremity veins, had a lower VTE rate compared to their counterparts with unavailable B-scan ultrasonography (OR = 1.661, 95% CI: 1.096-2.518). To eliminate the bias in hospital resource availability, subgroup analysis of hospitals with accessible B-scan ultrasonography of lower extremity veins and D-dimer assessment was performed (Table 3). In this analysis, the association between patient education with VTE prevalence was significant in the multivariable analyses.

In addition, analysis of the variation between hospitals in VTE rate was also performed (Figure 1). The variation of VTE prevalence was reduced with the increase in the annual live birth numbers. After adjustment by organizational factors, the range of VTE prevalence was changed from 0 to 63.1 to 15.3 to 78.8 per 100,000 live births.

Discussion

Principle Findings

This hospital-based point prevalence survey was one of the largest epidemiological multiple center surveys in China

undertaken in a real-world setting. Of the total of 770,828 deliveries in 113 enrolled hospitals, 526 VTE cases (prevalence of 68.2 per 100,000 live births) were reported. The proportion of DVT cases was 423, with a prevalence of 54.9 per 100,000 live births (95% CI: 54.6-55.1). We also found a varied prevalence of thromboembolism in pregnancy that was related to organizational factors. These included resource availability and competency. These organizational factors appeared insufficient in some hospitals; and therefore, further effort towards strengthening the hospitals' resource availability and competency, especially patient education, is warranted, to reduce VTE related maternal mortality and morbidity.

Clinical Implications

First, we found that the prevalence of VTE ranged from 625.0 to 0 per 100,000 live births among 113 enrolled hospitals, providing the baseline status of VTE across China. This large variation was consistent with previous reports in the United States (172 per 100,000 live births)¹⁷ and United Kingdom (85 per 100,000 live births).⁹ National epidemiological reports in China are scarce. In China, there were several regional reports providing VTE prevalence data, such as 257.8 per 100,000 live births in Liaoning¹⁸ and 140 per 100,000 live birth in meta-analysis.¹⁹ With the increasing usage of diagnostic methods, the prevalence of VTE must be updated to ensure earlier screening and diagnosis. Therefore, our study provides a real-world national prevalence of VTE during pregnancy and puerperium in China, which is necessary for updating the prevalence of pregnancy-related thrombosis events.

Second, the effect of organizational factors on the prevalence of VTE is complex, besides the individual heterogeneity. On one hand, sufficient resources including screening and diagnostic methods, potentially correlate with a higher reported prevalence of VTE, because substantial VTE cases are asymptomatic or unspecific with dyspnea or swollen ankles. In our study, D-dimer testing for screening and B ultrasonography of the lower extremity veins were commonly performed in more than 90% of the enrolled hospitals, together with 80% CTPA available. Thus, it is reasonable that ultrasonography of the lower extremity veins was associated with VTE prevalence in our multivariate analysis, and that D-dimer testing and CTPA were not statistically significant. This is partly due to the bias of missing diagnoses and the confounding effect of other related factors. On the other hand, organizational competency is critical in VTE prevention and treatment. In those hospitals with available resources, the prevalence of VTE could possibly be further reduced with high competency, since we found that those hospitals with risk assessment, anticoagulant use and patient education reported lower prevalence of VTE. Therefore, more attention should be paid to promoting risk assessments and the utilization of anticoagulants for further elimination of the risk of VTE in pregnancy and the related maternal mortality.

Furthermore, we found that patient education was significantly associated with a lower prevalence of VTE in pregnancy, which was initiated from early pregnancy to the postpartum

Table 1. Hospital factors in the 113 responding hospitals in mainland China.

	Total		Eastern		Middle		Western	
	Hospital, n% N = 113	Delivery, N N = 770828	Hospital, n% N = 82	Delivery, N N = 446667	Hospitals, n% N = 17	Delivery, N N = 189037	Hospitals, n% N = 14	Delivery, N N = 135124
Hospital type	89 (78.9)	680658	61 (74.4)	366291	14 (82.4)	179243	14 (100)	135124
Tertiary hospital	24 (21.1)	90170	21 (25.6)	80376	3 (17.6)	9794	0 (0)	0
Secondary or primary hospital	42 (37.2)	484111	28 (34.1)	233014	7 (41.2)	144490	7 (50)	106607
Hospital characteristics	71 (62.8)	286717	54 (65.9)	213653	10 (58.8)	44547	7 (50)	28517
General hospital	16 (14.2)	276498	9 (11.0)	154782	3 (17.6)	67333	4 (28.6)	54383
Group 1 (>10,000)	31 (27.4)	322551	20 (24.4)	159745	7 (41.2)	99410	4 (28.6)	63396
Group 2 (5000-10,000)	28 (24.8)	107587	21 (25.6)	80227	4 (23.5)	15100	3 (21.4)	12260
Group 3 (3000-5000)	38 (33.6)	64192	32 (39.0)	51913	3 (17.6)	7194	3 (21.4)	5085
Group 4 (<3000)	112 (99.1)	760568	81 (98.8)	436407	17 (100)	189037	14 (100)	135124
D-dimer test	1 (0.9)	10260	1 (1.2)	10260	0 (0)	0	0 (0)	0
No	104 (92.0)	717367	73 (89.0)	393206	17 (100)	189037	14 (100)	135124
Yes	9 (8.0)	53461	9 (11.0)	53461	0 (0)	0	0 (0)	0
B-scan ultrasonography*	91 (80.5)	644735	62 (75.6)	325359	16 (94.1)	187037	13 (92.9)	132339
No	22 (19.5)	126093	20 (24.4)	121308	1 (5.9)	2000	1 (7.1)	2785
Yes	85 (75.2)	592703	63 (76.8)	360549	11 (64.7)	118847	11 (78.6)	113307
Risk assessment	28 (24.8)	178125	19 (23.2)	86118	6 (35.3)	70910	3 (21.4)	21817
No	92 (81.4)	665850	63 (76.8)	362489	16 (94.1)	173037	13 (92.9)	130324
Yes	21 (18.6)	104978	19 (23.2)	84178	1 (5.9)	16000	1 (7.1)	4800
Emergency transfer	109 (96.5)	751778	78 (95.1)	427617	17 (100)	189037	14 (100)	135124
No	4 (3.5)	19050	4 (4.9)	19050	0 (0)	0	0 (0)	0
Group 1 (no)	5 (4.4)	20358	3 (2.7)	9958	2 (11.8)	10400	0 (0)	0
Group 2 (postpartum)	4 (3.5)	40091	2 (2.4)	8758	2 (11.8)	31333	0 (0)	0
Group 3 (inpatient)	17 (15.0)	137465	12 (14.6)	66034	2 (11.8)	8600	3 (21.4)	62831
Group 4 (during pregnancy)	32 (28.3)	178917	25 (30.5)	112751	5 (29.4)	50666	2 (14.3)	15500
Group 5 (at first antenatal visit)	55 (48.7)	393997	40 (48.8)	249166	6 (35.3)	88038	9 (64.3)	56793

*B-scan ultrasonography of the lower extremity veins.

Table 2. Univariate and multivariate analyses of hospital factors affecting the prevalence of VTE in the 113 responding hospitals in mainland China.

	VTE, n (%) N = 526	Total, n N = 770828	Univariate, OR (95% CI)	Multivariate*, OR (95% CI)
Hospital type	492 (0.072)	680658	Ref	Ref
Hospital characteristics	34 (0.038)	90170	0.486 (0.338-0.698)	0.803 (0.530-1.216)
Hospital region	154 (0.032)	484111	Ref	Ref
Number of live births, per year	372 (0.130)	286717	4.079 (3.380-4.922)	4.251 (3.373-5.357)
B-scan ultrasonography†	110 (0.081)	135124	Ref	Ref
CTPA	147 (0.078)	189037	0.955 (0.746-1.223)	0.821 (0.628-1.072)
Risk assessment	269 (0.060)	446667	0.740 (0.593-0.924)	0.465 (0.365-0.594)
Anticoagulant use	82 (0.030)	276498	Ref	Ref
Patient education	276 (0.086)	322551	2.885 (2.255-3.692)	2.193 (1.670-2.880)
	107 (0.099)	107587	3.354 (2.515-4.472)	1.438 (1.033-2.003)
	61 (0.095)	64192	3.204 (2.300-4.464)	1.650 (1.147-2.374)
	497 (0.069)	717367	Ref	Ref
	29 (0.054)	53461	0.783 (0.538-1.139)	1.661 (1.096-2.518)
	456 (0.071)	644735	Ref	Ref
	70 (0.056)	126093	0.785 (0.610-1.010)	0.904 (0.684-1.195)
	456 (0.077)	592703	Ref	Ref
	70 (0.039)	178125	0.511 (0.397-0.657)	0.458 (0.307-0.683)
	463 (0.070)	665850	Ref	Ref
	63 (0.060)	104978	0.863 (0.663-1.123)	1.002 (0.751-1.338)
	30 (0.147)	20358	Ref	Ref
	35 (0.087)	40091	0.592 (0.364-0.965)	1.075 (0.511-2.261)
	67 (0.049)	137465	0.331 (0.215-0.509)	0.296 (0.148-0.593)
	97 (0.054)	178917	0.368 (0.244-0.554)	0.307 (0.157-0.603)
	297 (0.075)	393997	0.512 (0.351-0.745)	0.374 (0.190-0.737)

*Adjusted for hospital types, characteristics, region, live birth number, risk assessment, patient education, availability of B-scan ultrasonography of the lower extremity veins and CTPA, and use of anticoagulants.

†B ultrasound of lower extremity vein.

Table 3. Univariate and multivariate analyses of hospital factors affecting the prevalence of VTE in 113 hospitals with VTE diagnosis competency in mainland China.

Hospital type	VTE, n (%) N = 496	Total, n N = 707107	Univariate, OR (95% CI)		Multivariate*, OR (95% CI)	
			OR	95% CI	OR	95% CI
Hospital characteristics						
Hospital region						
Number of live births, per year						
CTPA						
Risk assessment						
Anticoagulant use						
Patient education						
	463 (0.072)	639190	Ref	Ref	Ref	Ref
	21 (0.031)	67917	0.627 (0.434-0.908)	0.627 (0.434-0.908)	0.944 (0.610-1.461)	0.944 (0.610-1.461)
	151 (0.034)	443850	Ref	Ref	Ref	Ref
	345 (0.131)	263257	3.852 (3.181-4.664)	3.852 (3.181-4.664)	4.018 (3.164-5.104)	4.018 (3.164-5.104)
	110 (0.081)	135124	Ref	Ref	Ref	Ref
	147 (0.078)	189037	0.955 (0.746-1.223)	0.955 (0.746-1.223)	0.761 (0.580-0.998)	0.761 (0.580-0.998)
	239 (0.062)	382946	0.767 (0.612-0.961)	0.767 (0.612-0.961)	0.446 (0.348-0.571)	0.446 (0.348-0.571)
	80 (0.032)	249645	Ref	Ref	Ref	Ref
	274 (0.090)	306117	2.793 (2.177-3.583)	2.793 (2.177-3.583)	2.220 (1.683-2.929)	2.220 (1.683-2.929)
	81 (0.088)	92487	2.733 (2.006-3.723)	2.733 (2.006-3.723)	1.203 (0.843-1.715)	1.203 (0.843-1.715)
	61 (0.104)	58858	3.234 (2.317-4.513)	3.234 (2.317-4.513)	1.610 (1.062-2.442)	1.610 (1.062-2.442)
	453 (0.073)	621115	Ref	Ref	Ref	Ref
	43 (0.050)	85992	0.686 (0.501-0.937)	0.686 (0.501-0.937)	1.051 (0.556-1.984)	1.051 (0.556-1.984)
	428 (0.070)	610467	Ref	Ref	Ref	Ref
	68 (0.070)	96640	1.004 (0.777-1.296)	1.004 (0.777-1.296)	1.044 (0.788-1.381)	1.044 (0.788-1.381)
	431 (0.079)	547742	Ref	Ref	Ref	Ref
	65 (0.041)	159365	0.518 (0.399-0.673)	0.518 (0.399-0.673)	0.432 (0.285-0.655)	0.432 (0.285-0.655)
	443 (0.071)	626396	Ref	Ref	Ref	Ref
	53 (0.066)	80711	0.929 (0.698-1.235)	0.929 (0.698-1.235)	1.199 (0.884-1.627)	1.199 (0.884-1.627)
	30 (0.147)	20358	Ref	Ref	Ref	Ref
	35 (0.098)	35591	0.667 (0.410-1.087)	0.667 (0.410-1.087)	1.823 (0.810-4.105)	1.823 (0.810-4.105)
	54 (0.040)	134365	0.273 (0.174-0.426)	0.273 (0.174-0.426)	0.350 (0.169-0.724)	0.350 (0.169-0.724)
	95 (0.063)	150490	0.428 (0.284-0.646)	0.428 (0.284-0.646)	0.501 (0.224-1.029)	0.501 (0.224-1.029)
	282 (0.077)	366303	0.522 (0.358-0.761)	0.522 (0.358-0.761)	0.573 (0.281-1.168)	0.573 (0.281-1.168)

*Adjusted by hospital types, characteristics, region, live birth number, risk assessment, patient education, CTPA availability and use of anticoagulants.

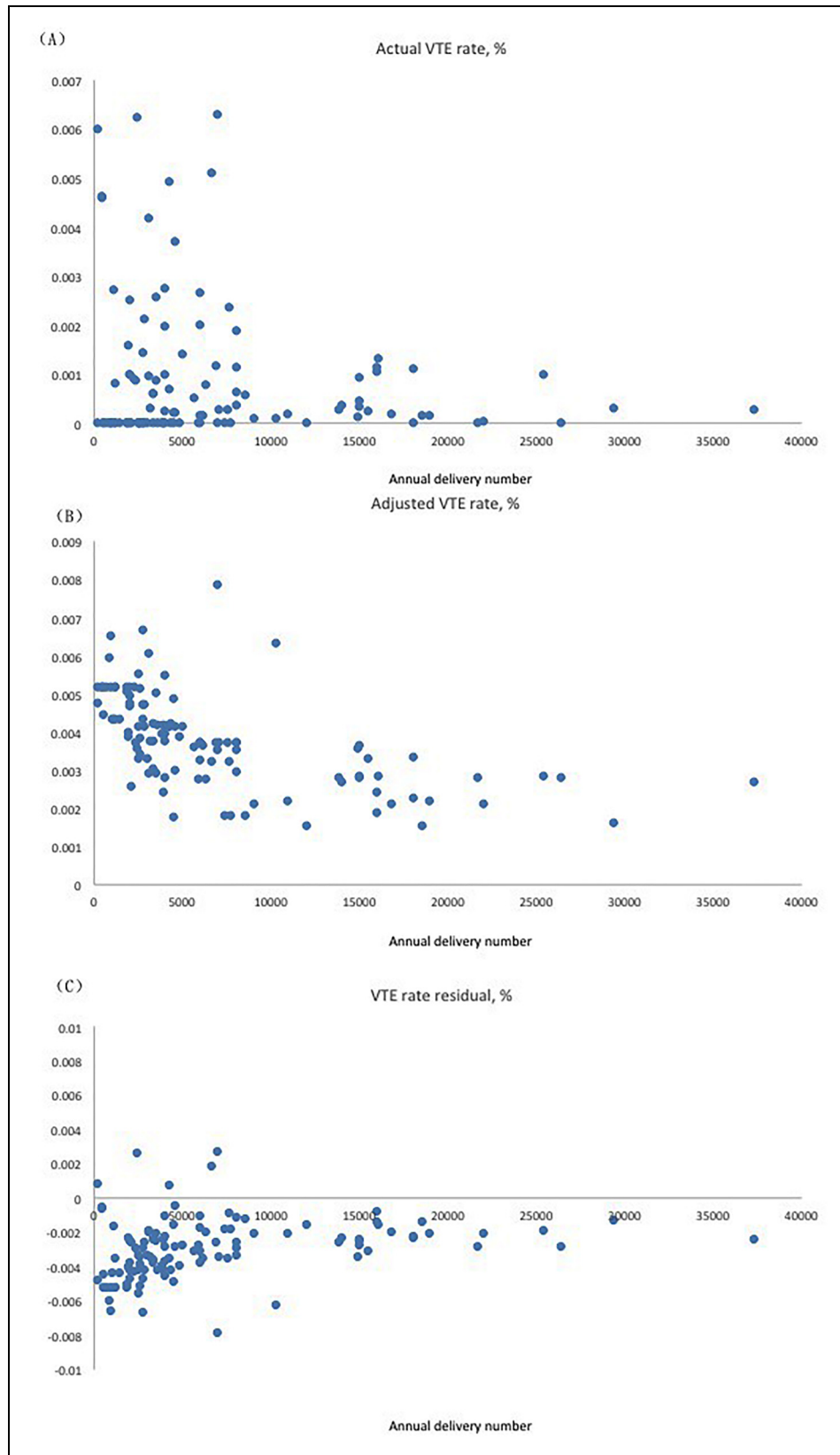


Figure I. Variation of VTE rate in 113 hospitals (A) crude VTE rate; (B) adjusted VTE rate, after adjusted by hospital types, characteristics, region, live birth number, risk assessment, patient education, availability of B-scan ultrasonography of lower extremity veins and the CTPA, and use of anticoagulants; (C) residual of VTE rate calculated by the variation between actual and adjusted prevalence of VTE.

period. Possible reasons could be: first, the initiation of early mobilization and use of stockings is an active response of pregnant women instead of their receiving passive treatment from the obstetricians. Second, prophylactic use of anticoagulants during pregnancy or in postpartum requires more understanding and the confidence of pregnant women, and then they would correctly use the anticoagulants following their doctor's advice. Third, consciousness of suspicious symptoms in the early phase in pregnant women is the key to timely screening and diagnosing VTE, which is necessary to reduce the related maternal mortality and morbidity. Thus, the provision of detailed health-related education is needed especially in terms of early mobilization, and the use of stockings and intermittent pneumatic compression devices, both after vaginal delivery and Cesarean section.

In addition, this study indicated that more attention is required for the construction of organizational resources and enhancement of competency. Since VTE is considered a preventable and modifiable disorder, our study indicated that the efficiency of implementation should be improved. In our study, the prevalence of VTE was less varied after being adjusted by the organizational factors. Organizations are beneficial for facilitating the work of patient-centered teams.²⁰ Besides individual factors, organizational effects should be considered in the macro-environment in hospitals. Second, in the whole course of VTE prevention and treatment, readiness is of great importance, which covers multi-levels of patient, doctor, department, and policy. Available resources and sufficient competency are an essential part of readiness. Thus, further efforts should be made towards improving these organizational factors as much as possible.

Strengths and Limitations

Our main strength is that it was a nation-wide hospital-based survey to evaluate the VTE status in China that accounted for potential hospital-related factors, including hospital types, resource availability, and competency. It covered 26 provinces in mainland China and enrolled 113 hospitals of varied types, characteristics, and scale. Due to the ethical considerations, our study design of a prevalence survey had the potential to explore the association between organizational factors and the prevalence of VTE. Moreover, multivariable analyses and adjustments were performed when investigating the association. Additionally, this survey covered alternative hospital-related factors that could be improved upon for the elimination of VTE risk. Thus, the findings are practical and indicate the potential for clinical implementation.

This study has some limitations. First, this survey was based on a questionnaire, and therefore, reporting bias should be considered. The numbers that emerged from the survey may not represent the true incidence of VTE in China. The incidence of VTE in those hospitals not responding may be lower, as this study recruited a high proportion of tertiary care hospitals. However, in the present case, the numbers represent the true positives out of all patients suspected of having VTE.

Second, the hospitals participating in this survey were mainly tertiary and secondary hospitals, and only one primary hospital was enrolled. Since most of the hospitals were at a tertiary level of care (80%), there is possibly a bias as the findings do not represent the general situation and care for the patients. To eliminate this selection bias, the hospital characteristics, hospital type, and annual live birth numbers have been adjusted for, in the analysis. Third, the site of the enrolled hospitals was mainly the eastern region of mainland China, and the populations in different parts of China differ in their ethnic background as well as in their predisposition for VTE, based on other risk factors. Thus, subgroup analysis of the different regions was conducted. Fourth, whether resources are available and the hospital is competent were the main outcome parameters in this study, but the implementation has not been discussed. Organizational factors included resource availability and competency, but there was no information about false positive and false negative rates of diagnosis, with substantial variability due to different clinical suspicions, the modality being used and the expertise of the physicians. However, this survey was completed by the department Chief or senior physicians from the Department of Obstetrics from each hospital, and trained staff members were assigned for data quality control by telephoning the point of contact if there were any queries, which ensured the quality of the survey to some extent.

Conclusions

In conclusion, organizational factors were observed to play an important role in the variation of prevalence of thromboembolism during pregnancy in China. This hospital-based point prevalence survey demonstrated that the prevalence of VTE was significantly influenced by organizational factors such as hospital resource availability and competency. Additional efforts should be accelerated towards the improvement of hospital resources and competency towards reducing the risk of VTE related maternal mortality and morbidity.

Acknowledgments

The authors thank all 113 hospitals that completed the venous thromboembolism (VTE) survey in China.

Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding authors had full access to all the data in the study and, along with the other authors, had final responsibility for the decision to submit for publication. The role of the sponsor in the design, execution, analysis, reporting, and funding is fully disclosed.

Disclosure of Interests

The authors have nothing to disclose. All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

Contribution to Authorship

Dr Zhou QJ and Dr Li XT had full access to all of the study data and take responsibility for the integrity of the data and accuracy of the data analysis.

Concept and design: Zhou and Li.

Acquisition, analysis, or interpretation of data: Zhou and Li.

Drafting of the manuscript: All authors.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Zhou and Li.

Obtained funding: Li.

Administrative, technical, or material support: Li.

Details of Ethics Approval


The Institutional Review Board of the Obstetrics and Gynecology Hospital of Fudan University approved the project, and written informed consent was obtained from the participants (IRB202010, 20th January 2020).

Funding

This study was supported by the National Key Research and Development Program (2021YFC2701600, 2021YFC2701601), the Shanghai Key Program of Clinical Science and Technology Innovation (No. 17411950500, No. 17411950501 and No. 18511105602), Clinical Research Plan of SHDC (SHDC2020CR1047B and SHDC2020CR 6021), the Shanghai Excellent Young Scholar Plan of Public Health (2020-2022, GWV-10.2-YQ13), Elite Young Scholar 2025 of Fudan University (2020-2023), National Science Foundation of China (81741047), Shanghai Medical Center of Key Programs for Female Reproductive Diseases (2017ZZ01016).

CONDENSATION: It is vital to improve hospital resource availability and competency towards reducing VTE-related maternal mortality and morbidity risk.

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Data Availability

The data used and analyzed during the current study are available from the corresponding author on reasonable request.

Supplemental Material

Supplemental material for this article is available online.

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