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Complete List of Authors:	Zhu, Weiying ; Jiaxing University, Obstetric Department of Jiaxing Maternity and Children Health Care Hospital Ai, Ling ; Jiaxing University, Obstetric Department of Jiaxing Maternity and Children Health Care Hospital Feng, Ying ; Jiaxing University, Obstetric Department of Jiaxing Maternity and Children Health Care Hospital Yuan, Haiyan ; Jiaxing University, Obstetric Department of Jiaxing Maternity and Children Health Care Hospital Wang, Yu ; Jiaxing University, Science and Education Division of Jiaxing Maternity and Children Health Care Hospital Wang, Meitang ; Changhai Hospital, Emergency Department Mei, Zubing; Shuguang Hospital, Department of Anorectal Surgery
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Factors predicting successful vaginal birth after caesarean section: protocol for evidence-based consensus recommendations using a Delphi survey

Weiying Zhu[1], Ling Ai[1#], Ying Feng[1], Haiyan Yuan[1], Yu Wang[2], Meitang Wang[3#], Zubing Mei[4. 5#]

1. Obstetric Department of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing,314000, China
2. Science and Education Division of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing, 314000, China
3. Emergency Department, Changhai Hospital, Navy Medical University, Shanghai, 200433, China.
4. Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine, Shanghai, 201203, China;
5. Anorectal Disease Institute of Shuguang Hospital, Shanghai, 201203, China.

Correspondence to:

Dr. Ling Ai

Obstetric Department of Jiaxing Maternity and Children Health Care Hospital,

Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and

Children

No.2468 East Central Road, South lake district, Jiaxing, 314000, China

Tel: 086 13736836830

E-mail:13736836830@163.com

Dr. Meitang Wang,

Emergency Department, Changhai Hospital, Navy Medical University, Shanghai,

168 Changhai Road, Shanghai 200433, China.

Tel: 86- 189 3010 3301;

E-mail: wmt88@sina.com

Dr. Zubing Mei, MD, PhD

Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine; Anorectal Disease Institute of Shuguang Hospital

528 Zhangheng Road, Shanghai 201203, China

Tel: 086-2120256187

E-mail: herrmayor@126.com

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Acquisition, analysis, or interpretation of data: Weiying Zhu, Ling Ai, Ying Feng, Haiyan Yuan, Yu Wang, and Meitang Wang.

Drafting of the manuscript: Weiying Zhu, Zubing Mei.

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Abstract

Introduction

With the wide adoption of the two-child policy in China since 2016, a large percentage of women with a history of caesarean delivery plan to have a second child. Accordingly, the rate of Vaginal Birth after Cesarean Delivery (VBAC) is increasing. Women attempting repeat VBAC may experience multiple morbidities, which is also one of the leading causes of maternal and perinatal mortality. However, it remains far below expectations how to evaluate successful VBAC. This study aims to use a novel approach to identify a set of predictive factors for successful VBAC to be included in prediction models. We plan to validate these predicting factors collected through a comprehensive literature review combined with a two-round international Delphi survey.

Methods and analysis

This study will apply a methodology through an evidence-based approach. A long list of potential prediction factors for successful VBAC will be extracted and identified through the following stages: First, a systematic review of the published literature will be conducted to extract candidate factors that contribute to the successful VBAC. The online questionnaires will be developed in the field of patient, maternal and fetal-related factors. A two-round international Delphi survey will be distributed to the expert panel in the field of perinatal medicine using Google Forms. Experts will be asked to score each factor using the 9-point Likert rating scale to establish core

predictive factors for the successful VBAC. The expert panel will determine on whether to include, potentially include, or exclude predictive factors, based on the GRADE approach and the Delphi method.

Ethics and dissemination

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital (approval number: 2019-79). The results of this study will be submitted to international peer-reviewed journals or conferences in perinatal medicine or obstetrics.

Trial registration number

Open Science Framework (OSF): DOI 10.17605/OSF.IO/8D6XY.

Key words

Vaginal birth after caesarean section (VBAC), predictive factors, systematic review, Delphi survey, evidence-based consensus

Strengths and limitations of this study

- This is the first novel mixed methods used to select predictive factors for successful vaginal birth after cesarean delivery (VBAC) for obstetric patients.
- Predictive factors for successful VBAC will be identified through the combination of a systematic review and Delphi process.
- The consensus on determination of predictive factors for successful VBAC will be based on a two-round Delphi survey among international obstetric experts.
- A Delphi survey-based expert judgment will be made to include or exclude predictive factors for successful VBAC.

Introduction

The overall cesarean delivery (CD) rates have accelerated significantly globally in recent years.[1] It has been reported that successful vaginal birth after cesarean delivery (VBAC) reduces morbidity or complications compared to an elective repeat CD.[2] In China, with the wide adoption of the two-child policy since 2016, a large percentage of women with a history of CD plan to have a second child. Therefore, a trial of labor after one cesarean (TOLAC) is encouraged in some countries to reduce CD rates and associated maternal adverse outcomes. [3-5] Studies have shown that CD after an unsuccessful TOLAC may lead to increased bleeding, postoperative infection, endometritis and increased health care expenditure.[6-9]

It is crucial to determine the protective and risk factors for an obstetrician to decide on a woman's chance for successful VBAC based on the patients baseline characteristics. Several studies have reported that patient- related demographic characteristics (patient race and ethnicity, education level and gestational week),[10 11] maternal factors (maternal age, body mass index and bishop score) [12 13] and fetal factors (estimated birth weight)[14] that may be associated with a woman's chance for successful VBAC. Some predictive models for successful VBAC have also been published in recent years.[2 12 15] However, the quality of these models varied considerably in terms of study design, enrolled patients, model internal and external validity, which make the applicability domain of the model rather dubious.

The aim of this study is to use a novel approach to identify a set of predictive factors for success of VBAC to be included in prediction models. We plan to validate these predicting variables collected through a comprehensive literature review combined with an international two-round Delphi survey.

Ethics

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital.

Study design

We will carry out a study that combines a comprehensive systematic review and an evaluation of the certainty of the evidence based on Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach.[16] As demonstrated in the flowchart (Figure 1), a structured Delphi survey-based expert judgment will be made to include or exclude predictive factors for successful VBAC.

Systematic literature review

The systematic review will be performed based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines,[17] and aims to update all potential predictive factors for successful VBAC in hospitalised obstetric patients, the search strategy of which is described in detail in Table 1. In summary, we will

search Pubmed, EMBASE, Cochrane Library and SinoMed from inception to November, 2020. Predictive factors and prediction model studies will be selected that report potential predictive factors for successful VBAC in hospitalised obstetric patients. We define successful VBAC as a successful vaginal delivery after a previous cesarean section. Two independent reviewers will screen the articles for eligibility and extract the data after duplicated citations are removed. Then the GRADE approach will be applied to assess and rate the certainty of the evidence independently.[16] The results of the systematic review will provide the basis to develop a framework for voting in the two-round international Delphi survey.

When the systematic review is finished, we will hold a face-to-face meeting among the research team to discuss the main findings of the systematic review. Through the discussion, we will judge which predictive factors should be included in the Delphi process. The results will be presented with forest plots for each meta-analysis combined with the effect estimates and their confidence intervals. We will also evaluate the evidence of the observational studies which will be graded into high-quality, moderate-quality and low-quality evidence according to Egger's P value, total sample size and between-study heterogeneity as recommended by Mei et al.[18] After grading the evidence, the research team members will discuss the feasibility and acceptability of the potential predictive factors included in the Delphi survey, which will be categorised into 3 groups: included, potentially included, and excluded predictive factors, the method of which was recommended by Darzi, et al.[19] The

included predictive factors are defined as those that should be included in the future prediction model. The potentially included predictive factors are defined as candidates that will potentially be included in the future prediction model. The excluded predictive factors are those that will not be considered to be included in the prediction model.

Expert panel participants

The expert panel will be selected from all over the world including obstetricians and senior researchers with expertise in management of obstetric or perinatal complications in hospitalised obstetric patients, and in the development, validation, and application of predictive models for clinical practice. Panel experts will participate in a web-based panel conference, complete surveys and questionnaires, if necessary, will also provide feedback on reports. They will disclose that they do not have any conflicts of interest and then complete the declaration-of-interest forms to avoid any potentially existing conflicts regarding the existing predictive models and other factors. We anticipate that at least 20 representatives from the expert panel with at least five representatives from each of international association will be included.

We will select members of the expert panel by using the following predesigned criteria:

1) First or corresponding authors of a journal article on predictive factors for successful VBAC in hospitalised obstetric patients.

2) Representative members from International Federation of Gynaecologists and Obstetricians (FIGO), the American College of Obstetricians and Gynecologists (ACOG), the Royal College of Obstetricians and Gynaecologists (RCOG), and Chinese Obstetricians and Gynecologists Association (COGA).
3) Guideline authors of the above mentioned associations of obstetricians and gynecologists.

The research team is composed of one senior obstetrician, 2 to 3 resident physicians working in gynecology and obstetrics, a senior researcher, who will work together to compile the evidence for presentation, draft the questionnaire for the two-round Delphi survey, analyse the responses, and summarise the results.

Two-round Delphi survey

A list of predictive factors will be delivered to the expert panel by e-mail in the form of google form questionnaire, which we summarise based on the results of the systematic review and identify them finally by group discussion among the research team members. Each member of expert panel will provide his or her respondence independently. Discussions are not allowed among expert panel members. During the first-round survey, the initial list of predictive factors yielded by the systematic review will be supplemented with other relevant factors which might be suggested by the expert panel members. These will constitute all the item list of the first-round Delphi survey. We initially classify the predictive factors into three categories according to the literature reports and general knowledge, including patient-related

factors (race/ethnicity, level of education, delivery interval and gestational week), maternal-related factors (maternal age, body mass index, previous vaginal delivery history and trial of labor after a caesarean delivery history) and fetal-related factors (estimated fetal weight).

The second-round Delphi survey will be designed for the experts to make final clinical or methodological judgements regarding the predictive factors for successful VBAC based on the reports of the first-round survey.

The expert panel members will be asked to rate the importance of each candidate item using a 9-point Likert scale, where 1 to 3 means "low importance", 4 to 6 means "not critically important" and 7 to 9 means "critical importance".[20-23] An "unable to rate" option will also be set. The expert panel members will be instructed to choose "unable to rate" if they think they do not have adequate knowledge or expertise on a particular list of statement.[24 25] During the first round, panel members can suggest some more related items to be incorporated into the second round of survey after discussion by the research team. Only panel members who have finished the first-round survey can move to the second-round survey. During the second round, they will be reminded of what they rated during the first round and will be shown the distribution of responses across the 1 to 9 scale for each question in the questionnaire. The expert panel members have the right to retain their first-round scores or rescored for some specific statements. Both rounds of online voting are anonymous to minimise bias.

Consensus definition and analysis plan

We will consider consensus to be reached and the predictive factors will be included if more than 70% of panel members score the statement within 7 to 9 (critical importance) or less than 15% of panel members score the statement within 1 to 3 (low importance); or in contrast, the predictive factors will be excluded if more than 70% of panel members score the statement within 1 to 3 (low importance) or less than 15% of panel members score the statement within 7 to 9 (critical importance).

This framework is recommended by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) group used to assess the importance of evidence. At the end of the questionnaire, we will encourage experts who participate in the survey to add some other potential predictive factors that they think are relevant, and it is better to provide some reasons.

Finally, the panel members' agreement on the factors' importance will be assessed using the Disagreement Index (DI), as described in the RAND/UCLA approach.[26] The DI generally reflects the distribution and symmetry of the scores (ranging from 1 to 9), with a higher DI representing wider spread across the 9-point scale, while lower DI representing increasing consensus. If the DI exceeds 1.0, the distribution is regarded as extreme variation in rated scores, while the DI is less than 1.0, we consider no extreme variation existence, which means that a consensus is reached.

Ethics and dissemination

Information from patients and the public has informed the conception and requirement for this Delphi study as part of an existing programme of research that is centred on lumbar spinal surgery for LBLP and patient outcome.

Ethics and dissemination

Results of this evidence-based international Delphi survey to provide recommended predictive factors will be presented at relevant international conferences, and will be published in peer-reviewed journals. It will provide both obstetricians and researchers with valid and consensus predictors which can be used both in clinical practice and in quality improvement initiatives.

Patient and public involvement

Details from patients and the public have provided the conception and requirement for this Delphi process as one part of the study protocol that is focused on predictive factors of successful VBAC.

Discussion

In this work, we will apply a novel evidence-based approach to systematically identify and assess predictive factors of successful VBAC in hospitalised obstetric patients. We will first conduct an extensive systematic literature review to identify a

number of potentially relevant patient, maternal and fetal-related predictive factors through GRADE approach. We will next develop an international two-round Delphi survey to reach a consensus among international obstetric experts from 4 international obstetricians and gynecologists associations of the world (FIGO, ACOG, RCOG and COGA) on the importance of the selected factors. Our ultimate purpose of this study is to reach evidence-based consensus on the predictive factors of successful VBAC used for future international prediction model development for successful VBAC. At the moment, there are no validated prediction models for successful VBAC based on large prospective cohort studies.

Strengths and limitations

Our study has several strengths due to its rigorous methods that are robust and reproducible for several reasons. First, our systematic review will be conducted based on the PRISMA guidelines.[17] The search strategy is most comprehensive compared with the previously ones.[11 27] Secondly, we will apply the GRADE approach to assess the certainty of evidence, which is a most solid method for decision making in several aspects, including for the development of future clinical guidelines.[16] Thirdly, our research team will provide objective suggestions to identify all potential predictive factors for successful VBAC. Fourthly, the consensus regarding the issue will be based on a two-round Delphi survey among international obstetric experts from multiple international obstetrician and gynecologist associations of the world, making the results more convincing. Moreover, the two-round Delphi survey will be

completely anonymous to reduce bias to the greatest extent. These set of methods will guarantee the internal and external validity of the study results.

There are limitations to this study as well. Firstly, the quality of the included studies varied considerably because most of the studies are observational cohort studies, and some are retrospective in study design. Secondly, the statements of Delphi survey to be developed are generally brief in nature. Some unknown domains related to the predictive factors may not be involved and addressed adequately. Thirdly, some of the experts involved in the Delphi survey will be clinical researchers instead of obstetricians, and they might lack knowledge regarding certain aspects of factors for successful of VBAC. Fourthly, though representative participants will be enrolled as expert panel in the Delphi survey mainly from Europe, USA and China, the experts do not cover the whole global regions, which may lead to a selection bias, and the results could not be applicable to regions outside Europe, USA and China.

In summary, this study protocol summarises the design of validation of studies predicting factors collected through a comprehensive literature review combined with a two-round international Delphi survey . The results from this study will be interpreted for the purpose of clinical decision making for obstetricians to determine the suitable patients for VBAC.

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Table 1. Search strategy for Pubmed.

1. "Vaginal Birth after Cesarean"[Mesh]
2. "Trial of Labor"[Mesh]
3. "Cesarean Section, Repeat"[Mesh]
4. "Cesarean Section"[Mesh]
5. 1-4/OR
6. 'Vaginal Birth after Cesarean' OR VBAC OR 'trial of labor' OR 'cesarean section' OR TOLAC OR 'vaginal birth*' OR 'vaginal deliver*' OR 'trial of labour' OR 'active labor' OR 'active labour'
7. 5 OR 6

Figure legend

Figure 1. Flowchart of the study design.

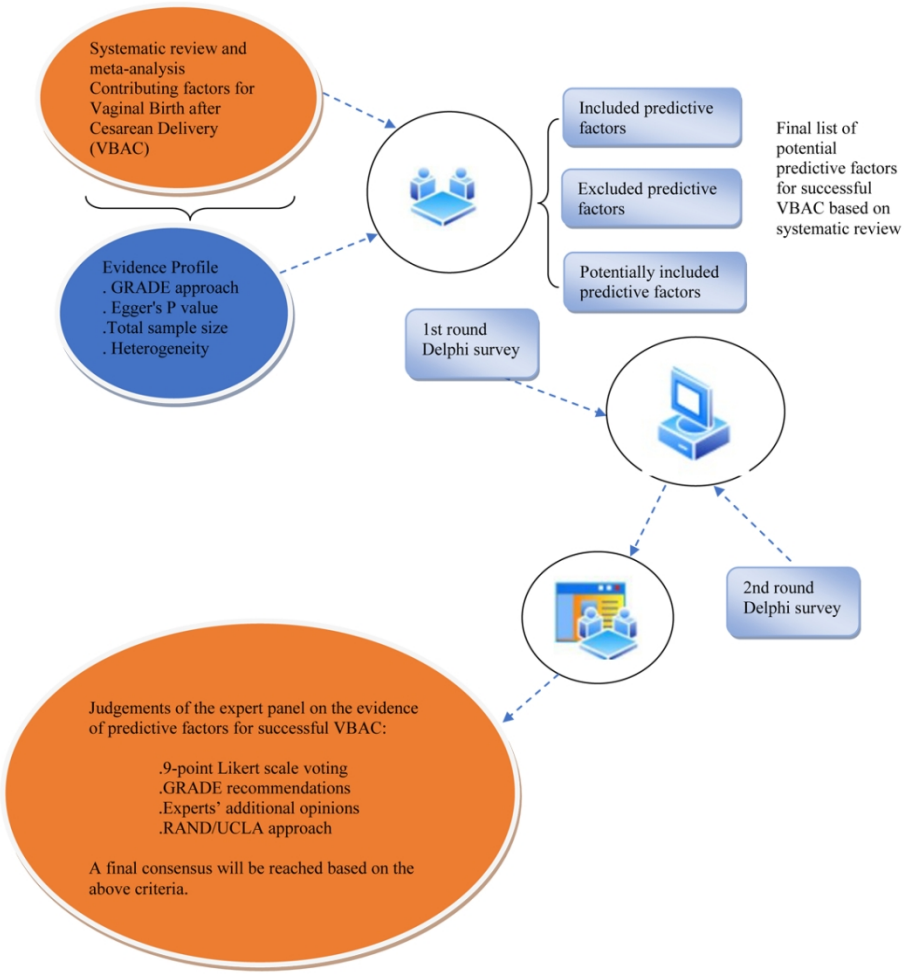

Figure 1. Flowchart of the study design.

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Weiying Zhu[1], Ling Ai[1#], Ying Feng[1], Haiyan Yuan[1], Yu Wang[2], Meitang Wang[3], Zubing Mei[4, 5#]

1. Obstetric Department of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing,314000, China
2. Science and Education Division of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing, 314000, China
3. Emergency Department, Changhai Hospital, Navy Medical University, Shanghai, 200433, China.
4. Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine, Shanghai, 201203, China;
5. Anorectal Disease Institute of Shuguang Hospital, Shanghai, 201203, China.

Correspondence to:

Dr. Ling Ai

Obstetric Department of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children

No.2468 East Central Road, South lake district, Jiaxing, 314000, China

Tel: 086 13736836830

E-mail:13736836830@163.com

Dr. Zubing Mei, MD, PhD

Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine; Anorectal Disease Institute of Shuguang Hospital
528 Zhangheng Road, Shanghai 201203, China
Tel: 086-2120256187
E-mail: herrmayor@126.com

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vaginal birth after caesarean section (VBAC), predictive factors, systematic review, Delphi survey, evidence-based consensus

Abstract

Introduction

With the wide adoption of the two-child policy in China since 2016, a large percentage of women with a history of caesarean delivery (CD) plan to have a second child. Accordingly, the rate of vaginal birth after cesarean delivery (VBAC) is increasing. Women attempting repeat VBAC may experience multiple morbidities, which is also one of the leading causes of maternal and perinatal mortality. However, it remains to be addressed how we evaluate factors for successful VBAC. This study aims to use a novel approach to identify a set of potential predictive factors for successful VBAC, especially for Chinese women, to be included in prediction models which can be most applicable to pregnant women in China. We plan to assess all potential predictive factors collected through a comprehensive literature review. Then the certainty of the evidence for the identified potential predictive factors will be assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process. Finally, a two-round international Delphi survey will be conducted to determine the level of consensus.

Methods and analysis

This study will apply a methodology through an evidence-based approach. A long list of potential predictive factors for successful VBAC will be extracted and identified through the following stages: First, an up-to-date systematic review of the published literature will be conducted to extract identified potential predictive factors for

successful VBAC. Second, an online Delphi survey will be performed to achieve expert consensus on which factors should be included in future prediction models. The online questionnaires will be developed in the field of patient, maternal and fetal-related factors. A two-round international Delphi survey will be distributed to the expert panel in the field of perinatal medicine using Google Forms. Experts will be asked to score each factor using the 9-point Likert rating scale to establish potential predictive factors for the successful VBAC. The expert panel will determine on whether to include, potentially include, or exclude predictive factors, based on a systematic review of clinical evidence and the Delphi method.

Ethics and dissemination

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital (approval number: 2019-79). The results of this study will be submitted to international peer-reviewed journals or conferences in perinatal medicine or obstetrics.

Trial registration number

Open Science Framework (OSF): DOI 10.17605/OSF.IO/8D6XY.

Key words

Vaginal birth after caesarean section (VBAC), predictive factors, systematic review, Delphi survey, evidence-based consensus

Strengths and limitations of this study

- This study aims to use a mixed methods approach to select potential predictive factors for successful vaginal birth after caesarean section (VBAC) for obstetric patients.

- Potential predictive factors for successful VBAC will be identified through a combination of a systematic literature review and a modified Delphi process.

- The consensus on the potential predictive factors for successful VBAC will be achieved based on a two-round Delphi survey among international experts in the field of obstetrics.

- The expert panel will determine whether to include, potentially include, or exclude the candidate predictive factors, based on the GRADE approach and the Delphi method.

Introduction

The overall cesarean delivery (CD) rates have accelerated significantly globally in recent years.[1] Though successful vaginal birth after cesarean delivery (VBAC) has been reported to reduce morbidity or complications compared to an elective repeat CD,[2] recent evidence has continued to highlight the risks of VBAC.[3] In China, with the wide adoption of the two-child policy since 2016, a large percentage of women with a history of CD plan to have a second child and an elective repeat CD can be a suitable choice. However, a trial of labor after one cesarean (TOLAC) is encouraged in some countries which has been reported to reduce maternal adverse outcomes. [4-6] Studies have also shown that CD after an unsuccessful TOLAC may lead to increased bleeding, postoperative infection, endometritis and increased health care expenditure.[7-10]

Therefore, for obstetricians, it is crucial to identify the potential protective and risk factors influencing a woman's successful VBAC based on the patients' baseline characteristics. Several studies have reported that patient demographic characteristics (patient race and ethnicity, education level and gestational week),[11 12] maternal factors (maternal age, body mass index, bishop score, diabetes, hypertensive disorders complicating pregnancy and previous vaginal deliver) [12-15], fetal factors (estimated birth weight)[16] and other related factors (oxytocin implementation)[15] that may be associated with a woman's chance for successful VBAC. Some predictive models for successful VBAC have also been published in recent years.[13 17 18] However, the

quality of these models varied considerably in terms of study design, enrolled patients, internal and external validity of the models, which make the models' applicability domain rather dubious.

This study aims to use a novel approach to identify a set of potential predictive factors for successful VBAC, especially for Chinese women, to be included in future prediction models which can be most applicable to pregnant women in China. We plan to assess all potential predictive factors collected through a comprehensive literature review. Then the certainty of the evidence for the identified potential predictive factors will be assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process. Finally, a two-round international Delphi survey will be conducted to determine the level of consensus.

Ethics

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital.

Study design

We will carry out a study that combines a comprehensive systematic review and an evaluation of the certainty of the evidence based on GRADE approach.[19] As demonstrated in the flowchart (**Figure 1**), a structured Delphi survey-based expert

judgment will be made to include or exclude potential predictive factors for successful VBAC.

Systematic literature review

The systematic review will be performed based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines,[20] and aims to update all potential predictive factors for successful VBAC among women with a previous CD history, the search strategy of which is described in detail in Table 1. In summary, we will search Pubmed, EMBASE, Cochrane Library and SinoMed from inception to November, 2020. Predictive factors and prediction model studies will be selected that report potential predictive factors for successful VBAC among women with a previous history of CD. We define successful VBAC as a successful vaginal delivery after a previous cesarean section. Two independent reviewers will screen the articles for eligibility and extract the data after duplicated citations are removed.

For a given potential predictive factor, we will pool the summary relative risks (RRs) or odds ratios (ORs) with 95% CIs for predictive factors reported $\geqslant$2 studies using random-effects models.[21] Cochran Q and the I^2 statistics will be applied to investigate sources of heterogeneity, with an I^2 statistic >50% referring to substantial heterogeneity.[22] Publication bias will be tested using Egger's test, with a P value < 0.1 indicating significant difference.[23] Then the GRADE approach will be applied to assess and rate the certainty of the evidence independently.[19] The results of the

systematic review will provide the basis to develop a framework for voting in the two-round international Delphi survey.

When the systematic review is finished, we will hold a face-to-face meeting among the research team to discuss the main findings of the systematic review. Through the discussion, we will judge which potential predictive factors should be included in the Delphi process. The results will be presented with forest plots for each meta-analysis combined with the effect estimates and their confidence intervals. We will also evaluate the evidence of the observational studies which will be graded into high-quality, moderate-quality and low-quality evidence according to Egger's P value, total sample size and between-study heterogeneity as recommended by Mei et al.[24] After grading the evidence, the research team members will discuss the feasibility and acceptability of the potential predictive factors included in the Delphi survey, which will be categorised into 3 groups: included, potentially included, and excluded predictive factors, the method of which was recommended by Darzi, et al.[25] The included potential predictive factors are defined as those that should be included in the future prediction model. The potentially included predictive factors are defined as candidates that will potentially be included in the future prediction model. The excluded predictive factors are those that will not be considered to be included in the prediction model.

Expert panel participants

The expert panel will be selected from all over the world including obstetricians and senior researchers with expertise in management of obstetric or perinatal complications for pregnant women with a previous history of CD, and in the development, validation, and application of predictive models for clinical practice. Panel experts will participate in a web-based panel conference, complete surveys and questionnaires, if necessary, will also provide feedback on reports. They will disclose that they do not have any conflicts of interest and then complete the declaration-of-interest forms to avoid any potentially existing conflicts regarding the existing predictive models and other factors.

We will select members of the expert panel by using the following predesigned criteria:

1) First or corresponding authors of a journal article on potential predictive factors for successful VBAC in hospitalised obstetric patients.
2) Representative members from International Federation of Gynaecologists and Obstetricians (FIGO), the American College of Obstetricians and Gynecologists (ACOG), the Royal College of Obstetricians and Gynaecologists (RCOG), and Chinese Obstetricians and Gynecologists Association (COGA).
3) Guideline authors of the above mentioned associations of obstetricians and gynecologists.

The research team is composed of one senior obstetrician, 2 to 3 resident physicians working in gynecology and obstetrics, a senior researcher, who will work together to

compile the evidence for presentation, draft the questionnaire for the two-round Delphi survey, analyse the responses, and summarise the results.

Two-round Delphi survey

The expert panel will answer questions on three categories of the potential predictive factors for successful VBAC: patient-related, maternal-related and fetal-related predictive factors. The results of the systematic review will be presented to the experts and they will be asked to rate their agreement with these three aspects of potential predictive factor proposals. For example, they will rate their agreements with the following statements: (1) that maternal age is a predictive factor of limited / critical importance to successful VBAC; (2) that level of education is a predictive factor of limited / critical importance to successful VBAC; or (3) that estimated fetal weight is a predictive factor of limited / critical importance to successful VBAC.

A list of potential predictive factors will be delivered to the expert panel by e-mail in the form of google form questionnaire, which we summarise based on the results of the systematic review and identify them finally by group discussion among the research team members. Each member of expert panel will provide his or her respondence independently. Discussions are not allowed among expert panel members. During the first-round survey, the initial list of potential predictive factors yielded by the systematic review will be supplemented with other relevant factors which might be suggested by the expert panel members. These will constitute all the

item list of the first-round Delphi survey. We initially classify the potential predictive factors into three categories according to the literature reports and general knowledge, including patient-related factors (race/ethnicity, level of education, delivery interval and gestational week), maternal-related factors (maternal age, body mass index, previous vaginal delivery history and trial of labor after a CD history) and fetal-related factors (estimated fetal weight).

The second-round Delphi survey will be designed for the experts to make final clinical or methodological judgements regarding the potential predictive factors for successful VBAC based on the reports of the first-round survey.

The expert panel members will be asked to rate the importance of each candidate item using a 9-point Likert scale, where 1 to 3 means "low importance", 4 to 6 means "not critically important" and 7 to 9 means "critical importance".[26-29]

An "unable to rate" option will also be set. The expert panel members will be instructed to choose "unable to rate" if they think they do not have adequate knowledge or expertise on a particular list of statement.[30 31] During the first round, panel members can suggest some more related items to be incorporated into the second round of survey after discussion by the research team. Only panel members who have finished the first-round survey can move to the second-round survey. During the second round, they will be reminded of what they rated during the first round and will be shown the distribution of responses across the 1 to 9 scale for

each question in the questionnaire. The expert panel members have the right to retain their first-round scores or rescored for some specific statements. Both rounds of online voting are anonymous to minimise bias.

Consensus definition and analysis plan

We will consider consensus to be reached and the potential predictive factors will be included if more than 70% of panel members score the statement within 7 to 9 (critical importance) or less than 15% of panel members score the statement within 1 to 3 (low importance); or in contrast, the potential predictive factors will be excluded if more than 70% of panel members score the statement within 1 to 3 (low importance) or less than 15% of panel members score the statement within 7 to 9 (critical importance).[32]

This framework is recommended by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) group used to assess the importance of evidence. At the end of the questionnaire, we will encourage experts who participate in the survey to add some other potential predictive factors that they think are relevant, and it is better to provide some reasons.

Finally, the panel members' agreement on the factors' importance will be assessed using the Disagreement Index (DI), as described in the RAND/UCLA approach.[33] The DI generally reflects the distribution and symmetry of the scores (ranging from 1 to 9),

with a higher DI representing wider spread across the 9-point scale, while lower DI representing increasing consensus. If the DI exceeds 1.0, the distribution is regarded as extreme variation in rated scores, while the DI is less than 1.0, we consider no extreme variation existence, which means that a consensus is reached.

Patient and public involvement

This protocol will be carried out without patient or public involvement.

Discussion

In this work, we will apply a novel evidence-based approach to systematically identify a set of potential predictive factors for successful VBAC in pregnant women with a history of CD. We will first conduct an extensive systematic literature review to identify a number of potentially relevant patient, maternal and fetal-related predictive factors through systematic review and assess the level of evidence of their predictive value using the GRADE approach. We will next develop an international two-round Delphi survey to reach a consensus among international obstetric experts from 4 international obstetricians and gynecologists associations of the world (FIGO, ACOG, RCOG and COGA) on the importance of the selected factors. Our ultimate purpose of this study is to reach evidence-based consensus on the potential predictive factors of successful VBAC used for future prediction model development. At the moment, there are no validated prediction models for successful VBAC based on large prospective cohort studies.

Strengths and limitations

Our study has several strengths due to its rigorous methods that are robust and reproducible for several reasons. First, our systematic review will be conducted based on the PRISMA guidelines.[20] The search strategy is most comprehensive compared with the previously ones.[12 34] Secondly, we will apply the GRADE approach to assess the certainty of evidence, which is a most solid method for decision making in several aspects, including for the development of future clinical guidelines.[19] Thirdly, our research team will provide objective suggestions to identify all potential predictive factors for successful VBAC. Fourthly, the consensus regarding the issue will be based on a two-round Delphi survey among international obstetric experts from multiple international obstetricians and gynecologists associations of the world, making the results more convincing. Moreover, the two-round Delphi survey will be completely anonymous to reduce bias to the greatest extent. These set of methods will guarantee the internal and external validity of the study results.

There are limitations to this study as well. Firstly, the quality of the included studies varied considerably because most of the studies are observational cohort studies, and some are retrospective in study design. Secondly, the statements of Delphi survey to be developed are generally brief in nature. Some unknown domains related to the potential predictive factors may not be involved and addressed adequately. Thirdly, some of the experts involved in the Delphi survey will be clinical researchers instead

of obstetricians, and they might lack knowledge regarding certain aspects of factors for successful VBAC. However, clinical researchers will be trained in advance and may have a more evidence-based perspective of predictive factors, thus they may be more aware of the evidence and how factors appear to interact. Fourthly, though representative participants will be enrolled as expert panel in the Delphi survey mainly from Europe, USA and China, the experts do not cover the whole global regions, which may lead to a selection bias, and the results could not be applicable to regions outside Europe, USA and China.

Implications for clinical practice and further research

This study will present a group of agreed predictors that the expert panel can use to predict successful VBAC more accurately. First of all, the evaluated predictors may help obstetricians assess the risk of the individual patient. Based on the findings of this study, further investigations are warranted to provide some more possible predictors.

In a related study to be conducted by our research team, we will involve these variables that predict successful VBAC found in this consensus study. This will enable us to make adjustment for these factors in terms of the level of evidence based on the results of the study, which will improve the prediction accuracy. Further research should focus on evaluating the importance of these predictors. In addition, this study could provide the direction of future research on the evaluation of risk

factors for successful VBAC, which will ultimately be incorporated in the development and validation of prediction models of successful VBAC.

Conclusion

In summary, this study protocol summarises the design of the assessment of potential predictive factors collected through a comprehensive literature review combined with a two-round international Delphi survey . The results from this study will be interpreted for the purpose of clinical decision making for obstetricians to determine the suitable patients for VBAC, which will be most applicable to pregnant women in China.

Contributorship statement:

Ling Ai and Zubing Mei contributed equally as co-corresponding author.

Dr. Weiying Zhu had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Weiying Zhu and Zubing Mei.

Acquisition, analysis, or interpretation of data: Weiying Zhu, Ling Ai, Ying Feng, Haiyan Yuan, Yu Wang, and Meitang Wang.

Drafting of the manuscript: Weiying Zhu, Zubing Mei.

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

Statistical analysis: Zubing Mei, Ling Ai

Administrative, technical, or material support: All authors.

Study supervision: Zubing Mei.

Competing interests:

The authors declare that they have no conflict of interest.

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Table 1. Search strategy for Pubmed.

1. "Vaginal Birth after Cesarean"[Mesh]
2. "Trial of Labor"[Mesh]
3. "Cesarean Section, Repeat"[Mesh]
4. "Cesarean Section"[Mesh]
5. 1-4/OR
6. 'Vaginal Birth after Cesarean' OR VBAC OR 'trial of labor' OR 'cesarean section' OR TOLAC OR 'vaginal birth*' OR 'vaginal deliver*' OR 'trial of labour' OR 'active labor' OR 'active labour'
7. 5 OR 6

Figure legend

Figure 1. Flowchart of the study design.

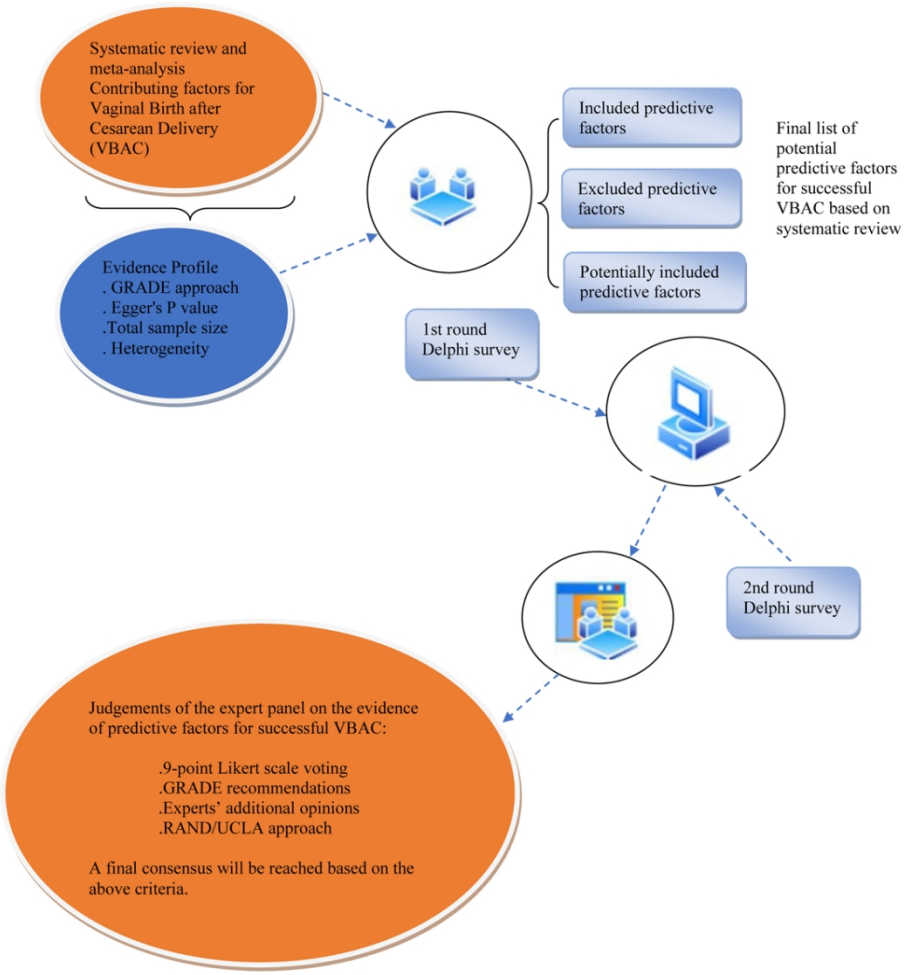

Figure 1. Flowchart of the study design.

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Factors predicting successful vaginal birth after caesarean section: protocol for evidence-based consensus recommendations using a Delphi survey

Weiying Zhu[1], Ling Ai[1#], Ying Feng[1], Haiyan Yuan[1], Yu Wang[2], Meitang Wang[3], Zubing Mei[4, 5#]

1. Obstetric Department of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing,314000, China
2. Science and Education Division of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children, Jiaxing, 314000, China
3. Emergency Department, Changhai Hospital, Navy Medical University, Shanghai, 200433, China.
4. Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine, Shanghai, 201203, China;
5. Anorectal Disease Institute of Shuguang Hospital, Shanghai, 201203, China.

Correspondence to:

Dr. Ling Ai

Obstetric Department of Jiaxing Maternity and Children Health Care Hospital, Jiaxing University, Wenzhou Medical University Affiliated Hospital of Women and Children

No.2468 East Central Road, South lake district, Jiaxing, 314000, China

Tel: 086 13736836830

E-mail:13736836830@163.com

Dr. Zubing Mei, MD, PhD

Department of Anorectal Surgery, Shuguang Hospital, Shanghai University of Traditional Chinese Medicine; Anorectal Disease Institute of Shuguang Hospital
528 Zhangheng Road, Shanghai 201203, China
Tel: 086-2120256187
E-mail: herrmayor@126.com or herrmayor@shutcm.edu.cn

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Abstract

Introduction

With the wide adoption of the two-child policy in China since 2016, a large percentage of women with a history of caesarean delivery (CD) plan to have a second child. Accordingly, the rate of vaginal birth after cesarean delivery (VBAC) is increasing. Women attempting repeat VBAC may experience multiple morbidities, which is also one of the leading causes of maternal and perinatal mortality. However, it remains to be addressed how we evaluate factors for successful VBAC. This study aims to use a novel approach to identify a set of potential predictive factors for successful VBAC, especially for Chinese women, to be included in prediction models which can be most applicable to pregnant women in China. We plan to assess all potential predictive factors collected through a comprehensive literature review. Then the certainty of the evidence for the identified potential predictive factors will be assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process. Finally, a two-round international Delphi survey will be conducted to determine the level of consensus.

Methods and analysis

This study will apply a methodology through an evidence-based approach. A long list of potential predictive factors for successful VBAC will be extracted and identified through the following stages: First, an up-to-date systematic review of the published literature will be conducted to extract identified potential predictive factors for

successful VBAC. Second, an online Delphi survey will be performed to achieve expert consensus on which factors should be included in future prediction models. The online questionnaires will be developed in the field of patient, maternal and fetal-related factors. A two-round international Delphi survey will be distributed to the expert panel in the field of perinatal medicine using Google Forms. Experts will be asked to score each factor using the 9-point Likert rating scale to establish potential predictive factors for the successful VBAC. The expert panel will determine on whether to include, potentially include, or exclude predictive factors, based on a systematic review of clinical evidence and the Delphi method.

Ethics and dissemination

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital (approval number: 2019-79). The results of this study will be submitted to international peer-reviewed journals or conferences in perinatal medicine or obstetrics.

Trial registration number

Open Science Framework (OSF): DOI 10.17605/OSF.IO/8D6XY.

Key words

Vaginal birth after caesarean section (VBAC), predictive factors, systematic review, Delphi survey, evidence-based consensus

Strengths and limitations of this study

- This study aims to use a mixed methods approach to select potential predictive factors for successful vaginal birth after caesarean section (VBAC) for obstetric patients.

- Potential predictive factors for successful VBAC will be identified through a combination of a systematic literature review and a modified Delphi process.

- The consensus on the potential predictive factors for successful VBAC will be achieved based on a two-round Delphi survey among international experts in the field of obstetrics.

- The expert panel will determine whether to include, potentially include, or exclude the candidate predictive factors, based on the GRADE approach and the Delphi method.

Introduction

The overall cesarean delivery (CD) rates have accelerated significantly globally in recent years.[1] Though successful vaginal birth after cesarean delivery (VBAC) has been reported to reduce morbidity or complications compared to an elective repeat CD,[2] recent evidence has continued to highlight the risks of VBAC.[3] In China, with the wide adoption of the two-child policy since 2016, a large percentage of women with a history of CD plan to have a second child and an elective repeat CD can be a suitable choice. However, a trial of labor after one cesarean (TOLAC) is encouraged in some countries which has been reported to reduce maternal adverse outcomes. [4-6] Studies have also shown that CD after an unsuccessful TOLAC may lead to increased bleeding, postoperative infection, endometritis and increased health care expenditure.[7-10]

Therefore, for obstetricians, it is crucial to identify the potential protective and risk factors influencing a woman's successful VBAC based on the patients' baseline characteristics. Several studies have reported that patient demographic characteristics (patient race and ethnicity, education level and gestational week),[11 12] maternal factors (maternal age, body mass index, bishop score, diabetes, hypertensive disorders complicating pregnancy and previous vaginal deliver) [12-15], fetal factors (estimated birth weight)[16] and other related factors (oxytocin implementation)[15] that may be associated with a woman's chance for successful VBAC. Some predictive models for successful VBAC have also been published in recent years.[13 17 18] However, the

quality of these models varied considerably in terms of study design, enrolled patients, internal and external validity of the models, which make the models' applicability domain rather dubious.

This study aims to use a novel approach to identify a set of potential predictive factors for successful VBAC, especially for Chinese women, to be included in future prediction models which can be most applicable to pregnant women in China. We plan to assess all potential predictive factors collected through a comprehensive literature review. Then the certainty of the evidence for the identified potential predictive factors will be assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process. Finally, a two-round international Delphi survey will be conducted to determine the level of consensus.

Ethics

The study was approved by the Institutional Review Board of the Jiaxing Maternity and Children Health Care Hospital.

Study design

We will carry out a study that combines a comprehensive systematic review and an evaluation of the certainty of the evidence based on GRADE approach.[19] As demonstrated in the flowchart (**Figure 1**), a structured Delphi survey-based expert

judgment will be made to include or exclude potential predictive factors for successful VBAC.

Systematic literature review

The systematic review will be performed based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines,[20] and aims to update all potential predictive factors for successful VBAC among women with a previous CD history, the search strategy of which is described in detail in Table 1. In summary, we will search Pubmed, EMBASE, Cochrane Library and SinoMed from inception to November, 2020. Predictive factors and prediction model studies will be selected that report potential predictive factors for successful VBAC among women with a previous history of CD. We define successful VBAC as a successful vaginal delivery after a previous cesarean section. Two independent reviewers will screen the articles for eligibility and extract the data after duplicated citations are removed.

For a given potential predictive factor, we will pool the summary relative risks (RRs) or odds ratios (ORs) with 95% CIs for predictive factors reported $\geqslant$2 studies using random-effects models.[21] Cochran Q and the I^2 statistics will be applied to investigate sources of heterogeneity, with an I^2 statistic >50% referring to substantial heterogeneity.[22] Publication bias will be tested using Egger's test, with a P value < 0.1 indicating significant difference.[23] Then the GRADE approach will be applied to assess and rate the certainty of the evidence independently.[19] The results of the

systematic review will provide the basis to develop a framework for voting in the two-round international Delphi survey.

When the systematic review is finished, we will hold a face-to-face meeting among the research team to discuss the main findings of the systematic review. Through the discussion, we will judge which potential predictive factors should be included in the Delphi process. The results will be presented with forest plots for each meta-analysis combined with the effect estimates and their confidence intervals. We will also evaluate the evidence of the observational studies which will be graded into high-quality, moderate-quality and low-quality evidence according to Egger's P value, total sample size and between-study heterogeneity as recommended by Mei et al.[24] After grading the evidence, the research team members will discuss the feasibility and acceptability of the potential predictive factors included in the Delphi survey, which will be categorised into 3 groups: included, potentially included, and excluded predictive factors, the method of which was recommended by Darzi, et al.[25] The included potential predictive factors are defined as those that should be included in the future prediction model. The potentially included predictive factors are defined as candidates that will potentially be included in the future prediction model. The excluded predictive factors are those that will not be considered to be included in the prediction model.

Expert panel participants

The expert panel will be selected from all over the world including obstetricians and senior researchers with expertise in management of obstetric or perinatal complications for pregnant women with a previous history of CD, and in the development, validation, and application of predictive models for clinical practice. Panel experts will participate in a web-based panel conference, complete surveys and questionnaires, if necessary, will also provide feedback on reports. They will disclose that they do not have any conflicts of interest and then complete the declaration-of-interest forms to avoid any potentially existing conflicts regarding the existing predictive models and other factors.

We will select members of the expert panel by using the following predesigned criteria:

1) First or corresponding authors of a journal article on potential predictive factors for successful VBAC in hospitalised obstetric patients.
2) Representative members from International Federation of Gynaecologists and Obstetricians (FIGO), the American College of Obstetricians and Gynecologists (ACOG), the Royal College of Obstetricians and Gynaecologists (RCOG), and Chinese Obstetricians and Gynecologists Association (COGA).
3) Guideline authors of the above mentioned associations of obstetricians and gynecologists.

The research team is composed of one senior obstetrician, 2 to 3 resident physicians working in gynecology and obstetrics, a senior researcher, who will work together to

compile the evidence for presentation, draft the questionnaire for the two-round Delphi survey, analyse the responses, and summarise the results.

Two-round Delphi survey

The expert panel will answer questions on three categories of the potential predictive factors for successful VBAC: patient-related, maternal-related and fetal-related predictive factors. The results of the systematic review will be presented to the experts and they will be asked to rate their agreement with these three aspects of potential predictive factor proposals. For example, they will rate their agreements with the following statements: (1) that maternal age is a predictive factor of limited / critical importance to successful VBAC; (2) that level of education is a predictive factor of limited / critical importance to successful VBAC; or (3) that estimated fetal weight is a predictive factor of limited / critical importance to successful VBAC.

A list of potential predictive factors will be delivered to the expert panel by e-mail in the form of google form questionnaire, which we summarise based on the results of the systematic review and identify them finally by group discussion among the research team members. Each member of expert panel will provide his or her respondence independently. Discussions are not allowed among expert panel members. During the first-round survey, the initial list of potential predictive factors yielded by the systematic review will be supplemented with other relevant factors which might be suggested by the expert panel members. These will constitute all the

item list of the first-round Delphi survey. We initially classify the potential predictive factors into three categories according to the literature reports and general knowledge, including patient-related factors (race/ethnicity, level of education, delivery interval and gestational week), maternal-related factors (maternal age, body mass index, previous vaginal delivery history and trial of labor after a CD history) and fetal-related factors (estimated fetal weight).

The second-round Delphi survey will be designed for the experts to make final clinical or methodological judgements regarding the potential predictive factors for successful VBAC based on the reports of the first-round survey.

The expert panel members will be asked to rate the importance of each candidate item using a 9-point Likert scale, where 1 to 3 means "low importance", 4 to 6 means "not critically important" and 7 to 9 means "critical importance".[26-29]

An "unable to rate" option will also be set. The expert panel members will be instructed to choose "unable to rate" if they think they do not have adequate knowledge or expertise on a particular list of statement.[30 31] During the first round, panel members can suggest some more related items to be incorporated into the second round of survey after discussion by the research team. Only panel members who have finished the first-round survey can move to the second-round survey. During the second round, they will be reminded of what they rated during the first round and will be shown the distribution of responses across the 1 to 9 scale for

each question in the questionnaire. The expert panel members have the right to retain their first-round scores or rescored for some specific statements. Both rounds of online voting are anonymous to minimise bias.

Consensus definition and analysis plan

We will consider consensus to be reached and the potential predictive factors will be included if more than 70% of panel members score the statement within 7 to 9 (critical importance) or less than 15% of panel members score the statement within 1 to 3 (low importance); or in contrast, the potential predictive factors will be excluded if more than 70% of panel members score the statement within 1 to 3 (low importance) or less than 15% of panel members score the statement within 7 to 9 (critical importance).[32]

This framework is recommended by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) group used to assess the importance of evidence. At the end of the questionnaire, we will encourage experts who participate in the survey to add some other potential predictive factors that they think are relevant, and it is better to provide some reasons.

Finally, the panel members' agreement on the factors' importance will be assessed using the Disagreement Index (DI), as described in the RAND/UCLA approach.[33] The DI generally reflects the distribution and symmetry of the scores (ranging from 1 to 9),

with a higher DI representing wider spread across the 9-point scale, while lower DI representing increasing consensus. If the DI exceeds 1.0, the distribution is regarded as extreme variation in rated scores, while the DI is less than 1.0, we consider no extreme variation existence, which means that a consensus is reached.

Patient and public involvement

This protocol will be carried out without patient or public involvement.

Discussion

In this work, we will apply a novel evidence-based approach to systematically identify a set of potential predictive factors for successful VBAC in pregnant women with a history of CD. We will first conduct an extensive systematic literature review to identify a number of potentially relevant patient, maternal and fetal-related predictive factors through systematic review and assess the level of evidence of their predictive value using the GRADE approach. We will next develop an international two-round Delphi survey to reach a consensus among international obstetric experts from 4 international obstetricians and gynecologists associations of the world (FIGO, ACOG, RCOG and COGA) on the importance of the selected factors. Our ultimate purpose of this study is to reach evidence-based consensus on the potential predictive factors of successful VBAC used for future prediction model development. At the moment, there are no validated prediction models for successful VBAC based on large prospective cohort studies.

Strengths and limitations

Our study has several strengths due to its rigorous methods that are robust and reproducible for several reasons. First, our systematic review will be conducted based on the PRISMA guidelines.[20] The search strategy is most comprehensive compared with the previously ones.[12 34] Secondly, we will apply the GRADE approach to assess the certainty of evidence, which is a most solid method for decision making in several aspects, including for the development of future clinical guidelines.[19] Thirdly, our research team will provide objective suggestions to identify all potential predictive factors for successful VBAC. Fourthly, the consensus regarding the issue will be based on a two-round Delphi survey among international obstetric experts from multiple international obstetricians and gynecologists associations of the world, making the results more convincing. Moreover, the two-round Delphi survey will be completely anonymous to reduce bias to the greatest extent. These set of methods will guarantee the internal and external validity of the study results.

There are limitations to this study as well. Firstly, the quality of the included studies varied considerably because most of the studies are observational cohort studies, and some are retrospective in study design. Secondly, the statements of Delphi survey to be developed are generally brief in nature. Some unknown domains related to the potential predictive factors may not be involved and addressed adequately. Thirdly, some of the experts involved in the Delphi survey will be clinical researchers instead

of obstetricians, and they might lack knowledge regarding certain aspects of factors for successful VBAC. However, clinical researchers will be trained in advance and may have a more evidence-based perspective of predictive factors, thus they may be more aware of the evidence and how factors appear to interact. Fourthly, though representative participants will be enrolled as expert panel in the Delphi survey mainly from Europe, USA and China, the experts do not cover the whole global regions, which may lead to a selection bias, and the results could not be applicable to regions outside Europe, USA and China.

Implications for clinical practice and further research

This study will present a group of agreed predictors that the expert panel can use to predict successful VBAC more accurately. First of all, the evaluated predictors may help obstetricians assess the risk of the individual patient. Based on the findings of this study, further investigations are warranted to provide some more possible predictors.

In a related study to be conducted by our research team, we will involve these variables that predict successful VBAC found in this consensus study. This will enable us to make adjustment for these factors in terms of the level of evidence based on the results of the study, which will improve the prediction accuracy. Further research should focus on evaluating the importance of these predictors. In addition, this study could provide the direction of future research on the evaluation of risk

factors for successful VBAC, which will ultimately be incorporated in the development and validation of prediction models of successful VBAC.

Therefore, this study protocol summarises the design of the assessment of potential predictive factors collected through a comprehensive literature review combined with a two-round international Delphi survey . The results from this study will be interpreted for the purpose of clinical decision making for obstetricians to determine the suitable patients for VBAC, which will be most applicable to pregnant women in China.

Contributorship statement:

Ling Ai and Zubing Mei contributed equally as co-corresponding author.

Dr. Weiying Zhu had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Weiying Zhu and Zubing Mei.

Acquisition, analysis, or interpretation of data: Weiying Zhu, Ling Ai, Ying Feng, Haiyan Yuan, Yu Wang, and Meitang Wang.

Drafting of the manuscript: Weiying Zhu, Zubing Mei.

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

Statistical analysis: Zubing Mei, Ling Ai

Administrative, technical, or material support: All authors.

Study supervision: Zubing Mei.

Competing interests:

The authors declare that they have no conflict of interest.

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Table 1. Search strategy for Pubmed.

1. "Vaginal Birth after Cesarean"[Mesh]
2. "Trial of Labor"[Mesh]
3. "Cesarean Section, Repeat"[Mesh]
4. "Cesarean Section"[Mesh]
5. 1-4/OR
6. 'Vaginal Birth after Cesarean' OR VBAC OR 'trial of labor' OR 'cesarean section' OR TOLAC OR 'vaginal birth*' OR 'vaginal deliver*' OR 'trial of labour' OR 'active labor' OR 'active labour'
7. 5 OR 6

Figure legend

Figure 1. Flowchart of the study design.

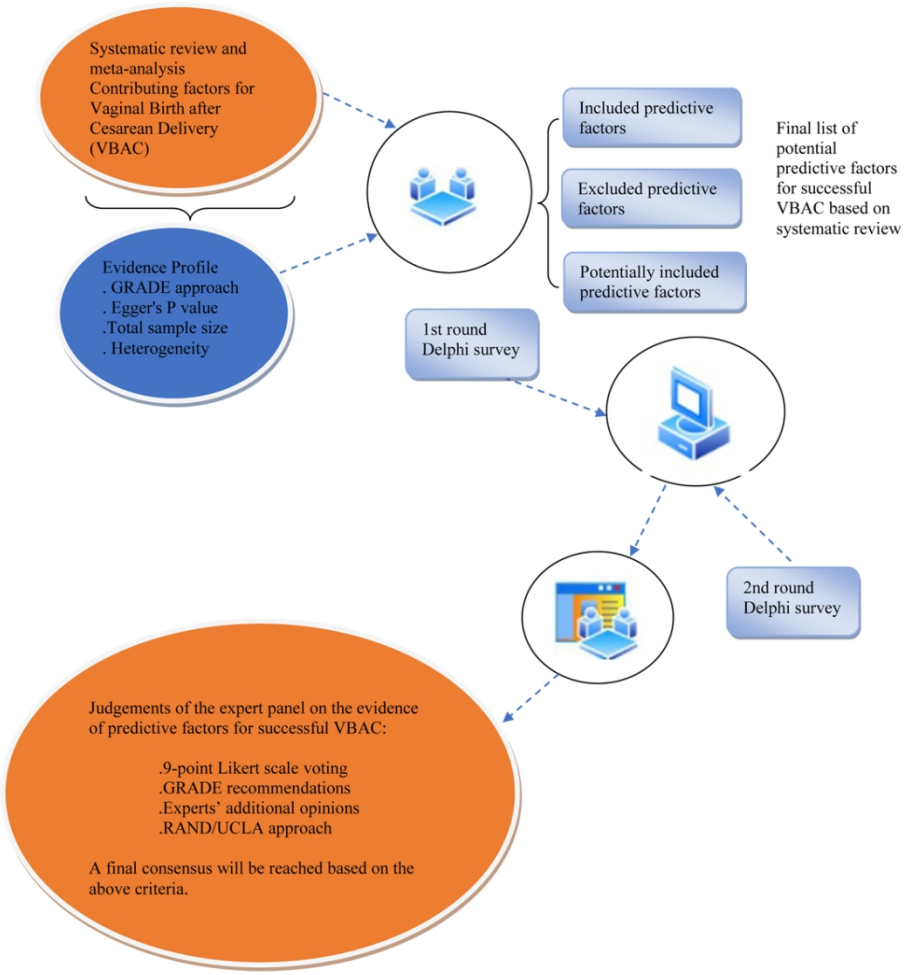

Figure 1. Flowchart of the study design.