BMJ Open

Late pregnancy ultrasound parameters identifying fetuses at risk of adverse perinatal outcomes: a protocol for a systematic review of systematic reviews

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To cite: Aderoba AK, Nasir N, Quigley M, *et al*. Late pregnancy ultrasound parameters identifying fetuses at risk of adverse perinatal outcomes: a protocol for a systematic review of systematic reviews. *BMJ Open* 2022;**12**:e058293. doi:10.1136/bmjopen-2021-058293

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-058293).

Received 12 October 2021
Accepted 23 February 2022

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ABSTRACT

Introduction Stillbirths and neonatal deaths are leading contributors to the global burden of disease and pregnancy ultrasound has the potential to help decrease this burden. In the absence of high-Grading of Recommendations Assessment, Development and Evaluation (GRADE) evidence on universal obstetric ultrasound screening at or close to term, many different screening strategies have been proposed. Systematic reviews have rapidly increased over the past decade owing to the diverse nature of ultrasound parameters and the wide range of possible adverse perinatal outcomes. This systematic review will summarise the evidence on key ultrasound parameters in the published literature to help develop an obstetric ultrasound protocol that identifies pregnancies at risk of adverse perinatal outcomes at or close to term.

Methods This study will follow the recent Cochrane guidelines for a systematic review of systematic reviews. A comprehensive literature search will be conducted using Embase (OvidSP), Medline (OvidSP), CDSR, CINAHL (EBSCOhost) and Scopus. Systematic reviews evaluating at least one ultrasound parameter in late pregnancy to detect pregnancies at risk of adverse perinatal outcomes will be included. Two independent reviewers will screen, assess the quality including the risk of bias using the ROBIS tool, and extract data from eligible systematic reviews that meet the study inclusion criteria. Overlapping data will be assessed and managed with decision rules, and study evidence including the GRADE assessment of the certainty of results will be presented as a narrative synthesis as described in the Cochrane guidelines for an overview of reviews.

Ethics and dissemination This research uses publicly available published data; thus, an ethics committee review is not required. The findings will be published in a peer-reviewed journal.

PROSPERO registration number CRD42021266108.

Strengths and limitations of this study

- To the best of our knowledge, this will be the first systematic review of systematic reviews of obstetric ultrasound parameters that identify fetuses at risk of adverse prenatal outcomes at or close to term.
- The review will use a rigorous methodology based on current guidelines and will provide a high-quality summary for clinicians, guideline developers and policy-makers. In addition, the detailed methods allow for an easy update in the future and applicability to similar conditions.
- Double counting duplicate data might give undue weight to some studies and a potential limitation of this review might be the tendency to lose data by dropping systematic reviews with overlapping primary studies.

BACKGROUND

Stillbirths and neonatal deaths remain leading contributors to the global burden of disease in high-income and low-income countries.[1] Annually, over two million stillbirths occur, and additional babies die during the neonatal period.[1] Many babies who survive severe pregnancy and childbirth complications live with permanent brain damage and have special education needs.[2] Evidence exists that when at-risk fetuses are identified before birth, the risk of these adverse perinatal outcomes is mitigated.[3 4]

Many systematic reviews show that late pregnancy ultrasound can help to detect pregnancy complications in women with suspected high-risk conditions such as fetal growth restriction (FGR) and small for gestational age.[5] However, in low-risk pregnancies, routine late pregnancy ultrasound is not recommended because current evidence, primarily from a Cochrane review, shows that it is not beneficial for a woman or her baby.[6] Routine late pregnancy ultrasound is not offered or used in many countries,[7 8] despite the methodological weaknesses identified in the Cochrane review.[9] These weaknesses include using different definitions for a positive test, varied test performance and not combining a positive ultrasound test with interventions known to improve perinatal

outcomes,[9] such as induction of labour[10] or elective caesarean section.

In the absence of high-Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria,[11] evidence on universal obstetric ultrasound screening at or close to term to prevent adverse outcomes, many different screening strategies have been proposed. Similarly, due to the diverse nature of ultrasound parameters and the wide range of possible adverse perinatal outcomes,[12] the last decade has witnessed a rapid proliferation of systematic reviews in this area.[13–18] Therefore, clinicians and policy-makers are overwhelmed by the current pace of evidence.[19] It has also been challenging to have an overarching assessment of the cost-effectiveness of late pregnancy ultrasound, given that multiple combinations of ultrasound parameters are possible. As a consequence, current estimates of the cost-effectiveness of late pregnancy ultrasound have focused on individual parameters.[20–22] A systematic review of systematic reviews, also referred to as an umbrella review or overview of reviews, may help with evidence synthesis to support the development of an obstetric ultrasound protocol by identifying effective ultrasound parameters for the identification of pregnancies at risk of adverse perinatal outcomes despite being apparently low risk at or close to term.[23] It will also provide guidance as to the effective parameters for use in women who are suspected to be at high risk of adverse outcomes. Thus, it will pave the way for more relevant and up-to-date clinical guidelines for routine screening and estimation of cost-effectiveness.

OBJECTIVE

This study aims to systematically review existing systematic reviews to identify effective ultrasound parameters, for an obstetric ultrasound management protocol that detects pregnancies at risk of adverse perinatal outcomes at or close to term.

METHODS

This systematic review of systematic reviews protocol was developed using the guidelines by Aromataris *et al*[24] and Pollock *et al*.[25] Further guidance comes from adapting guidelines for systematic review protocols,[26] searches,[27] quality and certainty of evidence,[11 28] synthesis[29 30] and reporting.[31] This study was registered in the PROSPERO registry (registration number: CRD42021266108).

Inclusion criteria

Type of studies

The study will include qualitative systematic reviews with numerical outcome data that fulfil the criteria defined by Labarca *et al*,[32] which are 'systematic reviews that reported at least one inclusion criterion, searched at least one database, reported a pooled measure of effect for at least one outcome, and evaluated the risk of bias of the primary studies'. This review will also include systematic reviews of randomised and non-randomised studies because it aims to determine the ultrasound parameter(s) that effectively identify adverse perinatal outcomes.

Although Cochrane reviews tend to have superior methodological quality,[33] this protocol presumes that data overlap would likely exist between Cochrane and non-Cochrane systematic reviews, and an overview of only Cochrane reviews might not sufficiently answer this study's research question. Further, avoiding bias from double counting overlapping data (ie, duplicate primary studies) in the systematic reviews in an umbrella review is methodologically challenging, time-intensive and prone to non-systematic and non-transparent conduct.[34] This study will note systematic reviews with overlapping primary studies. However, using the evidence-based decision tool by Pollock *et al*,[34] recommended for Cochrane overview of reviews,[25] non-overlapping systematic reviews will hopefully be analysed for each outcome. To balance the methodological complexity associated with analysing overlapping data with the potential bias from dropping them, a systematic review from a group of overlapping reviews will be prioritised for inclusion based on the following decision rule—if it has the best presentation of results in terms of recency, quality and completeness of numerical outcome data.

Type of participants

Singleton pregnancies at the 36-week scan will be included because this study aims to provide evidence for a late pregnancy ultrasound screening strategy to prevent stillbirths, perinatal mortality and adverse neurodevelopmental outcomes. Although the gestational age widow constituting the 36-week scan varies,[35–40] this study will include systematic reviews with obstetric scans from 34+0 weeks gestation. This study will not be limited to any context or language.

Type of intervention

A systematic review will be included if ultrasound parameters are assessed alone in late pregnancy (ie, from 34+0 weeks) or when combined with one or more ultrasound parameters to predict stillbirth or adverse perinatal outcomes. In the context of this study, an ultrasound parameter refers to any of the following: a characteristic sign or test that is observable while examining the contents of a pregnant uterus (ie, fetus, umbilical cord, placenta, or amniotic fluid) during an ultrasound scan.

Comparator and outcomes

This umbrella review will focus on systematic reviews that identified at least one of this study's primary or secondary outcomes by comparing a positive test in which one or more late pregnancy ultrasound parameters are assessed, with a negative test with the same parameters. The primary outcomes of this study are stillbirth or any other adverse perinatal outcome(s). In this study, late pregnancy is defined as gestational age from 34+0 weeks. Adverse perinatal outcome refers to any outcome that

is similar to any of the core outcome sets for neonatal research by Webbe *et al*.[12] These core outcomes include: (1) survival—stillbirth, perinatal or neonatal death, (2) sepsis, (3) necrotising enterocolitis, (4) brain injury on imaging, (5) general gross motor ability, (6) general cognitive ability, (7) quality of life, (8) adverse events, (9) visual impairment or blindness, (10) retinopathy of prematurity, (11) chronic lung disease/bronchopulmonary dysplasia and (12) hearing impairment or deafness. Outcomes associated with prematurity, items 3, 10 and 11 will be excluded because this study aims to provide evidence for an obstetric ultrasound screening strategy at or close to term to avert stillbirths, perinatal mortality and adverse neurodevelopmental outcomes. The secondary outcomes are small or large for gestational age babies, FGR, breech presentation, oligo or polyhydramnios, low-lying or invasive placenta, or other high-risk fetal conditions known to be associated with stillbirth or adverse perinatal outcomes.

Exclusion criteria

Systematic reviews to be excluded are

- Systematic reviews assessing ultrasound in twins or higher order pregnancies.
- Scoping reviews with a systematic search.
- Animal studies.
- Reviews without a meta-analysis or with non-numerical outcome data.
- Systematic reviews that compared a positive test with an ultrasound parameter(s) against a positive test with another ultrasound parameter(s), rather than with a negative test with the same ultrasound parameter(s). This study is not designed to rank or make direct or indirect comparisons between ultrasound parameters but to identify clinically effective parameters for a late pregnancy ultrasound protocol.
- Systematic reviews with extensive overlapping primary studies that do not meet the criteria of recency, quality and completeness of data for each outcome.
- Studies with ultrasound performed solely in labour.
- Previous systematic reviews on ultrasound with more recent published versions.
- Studies with ultrasound parameters that cannot be assessed at the 36-week scan or in which adverse perinatal outcomes were evaluated before 34+0 weeks' gestation or both.
- Studies that only assessed the cost-effectiveness of ultrasound.
- Systematic reviews in which ultrasound assessment focused entirely on congenital anomalies. Congenital anomalies may range widely in their types, severity of symptoms and interventions that can alleviate them. Therefore, existing systematic reviews are likely to be heterogeneous in their populations, interventions, and comparators. As advised by the Cochrane guidelines, answering an umbrella review question is likely not feasible in this scenario.[25]
- Withdrawn systematic reviews.
- Conference abstracts.

Information sources and search strategy

The following databases will be searched from inception: Embase (OvidSP), Medline (OvidSP), Cochrane Database of Systematic Reviews (www.cochranelibrary.com), Cumulative Index to Nursing and Allied Health Literature (CINAHL, EBSCOhost) and Scopus (www.scopus.com). Relevant thesaurus headings for ultrasonography, prenatal, fetus echography and fetal Doppler will be used, along with free-text search strings constructed for the title or abstract fields to search for pregnancy, prenatal (or prenatal, etc) ultrasonography (or ultrasound, etc), using the proximity indicator to narrow the search appropriately. Two systematic review search filters will be used for Ovid Embase[41] and Ovid Medline,[42] respectively. These filters will be adapted for the CINAHL (EBSCOhost) and Scopus searches. Additional relevant references will be retrieved from searches constructed for the WHO Global Index Medicus library (www.globalindexmedicus.net).

In addition, the reference lists of eligible studies will be manually searched for further relevant systematic reviews. The searches will be re-run just before the final analyses, and systematic reviews which meet the inclusion criteria will be added. The search strategy will be peer reviewed using the Peer Review of Electronic Search Strategies guideline statement,[43] by an information specialist (EH). The complete search strategy is available in online supplemental material 1. Search results from the different databases will be merged in the Covidence systematic review management software to facilitate deduplication and selection of studies. The results will then be exported to Microsoft Excel for review.

Data collection

Selection of studies

Systematic review screening and selection will be conducted independently by two reviewers using Covidence, a web-based software review platform. After removing duplicates, the search results will first be screened by their titles and abstracts for eligible systematic reviews using the inclusion and exclusion criteria. The full-text publications selected will then undergo full eligibility screening for the systematic reviews. The reasons for exclusion at each screening stage will be documented. Disagreements will be resolved by consensus between the two independent reviewers or by a discussion with the coinvestigator team if an agreement cannot be reached. Search results and the studies included or excluded will be summarised in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

Data extraction

Data will be extracted from each systematic review but not from their underlying studies using a structured form based on the 13-item standardised data extraction tool suggested by Aromataris *et al*[24] (figure 1). Two independent reviewers will extract data from each systematic

1. Citation details
2. Objectives of the included review
3. Type of review
4. Participant details
5. Setting and context
6. The number and names of databases sourced and searched
7. Date range of database searching
8. Publication date range of studies included in the review that inform each outcome of interest
9. Number of studies, types of studies and country of origin of studies included in each review
10. Instrument used to appraise the primary studies and the rating of their quality
11. Outcomes reported that are relevant to the umbrella review question e.g., stillbirth or adverse neurodevelopmental outcomes
12. Method of synthesis/analysis employed to synthesize the evidence
13. Comments or notes the umbrella review authors may have regarding any included study

Figure 1 Items suggested in the standard data extraction tool by Aromataris *et al*.[24]

review using structured data extraction forms. To ensure consistency, the reviewers will conduct calibration exercises with three randomly selected systematic reviews before commencing data extraction. If discrepancies exceed 10%, an additional training exercise with the structured data extraction form will be conducted. Discordance noted during data extraction will be resolved by consensus between the two independent reviewers or by discussing with the coinvestigator team if an agreement cannot be reached.

Quality assessment of systematic reviews

The risk of bias for each included systematic review will be evaluated independently by two reviewers using the ROBIS tool.[28] Each question in the ROBIS tool checklist can be scored as 'met', 'not met', 'unclear' or 'not applicable'. Discordant assessments between the reviewers will be resolved by consensus or discussion with the coinvestigator team if agreement cannot be reached.

Data analysis and synthesis

A meta-analysis is not planned because of the likely different types, definitions and thresholds of the ultrasound parameters and the wide range of adverse perinatal outcomes. Therefore, a narrative approach will be employed using reporting guidelines for systematic review of systematic reviews,[25] and further guidance in synthesising and reporting outcomes will involve adapting guidelines for conducting systematic reviews without meta-analysis.[29 30]

Data will be mapped for each adverse perinatal outcome with tables and narrative summaries of each systematic review contributing to an outcome. The date range of the studies used to map ultrasound parameters for each adverse perinatal outcome will be reported to show the recency of evidence. If applicable, the absence of data for an outcome and systematic reviews with overlapping primary studies will also be noted. The data from systematic reviews of randomised studies will be presented separately because current guidelines do not favour combining randomised and non-randomised studies in systematic reviews.[44] In addition, separate results will be presented for systematic reviews involving universal ultrasound (ie, routine ultrasound for all pregnant women) and reviews in which participants with a positive test are treated with an intervention known to improve perinatal outcomes such as induction of labour or caesarean section.

Using the GRADE criteria,[11] the certainty of the evidence for each outcome from the included systematic reviews will be extracted from each study when available or assessed with data from the reviews by two independent reviewers. Disagreements will be resolved by consensus between the reviewers or by discussion with the coinvestigator team. The GRADE criteria rate the certainty of results as 'high', 'moderate', 'low', or 'very low' based on five domains. These domains include (1) risk of bias, (2) imprecision, (3) inconsistency, (4) indirectness and (5) publication bias.[11] Ratings will be downgraded by one level for flaws in each domain up to a maximum of three levels for all domains. All randomised controlled trials are rated as high certainty but may be downgraded by one or two grades for serious or very serious flaws in any of these domains. Observational studies start from the low grade and are upgraded when assessed to have any of the following: a large magnitude of effect, a dose–response effect gradient, and all residual confounding decrease effect size in cases where an effect exists. In the case of reviews that access observation studies with the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool,[45] all studies are rated high certainty and downgraded afterwards for flaws detected because the ROBINS-I tool accounts for the risk of bias resulting from non-randomisation.[46]

This study will also assess the imprecision of systematic reviews by examining its 'optimal information size' and 95% confidence interval (CI).[47] Optimal information size refers to the number of patients required for a systematic review to power its results adequately.[47] A precise, systematic review should meet this criterion, and its 95% CI if it includes the line of no effect should exclude both appreciable benefit and no benefit. Guyatt *et al* suggested that systematic reviews should be rated down if the CI of risk ratios crosses the line of no effect and is less than 0.75 or above 1.25.[47] Therefore, effect sizes crossing the line of no effect with risk ratio thresholds less than 0.75 or above 1.25 will be interpreted as having wide CIs. The CI of risk ratios will also be considered wide if it does not cross the line of no effect (1.0), but it is less than or equal to 1.25, when the direction of effect is beneficial, or it is more than or equal to 0.75, when the direction of effect is not beneficial.

Ultrasound parameters will be classified as: (1) beneficial, (2) probably beneficial, (3) no effect, (4) probably not beneficial, (5) not beneficial and (6) inconclusive based on a framework employed in two recent umbrella reviews.[48 49] To accommodate the definitions of narrow and wide CIs described above, we

Direction of effect	Confidence Interval	GRADE	Study Recommendation	Recommendation Graphic signs*
Beneficial	Narrow CI not crossing the line of no effect	Moderate or high	Beneficial	
Not beneficial	Narrow CI not crossing the line of no effect	Moderate or high	Not beneficial	
No effect	Narrow CI crossing the line of no effect	Moderate or high	No effect	
Beneficial	CI not crossing the line of no effect	Low	Probably beneficial	
Beneficial	Narrow CI crossing the line of no effect	Moderate or high	Probably beneficial	
Beneficial	Wide CI not crossing the line of no effect	Moderate or high	Probably beneficial	
Not beneficial	CI not crossing the line of no effect	Low	Probably not beneficial	
Not beneficial	Narrow CI crossing the line of no effect	Moderate or high	Probably not beneficial	
Not beneficial	Wide CI not crossing the line of no effect	Moderate or high	Probably not beneficial	
Beneficial, not beneficial or no effect	Narrow CI crossing the line of no effect	Low	Inconclusive	
Beneficial, not beneficial or no effect	Wide CI crossing the line of no effect	Low, moderate or high	Inconclusive	
Beneficial or not beneficial	CI not crossing the line of no effect	Very low	Inconclusive	
Beneficial, not beneficial or no effect	CI crossing the line of no effect	Very low	Inconclusive	

Figure 2 Adapted framework for synthesising study recommendations. *All icons provided by Freepik at www.flaticon.com. GRADE, Grading of Recommendations Assessment, Development and Evaluation.

adapted the framework as shown in figure 2. Similar to these reviews,[48 49] tables with graphic icons developed by the WHO[50] will be used to illustrate the class of each ultrasound parameter and the certainty of the evidence.

If the data are available, separate results will be presented for systematic reviews involving randomised controlled trials, those with universal ultrasound (ie, routine ultrasound for all study participants) and reviews in which participants with a positive test are treated with an intervention known to improve perinatal outcomes such as induction of labour or caesarean section. A limited scope for a meta-analysis is anticipated. However, where feasible, results will be pooled using a random-effect meta-analysis, with standardised mean differences for continuous outcomes and risk ratios for binary outcomes. In particular, a nested meta-analysis may be conducted for pregnancies with universal ultrasound and those in which late pregnancy ultrasound is coupled with induction of labour or a caesarean section. Heterogeneity will be assessed using both the χ^2 test and the I-squared statistic. I-squared statistic greater than 50% will be considered as identifying substantial heterogeneity.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

CONCLUSION

This paper presents a protocol for a systematic review of systematic reviews of key obstetric ultrasound parameters to identify pregnancies at risk of adverse perinatal outcomes at or close to term. It will use rigorous methodology based on current guidelines,[16–19 21 23–25] and to the best of our knowledge, this is the first systematic overview of systematic reviews in this area. Adverse perinatal outcomes remain a critical contributor to under-5 year mortality and lifelong neurodevelopmental complications.[1 2] Despite anticipated

heterogeneity due to the diverse nature of ultrasound parameters and the wide range of possible adverse perinatal outcomes, this research has the potential to provide a high-quality summary for clinicians, guideline developers, and policy-makers and highlight existing knowledge gaps.

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Acknowledgements We acknowledge Elinor Harriss (EH) for helping to peer review and refine the search strategy.

Contributors AKA conceptualised and designed the study and drafted the protocol. AKA, MQ, LI, OR-A and JJK provided inputs on methodological issues. The search strategy was developed by AKA and peer reviewed by EH. AKA and NN will screen and select articles, assess the quality of studies and extra data. All authors reviewed the final protocol and approved the manuscript. AKA is the guarantor of the article.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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