Ultrasound for fetal assessment in early pregnancy (Review)

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ABSTRACT

Background
Advantages of early pregnancy ultrasound screening are thought to be more accurate calculation of gestational age, earlier identification of multiple pregnancies, and diagnosis of non-viable pregnancies and certain fetal malformations.

Objectives
The objective of this review was to assess the use of routine (screening) ultrasound compared with the selective use of ultrasound in early pregnancy (ie before 24 weeks).

Search strategy
The Cochrane Pregnancy and Childbirth Group trials register and the Cochrane Controlled Trials Register (up to June 2001) were searched.

Selection criteria
Adequately controlled trials of routine ultrasound imaging in early pregnancy.

Data collection and analysis
One reviewer assessed trial quality and extracted data. Study authors were contacted for additional information.

Main results
Nine trials were included. The quality of the trials was generally good. Routine ultrasound examination was associated with earlier detection of multiple pregnancies (twins undiagnosed at 26 weeks, odds ratio 0.08, 95% confidence interval 0.04 to 0.16) and reduced rates of induction of labour for post-term pregnancy (odds ratio 0.61, 95% confidence interval 0.52 to 0.72). There were no differences detected for substantive clinical outcomes such as perinatal mortality (odds ratio 0.86, 95% confidence interval 0.67 to 1.12). Where detection of fetal abnormality was a specific aim of the examination, the number of terminations of pregnancy for fetal anomaly increased.

Authors' conclusions
Routine ultrasound in early pregnancy appears to enable better gestational age assessment, earlier detection of multiple pregnancies and earlier detection of clinically unsuspected fetal malformation at a time when termination of pregnancy is possible. However, the benefits for other substantive outcomes are less clear.

BACKGROUND

Diagnostic ultrasound examination may be employed in a number of specific circumstances during pregnancy such as after clinical complications (eg bleeding), or where the fetus is perceived to be at a particularly high risk of malformation or of being inappropriately grown. Because adverse outcome may also occur in pregnancies without clear risk features, assumptions have been made that the routine use of ultrasound in all pregnancies would prove beneficial. Such screening examinations may be planned for early pregnancy, or for late gestation, or for both. The focus of this review is on routine early pregnancy ultrasound and will not discuss late pregnancy screening. The main theoretical advantages of early pregnancy screening are more accurate calculation of gestational age, earlier identification of multiple pregnancies, and diagnosis of non-viable pregnancies and certain fetal malformations. However, the quality of ultrasound imaging is dependent not only on the technical capabilities of the ultrasound equipment but also on the experience and expertise of the operator, and standards are variable. Mistakes certainly occur in the prenatal diagnosis of fetal structural abnormalities (both false positive and false negative), and it is essential that a rigorous assessment of routine ultrasound is achieved before any confident recommendation that, in practice, it does more good than harm.

OBJECTIVES

To assess whether routine early pregnancy ultrasound (ie its use as a screening technique) influences the diagnosis of fetal malformations and of multiple pregnancies, the rate of clinical interventions, and the incidence of adverse fetal outcome (including perinatal death) compared with its selective use (for specific indications).

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

All acceptably controlled trials of routine ultrasound in early pregnancy. In light of the shortage of information, studies that employed quasi-random allocation (eg date of birth or hospital number) have been included. Trials have either compared routine versus selective performance of ultrasound, or routine versus selective reporting of ultrasound findings.

Types of participants

All participants were women with early pregnancies (usually less than 20 weeks). Their group characteristics varied between trials as some trialists attempted to recruit all women (eg Trondheim 1984) while others excluded the recruitment of women with risk features, previous complications, medical problems, and any clinical uncertainty about gestational age (eg Radius).

Types of intervention

Ultrasound examination. Only two trials (Helsinki; Radius) included, as an important priority, a detailed examination to detect anatomical malformations in the fetus.

Types of outcome measures

See 'Outcomes' under 'Characteristics of Included Studies'.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

This review has drawn on the search strategy developed for the Cochrane Pregnancy and Childbirth Group as a whole. The full list of journals and conference proceedings as well as the search strategies for the electronic databases, which are searched by the Group on behalf of its reviewers, are described in detail in the 'Search strategies for the identification of studies section' within the editorial information about the Cochrane Pregnancy and Childbirth Group. Briefly, the Group searches on a regular basis MEDLINE, the Cochrane Controlled Trials Register and reviews the Contents tables of a further 38 relevant journals received via ZETOC, an electronic current awareness service.

Relevant trials, which are identified through the Group's search strategy, are entered into the Group's Specialised Register of Controlled Trials. Please see Review Group's details for more detailed information. Date of last search: June 2001.

METHODS OF THE REVIEW

See Search Strategy.

DESCRIPTION OF STUDIES

See table of 'Characteristics of Included Studies'.

Only two of the trials (Helsinki; Radius) had a stated aim of detailed study of fetal anatomy to allow detection of fetal structural malformations.

METHODOLOGICAL QUALITY

The methodological quality was on the whole good. The London 1982 trial was 'quasi-randomized' with allocation effected by hospital case record number with a consequent risk of biased allocation; this study was further weakened by the revelation of 30% of results in the 'blind' control group, because of clinical concern in later pregnancy.

RESULTS

When compared with selective examinations, routine ultrasound examination in early pregnancy results in earlier diagnosis of twin pregnancies and a reduced incidence of induction of labour for apparent post-term pregnancy. Previous publications of this review have also reported an unexplained decrease in the incidence of babies born of low birthweight, and the perceived need for special neonatal care. With the addition of new data, particularly from the Tygerberg 1996 trial, no such effect on the incidence of low birthweight babies can be demonstrated, and although fewer babies from the routinely screened pregnancies were admitted for special care the 95 percent confidence limits now reach 1.00.

When the detection of fetal abnormality is a specific aim, the number of planned terminations of pregnancy increases. In the trial in which this policy was pursued with greatest commitment (Helsinki), this resulted in fewer perinatal deaths. Overall, however, no clear benefit in terms of a substantive outcome measure like perinatal mortality can yet be discerned to result from the routine use of ultrasound. There was also no evidence of reduced perinatal mortality among twin babies, despite generally earlier diagnosis in the ultrasound screened pregnancies.

Long-term follow-up of children in Norway who, as fetuses, were entered into the Alesund and Trondheim 1984 trials has shown no adverse influence on school performance or neurobehavioural function as a consequence of prenatal exposure to ultrasound; however, fewer of the ultrasound exposed children are right-handed. Similar follow-up of a sub-set of children from the Sweden trial also showed no evidence of an adverse effect on vision or hearing; this study failed to demonstrate any overall effect on non-right handedness, although there may have been an effect if male children who were exposed to early ultrasound (regardless of group of assignment in the trial) are considered separately.

DISCUSSION

See 'Reviewers' conclusions' .

AUTHORS' CONCLUSIONS

Implications for practice

Assumed benefits of routine ultrasonography in early pregnancy have been: (1) better gestational age assessment; (2) earlier detection of multiple pregnancies; (3) detection of clinically unsuspected fetal malformation at a time when termination of pregnancy is possible.

These assumptions appear to have been justified by analysis of data from the controlled studies. The reduced incidence of induction of labour for apparent post-term pregnancy in the routinely scanned groups presumably results from better gestational 'dating', and twin pregnancies are detected earlier. Neither of these effects has been shown to improve fetal outcome, but much larger numbers of participants would be required to do this if such an effect were to be real. The detection of fetal malformation has been addressed in detail only in two of the trials. The Helsinki trial showed improved detection with a resultant increase in the termination of pregnancy rate and a drop in perinatal mortality; there were, however, large differences in the detection rates between the two hospitals involved in this study, which reinforces the need for expert ultrasonography in such a programme. This point is further emphasised by the low detection rate of major fetal malformations in the large Radius trial - only 17% of such babies were identified in the ultrasound screened group before 24 weeks of pregnancy. Based on the Helsinki trial results and other reports of observational data, this implies unsatisfactory diagnostic expertise. A combination of low detection rates of malformation together with a gestational age limit of 24 weeks for legal termination of pregnancy in the Radius trial produced minimal impact on perinatal mortality, unlike the Helsinki experience.

Many obstetric units already practice routine early pregnancy ultrasonography. For those considering its introduction, the benefit of the demonstrated advantages would need to be considered against the theoretical possibility that the use of ultrasound during pregnancy could be hazardous, and the need for additional resources. At present, there is no clear evidence that ultrasound examination during pregnancy is harmful. The findings from the follow-up of school children, exposed as fetuses to ultrasound in the Norwegian and Swedish trials (Norway; Sweden) are generally reassuring; the finding that fewer children in the Norwegian ultrasound groups were right-handed was not confirmed by intention to treat analysis of long term follow-up data from the Swedish trial. The Norwegian finding is difficult to interpret. This may have been a chance observation that emanated from the large number of outcome measures assessed, or from the method of ascertainment; alternatively, if it was a real consequence of ultrasound exposure, then it could imply that the effect of diagnostic ultrasound on the developing brain may alter developmental pathways. No firm conclusion can be reached from available data, and there is a need to study these children formally rather than to rely on a limited number of questionnaire responses obtained from the parents (Paneth 1998).

The financial costs also need to be considered. Calculations by the authors of the Radius report indicate that screening four million pregnant women in the USA at 200 dollars per scan would increase costs by one billion dollars per year. While costs might be less in other countries, economic issues will still be relevant. Clinicians, health planners, and pregnant women need to decide if these results justify the expense of providing routine ultrasound examination in early pregnancy.

Ultrasound scans are, however, popular - the potential enjoyment

that parents can receive from seeing the image of their baby in utero is discussed elsewhere (Neilson 1995).

Implications for research

(1) Other benefits which could result from better gestational age assessment, eg better management of pregnancies complicated by fetal growth retardation, need to be assessed in much larger studies than have been reported so far.

(2) Earlier detection of twin pregnancies has not been translated into an improvement in fetal outcome. The continuing high perinatal mortality rate from multiple pregnancies is a legitimate cause for concern and requires to be studied on a number of fronts; at least, early detection improves the potential for the proper scientific study of other, potentially useful, interventions in multiple pregnancies.

(3) There is a lack of useful data about the value of detection of fetal malformations as part of routine ultrasound examination programmes. Most information comes from 'centres of excellence'. That these results may not be representative of those obtained in primary level obstetric units has been confirmed by Rosendahl and Kivinen (Rosendahl 1989) and indeed by the Radius trial.

(4) The optimal timing of the examination, if adopted, could be addressed by a randomized controlled trial. Earlier examination provides (theoretically) more accurate assessment of gestational age; later examination (eg between 18 and 22 weeks) allows more full inspection of fetal anatomy, but is more complex and time-consuming.

(5) The desirability, or not, of implementing a programme of routine ultrasound screening will be influenced by whether or not a screening programme for fetal Down's syndrome (eg by biochemical testing) is in operation. Analysis of such test results rely strongly on accurate knowledge of gestational age.

FEEDBACK

Olsen, December 1997

Summary

Types of outcome measures:
The Helsinki Trial had a specific aim of detecting fetal abnormality, and this should be mentioned as an outcome measure and the number of abnormalities detected presented. The Tygerberg Trial reports a comparison of expenditures between the groups, and it would be useful if economic outcomes could be presented.

[Summary of comments by Ole Olsen, December 1998]

Summary of analyses:
Data on birthweight <2500g from the Helsinki Trial have not been included in the review.

[Summary of comments by Ole Olsen, October 1997]

Data are reported for the diagnosis of twin pregnancies during pregnancy. A more clinically relevant outcome would be undiagnosed twins at the start of labour. For induction of labour, data are reported only for induction due to apparent post-term pregnancy. Data on induction for other reasons should also be presented.

Conclusions:
The assumption that routine ultrasonography in early pregnancy improves gestational age assessment has not been proven, and is probably not correct. None of the trials reported expected date of delivery.

[Summary of comments by Ole Olsen, December 1997]

References:
One citation for the Alesund study is described as 'submitted for publication', but this is no longer accurate. A request to confirm publication status in February 1998 has had no response from the first author, but one of the other authors has stated that the first author is resisting publication. This is important as the initial publication reported a reduced mortality (3 vs 8 deaths) whereas a revised analysis by an independent epidemiologist reported no change in morality (6 vs 7 deaths among non-malformed babies). The first publication has never been retracted, and the revised analysis has not been published.

[Summary of comments by Ole Olsen, August 1998]

Author's reply

A response from the reviewer will be published as soon as it is available.

Contributors

Ole Olsen

POTENTIAL CONFLICT OF INTEREST

None known.

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Prof SH Eik-Nes, Drs KA Salvesen, LJ Vatten, and O Okland have provided unpublished results from the Alesund trial. The review has been modified following the publication of a critique by the British Columbia Office of Health Technology Assessment, Canada.

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TABLES

Characteristics of included studies

Study	Alesund
Methods	Randomization by sealed envelopes.
Participants	Nearly all women in that geographical area, including those with 'high risk' pregnancies. Recruitment 1979-1981. 1628 women.
Interventions	Routine ultrasound examinations at 18 (biparietal diameter measured) and 32 weeks (biparietal diameter and abdominal circumference) with additional examination at 36 weeks if fetus small for gestational age or presenting by the breech - versus selective examination for specific clinical indications only. 77% of women in the control group did not have an ultrasound examination. Ultrasound examinations performed by one of two experienced doctors.
Outcomes	Primary outcome: induction of labour for 'post term' pregnancy; secondary outcomes: indices of perinatal mortality and morbidity.
Notes	This trial was first reported in letter form only in 1984. It subsequently became clear that there were inconsistencies in results and in reports of trial methodology. It was therefore withdrawn from recent reviews. The data have now been re-analysed by the authors. The data that have been entered into this version of the review are derived from only those pregnancies that were singleton, except for perinatal mortality rates which are calculated from all pregnancies.
Allocation concealment	D – Not used

Study	Helsinki
Methods	Randomization by sealed envelopes.
Participants	All women attending one of 64 health centres. Recruitment 1986-1987.
Interventions	Routine ultrasound examination at 16-20 weeks, versus selective scanning for specific reasons; 77% of women in the control group underwent at least one ultrasound scan during pregnancy. Mean scans per pregnancy: 2.1 (study group), 1.8 (control group).
Outcomes	Fetal outcome and clinical interventions.
Notes	
Allocation concealment	D – Not used

Study	London 1982
Methods	Allocation by last digit of hospital number.
Participants	All women attending one of three consultant antenatal clinics.
Interventions	Ultrasound on all at approximately 16 weeks - results revealed (study group) or concealed (controls). Recruitment started 1977.
Outcomes	Perinatal mortality; birthweight for gestational age; Apgar score (1 minute).
Notes	The value of this study was weakened by the revelation of 30% of results in the 'blind' concealed group, because of clinical concern in later pregnancy.
Allocation concealment	D – Not used

Study	Missouri 1990
Methods	Randomization by sequentially numbered sealed opaque envelopes. 'Double consent' randomization.

Characteristics of included studies (*Continued*)

Participants	Women who did not have 'an indication for ultrasonography' based on medical disorder, uncertain gestational age, previous or current pregnancy complication, ie those who were eligible for inclusion were at low risk of adverse pregnancy outcome. They also had to be < 18 weeks gestation. Only 42% of women fulfilled these criteria and were eligible for recruitment (1984-1986).
Interventions	Routine ultrasound - optimally at 10-12 weeks, but permissible up to 18 weeks, in the study group. Ultrasound for specific indications was allowed at any time in either group.
Outcomes	Major outcomes: Induction of labour for post-term pregnancy; early detection of multiple pregnancy (< 24 weeks); adverse perinatal outcome (perinatal death, admission NICU, 5 minutes Apgar < 6).
Notes	
Allocation concealment	D – Not used

Study	**Norway**
Methods	See Alesund and Trondheim trials.
Participants	See Alesund and Trondheim trials.
Interventions	See Alesund and Trondheim trials.
Outcomes	Educational, neurological, and other behavioural outcomes.
Notes	All traced children who, as fetuses, had been included in the Alesund and Trondheim trials of ultrasound screening were followed-up. The results from the two trials have not been analysed separately so the pooled outcome data have been designated 'Norway'.
Allocation concealment	D – Not used

Study	**Radius**
Methods	Randomization by microcomputer after stratification by practice site. Intention to treat.
Participants	Women who did not have 'an indication for ultrasonography' based on medical disorder, uncertain gestational age, previous or current pregnancy complication, ie those who were eligible for inclusion were at low risk of adverse pregnancy outcome (and comprised 40% of the total population).
Interventions	Intended ultrasound screen at 18-20 and at 31-33 weeks gestation, versus selective ultrasonography for specific reasons only. 97% of women in the screened group had at least 2 ultrasound examinations; 55% of women in the control group had no scan at all. The mean number of scans was 2.2 (screened group) and 0.6 (controls). Ultrasound was to include a detailed study of fetal anatomy. Recruitment 1987-1991.
Outcomes	Fetal outcome and indices of care/intervention during pregnancy. The primary outcomes were fetal and neonatal mortality, and 'moderate or severe' neonatal morbidity.
Notes	
Allocation concealment	D – Not used

Study	**Sweden**
Methods	Randomization by opaque sealed envelopes.
Participants	All consenting women at < 19 weeks who had not already had an ultrasound scan and who did not have one of a number of pre-specified indications for ultrasound (mainly uncertainties about gestational age, medical disorder, previous complications). Recruitment 1985-1987.
Interventions	It was planned that women allocated to the screening group would have an ultrasound scan at about 15 weeks (range 13-19 weeks) and 98.7% did; it was planned that control women would not have a scan before 19 weeks, although 4.1% did; 31% of control group women had an ultrasound scan after 19 weeks.
Outcomes	Major outcome; 'neonatal morbidity' defined by admission to (and duration of stay in) neonatal ward. Follow-up data on neurodevelopmental outcome are available for around 70% of the sample at ages 8-9; these data

	were obtained by postal questionnaire. Data are also available on growth characteristics during childhood but not in a form that allows inclusion in the data tables; there was little difference between groups.
Notes	
Allocation concealment	A – Adequate

Study	**Trondheim 1984**
Methods	Randomization by sealed envelopes.
Participants	Nearly all women in Trondheim attending for antenatal care 1979-1980.
Interventions	Ultrasound group offered ultrasound examinations at both 19 and 32 weeks of gestation.
Outcomes	Antenatal hospital admission; induction of labour; birthweight; length gain; head circumference gain; small for gestational age; large for gestational age; Apgar score (1 minute, 5 minutes); resuscitation; admission to NICU; death of baby.
Notes	
Allocation concealment	D – Not used

Study	**Tygerberg 1996**
Methods	Randomisation by sealed, opaque envelopes.
Participants	Women at less than 24 weeks of pregnancy. Exclusions: already had ultrasound exam, diabetes, Rhesus sensitisation, increased risk of fetal malformation. Recruitment 1991-1992.
Interventions	Study group - 'level 1' ultrasound examination by obstetric registrar or medical officer. Control group - ultrasound examination only for specific clinical indication (25% of women did undergo ultrasound examination at some time).
Outcomes	Sample size estimated from 'overall adverse outcome' - a composite index that includes perinatal mortality, admission to neonatal intensive care unit, and prolonged admission to neonatal ward. Economic implications were also explored.
Notes	Analysis by 'intention to treat'.
Allocation concealment	D – Not used

NICU - neonatal intensive care unit

ANALYSES

Comparison 01. Routine versus selective ultrasound in early pregnancy

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
51 Termination of pregnancy for fetal abnormality	4	27377	Peto Odds Ratio 95% CI	3.19 [1.54, 6.60]
52 Twins undiagnosed at 20 weeks	1	74	Peto Odds Ratio 95% CI	0.12 [0.03, 0.56]
53 Twins undiagnosed at 26 weeks	6	220	Peto Odds Ratio 95% CI	0.08 [0.04, 0.16]
54 Antenatal hospital admission	5	9044	Peto Odds Ratio 95% CI	1.01 [0.90, 1.13]
55 Induction for 'post-term' pregnancy	6	24195	Peto Odds Ratio 95% CI	0.61 [0.52, 0.72]
56 Apgar score < or = 7 at 1 minute	4	8136	Peto Odds Ratio 95% CI	1.11 [0.95, 1.29]
57 Apgar score < or = 7 at 5 minutes	4	8143	Peto Odds Ratio 95% CI	0.94 [0.69, 1.29]
58 Low birthweight (<2.5 kg) in singletons	6	17517	Peto Odds Ratio 95% CI	0.96 [0.82, 1.12]
59 Birthweight	0	0	Peto Odds Ratio 95% CI	Not estimable

60 Admission special care (singletons)	5	8927	Peto Odds Ratio 95% CI	0.86 [0.74, 1.00]
61 Perinatal mortality	8	34245	Peto Odds Ratio 95% CI	0.86 [0.67, 1.12]
62 Perinatal mortality excluding lethal malformations	8	34251	Peto Odds Ratio 95% CI	0.96 [0.72, 1.28]
63 Perinatal mortality (twins)	5	550	Peto Odds Ratio 95% CI	0.81 [0.36, 1.80]
81 Poor oral reading at school	1	1993	Peto Odds Ratio 95% CI	1.02 [0.72, 1.45]
82 Poor reading comprehension at school	1	1984	Peto Odds Ratio 95% CI	0.82 [0.54, 1.23]
83 Poor spelling at school	1	1982	Peto Odds Ratio 95% CI	0.73 [0.53, 1.00]
84 Poor arithmetic at school	1	1993	Peto Odds Ratio 95% CI	0.90 [0.59, 1.37]
85 Poor overall performance at school	1	1993	Peto Odds Ratio 95% CI	0.96 [0.61, 1.49]
86 Dyslexia	1	603	Peto Odds Ratio 95% CI	0.75 [0.41, 1.36]
87 Reduced hearing in childhood	2	5418	Peto Odds Ratio 95% CI	0.90 [0.67, 1.21]
88 Reduced vision in childhood	2	5417	Peto Odds Ratio 95% CI	0.82 [0.66, 1.01]
89 Use of spectacles	2	5331	Peto Odds Ratio 95% CI	0.87 [0.72, 1.05]
90 Non right-handedness	2	4715	Peto Odds Ratio 95% CI	1.13 [0.97, 1.32]
91 Left-handedness	1	1663	Peto Odds Ratio 95% CI	1.33 [0.90, 1.98]
92 Ambidexterity	1	1663	Peto Odds Ratio 95% CI	1.25 [0.92, 1.71]

INDEX TERMS

Medical Subject Headings (MeSH)

Prenatal Care; *Ultrasonography, Prenatal

MeSH check words

Female; Humans; Pregnancy

COVER SHEET

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GRAPHS AND OTHER TABLES

Analysis 01.51. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 51 Termination of pregnancy for fetal abnormality

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 51 Termination of pregnancy for fetal abnormality

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	2/825	0/803		6.9	7.20 [0.45, 115.29]
Helsinki	11/4691	0/4619		37.9	7.29 [2.23, 23.79]
Radius	9/7812	5/7718		48.3	1.75 [0.61, 4.99]
Tygerberg 1996	1/457	1/452		6.9	0.99 [0.06, 15.84]
Total (95% CI)	13785	13592		100.0	3.19 [1.54, 6.60]

Total events: 23 (Treatment), 6 (Control)

Test for heterogeneity chi-square=4.15 df=3 p=0.25 I^2 =27.8%

Test for overall effect z=3.12 p=0.002

Analysis 01.52. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 52 Twins undiagnosed at 20 weeks

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 52 Twins undiagnosed at 20 weeks

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Helsinki	0/36	7/38		100.0	0.12 [0.03, 0.56]
Total (95% CI)	36	38		100.0	0.12 [0.03, 0.56]
Total events: 0 (Treatment), 7 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.69 p=0.007					

Analysis 01.53. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 53 Twins undiagnosed at 26 weeks

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 53 Twins undiagnosed at 26 weeks

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	0/10	7/7		12.5	0.02 [0.00, 0.14]
London 1982	0/6	2/5		5.2	0.09 [0.00, 1.63]
Missouri 1990	0/2	1/7		2.0	0.28 [0.00, 30.84]
Radius	1/68	23/61		57.7	0.09 [0.04, 0.23]
Sweden	0/24	7/20		17.6	0.08 [0.02, 0.39]
Trondheim 1984	1/6	1/4		5.0	0.63 [0.03, 12.58]
Total (95% CI)	116	104		100.0	0.08 [0.04, 0.16]
Total events: 2 (Treatment), 41 (Control)					
Test for heterogeneity chi-square=4.13 df=5 p=0.53 I^2 =0.0%					
Test for overall effect z=7.23 p<0.00001					

Analysis 01.54. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 54 Antenatal hospital admission

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

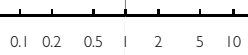
Outcome: 54 Antenatal hospital admission

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	148/774	178/736		21.4	0.74 [0.58, 0.95]
Missouri 1990	26/402	36/413		4.8	0.73 [0.43, 1.22]
Sweden	338/2389	335/2412		48.5	1.02 [0.87, 1.20]
Trondheim 1984	104/510	58/499		11.4	1.92 [1.37, 2.68]
Tygerberg 1996	110/457	105/452		13.8	1.05 [0.77, 1.42]
Total (95% CI)	4532	4512		100.0	1.01 [0.90, 1.13]

Total events: 726 (Treatment), 712 (Control)

Test for heterogeneity chi-square=21.67 df=4 p=0.0002 I^2 =81.5%

Test for overall effect z=0.20 p=0.8



Analysis 01.55. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 55 Induction for 'post-term' pregnancy

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 55 Induction for 'post-term' pregnancy

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	13/774	44/736		9.8	0.31 [0.18, 0.52]
Missouri 1990	28/402	31/413		9.8	0.92 [0.54, 1.57]
Radius	123/7617	161/7534		49.7	0.75 [0.60, 0.95]
Sweden	41/2389	88/2412		22.4	0.48 [0.34, 0.68]
Trondheim 1984	14/510	19/499		5.7	0.71 [0.36, 1.43]
Tygerberg 1996	1/457	14/452		2.6	0.17 [0.06, 0.47]
Total (95% CI)	12149	12046		100.0	0.61 [0.52, 0.72]

Total events: 220 (Treatment), 357 (Control)

Test for heterogeneity chi-square=20.03 df=5 p=0.001 I^2 =75.0%

Test for overall effect z=5.87 p<0.00001

Analysis 01.56. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 56 Apgar score < or = 7 at 1 minute

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 56 Apgar score < or = 7 at 1 minute

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	41/761	36/727		11.4	1.09 [0.69, 1.73]
Missouri 1990	102/404	87/420		22.8	1.29 [0.93, 1.79]
Sweden	199/2389	201/2412		57.4	1.00 [0.81, 1.23]
Trondheim 1984	34/516	23/507		8.4	1.48 [0.87, 2.52]
Total (95% CI)	4070	4066		100.0	1.11 [0.95, 1.29]
Total events: 376 (Treatment), 347 (Control)					
Test for heterogeneity chi-square=2.95 df=3 p=0.40 I^2 =0.0%					
Test for overall effect z=1.28 p=0.2					

Analysis 01.57. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 57 Apgar score < or = 7 at 5 minutes

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 57 Apgar score < or = 7 at 5 minutes

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	3/761	10/734		8.2	0.33 [0.11, 0.97]
Missouri 1990	13/404	14/420		16.6	0.96 [0.45, 2.08]
Sweden	47/2389	50/2412		60.3	0.95 [0.63, 1.42]
Trondheim 1984	15/516	9/507		14.9	1.64 [0.73, 3.68]
Total (95% CI)	4070	4073		100.0	0.94 [0.69, 1.29]
Total events: 78 (Treatment), 83 (Control)					
Test for heterogeneity chi-square=5.44 df=3 p=0.14 I^2 =44.8%					
Test for overall effect z=0.36 p=0.7					

Analysis 01.58. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 58 Low birthweight (<2.5 kg) in singletons

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 58 Low birthweight (<2.5 kg) in singletons

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	27/769	26/727		7.8	0.98 [0.57, 1.70]
Helsinki	130/4317	120/4271		37.3	1.07 [0.84, 1.38]
Missouri 1990	16/402	30/413		6.7	0.54 [0.30, 0.98]
Sweden	59/2365	95/2392		22.9	0.62 [0.45, 0.86]
Trondheim 1984	11/490	17/474		4.2	0.62 [0.29, 1.32]
Tygerberg 1996	102/451	68/446		21.2	1.61 [1.16, 2.25]
Total (95% CI)	8794	8723		100.0	0.96 [0.82, 1.12]

Total events: 345 (Treatment), 356 (Control)

Test for heterogeneity chi-square=21.88 df=5 p=0.0006 I^2 =77.1%

Test for overall effect z=0.54 p=0.6

Analysis 01.60. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 60 Admission special care (singletons)

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 60 Admission special care (singletons)

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	63/757	65/708		17.0	0.90 [0.62, 1.29]
Missouri 1990	30/404	37/420		9.0	0.83 [0.50, 1.37]
Sweden	231/2365	275/2412		66.0	0.84 [0.70, 1.01]
Trondheim 1984	17/490	22/474		5.5	0.74 [0.39, 1.40]
Tygerberg 1996	12/451	6/446		2.6	1.95 [0.77, 4.96]
Total (95% CI)	4467	4460		100.0	0.86 [0.74, 1.00]

Total events: 353 (Treatment), 405 (Control)

Test for heterogeneity chi-square=3.30 df=4 p=0.51 I^2 =0.0%

Test for overall effect z=1.94 p=0.05

Analysis 01.61. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 61 Perinatal mortality

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

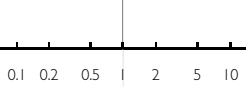
Outcome: 61 Perinatal mortality

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	6/794	10/765		6.7	0.58 [0.22, 1.56]
Helsinki	20/4389	39/4347		24.8	0.52 [0.31, 0.86]
London 1982	5/531	3/531		3.4	1.65 [0.41, 6.64]
Missouri 1990	2/404	4/420		2.5	0.53 [0.11, 2.65]
Radius	52/7685	41/7596		39.2	1.25 [0.83, 1.89]
Sweden	12/2413	12/2432		10.1	1.01 [0.45, 2.25]
Trondheim 1984	5/516	5/507		4.2	0.98 [0.28, 3.41]
Tygerberg 1996	9/460	13/455		9.1	0.68 [0.29, 1.59]
Total (95% CI)	17192	17053		100.0	0.86 [0.67, 1.12]

Total events: 111 (Treatment), 127 (Control)

Test for heterogeneity chi-square=9.34 df=7 p=0.23 I^2 =25.1%

Test for overall effect z=1.11 p=0.3



Analysis 01.62. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 62 Perinatal mortality excluding lethal malformations

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 62 Perinatal mortality excluding lethal malformations

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	6/792	7/761		6.9	0.82 [0.28, 2.45]
Helsinki	17/4389	28/4347		24.1	0.61 [0.34, 1.09]
London 1982	4/531	3/531		3.7	1.33 [0.30, 5.89]
Missouri 1990	2/404	4/420		3.2	0.53 [0.11, 2.65]
Radius	42/7685	27/7596		37.0	1.53 [0.95, 2.45]
Sweden	10/2413	10/2432		10.7	1.01 [0.42, 2.43]
Trondheim 1984	5/516	5/507		5.3	0.98 [0.28, 3.41]
Tygerberg 1996	6/467	11/460		9.0	0.54 [0.21, 1.41]

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Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Total (95% CI)	17197	17054		100.0	0.96 [0.72, 1.28]
Total events: 92 (Treatment), 95 (Control)					
Test for heterogeneity chi-square=8.27 df=7 p=0.31 I^2 =15.3%					
Test for overall effect z=0.29 p=0.8					

Analysis 01.63. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 63 Perinatal mortality (twins)

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 63 Perinatal mortality (twins)

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Alesund	2/20	2/15		15.1	0.73 [0.09, 5.78]
Helsinki	2/72	5/76		28.3	0.43 [0.10, 1.96]
Radius	4/136	4/123		32.8	0.90 [0.22, 3.68]
Sweden	4/48	0/40		16.2	6.68 [0.90, 49.49]
Trondheim 1984	0/12	2/8		7.7	0.07 [0.00, 1.31]
Total (95% CI)	288	262		100.0	0.81 [0.36, 1.80]
Total events: 12 (Treatment), 13 (Control)					
Test for heterogeneity chi-square=7.63 df=4 p=0.11 I^2 =47.6%					
Test for overall effect z=0.52 p=0.6					

Analysis 01.81. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 81 Poor oral reading at school

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 81 Poor oral reading at school

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	70/1007	67/986		100.0	1.02 [0.72, 1.45]
Total (95% CI)	1007	986		100.0	1.02 [0.72, 1.45]
Total events: 70 (Treatment), 67 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.14 p=0.9					

Analysis 01.82. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 82 Poor reading comprehension at school

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 82 Poor reading comprehension at school

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	44/1005	52/979		100.0	0.82 [0.54, 1.23]
Total (95% CI)	1005	979		100.0	0.82 [0.54, 1.23]
Total events: 44 (Treatment), 52 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.97 p=0.3					

Analysis 01.83. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 83 Poor spelling at school

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 83 Poor spelling at school

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	70/1001	92/981		100.0	0.73 [0.53, 1.00]
Total (95% CI)	1001	981		100.0	0.73 [0.53, 1.00]
Total events: 70 (Treatment), 92 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.94 p=0.05					

Analysis 01.84. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 84 Poor arithmetic at school

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 84 Poor arithmetic at school

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	44/1004	48/989		100.0	0.90 [0.59, 1.37]
Total (95% CI)	1004	989		100.0	0.90 [0.59, 1.37]
Total events: 44 (Treatment), 48 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.50 p=0.6					

Analysis 01.85. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 85 Poor overall performance at school

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 85 Poor overall performance at school

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	40/1006	41/987		100.0	0.96 [0.61, 1.49]
Total (95% CI)	1006	987		100.0	0.96 [0.61, 1.49]
Total events: 40 (Treatment), 41 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.20 p=0.8					

Analysis 01.86. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 86 Dyslexia

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 86 Dyslexia

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	21/309	26/294		100.0	0.75 [0.41, 1.36]
Total (95% CI)	309	294		100.0	0.75 [0.41, 1.36]
Total events: 21 (Treatment), 26 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.94 p=0.3					

Analysis 01.87. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 87 Reduced hearing in childhood

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 87 Reduced hearing in childhood

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	32/1112	38/1041		38.5	0.78 [0.49, 1.26]
Sweden	56/1651	56/1614		61.5	0.98 [0.67, 1.42]
Total (95% CI)	2763	2655		100.0	0.90 [0.67, 1.21]

Total events: 88 (Treatment), 94 (Control)

Test for heterogeneity chi-square=0.51 df=1 p=0.47 I^2 =0.0%

Test for overall effect z=0.72 p=0.5

Analysis 01.88. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 88 Reduced vision in childhood

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 88 Reduced vision in childhood

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	68/1113	72/1039		38.0	0.87 [0.62, 1.23]
Sweden	103/1651	126/1614		62.0	0.79 [0.60, 1.03]
Total (95% CI)	2764	2653		100.0	0.82 [0.66, 1.01]

Total events: 171 (Treatment), 198 (Control)

Test for heterogeneity chi-square=0.23 df=1 p=0.63 I^2 =0.0%

Test for overall effect z=1.86 p=0.06

Analysis 01.89. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 89 Use of spectacles

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 89 Use of spectacles

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	82/1069	95/997		38.0	0.79 [0.58, 1.07]
Sweden	141/1651	149/1614		62.0	0.92 [0.72, 1.17]
Total (95% CI)	2720	2611		100.0	0.87 [0.72, 1.05]

Total events: 223 (Treatment), 244 (Control)

Test for heterogeneity chi-square=0.58 df=1 p=0.45 I^2 =0.0%

Test for overall effect z=1.48 p=0.1

Analysis 01.90. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 90 Non right-handedness

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 90 Non right-handedness

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	162/861	120/802		36.1	1.31 [1.02, 1.70]
Sweden	253/1544	240/1508		63.9	1.04 [0.85, 1.26]
Total (95% CI)	2405	2310		100.0	1.13 [0.97, 1.32]

Total events: 415 (Treatment), 360 (Control)

Test for heterogeneity chi-square=2.13 df=1 p=0.14 I^2 =53.0%

Test for overall effect z=1.54 p=0.1

Analysis 01.91. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 91 Left-handedness

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 91 Left-handedness

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	62/861	44/802		100.0	1.33 [0.90, 1.98]
Total (95% CI)	861	802		100.0	1.33 [0.90, 1.98]
Total events: 62 (Treatment), 44 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.43 p=0.2					

Analysis 01.92. Comparison 01 Routine versus selective ultrasound in early pregnancy, Outcome 92 Ambidexterity

Review: Ultrasound for fetal assessment in early pregnancy

Comparison: 01 Routine versus selective ultrasound in early pregnancy

Outcome: 92 Ambidexterity

Study	Treatment n/N	Control n/N	Peto Odds Ratio 95% CI	Weight (%)	Peto Odds Ratio 95% CI
Norway	100/861	76/802		100.0	1.25 [0.92, 1.71]
Total (95% CI)	861	802		100.0	1.25 [0.92, 1.71]
Total events: 100 (Treatment), 76 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.42 p=0.2					