National Institute for Health and Care Excellence

Final

Intrapartum care

[A] Evidence reviews for impact of BMI on choice of place of birth

NICE guideline NG235

Evidence reviews underpinning recommendation 1.3.6 and the associated risk tables in appendix B in the NICE guideline

September 2023

Final

These evidence reviews were developed by NICE

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Impact of BMI on choice of place of birth

Review question

What are the benefits and risks of different places of birth for women at different BMI thresholds?

Introduction

Giving birth in the UK is generally very safe in all birth settings and very few women die or have serious medical problems, regardless of place of birth. Similarly, outcomes for babies are similar for all birth settings. Decisions on place of birth often form an important part of women's birth plans, and this decision will need to consider factors such as the number of babies a woman has had previously, previous obstetric history, medical or obstetric conditions that might increase risk, as well as practical considerations such as location, desire to be cared for by familiar staff, or preferences around pain relief.

Current recommendations suggest that women with higher body mass index (BMI) should be advised to plan birth at an obstetric unit but there is no evidence to guide decision-making and with increasing rates of obesity in the general population, this guidance may apply to many women. This review aims to identify the evidence on the safety of each place of birth (including maternal and neonatal outcomes) for women with a raised BMI.

Summary of the protocol

See Table 1 for a summary of the Population, Intervention, Comparison and Outcome (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO table)

Population	• Women in labour who are pregnant with a single baby • Women in labour whose baby has not been identified before labour to be at high risk of adverse outcome • Otherwise healthy women at any BMI threshold who do not have any pre-existing medical conditions or antenatal conditions that predispose to a higher risk birth
Intervention	Planned place of birth at any of the following: • Alongside midwifery unit • Freestanding midwifery unit • Home (domiciliary) • Obstetric unit/hospital-based maternity unit (the only setting where doctors are present) Names of settings will be guided by the study. Actual place of birth will not be considered.

Comparison	Any of the planned places of birth listed in the intervention
Outcome	**Critical** • Maternal death or severe maternal morbidity (defined as admission to intensive care) • Mode of birth (for example, spontaneous, instrumental, caesarean birth; reported individually or as a combined measure) • Postpartum haemorrhage (reported individually or as a combined measure) **Important** • Shoulder dystocia • Neonatal admission (reported individually or as a combined measure) • Breastfeeding • Transfer to obstetric unit • Women's experience of labour and birth Evidence will be stratified by: • BMI thresholds on booking • Parity

BMI: body mass index

For further details see the review protocol in appendix A.

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document (supplementary document 1).

Declarations of interest were recorded according to NICE's conflicts of interest policy.

Studies in this review were included if they met the PICO criteria in protocol. Where different studies reported data from the same cohorts, outcomes were prioritised according to the stratifications pre-established in the review protocol.

The committee agreed that only studies conducted in high-income countries (as defined by the Organisation for Economic Co-operation and Development [OECD]) should be considered for inclusion because low- and middle-income countries are likely to have significantly different birth place settings.

Effectiveness evidence

Included studies

Five studies, reporting results from 3 different cohorts, were included in this review. Four observational studies (Brocklehurst 2011, Hollowell 2014, Hollowell 2015, Rowe 2018), reported results from the Birthplace in England cohort and UKMidSS cohort UK, and 1 retrospective cohort study (Stephenson-Famy 2018) reported results from the Washington State birth certificate cohort. Three studies (Brocklehurst 2011, Hollowell 2014 and Hollowell

2015) reported results from the same cohort (Birthplace in England cohort). The Birthplace publications differed in analysis due to different comparisons.

Four studies compared different BMI thresholds (Hollowell 2014, Hollowell 2015, Rowe 2018, Stephenson-Famy 2018). The results were stratified according to place of birth and parity. One study (Hollowell 2015) compared different places of birth and the results were stratified by parity. One study (Brocklehurst 2011) compared different places of birth, but only 1 of the outcomes was stratified by parity, other outcomes were not stratified by parity or BMI. The results from this study were not stratified by BMI or parity, so data from the 2 studies reporting further analysis from the same cohort were used (Hollowell 2014 and Hollowell 2015).

The studies were from England, Northern Ireland, Scotland, United States and Wales.

The included studies are summarised in Table 2.

See the literature search strategy in appendix B and study selection flow chart in appendix C.

Excluded studies

Studies not included in this review are listed, and reasons for their exclusion are provided in appendix J.

Summary of included studies

Summaries of the studies that were included in this review are presented in Table 2.

Table 2: Summary of included studies.

Study	Population	Intervention	Comparison	Outcomes	Other information
Brocklehurst 2011 Observational study England	Birthplace in England cohort N=64538 low risk women Obstetric unit (OU): n= 19706 Home: n=16840 Freestanding midwifery units (FMU): n=11282 Alongside midwifery units (AMU): n=16710	Planned place of birth at: • Home • FMU • AMU	Planned place of birth at: • OU	• Admission to higher level care • Spontaneous vaginal birth • Instrumental birth • Intrapartum caesarean birth • Blood transfusion • Transferred to obstetric unit	• Transfer to obstetric unit stratified by parity, other outcomes not stratified by parity or BMI • Study adjusted for confounders • Outcomes from this cohort have been reported in the secondary report by Howell 2015 as they include BMI information, therefore the outcomes from the primary report have not been

Study	Population	Intervention	Comparison	Outcomes	Other information
					included in the analysis for this review
Hollowell 2014 Observational study (See Brocklehurst 2011) England	Birthplace in England cohort N=17230 women who planned birth in an obstetric unit	Women who planned birth in an obstetric unit:	Women who planned birth in an obstetric unit	• Obstetric interventions and adverse maternal outcomes (stratified by parity for OU) *(Combined outcome included: Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care)* • Maternal admission to higher level care • Instrumental birth • Intrapartum caesarean birth • Maternal blood transfusion • Admission to neonatal unit or intrapartum stillbirth/early neonatal death (stratified by parity for OU)	• Secondary analysis for Brocklehurst 2011 • Supplementary data also provided information for BMI comparisons for planned place of birth at home, FMU and AMU. • Study adjusted for confounders • Women with different BMI ranges were compared to BMI range 18.5 to 24.9 kg/m^2
Hollowell 2015 Observational study (See Brocklehurst 2011)	Birthplace in England cohort See Brocklehurst 2011	For mode of birth outcomes: Planned place of birth at: • Home • FMU • AMU	For mode of birth outcomes: Planned place of birth at: • OU	• Spontaneous vaginal birth • Instrumental birth • Caesarean birth • Transfer to	• Secondary analysis for Brocklehurst 2011 • All outcomes stratified by parity • Study

Study	Population	Intervention	Comparison	Outcomes	Other information
England		For transfer to obstetric unit: Women who planned birth at home, FMU or AMU	For transfer to obstetric unit: • Women who planned birth at home, FMU or AMU	obstetric unit	adjusted for confounders • Women with different BMI ranges were compared to BMI range 18.5 to 24.9 kg/m^2
Rowe 2018 Observational study England, Wales, Scotland, Northern Ireland	UKMidSS cohort UK N=3071 Severely obese arm: n=1120 Comparison arm: n=1946	Women with a BMI >35 kg/m^2, with planned place of birth at AMU	Women with a BMI ≤35kg/m^2, with planned place of birth at AMU	• Maternal admission to higher level care • Intrapartum caesarean birth • Category 1 or 2 caesarean birth • Instrumental birth • Spontaneous vaginal birth • Postpartum haemorrhage • Shoulder dystocia • Neonatal unit admission • Initiation of breastfeeding • Transfer to obstetric unit	• All outcomes stratified by parity • Study adjusted for confounders • 92% of intervention group were between BMI 35.1-40 kg/m^2 so results may not be generalisable to women of BMI >40 kg/m^2. • Women with a BMI >35 kg/m^2 are not recommended to plan their birth in the AMU under national guidance, so will also have been 'selected' somewhat.
Stephenson-Famy 2018 Observational study United States	Washington State birth certificate cohort N=7118 women who planned birth in a free-standing midwife led birth centre	Women who planned birth in a free-standing birth centre	Women who planned birth in a free-standing birth centre	• Transfer to obstetric unit (nulliparous only)	• Study adjusted for confounders • Women with different BMI ranges were compared to BMI range 18.5 to 24.9 kg/m^2

AMU: alongside midwifery unit; BMI: body mass index; FMU: freestanding midwifery unit; OU: obstetric unit

See the full evidence tables in appendix D and the forest plots in appendix E.

Summary of the evidence

Most of the evidence compared different BMI ranges to BMI range 18.5 – 24.9 kg/m^2 (which was considered as a 'healthy weight range' BMI).

BMI <18.5 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

When a BMI <18.5 kg/m^2 was compared to the healthy weight range BMI, most of the evidence showed no evidence of an important difference for the outcomes of maternal admission to intensive care, modes of birth, maternal blood transfusion and transfer to an obstetric unit. The quality was mainly low for these outcomes due to imprecise findings, so should not be taken as definitive evidence of no difference between the groups. The evidence showed no important difference between groups for the combined outcome of obstetric interventions and adverse maternal outcomes (instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth degree tear, and maternal admission to higher level care) in nulliparous and mixed parity women whose planned place of birth was an obstetric unit, and no evidence of a difference in mixed parity women whose planned place of birth was a freestanding midwifery unit, alongside midwifery unit or home. There was an exception seen for the combined outcome of neonatal admissions/intrapartum stillbirth/early neonatal death in women of mixed parity who had planned birth in an alongside midwifery unit, where there was an important benefit for women with a BMI <18.5kg/m^2 when compared to the healthy weight range BMI. However, there was no evidence of a difference between the two BMI groups for this outcome in women of mixed parity who had planned birth at home or freestanding units, or women of any parity who had planned birth in the obstetric unit.

BMI range 25 – 29.9 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

When BMI range 25 – 29.9 kg/m^2 was compared to BMI range 18.5 – 24.9 kg/m^2, most of the evidence showed no important difference between outcomes, and some of the evidence showed no evidence of an important difference. There were more intrapartum caesarean births in the obstetric unit in group BMI range 25 – 29.9 kg/m^2, in women of mixed parity. There was no important differences between the BMI groups on transfer to an obstetric unit from home or in alongside unit for nulliparous women, and no evidence of a difference for transfers from home or an alongside unit for multiparous women. Two studies reported transfer to obstetric unit from a freestanding midwifery unit. One study from the UK, showed no important difference between groups in nulliparous women, and no evidence of a difference for multiparous women. However, 1 study from the US showed more transfers for nulliparous women with a BMI range 25 – 29.9 kg/m^2. Differences in the direction of effect could be attributed to the setting, as protocols for transfer may differ between the US and the UK. Most of the evidence was of high quality, with some evidence rated as moderate and low due to concerns around imprecision.

BMI range 30 – 35 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

When BMI range 30-35 kg/m^2 was compared to BMI range 18.5 – 24.9 kg/m^2, there was an important benefit for women of mixed parity in the higher BMI range, 30 – 35 kg/m^2, who had planned birth in a freestanding midwifery unit, with a reduction in the combined outcome of obstetric interventions and adverse maternal outcomes. The evidence was rated as moderate quality due to imprecision. High quality evidence showed no important difference for this outcome for nulliparous women who planned birth in the obstetric unit. High quality evidence also showed no important difference between groups for this outcome for planned birth in the obstetric unit, at home, or in an alongside midwifery unit, in women of mixed parity. High quality evidence also showed more intrapartum caesarean births in the group

BMI range 30-35 kg/m^2, in the obstetric unit in women of mixed parity, and moderate quality evidence showed more transfers to the obstetric unit from home in multiparous women. The remaining outcomes showed no important difference or no evidence of an important difference between groups.

BMI ≥30 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

When a BMI ≥30 kg/m^2 was compared to BMI range 18.5 – 24.9 kg/m^2, the evidence showed more transfers from a freestanding unit to the obstetric unit in nulliparous women with a BMI ≥30 kg/m^2 compared to nulliparous women with BMI range 18.5 – 24.9 kg/m^2. Transfer to an obstetric unit was the only outcome available for this comparison. The evidence was rated as moderate quality, with some concerns over risk of bias.

BMI >35 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

A BMI >35 kg/m^2 was compared to BMI range 18.5 – 24.9 kg/m^2 in women planning birth in an obstetric unit. The evidence showed no important difference, or no evidence of an important difference for obstetric interventions and adverse maternal outcomes combined for nulliparous and multiparous women, and also for maternal admission to intensive care, or maternal blood transfusion in women of mixed parity. There were fewer instrumental births with a BMI >35 kg/m^2 in women of mixed parity than in the BMI range 18.5 – 24.9 kg/m^2, but more intrapartum caesarean births. There was an important harm for a BMI >35 kg/m^2 when compared to BMI range 18.5 – 24.9 kg/m^2 for neonatal admission or intrapartum stillbirth/early neonatal death for nulliparous and multiparous women. The quality of the evidence ranged from high to low, with concerns around imprecision.

BMI range >35 – 40 kg/m^2 versus BMI range 18.5 – 24.9 kg/m^2

When BMI >35 – 40 kg/m^2 was compared to BMI range 18.5 – 24.9 kg/m^2, high quality evidence showed no important difference between groups for obstetric interventions and adverse maternal outcomes combined in women of mixed parity in the obstetric unit. In addition, low quality evidence showed no evidence of an important difference in this outcome in women of mixed parity at home, in freestanding midwifery units or alongside midwifery units. The evidence was downgraded for imprecision and should therefore not be taken as definitive evidence of no difference between groups. There was an important harm of BMI range >35-40 kg/m^2 for neonatal admissions or intrapartum stillbirth/early neonatal death in the obstetric unit (high quality) and the freestanding midwifery unit (moderate quality). The evidence was downgraded for imprecision. Low quality evidence showed no evidence of a difference for this outcome at home or the alongside midwifery unit, with concerns around imprecision, so should not be taken as definitive evidence of no difference between groups. At a BMI range of >35-40 kg/m^2, is it national guidance that women plan their birth at an obstetric unit, therefore concerns around imprecision are due to small sample sizes of women planning birth in settings other than the obstetric unit.

BMI >35 kg/m^2 versus BMI ≤35kg/m^2

A BMI >35 kg/m^2 was compared to a BMI ≤35kg/m^2 in women planning birth in an alongside midwifery unit. Most of the evidence showed no important difference or no evidence of an important difference between groups. The exceptions were a possible important harm for intrapartum caesarean births, for nulliparous women with a BMI range >35kg/m^2, but not multiparous women. There was a harm in category 1 and 2 caesarean births for nulliparous women with a BMI range >35 kg/m^2, but not multiparous women. There was also a harm in terms of postpartum haemorrhage in nulliparous women with BMI range >35 kg/m^2, but no evidence of an important difference in multiparous women. Most of the evidence was downgraded due to concerns around imprecision.

Planned places of birth at home or freestanding midwifery units or alongside midwifery units versus obstetric units

Some comparisons compared different planned places of birth to planned birth in an obstetric unit. The comparisons reported data on modes of birth, with stratifications by parity. The mean BMI range in both groups of women was 18.5 – 24.9 kg/m^2. Planned place of birth at home, in freestanding midwifery units, and alongside midwifery units all had a benefit over planned place of birth in obstetric units in terms of instrumental births, and caesarean births. There was an important benefit of planned place of birth at home, and in freestanding midwifery units over planned place of birth in obstetric units for spontaneous vaginal births in nulliparous women, but no important difference in multiparous women. There was no important difference between planned place of birth in alongside midwifery units and obstetric units in terms of spontaneous vaginal births for nulliparous or multiparous women. The evidence was rated as moderate to high quality, with some outcomes downgraded for imprecision.

There was no evidence identified for all the different places of birth compared to each other.

There was no evidence identified for the following outcomes: maternal death, or women's experience of labour and birth.

See appendix F for full GRADE tables.

Economic evidence

Included studies

See the literature search strategy in appendix B and economic study selection flow chart in appendix G.

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

Excluded studies

Economic studies not included in this review are listed, and reasons for their exclusion are provided in appendix J.

Economic model

No economic modelling was undertaken for this review because the clinical evidence review did not find comparative evidence for different places of birth by BMI category.

The committee's discussion and interpretation of the evidence

The outcomes that matter most

The committee chose maternal death or severe maternal morbidity, mode of birth and postpartum haemorrhage as the critical outcomes for this review. The committee agreed that to understand the safety of planned place of birth, maternal death or severe maternal morbidity, and postpartum haemorrhage would be the best indicators of the most severe negative outcomes for women. The committee also agreed that it was essential to find out about mode of birth, and whether different planned places of birth for women with different BMIs or parities, led to differences in mode of birth.

The committee also agreed on the important outcomes for this review. They agreed that it was important to look at the neonatal outcomes and whether there were any risks associated with planned place of birth for the baby. They agreed that shoulder dystocia and admission to neonatal unit would reflect this. The committee discussed that admission to neonatal unit may not cover all aspects of morbidity, and in some instances, admissions would be due to

precaution, however they agreed that this outcome would reflect the risks of separation between the mother and their baby. The committee agreed that shoulder dystocia was one of their key concerns in terms of neonatal morbidity and so used this as another indicator of morbidity of the neonate. The committee also discussed the importance of looking at breastfeeding rates, as this would be an indicator of the support available to the woman, and would also benefit the baby. The committee chose transfer to the obstetric unit as another important outcome as this would indicate if there had been any requirements or complications that could not be dealt with at the planned place of birth. The committee agreed that it was also important to find out about maternal satisfaction with labour and birth. The committee recognised the great importance of maternal satisfaction for place of birth, but they were aware that data on this outcome was likely to be sparse and unlikely to inform decision-making in a meaningful way, so they prioritised other outcomes as critical.

The quality of the evidence

The quality of the evidence for outcomes was assessed with GRADE and was rated from high to very low. Most of the evidence was downgraded due to imprecision around the effect estimate. Most women have a BMI in the range 18.5-25.9 kg/m^2, therefore sample sizes for women with other BMI ranges were smaller and affected imprecision. Some outcomes were also downgraded for inconsistency, as the difference in the direction of effect could not be explained by further subgroup analysis. Some studies were also downgraded for risk of bias concerns, mainly around selective reporting of subgroup analyses. All studies adjusted for confounders and the adjusted effect estimates were used, therefore the absolute effects were based on the relative effect applied to the observed effect rate.

Benefits and harms

The committee discussed the evidence for women with a healthy BMI range of 18.5 to 24.9 kg/m^2. This evidence showed that, for both nulliparous and multiparous women, planning birth in freestanding midwifery-led units, alongside midwifery-led units or at home, had benefits in terms of reduced obstetric interventions when compared to planning birth in an obstetric unit. The committee agreed that the evidence supports the current recommendation in the guideline that the rate of interventions is lower if birth is planned in midwifery-led units or at home for low-risk nulliparous and multiparous women. Therefore, the committee agreed to keep this recommendation in the guideline.

The committee were aware of data from the National Maternity and Perinatal Audit 2021 (Relph 2021) that shows that as BMI increases, the risk of intrapartum interventions, postpartum haemorrhage and adverse neonatal outcomes also increase. The National Maternity and Perinatal Audit 2021 was not formally included in the review as it did not meet the comparator criteria listed in the review protocol. They then reviewed the evidence to see if there were any identifiable risks with raised BMIs.

The committee discussed that the evidence in this review provided information about the risks of events occurring at different BMIs or BMI ranges compared to other BMIs or BMI ranges, but this was within defined planned places of birth. They discussed the limitations of the data presented, including the fact that for some of the outcomes they could not ascertain whether the benefits and risks presented were due to the planned place of birth or the BMI range. This is because some outcomes were not available for all planned places of birth and it was not possible to tease out whether a worse outcome would be better with a different planned place of birth. The committee had hoped the evidence would provide information between the risks and benefits of planning birth in a particular setting, for a given BMI or BMI range. Nonetheless, the committee agreed the evidence would be useful for advising women about their potential individual risks during labour and what support and care they might require, and therefore support them when planning their birth to identify where the best place of birth might possibly be for them. They discussed that overall the evidence used to make recommendations was of moderate to high quality and largely applicable to the UK context.

The committee discussed the best way to present the evidence so it could be used by women and clinicians when discussing their planned place of birth. They noted that they could not establish a BMI range cut-off above which planning birth in a specific setting was no longer recommended. However, the evidence showed that some outcomes increase with a higher BMI and the committee agreed to make a recommendation to summarise the key messages from the data and to present these risks in tables in an appendix to the guideline so it could be used to inform women when discussing and planning their place of birth.

The committee noted that one of the main areas of concern for women when planning place of birth are outcomes that lead to the separation between them and their baby. The committee noted that this should not be a concern for women when planning place of birth and that, in line with existing guideline recommendations, if a woman is transferred to an obstetric unit after the birth, healthcare professionals should ensure that her baby goes with her. However, the committee agreed that women may be separated from their baby if the baby requires admission to the neonatal unit, particularly if a higher level of neonatal care required transfer of the baby to another hospital, and this would be a concern for all women.

The committee first discussed the evidence for women with a booking BMI of <18.5kg/m^2 (that is, with a BMI lower than the 'healthy' range) compared to women with a booking BMI of 18.5 – 24.9 kg/m^2. Across all settings (obstetric units, alongside midwifery units, free-standing midwifery units and home) there was no evidence of an important difference for any of the available outcomes, with the exception of the combined neonatal outcome (neonatal admission, stillbirth, neonatal death), where there was a benefit for women with the lower BMI when planning birth in an alongside midwifery unit.

The committee next discussed the evidence for the comparison of women with a booking BMI in the range 25-29.9 kg/m^2 compared women with a booking BMI in the healthy weight range 18.5 to 24.9 kg/m^2. Across all settings (obstetric units, alongside midwifery units, free-standing midwifery units and home) there was no evidence of an important difference for most of the available outcomes, but there were 2 outcomes which showed an increased risk for women with a higher BMI:

1. Women planning birth in an obstetric unit (mixed parity) are more likely to have a caesarean birth. The committee noted that there was no data available from other planned places of births on caesarean births.
2. Nulliparous women planning birth in a freestanding midwifery unit were more likely to be transferred to an obstetric unit. However, for this difference, the committee noted that this evidence came from a US setting, and although the facilities at the freestanding midwifery units resemble those in the UK, there would be other differences such as reasons for transfer between the two settings that could explain the contradictory evidence. The committee also had concerns over the low quality of the evidence from the US setting. Therefore the committee based their decisions on other evidence from the UK setting that showed no differences between nulliparous women in the two BMI groups. As a result, the committee agreed that they would not highlight specific risks related to transfer to the obstetric unit from a freestanding midwifery unit, for nulliparous women with a booking BMI in the range 25-29.9 kg/m^2.

Overall, the committee therefore agreed to only highlight the risks relating to the first difference for this set of results.

The committee then discussed the evidence for women with a booking BMI in the range 30 – 35 kg/m^2, compared to women with a healthy booking BMI of 18.5 – 24.9 kg/m^2. As with the evidence for women with a booking BMI in the range 25 – 29.9 kg/m^2, there was no evidence of an important difference in the outcomes for the majority of comparisons, but for 3 outcomes there was a difference. For 2 of these differences an increased risk was shown for women with an increased BMI:

1. Women planning birth in an obstetric unit (mixed parity) are more likely to have a caesarean birth. The committee noted that there was no data available from other planned places of births on caesarean births.
2. Multiparous women planning birth at home, are more likely to be transferred to the obstetric unit.

The committee noted that these were the same risks that had been identified in the evidence for the previous BMI range 25 – 29.9 kg/m^2 and this reinforced their recommendations to highlight these risks to women with a raised BMI.

The third difference identified in this comparison was an increased risk for women with a healthy BMI, which was not what the committee expected to see. The increased risk was for the combined outcome of obstetric interventions and adverse maternal outcomes in a freestanding midwifery unit. However, for planned place of birth in all other settings (obstetric unit, alongside midwifery unit and home) there was no important difference, or no evidence of an important difference for this outcome. The committee discussed that this combined outcome included many different outcomes: instrumental births, intrapartum caesarean births, augmentation, general anaesthesia, maternal blood transfusion, third/fourth degree tears, and maternal admission to higher level care, and the evidence did not explain which specific component of the combined outcome contributed to the increased rate seen in women in the lower BMI range. They agreed that this lack of clarity regarding this outcome, the fact that the difference had only been seen in one setting, and was contrary to their expectations about risks increasing with increased BMI, meant that it should not be included in their recommendation.

The next BMI range the committee discussed was for women with a booking BMI >35 kg/m^2 together with the further analysis of women with a booking BMI in the range >35-40 kg/m^2 (both of which were compared to women with a booking BMI in the healthy range, 18.5 – 24.9 kg/m^2). The committee noted that this evidence showed that women with a booking BMI >35 kg/m^2 or 35 – 40 kg/m^2 planning birth in an obstetric unit (nulliparous or multiparous) or a FMU (mixed parity) were more likely to experience the combined outcome of neonatal admission, intrapartum stillbirth or early neonatal death, and agreed that this increased risk should be included in the planned risks table. The committee discussed that combining neonatal outcomes in this way did not provide enough information on neonatal admissions that were low dependency, or did not result in serious outcomes. However, the committee discussed that this outcome was still informative for making decisions about planned place of birth, as neonatal units are located alongside obstetric units. Therefore they agreed that it was important to highlight this as a risk for the groups of women with a BMI >35 kg/m^2 or 35-40 kg/m^2, so they could use this information to make decisions on their planned place of birth.

The committee also discussed that women with a booking BMI of >35 kg/m^2 planning birth in the obstetric unit were more likely than those of a BMI in the range 18.5-24.9 kg/m^2 planning birth in the obstetric unit, to have an intrapartum caesarean birth. There was no evidence for this outcome for other planned birth settings so the committee were unable to comment on the association of planned place of birth with intrapartum caesarean birth, but evidence for the combined outcome measure of obstetric interventions and adverse maternal outcomes found no difference between the higher (>35 kg/m^2 or 35-40 kg/m^2) and healthy BMI ranges in any setting. Therefore the committee agreed that this risk should be highlighted for all women with a booking BMI >35 kg/m^2, based on the available evidence.

The committee discussed the evidence that compared women with a booking BMI ≥35 kg/m^2 to women with a booking BMI ≤35 kg/m^2, who planned their birth in an alongside midwifery unit. The committee noted that over 90% of the women with a booking BMI ≥35 kg/m^2 had a BMI between 35.1 to 40 kg/m^2, so they acknowledged that the evidence may not be applicable to women with a BMI >40 kg/m^2. The committee noted that the evidence showed an increased risk for nulliparous women with a BMI ≥35 kg/m^2 of intrapartum or emergency

caesarean births, and postpartum haemorrhage. They noted that for intrapartum caesarean births, the increased risk was only seen when using a more liberal confidence interval of 90%, rather than 95%, but agreed that the absolute risks presented in the table of risks would highlight this. They acknowledged that these data came from women who planned their birth in alongside midwifery units, but without data from other planned birth settings the committee could not comment on the risks associated with this particular setting. However, they agreed that the care and support required in the event of these outcomes could only be provided in the obstetric unit and so the need for transfer from the alongside midwifery unit to the obstetric unit should be something that nulliparous women should consider in their decision making when planning their place of birth. The committee noted that there was no evidence of an important difference for multiparous women with regard to these outcomes.

Cost effectiveness and resource use

The committee discussed the fact that the current recommendations suggest that all women with a booking BMI of 30-35 kg/m^2 should have an individual assessment when planning place of birth. The committee suggested that the removal of this hard cut-off and instead the inclusion of a risk table may mean that more women with lower BMIs choose birth at home, or at an alongside midwifery unit or freestanding midwifery unit, and that this may reduce resource use whilst respecting and promoting individual choice with respect to place of birth.

Other factors the committee took into account

The committee were aware of data from the National Maternity and Perinatal Audit (NMPA) (Relph 2021) which showed that the likelihood of a woman experiencing an intrapartum intervention or adverse maternal outcome, or her baby experiencing very serious complications following birth, increases as BMI increases. The committee were therefore expecting to see increased risks in the higher BMI groups compared to women with a healthy BMI, and agreed that the data from the evidence review and the NMPA complemented each other, and supported their decision to alert women to these increased risks.

The committee discussed the fact that BMI ranges representing a healthy weight, overweight, or obesity may differ in women from different ethnic groups, and that this should be taken into consideration when assessing the risks for women at different BMIs. However, the committee noted that the evidence they had reviewed included a proportion of women from black, Asian and minority ethnic groups ranging from 12 to 16% (which is representative of the UK population) but that there was no separate evidence from the review on women from specific ethnic groups so the committee were unable to make separate recommendations. To provide additional information for users of the guideline the committee cross-referenced to the NICE guideline on the classification of overweight and obesity which provides guidance on how to adjust ranges for different ethnic groups. In addition, the committee noted that women from certain ethnic and socioeconomic groups may be likely to be overweight or obese and so the recommendations may apply to a higher proportion of women in these groups than in other groups.

Recommendations supported by this evidence review

This evidence review supports recommendation 1.3.6. and the associated risk tables in appendix B.

References – included studies

Effectiveness

Brocklehurst 2011

Brocklehurst P, Hardy P et al. (2011) Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. BMJ (Clinical research ed.) 343: d7400

Hollowell 2014

Hollowell, J., Pillas, D., Rowe, R. et al. (2014) The impact of maternal obesity on intrapartum outcomes in otherwise low risk women: secondary analysis of the Birthplace national prospective cohort study. BJOG : an international journal of obstetrics and gynaecology 121(3): 343-55

Hollowell 2015

Hollowell, J., Rowe, R., Townend, J. et al. (2015) The Birthplace in England national prospective cohort study: further analyses to enhance policy and service delivery decision-making for planned place of birth.

Rowe 2018

Rowe, Rachel; Knight, Marian; Kurinczuk, Jennifer J. (2018) Outcomes for women with BMI>35kg/m2 admitted for labour care to alongside midwifery units in the UK: A national prospective cohort study using the UK Midwifery Study System (UKMidSS). PLoS ONE 13(12): e0208041

Stephenson-Famy 2018

Stephenson-Famy, Alyssa, Masarie, Kaitlin S., Lewis, Ali et al. (2018) What are the risk factors associated with hospital birth among women planning to give birth in a birth center in Washington State?. Birth (Berkeley, Calif.) 45(2): 130-136

Other

Relph S, NMPA Project Team. NHS Maternity Care for Women with a Body Mass Index of 30 kg/m^2 or Above: Births between 1 April 2015 and 31 March 2017 in England, Wales and Scotland. London: RCOG; 2021.

Appendices

Appendix A Review protocols

Review protocol for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Table 3: Review protocol

Field	Content
PROSPERO registration number	CRD42021266256
Review title	Benefits and risks of different places of birth for women at different BMI thresholds
Review question	What are the benefits and risks of different places of birth for women at different BMI thresholds?
Objective	To update the recommendations in CG190 (2014) for risk factors to consider when planning place of birth.
Searches	The following databases will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • International Health Technology Assessment database Searches will be restricted by: • No date limitations • English language only • Human studies only Other searches:

Field	Content
	• Inclusion lists of systematic reviews The full search strategies for MEDLINE database will be published in the final review. For each search, the principal database search strategy is quality assured by a second information scientist using an adaptation of the PRESS 2015 Guideline Evidence-Based Checklist.
Condition or domain being studied	Benefits and risks of different planned places of birth for women who are pregnant with a single baby, at different BMI thresholds.
Population	• Women in labour who are pregnant with a single baby • Women in labour whose baby has not been identified before labour to be at high risk of adverse outcome • Otherwise healthy women at any BMI threshold who do not have any pre-existing medical conditions or antenatal conditions that predispose to a higher risk birth
Intervention	Planned place of birth at any of the following: • Alongside midwifery unit • Freestanding midwifery unit • Home (domiciliary) • Obstetric unit/hospital-based maternity unit (the only setting where doctors are present) Names of settings will be guided by the study. Actual place of birth will not be considered.
Comparator	Any of the planned places of birth listed in the intervention
Types of study to be included	Include published full-text papers: • Systematic reviews of RCTs and/or observational studies • Parallel RCTs (individual or cluster) • Prospective and retrospective cohort studies

Field	Content
	• Note: prospective and retrospective studies must make adjustment for confounding factors in their analysis Conference abstracts will not be included because these do not typically have sufficient information to allow full critical appraisal.
Other exclusion criteria	Population: • Women in labour who are identified before labour to be at high risk, or whose baby is at high risk, of complications or adverse outcomes • Women with non-cephalic presentation • Women in preterm labour • Women with an intrauterine fetal death • Women with multi-fetal pregnancies • Women who have had a previous caesarean birth or who are having a planned caesarean birth Setting: Countries other than high income countries (as defined by the OECD) If any study or systematic review includes <1/3 of women with the above characteristics/ who received care in the above setting, it will be considered for inclusion but, if included, the evidence will be downgraded for indirectness.
Context	This guideline will partly update the following: Intrapartum care for healthy women and babies (CG190)
Primary outcomes (critical outcomes)	• Maternal death or severe maternal morbidity (defined as admission to intensive care) • Mode of birth (for example, spontaneous, instrumental, caesarean birth; reported individually or as a combined measure) • Postpartum haemorrhage (reported individually or as a combined measure)

Field	Content
Secondary outcomes (important outcomes)	• Shoulder dystocia • Neonatal admission (includes neonatal intensive care unit [NICU] and special care baby unit [SCBU]; reported individually or as a combined measure) • Breastfeeding • Transfer to obstetric unit • Women's experience of labour and birth
Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI and de-duplicated. Titles and abstracts of the retrieved citations will be screened to identify studies that potentially meet the inclusion criteria outlined in the review protocol. Dual sifting will be performed on at least 10% of records; 90% agreement is required. Disagreements will be resolved via discussion between the two reviewers, and consultation with senior staff if necessary. Full versions of the selected studies will be obtained for assessment. Studies that fail to meet the inclusion criteria once the full version has been checked will be excluded at this stage. Each study excluded after checking the full version will be listed, along with the reason for its exclusion. A standardised form will be used to extract data from studies. The following data will be extracted: study details (reference, country where study was carried out, type and dates), participant characteristics, inclusion and exclusion criteria, details of the interventions if relevant, setting and follow-up, relevant outcome data and source of funding. One reviewer will extract relevant data into a standardised form, and this will be quality assessed by a senior reviewer.
Risk of bias (quality) assessment	Quality assessment of individual studies will be performed using the following checklists: • ROBIS tool for systematic reviews • Cochrane RoB tool v.2 for RCTs • Cochrane RoB tool v.2 for cluster randomised controlled trials • Cochrane ROBINS-I tool for non-randomised (clinical) controlled trials and cohort studies • The quality assessment will be performed by one reviewer and this will be quality assessed by a senior reviewer.
Strategy for data synthesis	Quantitative findings will be formally summarised in the review. Where multiple studies report on the same outcome for the same comparison, meta-analyses will be conducted using Cochrane Review Manager

Field	Content
	software. A fixed effect meta-analysis will be conducted and data will be presented as risk ratios if possible or odds ratios when required (for example, if only available in this form in included studies) for dichotomous outcomes, and mean differences or standardised mean differences for continuous outcomes. Heterogeneity in the effect estimates of the individual studies will be assessed using the I^2 statistic. Alongside visual inspection of the point estimates and confidence intervals, I^2 values of greater than 50% and 80% will be considered as significant and very significant heterogeneity, respectively. Heterogeneity will be explored as appropriate using sensitivity analyses and pre-specified subgroup analyses. If heterogeneity cannot be explained through subgroup analysis then a random effects model will be used for meta-analysis, or the data will not be pooled. The confidence in the findings across all available evidence will be evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group: http://www.gradeworkinggroup.org/ Minimally important differences: Maternal death or severe maternal morbidity (defined as admission to intensive care): statistical significance Validated scales/continuous outcomes: published MIDs where available All other outcomes & where published MIDs are not available: 0.8 and 1.25 for all relative dichotomous outcomes ; +/- 0.5x control group SD for continuous outcomes

Analysis of subgroups	Evidence will be stratified by:
	• BMI thresholds on booking:
	  ○ Underweight range: <18.5 kg/m2
	  ○ Healthy weight range: 18.5 to 24.9 kg/m2
	  ○ Overweight range: 25 to 29.99 kg/m2
	  ○ Obesity range 1: 30 to 34.99 kg/m2
	  ○ Obesity range 2: 35 to 39.99 kg/m2
	  ○ Obesity range 3 : >40 kg/m2
	• Parity (nulliparous vs mixed vs multiparous)

Field	Content	

	Stratifications will be dealt with in a hierarchy (this is, first by BMI threshold and then by parity)
	Evidence will be subgrouped by the following only in the event that there is significant heterogeneity in outcomes:
	• Age of woman (<35 vs >/= 35)
	• Ethnicity
	  ○ White
	  ○ Asian/Asian British
	  ○ Black/African/Caribbean/Black British
	  ○ Mixed/Multiple ethnic groups
	  ○ Other ethnic group
	• Women with disability versus not
	• Deprived socioeconomic groups vs not
	
	Where evidence is stratified or subgrouped the committee will consider on a case by case basis if separate recommendations should be made for distinct groups. Separate recommendations may be made where there is evidence of a differential effect of interventions in distinct groups. If there is a lack of evidence in one group, the committee will consider, based on their experience, whether it is reasonable to extrapolate and assume the interventions will have similar effects in that group compared with others.	

Type and method of review	☒	Intervention
	☐	Diagnostic
	☐	Prognostic
	☐	Qualitative
	☐	Epidemiologic
	☐	Service Delivery
	☐	Other (please specify)
Language	English	

Field	Content
Country	England
Anticipated or actual start date	22/06/2021
Anticipated completion date	23/04/2023
Named contact	5a. Named contact Guideline Development Team National Guideline Alliance (NGA) 5b. Named contact e-mail IPCupdate@nice.org.uk 5c. Organisational affiliation of the review Guideline Development Team NGA, Centre for Guidelines, National Institute for Health and Care Excellence (NICE
Review team members	From the Guideline Development Team NGA: • Senior Systematic Reviewer • Systematic Reviewer
Funding sources/sponsor	This systematic review is being completed by the Guideline Development Team NGA, Centre for Guidelines, which is part of the National Institute for Health and Care Excellence (NICE).
Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/cg190

Field	Content
Other registration details	None
URL for published protocol	https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=266256
Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: notifying registered stakeholders of publication publicising the guideline through NICE's newsletter and alerts issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
Keywords	adverse maternal outcomes, adverse perinatal outcomes, birth centre, risk factors, obesity
Details of existing review of same topic by same authors	Not applicable
Additional information	None
Details of final publication	www.nice.org.uk

BMI: body mass index; CDSR: Cochrane Database of Systematic Reviews; CENTRAL: Cochrane Central Register of Controlled Trials; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health Technology Assessment; MID: minimally important difference; NGA: National Guideline Alliance; NHS: National health service; NICE: National Institute for Health and Care Excellence; NICU: neonatal intensive care unit; OECD: Organisation for economic cooperation and development; PRESS: Peer review of electronic search strategies; RCT: randomised controlled trial; RoB(IS): risk of bias (in systematic reviews); ROBINS-I: Risk of bias in non-randomized studies of interventions; SCBU: special care baby unit; SD: standard deviation; UKMidSS: UK midwifery study system

Appendix B Literature search strategies

Literature search strategies for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Review question search strategies

Database: Medline - OVID interface

Date of last search: 06/12/2022

#	Searches
1	PREGNANCY/
2	PARTURITION/
3	exp LABOR, OBSTETRIC/
4	exp DELIVERY, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	(pregnan$ or labo?r? or childbirth$ or partu$ or intra?part$ or peri?part$).ab,ti.
7	((during or giving or give) adj5 (birth$ or deliver$)).ti,ab.
8	or/1-7
9	OBESITY/ or OBESITY, ABDOMINAL/ or OBESITY, MORBID/
10	BODY MASS INDEX/ or BODY SIZE/ or OVERWEIGHT/ or WAIST CIRCUMFERENCE/ or WAIST-HIP RATIO/
11	body mass index.ti.
12	(obesity or obese or heavy or heavier or overweight or fat$ or BMI).ti.
13	ADIPOSE TISSUE/ or ADIPOSE TISSUE, WHITE/
14	or/9-13
15	BIRTH SETTING/
16	(birth* adj3 setting?).ti,ab.
17	(place? adj3 birth*).ti,ab.
18	birthplace?.ti,ab.
19	BIRTHING CENTERS/
20	(birth* adj3 center?).ti,ab.
21	(midwife* adj3 unit?).ti,ab.
22	HOME CHILDBIRTH/
23	((home or domiciliary) adj3 (birth* or childbirth*)).ti,ab.
24	homebirth*.ti,ab.
25	((obstetric* or nonobstetric*) adj3 unit?).ti,ab.
26	(maternity adj3 unit?).ti,ab.
27	or/15-26
28	8 and 14 and 27
29	limit 28 to english language
30	LETTER/
31	EDITORIAL/
32	NEWS/
33	exp HISTORICAL ARTICLE/
34	ANECDOTES AS TOPIC/
35	COMMENT/
36	CASE REPORT/
37	(letter or comment*).ti.
38	or/30-37
39	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
40	38 not 39
41	ANIMALS/ not HUMANS/
42	exp ANIMALS, LABORATORY/
43	exp ANIMAL EXPERIMENTATION/
44	exp MODELS, ANIMAL/
45	exp RODENTIA/
46	(rat or rats or mouse or mice).ti.
47	or/40-46
48	29 not 47
49	META-ANALYSIS/
50	META-ANALYSIS AS TOPIC/
51	(meta analy* or metanaly* or metaanaly*).ti,ab.
52	((systematic* or evidence*) adj2 (review* or overview*)).ti,ab.

#	Searches
53	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
54	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
55	(search* adj4 literature).ab.
56	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
57	cochrane.jw.
58	or/49-57
59	randomized controlled trial.pt.
60	controlled clinical trial.pt.
61	pragmatic clinical trial.pt.
62	randomi#ed.ab.
63	placebo.ab.
64	randomly.ab.
65	CLINICAL TRIALS AS TOPIC/
66	trial.ti.
67	or/59-66
68	COHORT STUDIES/
69	FOLLOW-UP STUDIES/
70	LONGITUDINAL STUDIES/
71	PROSPECTIVE STUDIES/
72	RETROSPECTIVE STUDIES/
73	((cohort* or follow-up or follow?up or longitudinal* or prospective* or retrospective*) adj1 (stud* or research or analys*)).tw.
74	(incidence? adj (stud* or research or analys*)).tw.
75	(longitudinal* adj1 (survey* or evaluat*)).tw.
76	(prospective* adj method*).tw.
77	(retrospective* adj design*).tw.
78	or/68-77
79	48 and 58
80	48 and 67
81	48 and 78
82	or/79-81

Database: Embase – OVID interface

Date of last search: 06/12/2022

#	Searches
1	*PREGNANCY/
2	*PERINATAL PERIOD/
3	exp *BIRTH/
4	exp *LABOR/
5	*PREMATURE LABOR/
6	*INTRAPARTUM CARE/
7	(pregnan$ or labo?r? or childbirth$ or partu$ or intra?part$ or peri?part$).ab,ti.
8	((during or giving or give) adj5 (birth$ or deliver$)).ti,ab.
9	or/1-8
10	*OBESITY/ or *ABDOMINAL OBESITY/ or *MORBID OBESITY/
11	*BODY MASS/ or *BODY SIZE/ or *WAIST CIRCUMFERENCE/ or *WAIST-HIP RATIO/
12	body mass index.ti.
13	(obesity or obese or heavy or heavier or overweight or fat$ or BMI).ti.
14	*ADIPOSE TISSUE/ or *WHITE ADIPOSE TISSUE/
15	or/10-14
16	BIRTH SETTING/
17	(birth* adj3 setting?).ti,ab.
18	(place? adj3 birth*).ti,ab.
19	birthplace?.ti,ab.
20	(birth* adj3 center?).ti,ab.
21	(midwife* adj3 unit?).ti,ab.
22	HOME DELIVERY/
23	((home or domiciliary) adj3 (birth* or childbirth*)).ti,ab.
24	homebirth*.ti,ab.
25	MATERNITY WARD/
26	((obstetric* or nonobstetric*) adj3 unit?).ti,ab.
27	(maternity adj3 unit?).ti,ab.
28	or/16-27
29	9 and 15 and 28
30	limit 29 to english language
31	letter.pt. or LETTER/

#	Searches
32	note.pt.
33	editorial.pt.
34	CASE REPORT/ or CASE STUDY/
35	(letter or comment*).ti.
36	or/31-35
37	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
38	36 not 37
39	ANIMAL/ not HUMAN/
40	NONHUMAN/
41	exp ANIMAL EXPERIMENT/
42	exp EXPERIMENTAL ANIMAL/
43	ANIMAL MODEL/
44	exp RODENT/
45	(rat or rats or mouse or mice).ti.
46	or/38-45
47	30 not 46
48	SYSTEMATIC REVIEW/
49	META-ANALYSIS/
50	(meta analy* or metanaly* or metaanaly*).ti,ab.
51	((systematic or evidence) adj2 (review* or overview*)).ti,ab.
52	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
53	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
54	(search* adj4 literature).ab.
55	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
56	((pool* or combined) adj2 (data or trials or studies or results)).ab.
57	cochrane.jw.
58	or/48-57
59	random*.ti,ab.
60	factorial*.ti,ab.
61	(crossover* or cross over*).ti,ab.
62	((doubl* or singl*) adj blind*).ti,ab.
63	(assign* or allocat* or volunteer* or placebo*).ti,ab.
64	CROSSOVER PROCEDURE/
65	SINGLE BLIND PROCEDURE/
66	RANDOMIZED CONTROLLED TRIAL/
67	DOUBLE BLIND PROCEDURE/
68	or/59-67
69	COHORT ANALYSIS/
70	FOLLOW UP/
71	LONGITUDINAL STUDY/
72	PROSPECTIVE STUDY/
73	RETROSPECTIVE STUDIES/
74	((cohort* or follow-up or follow?up or longitudinal* or prospective* or retrospective*) adj1 (stud* or research or analys*)).tw.
75	(incidence? adj (stud* or research or analys*)).tw.
76	(longitudinal* adj1 (survey* or evaluat*)).tw.
77	(prospective* adj method*).tw.
78	(retrospective* adj design*).tw.
79	or/69-78
80	47 and 58
81	47 and 68
82	47 and 79
83	or/80-82

Databases: Cochrane Central Register of Controlled Trials; and Cochrane Database of Systematic Reviews – Wiley interface

Date of last search: 06/12/2022

#	Searches
#1	MeSH descriptor: [Pregnancy] this term only
#2	MeSH descriptor: [Parturition] this term only
#3	MeSH descriptor: [Labor, Obstetric] explode all trees
#4	MeSH descriptor: [Delivery, Obstetric] explode all trees
#5	MeSH descriptor: [Obstetric Labor, Premature] this term only

#	Searches
#6	(pregnan* or labor* or labour* or childbirth* or partu* or intrapart* or intra-part* or peripart* or peri-part*):ti,ab
#7	((during or giving or give) near/5 (birth* or deliver*)):ti,ab
#8	#1 or #2 or #3 or #4 or #5 or #6 or #7
#9	MeSH descriptor: [Obesity] this term only
#10	MeSH descriptor: [Obesity, Abdominal] this term only
#11	MeSH descriptor: [Obesity, Morbid] this term only
#12	MeSH descriptor: [Body Mass Index] this term only
#13	MeSH descriptor: [Body Size] this term only
#14	MeSH descriptor: [Overweight] this term only
#15	MeSH descriptor: [Waist Circumference] this term only
#16	MeSH descriptor: [Waist-Hip Ratio] this term only
#17	body mass index:ti
#18	(obesity or obese or heavy or heavier or overweight or fat* or BMI):ti
#19	MeSH descriptor: [Adipose Tissue] this term only
#20	MeSH descriptor: [Adipose Tissue, White] this term only
#21	#9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20
#22	MeSH descriptor: [Birth Setting] this term only
#23	(birth* near/3 setting*):ti,ab
#24	(place* near/3 birth*):ti,ab
#25	Birthplace*:ti,ab
#26	MeSH descriptor: [Birthing Centers] this term only
#27	(birth* near/3 center*):ti,ab
#28	(midwife* near/3 unit*):ti,ab
#29	MeSH descriptor: [Home Childbirth] this term only
#30	((home or domiciliary) near/3 (birth* or childbirth*)):ti,ab
#31	homebirth*:ti,ab
#32	((obstetric* or nonobstetric*) near/3 unit*):ti,ab
#33	(maternity near/3 unit*):ti,ab
#34	#22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33
#35	#8 and #21 and #34

Database: International Health Technology Assessment

Date of last search: 06/12/2022

#	Searches
	(BIRTH SETTING)[mh] OR (BIRTHING CENTERS)[mh] OR (HOME CHILDBIRTH)[mh]
	OR All: "birth setting" or "place of birth" or birthplace or "birth center" or "midwifery unit" or "home birth" or homebirth or "obstetric unit" or "maternity unit"

Health economics search strategies

Database: Medline - OVID interface

Date of last search: 06/12/2022

#	Searches
1	PREGNANCY/
2	PARTURITION/
3	exp LABOR, OBSTETRIC/
4	exp DELIVERY, OBSTETRIC/
5	OBSTETRIC LABOR, PREMATURE/
6	(pregnan$ or labo?r? or childbirth$ or partu$ or intra?part$ or peri?part$).ab,ti.
7	((during or giving or give) adj5 (birth$ or deliver$)).ti,ab.
8	or/1-7
9	OBESITY/ or OBESITY, ABDOMINAL/ or OBESITY, MORBID/
10	BODY MASS INDEX/ or BODY SIZE/ or OVERWEIGHT/ or WAIST CIRCUMFERENCE/ or WAIST-HIP RATIO/
11	body mass index.ti.
12	(obesity or obese or heavy or heavier or overweight or fat$ or BMI).ti.
13	ADIPOSE TISSUE/ or ADIPOSE TISSUE, WHITE/
14	or/9-13
15	BIRTH SETTING/
16	(birth* adj3 setting?).ti,ab.
17	(place? adj3 birth*).ti,ab.

#	Searches
18	birthplace?.ti,ab.
19	BIRTHING CENTERS/
20	(birth* adj3 center?).ti,ab.
21	(midwife* adj3 unit?).ti,ab.
22	HOME CHILDBIRTH/
23	((home or domiciliary) adj3 (birth* or childbirth*)).ti,ab.
24	homebirth*.ti,ab.
25	((obstetric* or nonobstetric*) adj3 unit?).ti,ab.
26	(maternity adj3 unit?).ti,ab.
27	or/15-26
28	8 and 14 and 27
29	limit 28 to english language
30	LETTER/
31	EDITORIAL/
32	NEWS/
33	exp HISTORICAL ARTICLE/
34	ANECDOTES AS TOPIC/
35	COMMENT/
36	CASE REPORT/
37	(letter or comment*).ti.
38	or/30-37
39	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
40	38 not 39
41	ANIMALS/ not HUMANS/
42	exp ANIMALS, LABORATORY/
43	exp ANIMAL EXPERIMENTATION/
44	exp MODELS, ANIMAL/
45	exp RODENTIA/
46	(rat or rats or mouse or mice).ti.
47	or/40-46
48	29 not 47
49	ECONOMICS/
50	VALUE OF LIFE/
51	exp "COSTS AND COST ANALYSIS"/
52	exp ECONOMICS, HOSPITAL/
53	exp ECONOMICS, MEDICAL/
54	exp RESOURCE ALLOCATION/
55	ECONOMICS, NURSING/
56	ECONOMICS, PHARMACEUTICAL/
57	exp "FEES AND CHARGES"/
58	exp BUDGETS/
59	budget*.ti,ab.
60	cost*.ti,ab.
61	(economic* or pharmaco?economic*).ti,ab.
62	(price* or pricing*).ti,ab.
63	(financ* or fee or fees or expenditure* or saving*).ti,ab.
64	(value adj2 (money or monetary)).ti,ab.
65	resourc* allocat*.ti,ab.
66	(fund or funds or funding* or funded).ti,ab.
67	(ration or rations or rationing* or rationed).ti,ab.
68	ec.fs.
69	or/49-68
70	48 and 69

Database: Embase – OVID interface

Date of last search: 06/12/2022

#	Searches
1	*PREGNANCY/
2	*PERINATAL PERIOD/
3	exp *BIRTH/
4	exp *LABOR/
5	*PREMATURE LABOR/
6	*INTRAPARTUM CARE/
7	(pregnan$ or labo?r? or childbirth$ or partu$ or intra?part$ or peri?part$).ab,ti.
8	((during or giving or give) adj5 (birth$ or deliver$)).ti,ab.
9	or/1-8
10	*OBESITY/ or *ABDOMINAL OBESITY/ or *MORBID OBESITY/

#	Searches
11	*BODY MASS/ or *BODY SIZE/ or *WAIST CIRCUMFERENCE/ or *WAIST-HIP RATIO/
12	body mass index.ti.
13	(obesity or obese or heavy or heavier or overweight or fat$ or BMI).ti.
14	*ADIPOSE TISSUE/ or *WHITE ADIPOSE TISSUE/
15	or/10-14
16	BIRTH SETTING/
17	(birth* adj3 setting?).ti,ab.
18	(place? adj3 birth*).ti,ab.
19	birthplace?.ti,ab.
20	(birth* adj3 center?).ti,ab.
21	(midwife* adj3 unit?).ti,ab.
22	HOME DELIVERY/
23	((home or domiciliary) adj3 (birth* or childbirth*)).ti,ab.
24	homebirth*.ti,ab.
25	MATERNITY WARD/
26	((obstetric* or nonobstetric*) adj3 unit?).ti,ab.
27	(maternity adj3 unit?).ti,ab.
28	or/16-27
29	9 and 15 and 28
30	limit 29 to english language
31	letter.pt. or LETTER/
32	note.pt.
33	editorial.pt.
34	CASE REPORT/ or CASE STUDY/
35	(letter or comment*).ti.
36	or/31-35
37	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
38	36 not 37
39	ANIMAL/ not HUMAN/
40	NONHUMAN/
41	exp ANIMAL EXPERIMENT/
42	exp EXPERIMENTAL ANIMAL/
43	ANIMAL MODEL/
44	exp RODENT/
45	(rat or rats or mouse or mice).ti.
46	or/38-45
47	30 not 46
48	HEALTH ECONOMICS/
49	exp ECONOMIC EVALUATION/
50	exp HEALTH CARE COST/
51	exp FEE/
52	BUDGET/
53	FUNDING/
54	RESOURCE ALLOCATION/
55	budget*.ti,ab.
56	cost*.ti,ab.
57	(economic* or pharmaco?economic*).ti,ab.
58	(price* or pricing*).ti,ab.
59	(financ* or fee or fees or expenditure* or saving*).ti,ab.
60	(value adj2 (money or monetary)).ti,ab.
61	resourc* allocat*.ti,ab.
62	(fund or funds or funding* or funded).ti,ab.
63	(ration or rations or rationing* or rationed).ti,ab.
64	or/48-63
65	47 and 64

Database: Cochrane Central Register of Controlled Trials – Wiley interface

Date of last search: 06/12/2022

#	Searches
#1	MeSH descriptor: [Pregnancy] this term only
#2	MeSH descriptor: [Parturition] this term only
#3	MeSH descriptor: [Labor, Obstetric] explode all trees
#4	MeSH descriptor: [Delivery, Obstetric] explode all trees
#5	MeSH descriptor: [Obstetric Labor, Premature] this term only
#6	(pregnan* or labor* or labour* or childbirth* or partu* or intrapart* or intra-part* or peripart* or peri-part*):ti,ab
#7	((during or giving or give) near/5 (birth* or deliver*)):ti,ab
#8	#1 or #2 or #3 or #4 or #5 or #6 or #7

#	Searches
#9	MeSH descriptor: [Obesity] this term only
#10	MeSH descriptor: [Obesity, Abdominal] this term only
#11	MeSH descriptor: [Obesity, Morbid] this term only
#12	MeSH descriptor: [Body Mass Index] this term only
#13	MeSH descriptor: [Body Size] this term only
#14	MeSH descriptor: [Overweight] this term only
#15	MeSH descriptor: [Waist Circumference] this term only
#16	MeSH descriptor: [Waist-Hip Ratio] this term only
#17	body mass index:ti
#18	(obesity or obese or heavy or heavier or overweight or fat* or BMI):ti
#19	MeSH descriptor: [Adipose Tissue] this term only
#20	MeSH descriptor: [Adipose Tissue, White] this term only
#21	#9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20
#22	MeSH descriptor: [Birth Setting] this term only
#23	(birth* near/3 setting*):ti,ab
#24	(place* near/3 birth*):ti,ab
#25	Birthplace*:ti,ab
#26	MeSH descriptor: [Birthing Centers] this term only
#27	(birth* near/3 center*):ti,ab
#28	(midwife* near/3 unit*):ti,ab
#29	MeSH descriptor: [Home Childbirth] this term only
#30	((home or domiciliary) near/3 (birth* or childbirth*)):ti,ab
#31	homebirth*:ti,ab
#32	((obstetric* or nonobstetric*) near/3 unit*):ti,ab
#33	(maternity near/3 unit*):ti,ab
#34	#22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33
#35	#8 and #21 and #34
#36	MeSH descriptor: [Economics] this term only
#37	MeSH descriptor: [Value of Life] this term only
#38	MeSH descriptor: [Costs and Cost Analysis] explode all trees
#39	MeSH descriptor: [Economics, Hospital] explode all trees
#40	MeSH descriptor: [Economics, Medical] explode all trees
#41	MeSH descriptor: [Resource Allocation] explode all trees
#42	MeSH descriptor: [Economics, Nursing] this term only
#43	MeSH descriptor: [Economics, Pharmaceutical] this term only
#44	MeSH descriptor: [Fees and Charges] explode all trees
#45	MeSH descriptor: [Budgets] explode all trees
#46	budget*:ti,ab
#47	cost*:ti,ab
#48	(economic* or pharmaco?economic*):ti,ab
#49	(price* or pricing*):ti,ab
#50	(financ* or fee or fees or expenditure* or saving*):ti,ab
#51	(value near/2 (money or monetary)):ti,ab
#52	resourc* allocat*:ti,ab
#53	(fund or funds or funding* or funded):ti,ab
#54	(ration or rations or rationing* or rationed):ti,ab
#55	#36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 or #49 or #50 or #51 or #52 or #53 or #54
#56	#35 and #55

Database: International Health Technology Assessment

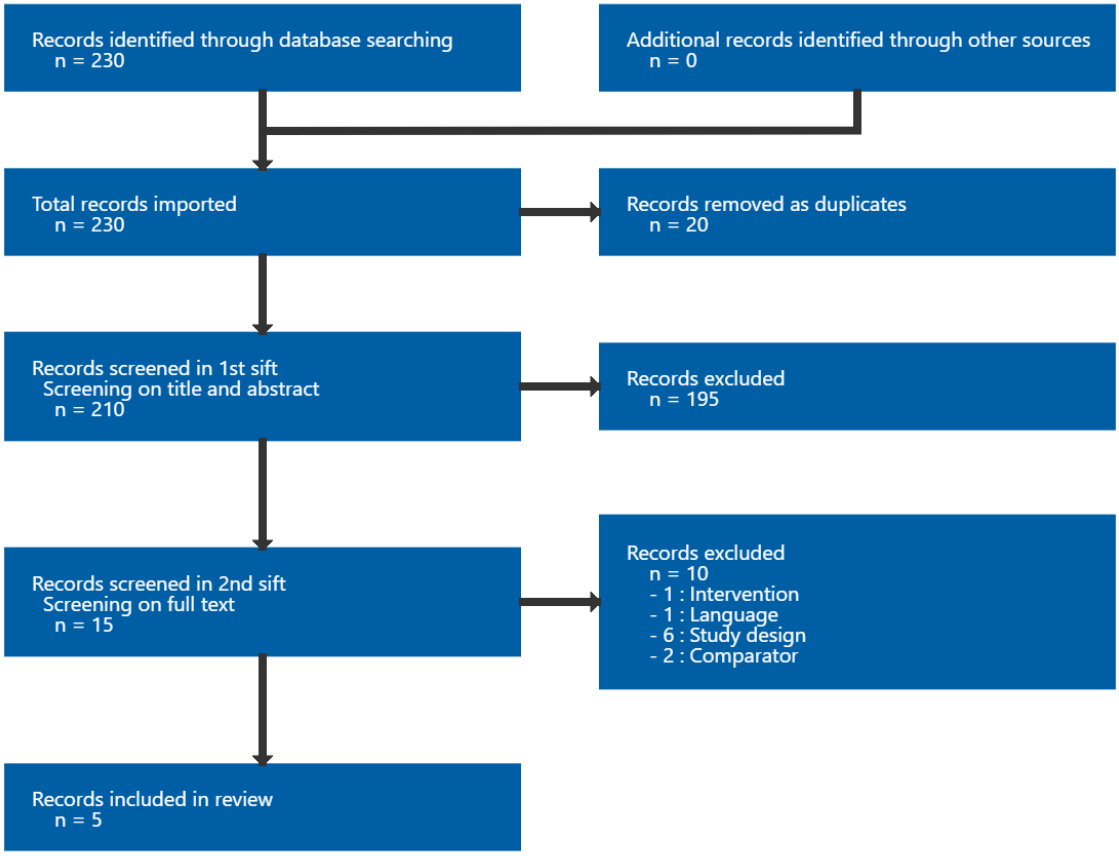
Date of last search: 06/12/2022

#	Searches
	(BIRTH SETTING)[mh] OR (BIRTHING CENTERS)[mh] OR (HOME CHILDBIRTH)[mh]
	OR All: "birth setting" or "place of birth" or birthplace or "birth center" or "midwifery unit" or "home birth" or homebirth or "obstetric unit" or "maternity unit"

Appendix C Effectiveness evidence study selection

Study selection for: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Figure 1: Study selection flow chart



Note: for this review, de-duplication was done outside of EPPI in EndNote for practical reasons, therefore the study selection flowchart does not accurately reflect the records removed as duplicates.

Appendix D Evidence tables

Evidence tables for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Brocklehurst, 2011

Bibliographic Reference Brocklehurst P; Hardy P; Hollowell J; Linsell L; Macfarlane A; McCourt C; Marlow N; Miller A; Newburn M; Petrou S; Puddicombe D; Redshaw M; Rowe R; Sandall J; Silverton L; Stewart M; Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study.; BMJ (Clinical research ed.); 2011; vol. 343

Study details

Country/ies where study was carried out	England
Study type	Prospective cohort study
Study dates	April 2008 - April 2010
Inclusion criteria	• Women attended by an NHS midwife during labour in their planned place of birth
Exclusion criteria	• women who had elective caesarean section • women who had caesarean section before onset of labour • preterm labour (<37 weeks' gestation) • multiple pregnancy • women who were 'unbooked' (had no antenatal care) • Stillbirths occurring before the start of care in labour
Patient characteristics	Age - mean (SD) Obstetric unit: 28.2 (6) Home: 31.1 (5.2) Freestanding midwifery unit: 28.8 (5.8)

	Alongside midwifery unit: 28.3 (5.7) Parity - nulliparous Obstetric unit: 54% Home: 27.2% Freestanding midwifery unit: 46% Alongside midwifery unit: 50.1% Gestational age - mean (SD) Obstetric unit: 39.8 (1.1) Home: 39.8 (1.0) Freestanding midwifery unit: 39.8 (1.0) Alongside midwifery unit: 39.7 (1.0) BMI - mean (SD): Obstetric unit: 24.4 (4.0) Home: 24.0 (3.7) Freestanding midwifery unit: 24.1 (3.7) Alongside midwifery unit: 24.0 (3.8) Ethnicity: **White** Obstetric unit: 81.7% Home: 94.8% Freestanding midwifery unit: 91.6% Alongside midwifery unit: 80.9% **Asian** Obstetric unit: 7.1% Home: 0.7% Freestanding midwifery unit: 3.6%

	Alongside midwifery unit: 7.2% **Black/African/Caribbean** Obstetric unit: 4.7% Home: 1.5% Freestanding midwifery unit: 1.2% Alongside midwifery unit: 4.3% **Mixed** Obstetric unit: 1.7% Home: 1.7% Freestanding midwifery unit: 1.1% Alongside midwifery unit: 1.8% **Other** Obstetric unit: 4.8% Home: 1.4% Freestanding midwifery unit: 2.5% Alongside midwifery unit: 6.0% <u>Confounders:</u> Effect estimates adjusted for maternal age, ethnic group, understanding of English, marital or partner status, body mass index, deprivation score quintile, parity (previous pregnancies ≥24weeks), and weeks of gestation
Intervention(s)/control	Planned place of birth at: • Obstetric unit • Home • Freestanding midwifery unit • Alongside midwifery unit
Sources of funding	Not industry funded
Sample size	N=64538 low risk women Obstetrics unit: n= 19706

	Home: n=16840 Freestanding midwifery units: n=11282 Alongside midwifery units: n=16710

NHS: national health service; SD: standard deviation;

Outcomes

Primary outcomes

Outcome	**Obstetric Unit, , N = 19706**	**Home, , N = 16840**	**Freestanding midwifery unit, , N = 11282**	**Alongside midwifery unit, , N = 16710**
Admission to a higher level of care No of events	n = 117	n = 58	n = 24	n = 82
Admission to a higher level of care Adjusted OR (adjusted for confounders[1])	adjusted OR 1	adjusted OR 0.77 (0.36 to 1.65)	adjusted OR 0.32 (0.13 to 0.84)	adjusted OR 1.17 (0.46 to 2.99)
Spontaneous vertex vaginal birth (number) No of events	n = 14645	n = 15590	n = 10150	n = 14413
Spontaneous vertex vaginal birth (number) Adjusted OR (adjusted for confounders[1])	adjusted OR 1	adjusted OR 3.61 (2.97 to 4.38)	adjusted OR 3.38 (2.70 to 4.25)	adjusted OR 2.22 (1.76 to 2.81)
Instrumental birth Forceps or ventouse No of events	n = 2842	n = 714	n = 686	n = 1524

Outcome	Obstetric Unit, , N = 19706	Home, , N = 16840	Freestanding midwifery unit, , N = 11282	Alongside midwifery unit, , N = 16710
Intrapartum caesarean section (number) No of events	n = 2158	n = 458	n = 405	n = 727
Intrapartum caesarean section (number) Adjusted OR (adjusted for confounders[1])	adjusted OR 1	adjusted OR 0.31 (0.23 to 0.41)	adjusted OR 0.32 (0.24 to 0.42)	adjusted OR 0.39 (0.29 to 0.53)
Blood transfusion No of events	n = 241	n = 101	n = 67	n = 136
Blood transfusion Adjusted OR (adjusted for confounders[1])	adjusted OR 1	adjusted OR 0.72 (0.47 to 1.12)	adjusted OR 0.48 (0.32 to 0.73)	adjusted OR 0.75 (0.55 to 1.02)
Transferred - Nulliparous (number) transfer before and after delivery No of events	N/A	n = 2057	n = 1884	n = 3360
Transferred - Multiparous (number) Transfer before and after delivery No of events	N/A	n = 1472	n = 573	n = 1041

OR: odds ratio
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, body mass index, deprivation score quintile, parity (previous pregnancies ≥24weeks), and weeks of gestation

Critical appraisal – ROBINS-I

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low *(No confounding expected)*
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(All eligible participants were included in the study and start of follow up and start of intervention coincide.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low *(Intervention status is well defined and based on information collected at the time of the intervention (BMI on booking).)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Moderate *(There may be some unbalanced co-interventions taking place across the different obstetric units, however, they would be in line with current practice in the UK and the variation would be a natural variation reflective of what is seen in practice so unlikely to have a big impact)*
5. Bias due to missing data	Risk of bias judgement for missing data	Low *(Data was reasonably complete.)*
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low *(Methods of outcome assessment are comparable across groups, and the outcome measure was unlikely to be influenced by knowledge of the intervention received by study participants.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low *(Pre-registered protocol reports all confounders to be used in the analysis, and intended outcomes.)*
Overall bias	Risk of bias judgement	Low
Overall bias	Risk of bias variation across outcomes	No variation

Section	Question	Answer
Overall bias	Directness	Directly applicable

BMI: body mass index

Hollowell, 2014

Bibliographic Reference	Hollowell, J.; Pillas, D.; Rowe, R.; Linsell, L.; Knight, M.; Brocklehurst, P.; The impact of maternal obesity on intrapartum outcomes in otherwise low risk women: secondary analysis of the Birthplace national prospective cohort study; BJOG : an international journal of obstetrics and gynaecology; 2014; vol. 121 (no. 3); 343-55

Study details

Country/ies where study was carried out	See Brocklehurst 2011
Study type	Prospective cohort study
Study dates	See Brocklehurst 2011
Inclusion criteria	See Brocklehurst 2011
Exclusion criteria	See Brocklehurst 2011
Patient characteristics	Mean age (SD) Underweight <18.5kg/m^2: 25.4 (5.6) Normal weight 18.5 – 24.9kg/m^2 : 28 (6.0) Overweight 25-29.9kg/m^2: 28.8 (5.9) Obese 30-35kg/m^2: 28.2 (5.8) Very obese >35kg/m^2: 28.1 (5.9) Nulliparous Underweight: 59.6% Normal weight: 56.0% Overweight: 50.6%

	Obese: 48.3% Very obese: 42.5% <u>Gestational age – mean (SD)</u> Underweight: 39.5 (1.2) Normal weight: 39.7 (1.1) Overweight: 39.8 (1.1) Obese: 39.9 (1.1) Very obese: 39.9 (1.1) <u>Ethnicity</u> **White** Underweight: 78.2% Normal weight: 81.7% Overweight: 81.5% Obese: 83.4% Very obese: 87.7% **Asian** Underweight: 11.1% Normal weight: 7.4% Overweight: 7.5% Obese: 5.5% Very obese: 3% **Black/Caribbean/African** Underweight: 2.8% Normal weight: 3.9% Overweight: 5.7% Obese: 6% Very obese: 6.3% **Mixed** Underweight: 1.7%

	Normal weight: 1.5% Overweight: 1.5% Obese: 1.5% Very obese: 1.5% **Other** Underweight: 6.1% Normal weight: 5.5% Overweight: 3.8% Obese: 3.3% Very obese: 1.3% Confounders: Maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery
Intervention(s)/control	Intervention: Women who planned birth in an obstetric unit, with BMI ranges: • < 18.5 kg/m^2 • 25-29.9 kg/m^2 • 30-35 kg/m^2 • >35-40 kg/m^2 Control: Women who planned birth in an obstetric unit, with BMI range: • 18.5 – 24.9kg/m^2 (Supplementary data provided data for women who planned birth at home, freestanding midwifery unit, or alongside midwifery unit with the same BMI comparisons)
Sources of funding	Not industry funded
Sample size	N=17230 women who planned birth in an obstetric suite without risk factors (other than BMI > 35 kg/m^2)

	Underweight n=577 Normal weight n=8936 Overweight n=4778 Obese n=1955 Very obese n=984
Other information	Data extracted for the outcome 'obstetric interventions and adverse maternal outcomes combined' was assumed to be adjusted. There seemed to be a typo in the study table 5 referring to these ratios as 'unadjusted'. Outcomes from this cohort have been reported in the secondary report by Hollowell 2015 as they include BMI information, therefore the outcomes from the primary report have not been included in the analysis for this review

BMI: body mass index; SD: standard deviation

Outcomes

Outcomes – Obstetric unit

Outcome	**Underweight BMI < 18.5 kg/m^2, N = 577**	**Normal weight BMI 18.5–24.9 kg/m^2, N = 8936**	**Overweight BMI 25–29.9 kg/m^2, N = 4778**	**Obese BMI 30–35 kg/m^2, N = 1955**	**Very obese BMI > 35 kg/m^2, N = 984**
Maternal admission to higher level care No of events	n = 5	n = 57	n = 28	n = 11	n = 5
Maternal admission to higher level care Adjusted RR (adjusted for confounders[1])	aRR 1.63 (0.72 to 3.69)	aRR 1	aRR 0.78 (0.41 to 1.49)	aRR 0.88 (0.50 to 1.54	aRR 0.71 (0.25 to 2.03)
Instrumental delivery No of events	n = 79	n = 1397	n = 635	n = 249	n = 84
Instrumental delivery Adjusted RR (adjusted for confounders[1])	aRR 0.95 (0.79 to 1.13)	aRR 1	0.87 (0.80 to 0.95)	aRR 0.86 (0.74 to 1.00)	aRR 0.70 (0.57 to 0.86)

Outcome	Underweight BMI < 18.5 kg/m^2, N = 577	Normal weight BMI 18.5–24.9 kg/m^2, N = 8936	Overweight BMI 25–29.9 kg/m^2, N = 4778	Obese BMI 30–35 kg/m^2, N = 1955	Very obese BMI > 35 kg/m^2, N = 984
Intrapartum caesarean birth No of events	n = 39	n = 846	n = 588	n = 260	n = 135
Intrapartum caesarean birth Adjusted RR (adjusted for confounders[1])	aRR 0.83 (0.61 to 1.13)	aRR 1	aRR 1.34 (1.20 to 1.50)	aRR 1.52 (1.30 to 1.79)	aRR 1.69 (1.35 to 2.12)
Maternal blood transfusion No of events	n = 6	n = 112	n = 61	n = 25	n = 9
Maternal blood transfusion Adjusted RR (adjusted for confounders[1])	aRR 1.03 (0.48 to 2.21)	RR 1	aRR 0.96 (0.62 to 1.48)	aRR 1.00 (0.65 to 1.53)	aRR 0.77 (0.40 to 1.50)
Obstetric interventions and adverse maternal outcomes combined – nulliparous Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care No of events	n = 150	n = 2524	n = 1277	n = 535	n = 225
Obstetric interventions and adverse maternal outcomes combined – nulliparous Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care Adjusted RR (adjusted for confounders[1])	aRR 0.94 (0.82 to 1.09)	aRR 1	aRR 1.04 (0.99 to 1.08)	aRR 1.12 (1.05 to 1.18)	aRR 1.08 (0.99 to 1.18)

Outcome	Underweight BMI < 18.5 kg/m^2, N = 577	Normal weight BMI 18.5–24.9 kg/m^2, N = 8936	Overweight BMI 25–29.9 kg/m^2, N = 4778	Obese BMI 30–35 kg/m^2, N = 1955	Very obese BMI > 35 kg/m^2, N = 984
Obstetric interventions and adverse maternal outcomes combined – multiparous No of events	n = 32	n = 666	n = 465	n = 212	n = 117
Obstetric interventions and adverse maternal outcomes combined – multiparous Adjusted RR (adjusted for confounders[1])	aRR 0.87 (0.57 to 1.31)	aRR 1	aRR 1.16 (1.02 to 1.32)	aRR 1.22 (1.05 to 1.42)	aRR 1.24 (0.97 to 1.59)
Admission to a neonatal unit or intrapartum stillbirth/early neonatal death – nulliparous No of events	n = 9	n = 180	n = 76	n = 39	n = 28
Admission to a neonatal unit or intrapartum stillbirth/early neonatal death – nulliparous Adjusted RR (adjusted for confounders[1])	aRR 0.72 (0.36 to 1.46)	aRR 1	aRR 0.88 (0.62 to 1.24)	aRR 1.18 (0.80 to 1.74)	aRR 2.00 (1.31 to 3.05)
Admission to a neonatal unit or intrapartum stillbirth/early neonatal death – multiparous No of events	n = 5	n = 68	n = 46	n = 19	n = 15
Admission to a neonatal unit or intrapartum stillbirth/early neonatal death – multiparous Adjusted RR (adjusted for confounders[1])	aRR 1.13 (0.40 to 3.19)	aRR 1	aRR 1.19 (0.88 to 1.61)	aRR 1.26 (0.69 to 2.28)	aRR 1.83 (1.22 to 2.75)

a(RR): adjusted risk ratio; BMI: body mass index
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery

Outcomes – Home

Outcome	Underweight BMI < 18.5 kg/m^2, N = 318	Normal weight BMI 18.5–24.9 kg/m^2, N = 8051	Overweight BMI 25–29.9 kg/m^2, N = 3723	Obese BMI 30–35 kg/m^2, N = 1211	Very obese BMI >35 – 40 kg/m^2 , N = 265
Obstetric interventions and adverse maternal outcomes combined Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care No of events	n = 29	n = 901	n = 396	n = 109	n = 19
Obstetric interventions and adverse maternal outcomes combined Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care Adjusted RR (adjusted for confounders[1])	aRR 0.97 (0.68 to 1.41)	aRR 1	aRR 1.03 (0.93 to 1.14)	aRR 1.04 (0.89 to 1.22)	aRR 0.95 (0.59 to 1.52)
Neonatal unit admission or intrapartum stillbirth/early neonatal death No of events	n = 7	n = 135	n = 70	n = 22	n = 5
Neonatal unit admission or intrapartum stillbirth/early neonatal death Adjusted RR (adjusted for confounders[1])	aRR 1.11 (0.47 to 2.63)	1	aRR 1.09 (0.81-1.47)	aRR 1.36 (0.80 to 2.29)	aRR 1.17 (0.49 to 2.81)

a(RR): adjusted risk ratio: BMI: body mass index
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery

Outcomes – freestanding midwifery unit

Outcome	Underweight BMI < 18.5 kg/m^2, N = 234	Normal weight BMI 18.5–24.9 kg/m^2, N = 5584	Overweight BMI 25–29.9 kg/m^2, N = 2650	Obese BMI 30–35 kg/m^2, , N = 911	Very obese BMI >35 - ≤40 kg/m^2, N = 62
Obstetric interventions and adverse maternal outcomes Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care No of events	n = 25	n = 813	n = 369	n = 86	n = 4
Obstetric interventions and adverse maternal outcomes Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care Adjusted RR (adjusted for confounders[1])	aRR 0.98 (0.61 to 1.57)	aRR 1	aRR 1.10 (0.98 to 1.22)	aRR 0.74 (0.61 to 0.89)	aRR 0.80 (0.33 to 1.94)
Neonatal unit admission or intrapartum stillbirth/early neonatal death No of events	n = 5	n = 95	n = 50	n = 19	n = 3
Neonatal unit admission or intrapartum stillbirth/early neonatal death Adjusted RR (adjusted for confounders[1])	aRR 1.29 (0.46 to 3.61)	aRR 1	aRR 1.15 (0.78 to 1.69)	aRR 1.33 (0.79 to 2.25)	aRR 3.95 (1.07- to 14.6)

a(RR) adjusted risk ratio: BMI: body mass index
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery

Outcomes – alongside midwifery unit

Outcome	Underweight BMI < 18.5 kg/m^2, N = 434	Normal weight BMI 18.5–24.9 kg/m^2, N = 8140	Overweight BMI 25–29.9 kg/m^2, N = 3735	Obese BMI 30–35 kg/m^2, N = 1253	Very obese BMI > 35 - ≤40 kg/m^2, N = 136
Obstetric interventions and adverse maternal outcomes Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care No of events	n = 88	n = 1647	n = 690	n = 212	n = 14
Obstetric interventions and adverse maternal outcomes Instrumental birth, intrapartum caesarean birth, augmentation, general anaesthesia, maternal blood transfusion, third/fourth-degree tear, maternal admission to higher level care Adjusted RR (adjusted for confounders[1])	aRR 1.08 (0.83 to 1.42)	aRR 1	aRR 1.02 (0.93 to 1.13)	aRR 1.00 (0.86 to 1.16)	aRR 0.89 (0.50 to 1.57)
Neonatal unit admission or intrapartum stillbirth/early neonatal death No of events	n = 3	n = 144	n = 77	n = 30	n = 1
Neonatal unit admission or intrapartum stillbirth/early neonatal death Adjusted RR (adjusted for confounders[1])	aRR 0.33 (0.13 to 0.86)	aRR 1	aRR 1.15 (0.78 to 1.68)	aRR 1.33 (0.75 to 2.37)	aRR 0.62 (0.15 to 2.59)

a(RR) adjusted risk ratio: adjusted risk ratio; BMI: body mass index
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery

Critical appraisal – ROBINS-I

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low *(No confounding expected.)*
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(All eligible participants were included, and start of follow up and intervention coincide.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low *(Intervention status is well defined and definition is based solely on information collected at the time of the intervention.)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Moderate *(There may be some unbalanced co-interventions taking place across the different obstetric units, however, they would be in line with current practice in the UK and the variation would be a natural variation reflective of what is seen in practice so unlikely to have a big impact.)*
5. Bias due to missing data	Risk of bias judgement for missing data	Low *(Data was reasonably complete.)*
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low *(Methods of outcomes assessment were comparable across groups. The outcome measure was unlikely to be influenced by knowledge of the intervention.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low *(Confounders, analysis and intended outcomes are as specified in the pre-registered protocol.)*
Overall bias	Risk of bias judgement	Low
Overall bias	Risk of bias variation across outcomes	No variation
Overall bias	Directness	Directly applicable

Hollowell, 2015

Bibliographic Reference	Hollowell, J.; Rowe, R.; Townend, J.; Knight, M.; Li, Y.; Linsell, L.; Redshaw, M.; Brocklehurst, P.; Macfarlane, A.; Marlow, N.; McCourt, C.; Newburn, M.; Sandall, J.; Silvert; The Birthplace in England national prospective cohort study: further analyses to enhance policy and service delivery decision-making for planned place of birth; 2015

Study details

Country/ies where study was carried out	See Brocklehurst 2011
Study type	Prospective cohort study
Study dates	See Brocklehurst 2011
Inclusion criteria	See Brocklehurst 2011
Exclusion criteria	See Brocklehurst 2011
Patient characteristics	See Brocklehurst 2011
Intervention(s)/control	For mode of birth: Intervention: Planned place of birth at: • Home • FMU • AMU Control: Planned place of birth at: • OU For transfer to obstetric unit:

	Intervention: Women who planned birth at home, FMU or AMU, with BMI ranges: • < 18.5 kg/m^2 • 25-29.9 kg/m^2 • 30-35 kg/m^2 • >35-40 kg/m^2 Control: Women who planned birth at home, FMU or AMU, with BMI range: • 18.5 – 24.9kg/m^2
Sources of funding	See Brocklehurst 2011
Sample size	N=61335 nulliparous, n=27312 multiparous, n=34023

AMU: alongside midwifery unit; BMI: body mass index; FMU: freestanding midwifery unit; OU: obstetric unit

Outcomes

Outcome	Obstetric unit , , N = 5916	Home, , N = 3237	Freestanding midwifery unit, , N = 3909	Alongside midwifery unit, , N = 5747
Mode of birth – straightforward birth – nulliparous vaginal birth without instruments, without caesarean, without 3rd or 4th degree perineal trauma or blood	n = 5916	n = 3237	n = 3909	n = 5747

Outcome	Obstetric unit , , N = 5916	Home, , N = 3237	Freestanding midwifery unit, , N = 3909	Alongside midwifery unit, , N = 5747
transfusion No of events				
Mode of birth – straightforward birth – nulliparous vaginal birth without instruments, without caesarean, without 3rd or 4th degree perineal trauma or blood transfusion Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 1.32 (1.26 to 1.39)	aRR 1.28 (1.23 to 1.34)	aRR 1.18 (1.12 to 1.23)
Mode of birth - straightforward birth - multiparous No of events	n = 7475	n = 11301	n = 5704	n = 7529
Mode of birth - straightforward birth - multiparous Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 1.10 (1.09 to 1.12)	aRR 1.10 (1.08 to 1.12)	aRR 1.07 (1.05 to 1.09)
Mode of birth - instrumental birth - nulliparous No of events	n = 2201	n = 575	n = 604	n = 1275
Mode of birth - instrumental birth - nulliparous Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 0.51 (0.44 to 0.59)	aRR 0.49 (0.41 to 0.60)	aRR 0.73 (0.62 to 0.86)
Mode of birth - instrumental birth - multiparous No of events	n = 482	n = 107	n = 69	n = 185
Mode of birth - instrumental birth - multiparous Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 0.15 (0.12 to 0.20)	aRR 0.19 (0.13 to 0.27)	aRR 0.46 (0.35 to 0.60)
Mode of birth - caesarean birth - nulliparous	n = 1545	n = 356	n = 342	n = 618

Outcome	Obstetric unit , , N = 5916	Home, , N = 3237	Freestanding midwifery unit, , N = 3909	Alongside midwifery unit, , N = 5747
No of events				
Mode of birth - caesarean birth - nulliparous Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 0.57 (0.47 to 0.70)	aRR 0.51 (0.42 to 0.61)	aRR 0.59 (0.48 to 0.71)
Mode of birth - caesarean birth - multiparous No of events	n = 446	n = 78	n = 44	n = 85
Mode of birth - caesarean birth - multiparous Adjusted RR (adjusted for confounders[1])	aRR 1	aRR 0.15 (0.10 to 0.21)	aRR 0.18 (0.12 to 0.26)	aRR 0.24 (0.17 to 0.36)
Transfer to obstetric unit - BMI <18.5 – nulliparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 28/80 aRR 0.79 (0.58 to 1.07)	n = 36/120 aRR 1.12 (0.80 to 1.57)	n = 90/242 aRR 1.02 (0.78 to 1.34)
Transfer to obstetric unit - BMI <18.5 – multiparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 28/237 aRR 1.27 (0.84 to 1.92)	n = 11/112 aRR 0.97 (0.51 to 1.87)	n = 25/194 aRR 1.21 (0.77 to 1.91)
Transfer to obstetric unit - BMI 18.5 - 24.9 - nulliparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 1050/2344 aRR 1	n = 931/2723 aRR 1	n = 1764/4385 aRR 1
Transfer to obstetric unit - BMI 18.5 - 24.9 - multiparous No of events	*N/A*	n = 579/5702 aRR 1	n = 243/2842 aRR 1	n = 460/3765 aRR 1

Outcome	Obstetric unit , , N = 5916	Home, , N = 3237	Freestanding midwifery unit, , N = 3909	Alongside midwifery unit, , N = 5747
Adjusted RR (adjusted for confounders[1])				
Transfer to obstetric unit - BMI 25 - 29.9 - nulliparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 438/902 aRR 1.05 (0.96 to 1.15)	n = 404/1091 aRR 1.11 (1.00 to 1.25)	n = 707/1699 aRR 1.02 (0.92 to 1.12)
Transfer to obstetric unit - BMI 25 - 29.9 - multiparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 361/2833 aRR 1.17 (1.03 to 1.32)	n = 143/1542 aRR 1.10 (0.88 to 1.39)	n = 256/2053 aRR 1.00 (0.86 to 1.16)
Transfer to obstetric unit - BMI 30 – 35 - nulliparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 115/252 aRR 1.03 (0.88 to 1.22)	n = 105/333 aRR 0.92 (0.77 to 1.10)	n = 211/518 aRR 1.01 (0.84 to 1.20)
Transfer to obstetric unit - BMI 30 – 35 - multiparous No of events Adjusted RR (adjusted for confounders[1])	*N/A*	n = 138/955 aRR 1.29 (1.08 to 1.54)	n = 42/572 aRR 0.83 (0.62 to 1.12)	n = 96/745 aRR 0.89 (0.68 to 1.17)

a(RR): adjusted risk ratio; BMI: body mass index
1. Confounders adjusted for: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery

Critical appraisal – ROBINS-I

Section	Question	Answer

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low *(No confounding expected)*
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(All eligible participants were included in the study and start of follow up and intervention coincide.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low *(Intervention status is well defined and based solely on information collected at the time of the intervention.)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Moderate *(There may be some unbalanced co-interventions taking place across the different obstetric units, however, they would be in line with current practice in the UK and the variation would be a natural variation reflective of what is seen in practice so unlikely to have a big impact.)*
5. Bias due to missing data	Risk of bias judgement for missing data	Low *(Data was reasonably complete.)*
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low *(The methods of outcome assessment were comparable across intervention groups and unlikely to be included by knowledge of the intervention.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low *(Confounders and intended outcomes were specified in the pre-registered protocol.)*
Overall bias	Risk of bias judgement	Low
Overall bias	Risk of bias variation across outcomes	No variation
Overall bias	Directness	Directly applicable

Rowe, 2018

Bibliographic Reference	Rowe, Rachel; Knight, Marian; Kurinczuk, Jennifer J.; Outcomes for women with BMI>35kg/m2 admitted for labour care to alongside midwifery units in the UK: A national prospective cohort study using the UK Midwifery Study System (UKMidSS); PLoS ONE; 2018; vol. 13 (no. 12); e0208041

Study details

Country/ies where study was carried out	England, Wales, Scotland, Northern Ireland.
Study type	Prospective cohort study
Study dates	January to December 2016
Inclusion criteria	Intervention group • Women with a BMI >35kg/m^2 at booking appointment (first antenatal appointment). • Admitted to an alongside midwifery unit and gave birth in the same admission. Comparison cohort • Women with a BMI ≤35kg/m^2 at booking appointment (first antenatal appointment). • Admitted to an alongside midwifery unit and gave birth in the same admission.
Exclusion criteria	• Women admitted assessment in the alongside midwifery unit but then discharged before giving birth. • Women admitted for assessment in the alongside midwifery unit and seen for obstetric triage. • Women whose BMI data was unclear and could not be confirmed by the midwife looking after them.
Patient characteristics	N=3071 <u>Parity</u>

	Women with a BMI >35kg/m^2: Nulliparous n= 312 (28%) Multiparous n=808 (72%) Women with a BMI ≤35kg/m^2: Nulliparous n=890 (46%) Multiparous n=1056 (54%) <u>Age</u> Women with a BMI >35kg/m^2: <35 n= 963 (86%) ≥35 n= 159 (14%) Women with a BMI ≤35kg/m^2: <35 n=1630 (84%) ≥35 n= 319 (16%) <u>Gestation at admission</u> Women with a BMI >35kg/m^2: 36-37 weeks n= 48 (4%) >37 weeks n= 1074 (96%) Women with a BMI ≤35kg/m^2: 36-37 weeks n= 91 (5%) >37 weeks n= 1858 (95%) <u>No pre-existing risk factors</u> Women with a BMI >35kg/m^2 n=980 (87%) Women with a BMI ≤35kg/m^2 :n=1803 (90%) <u>BMI at booking</u> Women with a BMI >35kg/m^2: 35.1-40 kg/m^2 = 92.2%

	40.1-45 kg/m^2 = 6.5% >45 kg/m^2 = 1.3% Women with a BMI ≤35kg/m^2: <18.5 kg/m^2 = 4.1% 18.5-24.9 kg/m^2 = 54.9% 25-29.9 kg/m^2 = 30% 30-35.0 kg/m^2 = 11% Confounders: Maternal age, ethnic group, gestational age at admission (completed weeks), Children in Low-income Families Measure quintile, parity (previous pregnancies ≥24 weeks), pre-existing risk factors (none, ≥1 clear, ≥1 possible).
Intervention(s)/control	Intervention - Severely obese group • Women with a BMI of >35 kg/m^2 admitted for labour in an alongside midwifery unit. Control - comparison group • Women with a BMI of ≤35 kg/m^2 admitted for labour in the same alongside midwifery units. • The comparison group was selected by recording data for the two women with a BMI of ≤35 kg/m^2 who had been admitted to the alongside midwifery unit immediately before the woman selected for the women with a BMI of >35 kg/m^2 group.
Sources of funding	Not industry funded
Sample size	N=3071 Women with a BMI >35kg/m^2: n=1122 Women with a BMI ≤35kg/m^2 : n=1949

BMI: body mass index

Outcomes

Outcome	Women with a BMI >35kg/m^2, , N = 1122	Women with a BMI ≤35kg/m^2, , N = 1949
Maternal admission for higher level care - nulliparous No of events	n = 10	n = 20
Maternal admission for higher level care - nulliparous aRR (adjusted for confounders[1])	aRR 1.34, 95% CI (0.44 to 4.11)	aRR 1
Maternal admission for higher level care – multiparous No of events	n = 9	n = 17
Maternal admission for higher level care – multiparous aRR (adjusted for confounders[1])	aRR 0.71, 95% CI (0.27 to 1.86)	aRR 1
Intrapartum caesarean birth – nulliparous No of events	n = 43	n = 73
Intrapartum caesarean birth – nulliparous aRR (adjusted for confounders[1])	aRR 1.62, 95% CI (0.98 to 2.67)	aRR 1
Intrapartum caesarean birth – multiparous No of events	n = 10	n = 7
Intrapartum caesarean birth – multiparous aRR (adjusted for confounders[1])	aRR 1.88, 95% CI (0.56 to 6.21)	aRR 1
Category 1 or 2 Caesarean birth – nulliparous No of events	n = 38	n = 58
Category 1 or 2 Caesarean birth – nulliparous	aRR 1.80, 95% CI (1.05 to 3.08)	aRR 1

Outcome	Women with a BMI >35kg/m^2, , N = 1122	Women with a BMI ≤35kg/m^2, , N = 1949
aRR (adjusted for confounders[1])		
Category 1 or 2 Caesarean birth – multiparous No of events	n = 8	n = 5
Category 1 or 2 Caesarean birth – multiparous aRR (adjusted for confounders[1])	aRR 2.10, 95% CI (0.48 to 9.11)	aRR 1
Instrumental birth - nulliparous No of events	n = 43	n = 155
Instrumental birth - nulliparous aRR (adjusted for confounders[1])	aRR 0.83, 95% CI (0.53 to 1.30)	aRR 1
Instrumental birth - multiparous No of events	n = 12	n = 26
Instrumental birth - multiparous aRR (adjusted for confounders[1])	aRR 0.6, 95% CI (0.22 to 1.61)	aRR 1
Straightforward vaginal birth - nulliparous No of events	n = 212	n = 621
Straightforward vaginal birth - nulliparous aRR (adjusted for confounders[1])	aRR 0.96, 95% CI (0.86 to 1.06)	aRR 1
Straightforward vaginal birth - multiparous No of events	n = 776	n = 986

Outcome	Women with a BMI >35kg/m^2, , N = 1122	Women with a BMI ≤35kg/m^2, , N = 1949
Straightforward vaginal birth - multiparous aRR (adjusted for confounders[1])	aRR 1.03, 95% CI (0.99 to 1.07)	aRR 1
Postpartum haemorrhage - nulliparous (≥1500ml) No of events	n = 16	n = 15
Postpartum haemorrhage - nulliparous (≥1500ml) aRR (adjusted for confounders[1])	aRR 3.01, 95% CI (1.24 to 7.31)	aRR 1
Postpartum haemorrhage - multiparous (≥1500ml) No of events	n = 15	n = 21
Postpartum haemorrhage - multiparous (≥1500ml) aRR (adjusted for confounders[1])	aRR 0.89, 95% CI (0.41 to 1.94)	aRR 1
Shoulder dystocia - nulliparous No of events	n = 3	n = 11
Shoulder dystocia - nulliparous aRR (adjusted for confounders[1])	aRR 0.79, 95% CI (0.14 to 4.51)	aRR 1
Shoulder dystocia - multiparous No of events	n = 12	n = 17
Shoulder dystocia - multiparous aRR (adjusted for confounders[1])	aRR 0.84, 95% CI (0.31 to 2.23)	aRR 1
Neonatal unit admission - nulliparous	n = 12	n = 29

Outcome	Women with a BMI >35kg/m^2, , N = 1122	Women with a BMI ≤35kg/m^2, , N = 1949
No of events		
Neonatal unit admission - nulliparous aRR (adjusted for confounders[1])	aRR 0.92, 95% CI (0.38 to 2.23)	aRR 1
Neonatal unit admission - multiparous No of events	n = 19	n = 20
Neonatal unit admission - multiparous aRR (adjusted for confounders[1])	aRR 1.10, 95% CI (0.46 to 2.68)	aRR 1
Initiation of breastfeeding - nulliparous No of events	n = 229	n = 693
Initiation of breastfeeding - nulliparous aRR (adjusted for confounders[1])	aRR 0.97, 95% CI (0.87 to 1.07)	aRR 1
Initiation of breastfeeding - multiparous No of events	n = 502	n = 747
Initiation of breastfeeding - multiparous aRR (adjusted for confounders[1])	aRR 0.92, 95% CI (0.85 to 1.00)	aRR 1
Transfer - nulliparous during labour or after birth No of events	n = 151	n = 375
Transfer - nulliparous during labour or after birth	aRR 1.18, 95% CI (0.98 to 1.43)	aRR 1

Outcome	Women with a BMI >35kg/m^2, , N = 1122	Women with a BMI ≤35kg/m^2, , N = 1949
aRR (adjusted for confounders[1])		
Transfer - multiparous during labour or after birth No of events	n = 118	n = 134
Transfer - multiparous during labour or after birth aRR (adjusted for confounders[1])	aRR 1.12, 95% CI (0.84 to 1.49)	aRR 1

a(RR): adjusted risk ratio; CI: confidence interval
1. Confounders adjusted for: maternal age, ethnic group, gestational age at admission (completed weeks), Children in Low-income Families Measure quintile, parity (previous pregnancies ≥24 weeks), pre-existing risk factors (none, ≥1 clear, ≥1 possible).

Critical appraisal – ROBINS-I

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low *(No confounding expected.)*
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(All eligible women were included, and start up and follow up time coincide.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low *(Intervention status is well defined and definition is based solely on information collected at the time of intervention.)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Moderate *(There may be some unbalanced co-interventions taking place across the different alongside midwifery units, however, they would be in line with current practice in the UK and the variation would be a natural reflection of what is seen in practice so unlikely to have a big impact.)*

Section	Question	Answer
5. Bias due to missing data	Risk of bias judgement for missing data	Low *(Data was sufficiently complete)*
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low *(The methods of outcome assessment were comparable across intervention groups and unlikely to be influenced by knowledge of the intervention.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low *(The adjusted effect estimates have been analysed according to the confounders specified in the protocol, and all intended outcomes.)*
Overall bias	Risk of bias judgement	Low
Overall bias	Risk of bias variation across outcomes	No variation
Overall bias	Directness	Directly applicable

Stephenson-Famy, 2018

Bibliographic Reference	Stephenson-Famy, Alyssa; Masarie, Kaitlin S.; Lewis, Ali; Schiff, Melissa A.; What are the risk factors associated with hospital birth among women planning to give birth in a birth center in Washington State?; Birth (Berkeley, Calif.); 2018; vol. 45 (no. 2); 130-136

Study details

Country/ies where study was carried out	United States
Study type	Retrospective cohort study
Study dates	January 1st 2004 and December 31st 2011

Inclusion criteria	• Women planning birth in a birth centre • Who delivered a singleton, vertex delivery and at 37 or more weeks gestation
Exclusion criteria	• Women who had a preterm birth • Women with a previous caesarean birth • Nonvertex presentation • Multiple gestations • Fetal death
Patient characteristics	Age <35 85.4% Ethnicity White: 93.7% African American/American Indian/Alaska Native: 2.6% Asian: 3.7% Non-Hispanic/Hispanic 96% non-Hispanic 4% Hispanic Parity Nulliparous: 45.3% Confounders Maternal age, non-Hispanic/Hispanic, marital status, maternal education, BMI, insurance status
Intervention(s)/control	Planned place of birth in a free-standing birth centre (midwife)
Sample size	N=7118 women planning birth in a birth centre

BMI: body mass index

Outcomes

Outcome	BMI <18.5, N =	BMI 18.5 - 24.9, N =	BMI 25.0 - 29.9, N =	BMI ≥ 30 , N =
Transfer to hospital - nulliparous adjusted OR (adjusted for confounders[1])	aOR 0.6 (0.3 to 1.5)	OR 1	aOR 1.9 (1.4 to 2.5)	aOR 2.3 (1.6 to 3.2)

a(OR): adjusted odds ratio; BMI: body mass index
1. Confounders adjusted for: maternal age, non-Hispanic/Hispanic, marital status, maternal education, BMI, insurance status.

Critical appraisal

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low *(The authors adjusted for the confounders that were statistically significant. These confounders were all the important confounders.)*
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(All eligible women were included. Start of follow up and start of intervention coincide.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Moderate *(Intervention definition is based solely on information collected at the time of intervention and taken from information recorded on birth certificates. However, the study reports that recording of planned place of birth on certificates has not been assessed for accuracy so there may be inaccuracies when reporting planned place of birth, which might have an effect of the transfer to hospital rates)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Moderate *(There may be unbalanced co-interventions among the different birth centres that would lead to a different rate of transfer for different women.)*
5. Bias due to missing data	Risk of bias judgement for missing data	Moderate *(There is not enough information regarding missing information but the authors describe a regression model that only included non-missing data.)*
6. Bias in measurement	Risk of bias judgement for	Low

Section	Question	Answer
of outcomes	measurement of outcomes	*(The methods of outcome assessment were comparable across intervention groups, and unlikely to be influenced by knowledge of the intervention.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Moderate *(There are concerns regarding the possibility of selecting results based on multiple analysis, as there is no protocol available to determine whether all the confounders which were classified as important were used. There were also no adjusted estimates reported for the multiparous group, only for all women and nulliparous.)*
Overall bias	Risk of bias judgement	Moderate
Overall bias	Risk of bias variation across outcomes	No variation
Overall bias	Directness	Directly applicable

Appendix E Forest plots

Forest plots for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

No meta-analysis was conducted for this review question and so there are no forest plots.

Appendix F GRADE tables

GRADE tables for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Table 4: Evidence profile for comparison 1: BMI <18.5kg/m^2 versus BMI 18.5 – 24.9kg/m^2

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI <18.5kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	153/330 (46.4%)	2524/4833 (52.2%)	aRR 0.94 (0.82 to 1.08)	31 fewer per 1000 (from 94 fewer to 42 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	32/228 (14%)	666/3809 (17.5%)	aRR 0.86 (0.54 to 1.36)	24 fewer per 1000 (from 80 fewer to 63 more)	LOW	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	182/558 (32.6%)	3192/8648 (36.9%)	aRR 0.94 (0.84 to 1.05)	22 fewer per 1000 (from 59 fewer to 18 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	29/318 (9.1%)	901/8051 (11.2%)	aRR 0.97 (0.68 to 1.38)	3 fewer per 1000 (from 36 fewer to 43 more)	LOW	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Freestanding midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	25/234 (10.7%)	813/5584 (14.6%)	aRR 0.98 (0.61 to 1.57)	3 fewer per 1000 (from 57 fewer to 83 more)	LOW	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Alongside midwifery unit - Mixed parity												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI <18.5kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	88/434 (20.3%)	1647/8140 (20.2%)	aRR 1.08 (0.83 to 1.41)	16 more per 1000 (from 34 fewer to 83 more)	MODERATE	CRITICAL
Maternal admission to intensive care - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	5/577 (0.87%)	57/8936 (0.64%)	aRR 1.63 (0.72 to 3.69)	4 more per 1000 (from 2 fewer to 17 more)	LOW	CRITICAL
Instrumental birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	79/577 (13.7%)	1397/8928 (15.6%)	aRR 0.95 (0.79 to 1.14)	8 fewer per 1000 (from 33 fewer to 22 more)	MODERATE	CRITICAL
Intrapartum caesarean birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	39/577 (6.8%)	846/8928 (9.5%)	aRR 0.83 (0.61 to 1.13)	16 fewer per 1000 (from 37 fewer to 12 more)	MODERATE	CRITICAL
Maternal blood transfusion - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	6/574 (1%)	112/8881 (1.3%)	aRR 1.03 (0.48 to 2.21)	0 more per 1000 (from 7 fewer to 15 more)	LOW	CRITICAL
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	9/344 (2.6%)	180/4979 (3.6%)	aRR 0.72 (0.36 to 1.44)	10 fewer per 1000 (from 23 fewer to 16 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	5/232 (2.2%)	68/3891 (1.7%)	aRR 1.13 (0.4 to 3.19)	2 more per 1000 (from 10 fewer to 38 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	14/576 (2.4%)	249/8881 (2.8%)	aRR 0.81 (0.48 to 1.37)	5 fewer per 1000 (from 15 fewer to 10 more)	LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI <18.5kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Neonatal admission or intrapartum stillbirth/early neonatal death - Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	7/321 (2.2%)	135/8088 (1.7%)	aRR 1.11 (0.47 to 2.62)	2 more per 1000 (from 9 fewer to 27 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Freestanding - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	5/236 (2.1%)	95/5623 (1.7%)	aRR 1.29 (0.46 to 3.62)	5 more per 1000 (from 9 fewer to 44 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Alongside - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	3/440 (0.68%)	144/8196 (1.8%)	aRR 0.33 (0.13 to 0.84)	12 fewer per 1000 (from 3 fewer to 15 fewer)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Home - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	28/80 (35%)	1050/2344 (44.8%)	aRR 0.79 (0.58 to 1.08)	94 fewer per 1000 (from 188 fewer to 36 more)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Home - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	28/237 (11.8%)	579/5702 (10.2%)	aRR 1.27 (0.84 to 1.92)	27 more per 1000 (from 16 fewer to 93 more)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Alongside - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	90/242 (37.2%)	1764/4385 (40.2%)	aRR 1.02 (0.78 to 1.33)	8 more per 1000 (from 89 fewer to 133 more)	LOW	IMPORTANT
Transfer to an obstetric unit - Alongside - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	25/194 (12.9%)	460/3765 (12.2%)	aRR 1.21 (0.77 to 1.9)	26 more per 1000 (from 28 fewer to 110 more)	LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI <18.5kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
Transfer to an obstetric unit - Freestanding - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	36/120 (30%)	931/2723 (34.2%)	aRR 1.12 (0.8 to 1.57)	41 more per 1000 (from 68 fewer to 195 more)	LOW	IMPORTANT
Transfer to an obstetric unit - Freestanding - Nulliparous												
1 (Stephenson-Famy 2018)	observational studies	serious[3]	no serious inconsistency	no serious indirectness	serious[2]	none	NR	NR	aOR 0.99 (0.73 to 1.35)	2 fewer per 1000 (from 67 fewer to 70 more)[4]	VERY LOW	IMPORTANT
Transfer to an obstetric unit - Freestanding - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	11/112 (9.8%)	243/2842 (8.6%)	aRR 0.97 (0.51 to 1.84)	3 fewer per 1000 (from 42 fewer to 72 more)	LOW	IMPORTANT

aOR: adjusted odds ratio (for Stephenson-Famy 2018: maternal age, non-Hispanic/Hispanic, marital status, maternal education, BMI, insurance status); aRR: adjusted risk ratio (for Hollowell 2014 and Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); BMI: body mass index; CI: confidence interval; NR: not reported
1 95% CI crosses 2 MIDs
2 95% CI crosses 1 MID
3 Serious risk of bias in the evidence contributing to the outcomes as per ROBINS-I
4 Control group risk was not reported by the study. Absolute effect calculated using control group risk from Hollowell 2015

Table 5: Evidence profile for comparison 2: BMI 25-29.9 kg/m^2 versus BMI 18.5-24.9kg/m^2

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 25-29.9kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious	no serious inconsistency	no serious indirectness	no serious imprecision	none	1277/2321 (55%)	2524/4833 (52.2%)	aRR 1.04 (0.99 to 1.09)	21 more per 1000 (from 5 fewer to 47 more)	HIGH	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 25-29.9kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
		risk of bias										
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	465/2290 (20.3%)	666/3809 (17.5%)	aRR 1.16 (1.02 to 1.32)	28 more per 1000 (from 3 more to 56 more)	MODERATE	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	1747/4621 (37.8%)	3192/8648 (36.9%)	aRR 1.06 (1.01 to 1.11)	22 more per 1000 (from 4 more to 41 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	396/3723 (10.6%)	901/8051 (11.2%)	aRR 1.03 (0.93 to 1.14)	3 more per 1000 (from 8 fewer to 16 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Freestanding midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	369/2650 (13.9%)	813/5584 (14.6%)	aRR 1.1 (0.98 to 1.23)	15 more per 1000 (from 3 fewer to 33 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Alongside midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	690/3735 (18.5%)	1647/8140 (20.2%)	aRR 1.02 (0.93 to 1.12)	4 more per 1000 (from 14 fewer to 24 more)	HIGH	CRITICAL
Maternal admission to intensive care - Obstetric unit - Mixed parity												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 25-29.9kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	28/4778 (0.59%)	57/8936 (0.64%)	aRR 0.78 (0.41 to 1.48)	1 fewer per 1000 (from 4 fewer to 3 more)	LOW	CRITICAL
Instrumental birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	635/4774 (13.3%)	1397/8928 (15.6%)	aRR 0.87 (0.8 to 0.95)	20 fewer per 1000 (from 8 fewer to 31 fewer)	HIGH	CRITICAL
Intrapartum caesarean birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	588/4774 (12.3%)	846/8928 (9.5%)	aRR 1.34 (1.2 to 1.5)	32 more per 1000 (from 19 more to 47 more)	MODERATE	CRITICAL
Maternal blood transfusion - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	61/4735 (1.3%)	112/8881 (1.3%)	aRR 0.96 (0.62 to 1.49)	1 fewer per 1000 (from 5 fewer to 6 more)	LOW	CRITICAL
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	76/2406 (3.2%)	180/4979 (3.6%)	aRR 0.88 (0.62 to 1.25)	4 fewer per 1000 (from 14 fewer to 9 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	46/2333 (2%)	68/3891 (1.7%)	aRR 1.19 (0.88 to 1.61)	3 more per 1000 (from 2 fewer to 11 more)	MODERATE	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 25-29.9kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	123/4750 (2.6%)	58/1946 (3%)	aRR 0.96 (0.75 to 1.23)	1 fewer per 1000 (from 7 fewer to 7 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	70/3750 (1.9%)	135/8088 (1.7%)	aRR 1.09 (0.81 to 1.47)	2 more per 1000 (from 3 fewer to 8 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Freestanding - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	50/2673 (1.9%)	95/5623 (1.7%)	aRR 1.15 (0.78 to 1.7)	3 more per 1000 (from 4 fewer to 12 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Alongside - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	77/3781 (2%)	144/8196 (1.8%)	aRR 1.15 (0.78 to 1.7)	3 more per 1000 (from 4 fewer to 12 more)	LOW	IMPORTANT
Transfer to an obstetric unit - Home - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision[2]	none	438/902 (48.6%)	1050/2344 (44.8%)	aRR 1.05 (0.96 to 1.15)	22 more per 1000 (from 18 fewer to 67 more)	HIGH	IMPORTANT
Transfer to an obstetric unit - Home - Multiparous												
1 (Hollowell 2014)	observational studies	no serious	no serious inconsistency	no serious indirectness	serious[1]	none	361/2833 (12.7%)	579/5702 (10.2%)	aRR 1.17 (1.03 to 1.33)	17 more per 1000 (from 3 more to 34 more)	MODERATE	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 25-29.9kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		
		risk of bias										
Transfer to an obstetric unit - Alongside - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision[2]	none	707/1699 (41.6%)	1764/4385 (40.2%)	aRR 1.02 (0.92 to 1.13)	8 more per 1000 (from 32 fewer to 52 more)	HIGH	IMPORTANT
Transfer to an obstetric unit - Alongside - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	256/2053 (12.5%)	460/3765 (12.2%)	aRR 1 (0.86 to 1.16)	0 fewer per 1000 (from 17 fewer to 20 more)	HIGH	IMPORTANT
Transfer to an obstetric unit - Freestanding - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	serious[3]	no serious indirectness	no serious imprecision	none	404/1091 (37%)	931/2723 (34.2%)	aRR 1.11 (1 to 1.23)	38 more per 1000 (from 0 more to 79 more)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Freestanding - Nulliparous												
1 (Stephenson-Famy 2018)	observational studies	serious[4]	serious[3]	no serious indirectness	no serious imprecision	none	NR	NR	aOR 1.9 (1.40 to 2.58)	155 more per 1000 (from 79 more to 231 more)[5]	LOW	IMPORTANT
Transfer to an obstetric unit - Freestanding - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	143/1542 (9.3%)	243/2842 (8.6%)	aRR 1.1 (0.88 to 1.38)	9 more per 1000 (from 10 fewer to 32 more)	MODERATE	IMPORTANT

aOR: adjusted odds ratio (for Stephenson-Famy 2018: maternal age, non-Hispanic/Hispanic, marital status, maternal education, BMI, insurance status); aRR: adjusted risk ratio (for Hollowell 2014 and Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); BMI: body mass index; CI: confidence interval; NR: not reported

1 95% CI crosses 1 MID
2 95% CI crosses 2 MIDs
3 Contradictory evidence from studies that cannot be meta-analysed due to specifics of outcome reported
4 Serious risk of bias in the evidence contributing to the outcomes as per ROBINS-I
5 Control group risk was not reported by the study. Absolute effect calculated using control group risk from Hollowell 2015

Table 6: Evidence profile for comparison 3: BMI 30-35kg/m^2 versus BMI 18.5-24.9kg/m^2

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 30-35kg/m^2	BMI 18.5-24.9 kg/m^2	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	535/907 (59%)	2524/4833 (52.2%)	aRR 1.12 (1.05 to 1.19)	63 more per 1000 (from 26 more to 99 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	212/975 (21.7%)	666/3809 (17.5%)	aRR 1.22 (1.05 to 1.42)	38 more per 1000 (from 9 more to 73 more)	MODERATE	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	748/1885 (39.7%)	3192/8648 (36.9%)	aRR 1.14 (1.08 to 1.2)	52 more per 1000 (from 30 more to 74 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	109/1211 (9%)	901/8051 (11.2%)	aRR 1.04 (0.89 to 1.22)	4 more per 1000 (from 12 fewer to 25 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Freestanding midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	86/911 (9.4%)	813/5584 (14.6%)	aRR 0.74 (0.61 to 0.9)	38 fewer per 1000 (from 15 fewer to 57 fewer)	MODERATE	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 30-35kg/m²	BMI 18.5-24.9 kg/m²	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Alongside midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	212/1253 (16.9%)	1647/8140 (20.2%)	aRR 1 (0.86 to 1.16)	0 fewer per 1000 (from 28 fewer to 32 more)	HIGH	CRITICAL
Maternal admission to intensive care - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	11/1955 (0.56%)	57/8936 (0.64%)	aRR 0.88 (0.5 to 1.55)	1 fewer per 1000 (from 3 fewer to 4 more)	LOW	CRITICAL
Instrumental birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	249/1951 (12.8%)	1397/8928 (15.6%)	aRR 0.86 (0.74 to 1)	22 fewer per 1000 (from 41 fewer to 0 more)	MODERATE	CRITICAL
Intrapartum caesarean birth - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	260/1951 (13.3%)	846/8928 (9.5%)	aRR 1.52 (1.3 to 1.78)	49 more per 1000 (from 28 more to 74 more)	HIGH	CRITICAL
Maternal blood transfusion - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	25/1945 (1.3%)	112/8881 (1.3%)	aRR 1 (0.65 to 1.54)	0 fewer per 1000 (from 4 fewer to 7 more)	LOW	CRITICAL
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	39/938 (4.2%)	180/4979 (3.6%)	aRR 1.18 (0.8 to 1.74)	7 more per 1000 (from 7 fewer to 27 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Multiparous												
1 (Hollowell	observational	no serious	no serious	no serious	very serious[2]	none	19/1005	68/3891	aRR 1.26	5 more per 1000	LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 30-35kg/m²	BMI 18.5-24.9 kg/m²	Relative (95% CI)	Absolute		
2014)	studies	risk of bias	inconsistency	indirectness			(1.9%)	(1.7%)	(0.69 to 2.3)	(from 5 fewer to 23 more)		
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	58/1946 (3%)	249/8881 (2.8%)	aRR 1.18 (0.85 to 1.64)	5 more per 1000 (from 4 fewer to 18 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death – Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	22/1224 (1.8%)	135/8088 (1.7%)	aRR 1.36 (0.8 to 2.31)	6 more per 1000 (from 3 fewer to 22 more)	MODERATE	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death – Freestanding - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	19/915 (2.1%)	95/5623 (1.7%)	aRR 1.33 (0.79 to 2.24)	6 more per 1000 (from 4 fewer to 21 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death – Alongside - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	30/1262 (2.4%)	144/8196 (1.8%)	aRR 1.33 (0.75 to 2.36)	6 more per 1000 (from 4 fewer to 24 more)	LOW	IMPORTANT
Transfer to an obstetric unit - Home - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	115/252 (45.6%)	1050/2344 (44.8%)	aRR 1.03 (0.88 to 1.21)	13 more per 1000 (from 54 fewer to 94 more)	HIGH	IMPORTANT
Transfer to an obstetric unit - Home - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	138/955 (14.5%)	579/5702 (10.2%)	aRR 1.29 (1.08 to 1.54)	29 more per 1000 (from 8 more to 55 more)	MODERATE	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI 30-35kg/m^2	BMI 18.5-24.9 kg/m^2	Relative (95% CI)	Absolute		
Transfer to an obstetric unit - Alongside - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	211/518 (40.7%)	1764/4385 (40.2%)	aRR 1.01 (0.84 to 1.21)	4 more per 1000 (from 64 fewer to 84 more)	HIGH	IMPORTANT
Transfer to an obstetric unit - Alongside - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	96/745 (12.9%)	460/3765 (12.2%)	aRR 0.89 (0.68 to 1.16)	13 fewer per 1000 (from 39 fewer to 20 more)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Freestanding - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	105/333 (31.5%)	931/2723 (34.2%)	aRR 0.92 (0.77 to 1.1)	27 fewer per 1000 (from 79 fewer to 34 more)	MODERATE	IMPORTANT
Transfer to an obstetric unit - Freestanding - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	42/572 (7.3%)	243/2842 (8.6%)	aRR 0.83 (0.62 to 1.11)	15 fewer per 1000 (from 32 fewer to 9 more)	MODERATE	IMPORTANT

aRR: adjusted risk ratio (for Hollowell 2014 and Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); BMI: body mass index; CI: confidence interval
1 95% CI crosses 1 MID
2 95% CI crosses 2 MID

Table 7: Evidence profile for comparison 4: BMI ≥30kg/m^2 versus BMI 18.5-24.9kg/m^2

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI ≥30kg/m^2	BMI 18.5-24.9kg/m^2	Relative (95% CI)	Absolute		

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI ≥30kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Transfer to an obstetric unit - Freestanding – Nulliparous												
1 (Stephenson-Famy 2018)	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	NR	NR	aOR 2.3 (1.6 to 3.31)[2]	203 more per 1000 (from 112 more to 290 more)	MODERATE	IMPORTANT

aOR: adjusted odds ratio (for Stephenson-Famy 2018: maternal age, non-Hispanic/Hispanic, marital status, maternal education, BMI, insurance status); BMI: body mass index; CI: confidence interval; NR: not reported
1 Serious risk of bias in the evidence contributing to the outcomes as per ROBINS-I
2 Control group risk was not reported by the study. Absolute effect calculated using control group risk from Hollowell 2015

Table 8: Evidence profile for comparison 5: BMI >35kg/m² versus BMI 18.5-24.9kg/m²

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	225/404 (55.7%)	2524/4833 (52.2%)	aRR 1.08 (0.99 to 1.18)	42 more per 1000 (from 5 fewer to 94 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	117/555 (21.1%)	666/3809 (17.5%)	aRR 1.24 (0.97 to 1.59)	42 more per 1000 (from 5 fewer to 103 more)	MODERATE	CRITICAL
Maternal admission to intensive care - Obstetric unit – Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	5/984 (0.51%)	57/8936 (0.64%)	aRR 0.71 (0.25 to 2.02)	2 fewer per 1000 (from 5 fewer to 7 more)	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Instrumental birth - Obstetric unit – Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	84/983 (8.5%)	1397/8928 (15.6%)	aRR 0.7 (0.57 to 0.86)	47 fewer per 1000 (from 22 fewer to 67 fewer)	MODERATE	CRITICAL
Intrapartum caesarean birth - Obstetric unit – Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	135/983 (13.7%)	846/8928 (9.5%)	aRR 1.69 (1.35 to 2.12)	65 more per 1000 (from 33 more to 106 more)	HIGH	CRITICAL
Maternal blood transfusion - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	9/984 (0.91%)	112/8881 (1.3%)	aRR 0.77 (0.4 to 1.48)	3 fewer per 1000 (from 8 fewer to 6 more)	LOW	CRITICAL
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Nulliparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	28/417 (6.7%)	180/4979 (3.6%)	aRR 2 (1.31 to 3.05)	36 more per 1000 (from 11 more to 74 more)	HIGH	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Multiparous												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	15/563 (2.7%)	68/3891 (1.7%)	aRR 1.83 (1.22 to 2.75)	15 more per 1000 (from 4 more to 31 more)	MODERATE	IMPORTANT

aRR: adjusted risk ratio (for Hollowell 2014: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); BMI: body mass index; CI: confidence interval
1 95% CI crosses 1 MID
2 95% CI crosses 2 MIDs

Table 9: Evidence profile for comparison 6: BMI >35-40 kg/m² versus BMI 18.5-24.9kg/m²

Quality assessment	No of patients	Effect	Quality	Importance

No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35-40kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Obstetric interventions and adverse maternal outcomes combined - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	234/655 (35.7%)	3192/8648 (36.9%)	aRR 1.1 (1 to 1.21)	37 more per 1000 (from 0 more to 78 more)	HIGH	CRITICAL
Obstetric interventions and adverse maternal outcomes combined – Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	19/265 (7.2%)	901/8051 (11.2%)	aRR 0.95 (0.59 to 1.53)	6 fewer per 1000 (from 46 fewer to 59 more)	LOW	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Freestanding midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	4/62 (6.5%)	813/5584 (14.6%)	aRR 0.8 (0.33 to 1.94)	29 fewer per 1000 (from 98 fewer to 137 more)	LOW	CRITICAL
Obstetric interventions and adverse maternal outcomes combined - Alongside midwifery unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	14/136 (10.3%)	1647/8140 (20.2%)	aRR 0.89 (0.5 to 1.58)	22 fewer per 1000 (from 101 fewer to 117 more)	LOW	CRITICAL
Neonatal admission or intrapartum stillbirth/early neonatal death - Obstetric unit - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	34/672 (5.1%)	249/8881 (2.8%)	aRR 2.16 (1.57 to 2.97)	33 more per 1000 (from 16 more to 55 more)	HIGH	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death – Home - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	5/263 (1.9%)	135/8088 (1.7%)	aRR 1.17 (0.49 to 2.79)	3 more per 1000 (from 9 fewer to 30 more)	LOW	IMPORTANT
Neonatal admission or intrapartum stillbirth/early neonatal death – Freestanding - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	3/63 (4.8%)	95/5623 (1.7%)	aRR 3.95 (1.07 to 14.58)	50 more per 1000 (from 1 more to 229 more)	MODERATE	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35-40kg/m²	BMI 18.5-24.9kg/m²	Relative (95% CI)	Absolute		
Neonatal admission or intrapartum stillbirth/early neonatal death – Alongside - Mixed parity												
1 (Hollowell 2014)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	1/138 (0.72%)	144/8196 (1.8%)	aRR 0.62 (0.15 to 2.56)	7 fewer per 1000 (from 15 fewer to 27 more)	LOW	IMPORTANT

aRR: adjusted risk ratio (for Hollowell 2014: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); BMI: body mass index; CI: confidence interval
1 95% CI crosses 2 MIDs
2 95% CI crosses 1 MID

Table 10: Evidence profile for comparison 7: BMI >35 kg/m² versus BMI ≤35kg/m²

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m²	BMI ≤35kg/m²	Relative (95% CI)	Absolute		
Maternal admission to intensive care - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	10/312 (3.2%)	20/890 (2.2%)	aRR 1.34 (0.44 to 4.08)	8 more per 1000 (from 13 fewer to 69 more)	LOW	CRITICAL
Maternal admission to intensive care - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	9/806 (1.1%)	17/1054 (1.6%)	aRR 0.71 (0.27 to 1.87)	5 fewer per 1000 (from 12 fewer to 14 more)	LOW	CRITICAL
Spontaneous vaginal birth - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	226/312 (72.4%)	662/890 (74.4%)	aRR 0.97 (0.88 to 1.07)	22 fewer per 1000 (from 89 fewer to 52 more)	HIGH	CRITICAL
Spontaneous vaginal birth - Alongside midwifery unit - Multiparous												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m²	BMI ≤35kg/m²	Relative (95% CI)	Absolute		
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	776/806 (96.3%)	986/1055 (93.5%)	aRR 1 (0.98 to 1.02)	0 fewer per 1000 (from 19 fewer to 19 more)	HIGH	CRITICAL
Instrumental birth - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	43/312 (13.8%)	155/890 (17.4%)	aRR 0.83 (0.53 to 1.3)	30 fewer per 1000 (from 82 fewer to 52 more)	LOW	CRITICAL
Instrumental birth - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	12/808 (1.5%)	26/1056 (2.5%)	aRR 0.6 (0.22 to 1.64)	10 fewer per 1000 (from 19 fewer to 16 more)	LOW	CRITICAL
Intrapartum caesarean birth - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	43/312 (13.8%)	73/890 (8.2%)	aRR 1.62 (0.98 to 2.68)	51 more per 1000 (from 2 fewer to 138 more)	MODERATE	CRITICAL
Intrapartum caesarean birth - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	10/808 (1.2%)	7/1056 (0.66%)	aRR 1.8 (0.52 to 6.23)	5 more per 1000 (from 3 fewer to 35 more)	LOW	CRITICAL
Category 1 or 2 caesarean birth - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	38/312 (12.2%)	58/890 (6.5%)	aRR 1.8 (1.05 to 3.09)	52 more per 1000 (from 3 more to 136 more)	MODERATE	CRITICAL
Category 1 or 2 caesarean birth - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	8/808 (0.99%)	5/1056 (0.47%)	aRR 2.1 (0.48 to 9.19)	5 more per 1000 (from 2 fewer to 39 more)	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m²	BMI ≤35kg/m²	Relative (95% CI)	Absolute		
Postpartum haemorrhage - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	16/312 (5.1%)	15/890 (1.7%)	aRR 3.01 (1.24 to 7.31)	34 more per 1000 (from 4 more to 106 more)	MODERATE	CRITICAL
Postpartum haemorrhage - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	15/806 (1.9%)	21/1055 (2%)	aRR 0.89 (0.41 to 1.93)	2 fewer per 1000 (from 12 fewer to 19 more)	LOW	CRITICAL
Shoulder dystocia - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	3/312 (0.96%)	11/890 (1.2%)	aRR 0.79 (0.14 to 4.46)	3 fewer per 1000 (from 11 fewer to 43 more)	LOW	IMPORTANT
Shoulder dystocia - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	12/808 (1.5%)	17/1056 (1.6%)	aRR 0.84 (0.31 to 2.28)	3 fewer per 1000 (from 11 fewer to 21 more)	LOW	IMPORTANT
Neonatal unit admission - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	12/312 (3.8%)	29/886 (3.3%)	aRR 0.92 (0.38 to 2.23)	3 fewer per 1000 (from 20 fewer to 40 more)	LOW	IMPORTANT
Neonatal unit admission - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[1]	none	19/806 (2.4%)	20/1054 (1.9%)	aRR 1.1 (0.46 to 2.63)	2 more per 1000 (from 10 fewer to 31 more)	LOW	IMPORTANT
Initiation of breastfeeding - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	229/312 (73.4%)	693/886 (78.2%)	aRR 0.97 (0.87 to 1.08)	23 fewer per 1000 (from 102 fewer to 63 more)	HIGH	IMPORTANT
Initiation of breastfeeding - Alongside midwifery unit - Multiparous												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	BMI >35kg/m^2	BMI ≤35kg/m^2	Relative (95% CI)	Absolute		
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	502/806 (62.3%)	747/1054 (70.9%)	aRR 0.92 (0.85 to 1)	57 fewer per 1000 (from 106 fewer to 0 more)	HIGH	IMPORTANT
Transfer to obstetric - Alongside midwifery unit - Nulliparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	151/312 (48.4%)	375/890 (42.1%)	aRR 1.18 (0.98 to 1.42)	76 more per 1000 (from 8 fewer to 177 more)	MODERATE	IMPORTANT
Transfer to obstetric - Alongside midwifery unit - Multiparous												
1 (Rowe 2018)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	118/808 (14.6%)	134/1056 (12.7%)	aRR 1.12 (0.84 to 1.49)	15 more per 1000 (from 20 fewer to 62 more)	MODERATE	IMPORTANT

aRR: adjusted risk ratio (for Rowe 2018: maternal age, ethnic group, gestational age at admission (completed weeks), Children in Low-income Families Measure quintile, parity (previous pregnancies ≥24 weeks), pre-existing risk factors (none, ≥1 clear, ≥1 possible); BMI: body mass index; CI: confidence interval
1 95% CI crosses 2 MIDs
2 95% CI crosses 1 MID

Table 11: Evidence profiles for comparison 8: Home versus Obstetric unit (for women with a mean booking BMI 18.5 – 24.9 kg/m^2)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Home	Obstetric Unit	Relative (95% CI)	Absolute		
Spontaneous birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	3237/4332 (74.7%)	5916/9986 (59.2%)	aRR 1.32 (1.26 to 1.38)	190 more per 1000 (from 154 more to 225 more)	HIGH	CRITICAL
Spontaneous birth - Multiparous												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Home	Obstetric Unit	Relative (95% CI)	Absolute		
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	11301/11632 (97.2%)	7475/8559 (87.3%)	aRR 1.1 (1.09 to 1.11)	87 more per 1000 (from 79 more to 96 more)	HIGH	CRITICAL
Instrumental birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	575/4359 (13.2%)	2201/10039 (21.9%)	aRR 0.51 (0.44 to 0.59)	107 fewer per 1000 (from 90 fewer to 123 fewer)	HIGH	CRITICAL
Instrumental birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	107/11733 (0.91%)	482/8616 (5.6%)	aRR 0.15 (0.12 to 0.19)	48 fewer per 1000 (from 45 fewer to 49 fewer)	HIGH	CRITICAL
Caesarean birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	356/4359 (8.2%)	1545/10039 (15.4%)	aRR 0.57 (0.47 to 0.69)	66 fewer per 1000 (from 48 fewer to 82 fewer)	HIGH	CRITICAL
Caesarean birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	78/11733 (0.66%)	446/8616 (5.2%)	aRR 0.15 (0.1 to 0.23)	44 fewer per 1000 (from 40 fewer to 47 fewer)	HIGH	CRITICAL

aRR: adjusted risk ratio (for Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); CI: confidence interval

Table 12: Evidence profile for comparison 9: Freestanding versus Obstetric unit (for women with a mean booking BMI 18.5 – 24.9 kg/m^2)

Quality assessment	No of patients	Effect	Quality	Importance

No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Freestanding midwifery unit	Obstetric unit	Relative (95% CI)	Absolute		
Spontaneous birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	3909/5032 (77.7%)	5916/9986 (59.2%)	aRR 1.28 (1.23 to 1.33)	166 more per 1000 (from 136 more to 196 more)	MODERATE	CRITICAL
Spontaneous birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	5704/5890 (96.8%)	7475/8559 (87.3%)	aRR 1.1 (1.08 to 1.12)	87 more per 1000 (from 70 more to 105 more)	HIGH	CRITICAL
Instrumental birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	604/5047 (12%)	2201/10039 (21.9%)	aRR 0.49 (0.41 to 0.59)	112 fewer per 1000 (from 90 fewer to 129 fewer)	HIGH	CRITICAL
Instrumental birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	69/5934 (1.2%)	482/8616 (5.6%)	aRR 0.19 (0.13 to 0.28)	45 fewer per 1000 (from 40 fewer to 49 fewer)	HIGH	CRITICAL
Caesarean birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	342/5047 (6.8%)	1545/10039 (15.4%)	aRR 0.51 (0.42 to 0.62)	75 fewer per 1000 (from 58 fewer to 89 fewer)	HIGH	CRITICAL
Caesarean birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	44/5934 (0.74%)	446/8616 (5.2%)	aRR 0.18 (0.15 to 0.22)	42 fewer per 1000 (from 40 fewer to 44 fewer)	HIGH	CRITICAL

aRR: adjusted risk ratio (for Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery; CI: confidence interval
1 95% CI crosses 1 MID

Table 13: Evidence profile for comparison 10: Alongside midwifery unit versus Obstetric unit (for women with a mean booking BMI 18.5 – 24.9 kg/m^2)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Alongside midwifery unit	Obstetric unit	Relative (95% CI)	Absolute		
Spontaneous birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	5747/7962 (72.2%)	5916/9986 (59.2%)	aRR 1.18 (1.12 to 1.24)	107 more per 1000 (from 71 more to 142 more)	HIGH	CRITICAL
Spontaneous birth – Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	7529/7942 (94.8%)	7475/8559 (87.3%)	aRR 1.07 (1.05 to 1.09)	61 more per 1000 (from 44 more to 79 more)	HIGH	CRITICAL
Instrumental birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	1275/8032 (15.9%)	2201/10039 (21.9%)	aRR 0.73 (0.62 to 0.86)	59 fewer per 1000 (from 31 fewer to 83 fewer)	MODERATE	CRITICAL
Instrumental birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	185/8022 (2.3%)	482/8616 (5.6%)	aRR 0.46 (0.35 to 0.6)	30 fewer per 1000 (from 22 fewer to 36 fewer)	HIGH	CRITICAL
Caesarean birth - Nulliparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	618/8032 (7.7%)	1545/10039 (15.4%)	aRR 0.59 (0.42 to 0.83)	63 fewer per 1000 (from 26 fewer to 89 fewer)	MODERATE	CRITICAL
Caesarean birth - Multiparous												
1 (Hollowell 2015)	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	85/8022 (1.1%)	446/8616 (5.2%)	aRR 0.24 (0.17 to 0.34)	39 fewer per 1000 (from 34 fewer to 43 fewer)	HIGH	CRITICAL

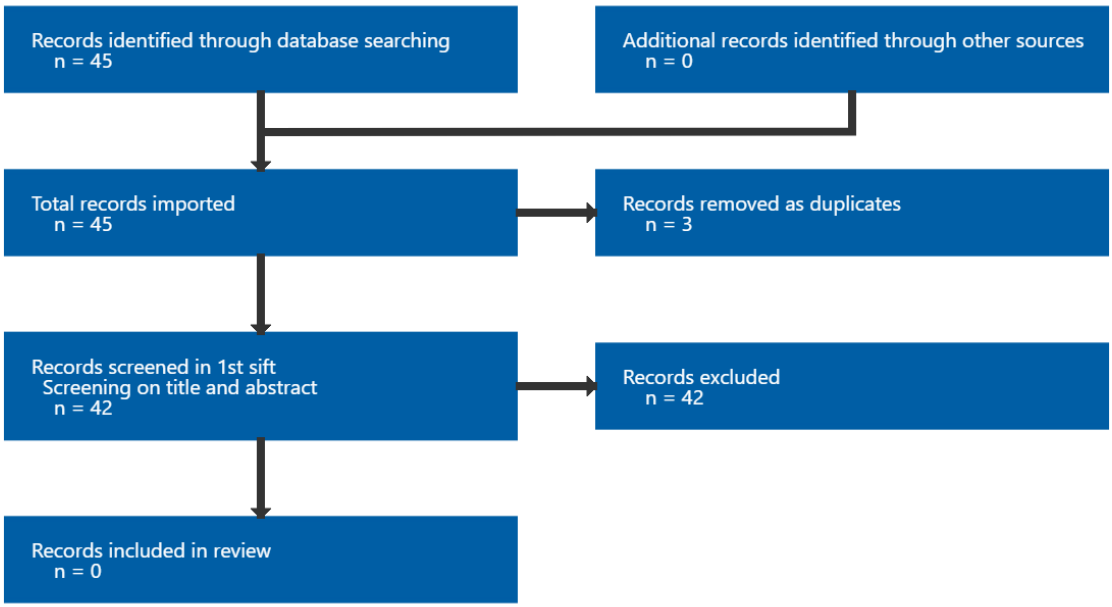
aRR: adjusted risk ratio (for Hollowell 2015: maternal age, ethnic group, understanding of English, marital or partner status, Index of Multiple Deprivation score, parity (previous pregnancies ≥24weeks), gestation at delivery); CI: confidence interval
1 95% CI cross 1 MID

Appendix G Economic evidence study selection

Study selection for: What are the benefits and risks of different places of birth for women at different BMI thresholds?

No economic evidence was identified which was applicable to this review question.

Figure 2: Study selection flowchart



Appendix H Economic evidence tables

Economic evidence tables for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

No evidence was identified which was applicable to this review question.

Appendix I Economic model

Economic model for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

No economic analysis was conducted for this review question.

Appendix J Excluded studies

Excluded studies for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

Excluded effectiveness studies

Table 14: Excluded studies and reasons for their exclusion

Study	Reason
Andalusian Agency for Health Technology, Assessment (2007) [Planned home birth. Current situation in developed countries].	- Language Full text not in English
Carlson, Nicole S., Breman, Rachel, Neal, Jeremy L. et al. (2020) Preventing Cesarean Birth in Women with Obesity: Influence of Unit-Level Midwifery Presence on Use of Cesarean among Women in the Consortium on Safe Labor Data Set. Journal of midwifery & women's health 65(1): 22-32	- Comparator Physician only unit included as a comparator, which is not specified as a place of birth option in the protocol
Dalbye, R., Gunnes, N., Blix, E. et al. (2021) Maternal body mass index and risk of obstetric, maternal and neonatal outcomes: a cohort study of nulliparous women with spontaneous onset of labor. Acta obstetricia et gynecologica Scandinavica 100(3): 521-530	- Comparator No comparison group
Denison, F. C., Norman, J. E., Norwood, P. et al. (2014) Association between maternal body mass index during pregnancy, short-term morbidity, and increased health service costs: A population-based study. BJOG: An International Journal of Obstetrics and Gynaecology 121(1): 72-82	- Intervention Women who have given birth in hospital, but no information regarding their planned place of birth
Hollowell, J., Pillas, D., Rowe, R. et al. (2013) What are the intrapartum risks associated with obesity in healthy women without additional risk factors? Evidence from the birthplace in england national prospective cohort study. Archives of Disease in Childhood: Fetal and Neonatal Edition 98(suppl1)	- Study design Conference abstract only
Johansson, M., Lindgren, H., Nordström, L. et al. (2013) Risks associated with planned home delivery for nulliparous women.	- Study design Review, included studies checked and 1 included study included in our review (Brocklehurst 2011)
Rowe, R. (2018) Outcomes for severely obese women admitted to alongside midwifery units in the UK: Results from a national cohort study using the UK Midwifery Study System (UKMidSS). BJOG: An International Journal of Obstetrics and Gynaecology 125(supplement2): 8	- Study design Conference abstract only, full results assessed under Rowe 2018 and included
Rowe, Rachel E., Kurinczuk, Jennifer J., Hollowell, Jennifer et al. (2016) The UK Midwifery Study System (UKMidSS): a programme of work to establish a research infrastructure to carry out national studies of uncommon conditions and events in midwifery units. BMC pregnancy and childbirth 16: 77	- Study design Protocol only

Study	Reason
Thompson, L. (2012) Safety and risk associated with free standing midwife led maternity units. This evidence note updates evidence note 18 published in August 2007.	- Study design Update note for an evidence note. Neither meet specified study criteria
Walsh, D., Spiby, H., McCourt, C. et al. (2020) Factors influencing the utilisation of free-standing and alongside midwifery units in England: a mixed methods research study.	- Study design Mixed method study, quantitative aspect does not fit the specified study designs in the protocol

Excluded economic studies

No economic evidence was identified for this review.

Appendix K Research recommendations – full details

Research recommendations for review question: What are the benefits and risks of different places of birth for women at different BMI thresholds?

No research recommendations were made for this review question.