



Maternal obesity in the UK: findings from a national project

2010

United Kingdom



changing the future of diabetes

Living with diabetes isn't easy. It takes discipline, control and support from the people around you. At Novo Nordisk, we want to be your partner in living well with diabetes.

We know that we are not simply treating diabetes. We are helping real people live better lives. We understand that diabetes is just a part of who you are – not what defines you. This understanding is behind every decision or action we take, and fuels our passion for changing the perception, treatment and future of diabetes for good.

At Novo Nordisk, we are Changing Diabetes®
www.novonordisk.co.uk
www.changingdiabetes.co.uk



Maternal obesity in the UK: findings from a national project

2010
United Kingdom

CMACE Mission statement

Our aim is to improve the health of mothers, babies and children by carrying out confidential enquiries and other related work on a UK-wide basis and by widely disseminating the results.

Please cite this work as: Centre for Maternal and Child Enquiries (CMACE). Maternal obesity in the UK: Findings from a national project. London: CMACE, 2010

Disclaimers

This work was undertaken by the Centre for Maternal and Child Enquiries (CMACE) as part of the CEMACH programme. The work was funded by the National Patient Safety Agency; the Department of Health, Social Services and Public Safety of Northern Ireland; NHS Quality Improvement Scotland (QIS); and the Channel Islands and Isle of Man. The views expressed in this publication are those of CMACE and not those of the funding bodies.

The recommendations contained in this report represent the view of CMACE and the Obesity in Pregnancy project External Advisory Group, which was arrived at after a careful consideration of the available evidence. The recommendations do not override healthcare professionals' individual responsibility to make appropriate decisions in the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

Advertisements published in this document are not endorsed or supported in any way by CMACE, the authors or reviewers of this document. They are included as a way of supporting the work of CMACE and reducing the cost of the report.

Published December 2010

CMACE, Chiltern Court, 188 Baker Street, London, NW1 5SD

Tel: 020 7486 1191 Fax: 020 7486 6226

Email: info@cmace.org.uk Website: www.cmace.org.uk

Designed and produced by ie Marketing, Bristol. Tel: 0117 923 2235.

Printed by Henry Ling Ltd, at the Dorset Press, Dorchester, DT1 1HD.



ISBN: 978-0-9558055-4-7

Contents

Acknowledgements	vi
Abbreviations	vii
Glossary	viii
Foreword	xiii
1. Key findings and recommendations	1
1.1. Key findings	1
1.1.1. Prevalence of Class II, Class III and super-morbid obesity.....	1
1.1.2. Socio-demographic characteristics	1
1.1.3. Clinical characteristics	2
1.1.4. Poor pregnancy outcomes	3
1.1.5. Preconception care	3
1.1.6. Clinical care during pregnancy.....	4
1.1.7. Clinical care during labour and delivery.....	5
1.1.8. Postpartum care and follow-up	5
1.1.9. Facilities and equipment in maternity units	6
1.2. Key recommendations	6
2. Introduction	17
2.1. Context	17
2.2. Aims and objectives of the national project	18
2.3. Improving services and care.....	18
3. Methods	19
3.1. Consensus standards.....	19
3.1.1. Searching the scientific evidence	19
3.1.2. Stakeholder consultation.....	19
3.1.3. Multidisciplinary consensus standards group	20
3.1.4. Consensus process	20
3.2. Survey of maternity units	22
3.2.1. Sample.....	22
3.2.2. Development of the survey instrument	22
3.2.3. Pilot of survey questionnaire.....	23
3.2.4. Administration of survey questionnaire	23
3.2.5. Analyses	23
3.3. An observational study of mothers with a BMI ≥ 35 and their babies	23
3.3.1. Sample.....	23
3.3.2. Development of the data collection form	24
3.3.3. Pilot of data collection form.....	24
3.3.4. Data collection process.....	24
3.3.5. Analyses	24
3.4. Clinical audit	26
3.4.1. Sample.....	26
3.4.2. Development of the data collection form	26

3.4.3. Pilot of data collection form.....	27
3.4.4. Data collection process.....	27
3.4.5. Analyses	27
3.5. Developing recommendations	28
4. Maternity services for women with obesity.....	31
4.1. Responses.....	31
4.2. Service provision	31
4.2.1. Preconception care and advice	31
4.2.2. Provision of information for women.....	32
4.2.3. Measuring and recording height, weight and body mass index.....	32
4.2.4. Risk assessment during pregnancy.....	32
4.2.5. Breastfeeding.....	33
4.2.6. Local guidelines	33
4.2.7. Equipment and facilities.....	34
4.2.8. Education of healthcare professionals.....	35
4.3. Discussion	36
5. Prevalence of Class II, Class III and super-morbid obesity in pregnancy	37
5.1. UK national prevalence	37
5.2. Prevalence of obesity in the UK nations and Crown Dependencies	38
5.3. Prevalence of obesity by Strategic Health Authorities (England)	39
5.4. Prevalence of obesity identified in the first trimester	40
5.5. Discussion	40
6. Maternal obesity: Socio-demographics, clinical characteristics and pregnancy outcomes.....	43
6.1. Socio-demographic characteristics.....	43
6.1.1. Maternal weight and body mass index	43
6.1.2. Social deprivation.....	44
6.1.3. Ethnicity	44
6.1.4. Age.....	45
6.2. Clinical characteristics	45
6.2.1. Co-morbidities.....	45
6.2.2. Pregnancy-related characteristics.....	46
6.2.3. Gestational weight gain.....	47
6.2.4. Onset of labour	48
6.2.5. Place of delivery.....	49
6.2.6. Mode of delivery.....	50
6.2.7. Anaesthesia	51
6.2.8. Length of stay in hospital	52
6.3. Maternal outcomes	52
6.3.1. Maternal deaths	52
6.3.2. Postpartum haemorrhage	53
6.4. Pregnancy outcomes.....	55
6.4.1. Live births, stillbirths and early neonatal deaths	55
6.4.2. Gestational age.....	57

6.4.3. Fetal congenital anomalies	57
6.4.4. Neonatal unit admissions.....	58
6.4.5. Large for gestational age and small for gestational age	58
6.4.6. Feeding practices.....	59
6.5. Risk factors for pregnancy-related complications and outcomes among women with obesity.....	60
6.5.1. Maternal body mass index	60
6.5.2. Maternal age.....	61
6.5.3. Maternal ethnicity.....	61
6.5.4. Maternal co-morbidities.....	62
6.5.5. Maternal gestational weight gain	62
6.6. Discussion	63
7. Standards of care for women with Class II and Class III maternal obesity	65
7.1. Preconception care and advice	65
7.2. Measuring and recording height, weight and body mass index	67
7.3. Provision of information for women	68
7.4. Risk assessment during pregnancy.....	68
7.5. Thromboprophylaxis	69
7.5.1. Antenatal thromboprophylaxis	70
7.5.2. Postnatal thromboprophylaxis.....	71
7.6. Maternal surveillance and screening.....	74
7.7. Planning labour and delivery	75
7.8. Care during childbirth	76
7.9. Breastfeeding	80
7.10. Postnatal care and follow-up after pregnancy	80
7.11. Discussion	81
8. Conclusions.....	83
References	86
Index of tables	93
Index of figures.....	94
APPENDIX A: Stakeholder organisations consulted during February 2008.....	95
APPENDIX B: Members of the Consensus Standards Group by discipline.....	96
APPENDIX C. Process for developing the standards of care for women with obesity	97
APPENDIX D: Levels and grades of evidence	98
APPENDIX E: Standards of care for women with obesity in pregnancy.....	99
APPENDIX F: CMACE Obesity and maternity services survey.....	102
APPENDIX G: CMACE Obesity in pregnancy audit notification form.....	109
APPENDIX H: CMACE Obesity in pregnancy audit proforma.....	113
APPENDIX I: Contributors to the CMACE Obesity in Pregnancy project.....	120



Acknowledgements

Editor

Professor Ian Greer

*Executive Pro-Vice-Chancellor, Faculty of Health & Life Sciences, University of Liverpool;
Chair of the National Advisory Committee for CMACE*

Lead author

Dr Kate Fitzsimons

Senior Research Fellow, CMACE

Other author

Amy Sullivan

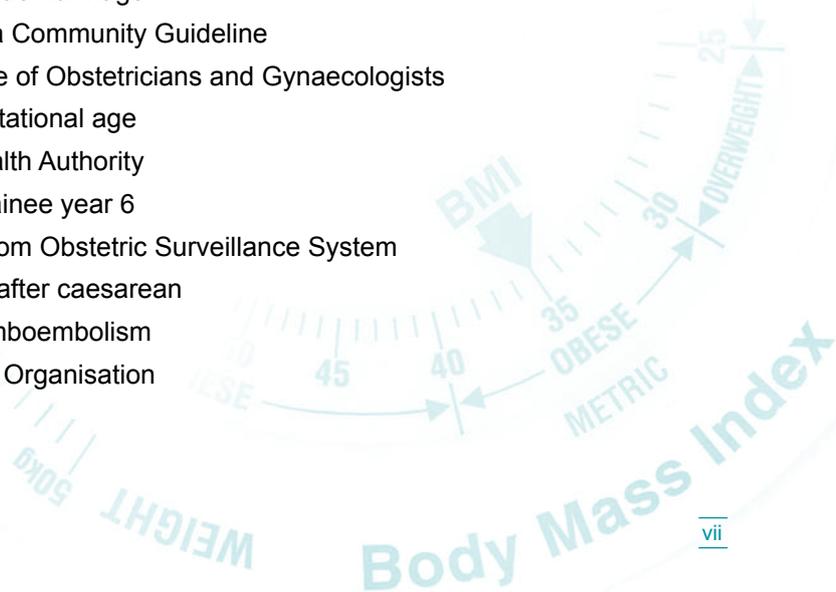
Researcher, CMACE

With special thanks to:

- The unit co-ordinators, clinicians and staff throughout England, Wales, Northern Ireland, Scotland, Channel Islands, and the Isle of Man, without whose commitment and continued support we would not have had the data to enable us to produce this report.
- All personnel in CMACE regional offices and affiliated offices involved in the collection and validation of all data provided for this report (See Appendix I).
- The CMACE Obesity Working Group: Dr Kate Fitzsimons, Senior Research Fellow; Alison Miller, Programme Director and Midwifery Lead; Rachael Davey, R&D Projects and Research Assistant; Julie Maddocks, West Midlands, North West and Wales Regional Manager.
- Richard Congdon, CMACE Chief Executive; Shona Golightly, CMACE R&D Director; Dr Imogen Stephens, CMACE Clinical Director; Amy Sullivan, CMACE Researcher; Anna Springett, CMACE Senior data analyst; James Hammond, CMACE Database development and IT officer; Clara Haken, CMACE Project Midwife; and all other staff at CMACE Central Office for their support and advice during the development of this report.
- Dr Jo Modder (formerly CMACE Clinical Director of Obstetrics), for providing clinical input for the project from its conception through to April 2010.
- The National Patient Safety Agency (NPSA) and the Department of Health, Social Services and Public Safety of Northern Ireland, the States of Jersey and Guernsey, the Isle of Man, and NHS Quality Improvement Scotland (NHS QIS) for funding this work.
- The CMACE Obesity in Pregnancy Project External Advisory Group (chaired by Professor Ian Greer) (see Appendix I).
- The Consensus Standards Development Group (chaired by Professor Ian Greer) (see Appendix I).
- The CMACE board of Trustees (see Appendix I)
- Peer-reviewers of the report:
 - Professor Scott Nelson, Muirhead Chair in Obstetrics & Gynaecology, Centre for Population and Health Sciences, University of Glasgow
 - Professor Pat Doyle, Non-Communicable Disease Epidemiology Unit, Department of Epidemiology and Population Health, London School of Hygiene & Tropical Medicine
 - Dr Helen Duncan, Director of the Child and Maternal Health Observatory (ChiMat), University of York

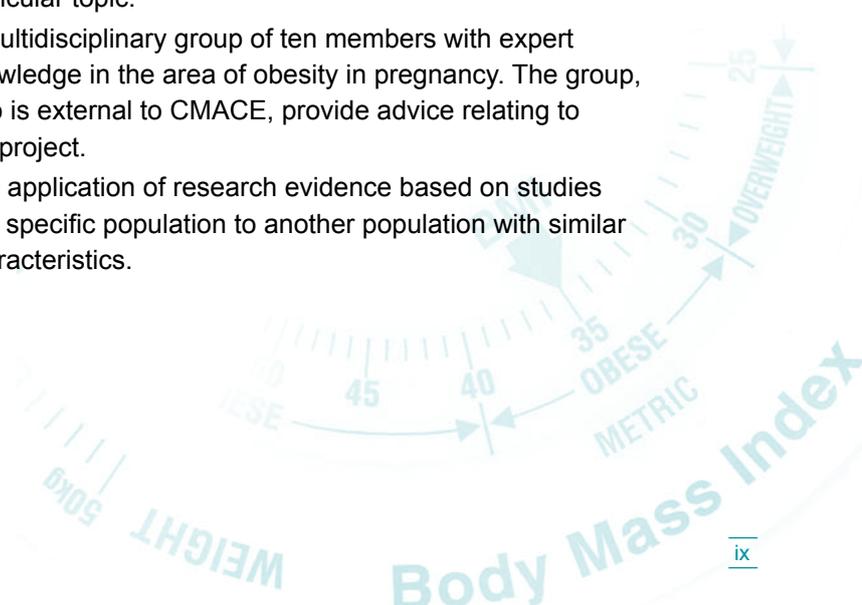
Abbreviations

AMU	Alongside midwifery unit
aOR	Adjusted odds ratio
BAPM	British Association of Perinatal Mortality
BME	Black and minority ethnic
BMI	Body mass index
CI	Confidence interval
CS	Caesarean section
CMACE	Centre for Maternal and Child Enquiries
CEMACH	Confidential Enquiry into Maternal and Child Health
CSG	Consensus standards group
DVT	Deep vein thrombosis
EAG	External advisory group
FMU	Freestanding midwifery unit
GDM	Gestational diabetes mellitus
HES	Hospital Episode Statistics
HoM	Head of Midwifery
IMD	Index of multiple deprivation
IQR	Interquartile range
Kg	Kilograms
LGA	Large for gestational age
LMWH	Low molecular weight heparin
NHS QIS	NHS Quality Improvement Scotland
NICE	National Institute of Health and Clinical Excellence
NICORE	Neonatal Intensive Care Outcomes Research and Evaluation
NPSA	The National Patient Safety Agency
NS	Non-significant
OGTT	Oral glucose tolerance test
ONS	Office for National Statistics
OR	Odds ratio
PASW	Statistical software
PDN	Perinatal death notification
PIH	Pregnancy induced hypertension
PPH	Postpartum haemorrhage
PRECOG	Preeclampsia Community Guideline
RCOG	Royal College of Obstetricians and Gynaecologists
SGA	Small for gestational age
SHA	Strategic Health Authority
ST6	Speciality Trainee year 6
UKOSS	United Kingdom Obstetric Surveillance System
VBAC	Vaginal birth after caesarean
VTE	Venous thromboembolism
WHO	World Health Organisation
X²	Chi square



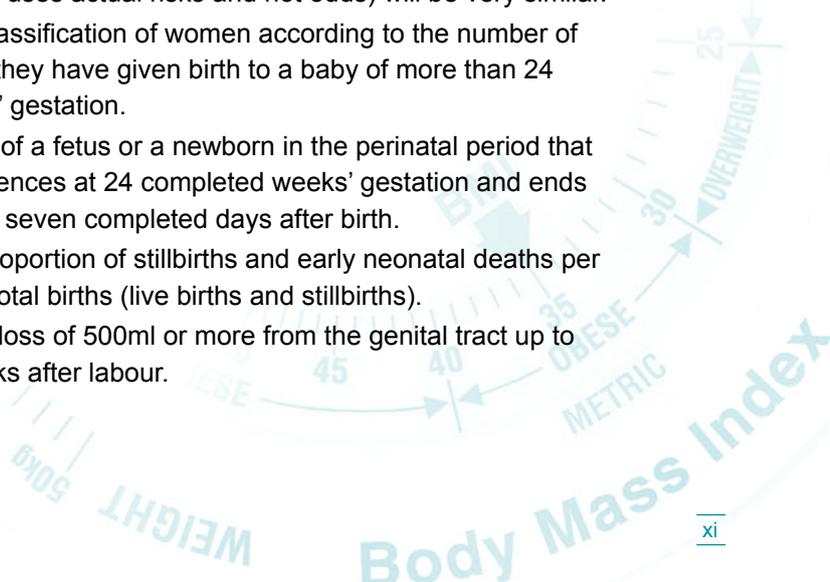
Alongside midwifery unit	An NHS clinical location offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care. During labour and birth, diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care, are available, should they be needed, in the same building, or in a separate building on the same site. Transfer will normally be by trolley, bed or wheelchair.
Anthropometric	Human body measurements.
Body mass index (BMI)	The body weight of an individual in kilograms divided by their height in metres squared. A BMI below 18.5 is categorised as underweight, a BMI of 18.5-24.9 is normal/healthy weight, a BMI of 25.0-29.9 is overweight and a BMI of 30 and above is obese.
Booking appointment	The first antenatal appointment a pregnant woman has, usually with a midwife and ideally before 12 weeks' gestation. A woman's medical, family and obstetric history is recorded, needs for care are assessed and plans for care are made.
Caesarean section	Surgical incision into the abdominal and uterine wall to achieve delivery of the baby.
<i>Grade 1</i>	Emergency: Immediate threat to the life of the woman or fetus (e.g. acute, severe bradycardia, cord prolapse, uterine rupture, fetal blood sampling pH less than 7.2.).
<i>Grade 2</i>	Urgent: Maternal or fetal compromise which is not immediately life threatening (e.g. antepartum haemorrhage, 'failure to progress' in labour with maternal or fetal compromise).
<i>Grade 3</i>	Scheduled: Needing early delivery but no maternal or fetal compromise (e.g. a woman booked for elective CS who is admitted with pre-labour spontaneous rupture of membranes or 'failure to progress' with no maternal or fetal compromise).
<i>Grade 4</i>	Elective: At a time to suit the woman and staff.
Clinical audit	A systematic process for setting and monitoring standards of clinical care. Whereas 'guidelines' define what the best clinical practice should be, 'audit' investigates whether best practice is being carried out.
Consensus methods	A variety of techniques that aim to reach an agreement on a particular issue. Formal consensus methods include the Delphi technique. In the development of clinical guidelines, consensus methods may be used where there is a lack of strong research evidence on a particular topic.
Crown Dependencies	The Channel Islands and the Isle of Man.
Cohort	A group of individuals who share something in common (e.g. obesity or born in the same year).

Cohort study	An observational study that takes a group (cohort) of individuals and observes their progress over time in order to measure outcomes, such as disease or mortality rates, and make comparisons according to different exposures, treatments or outcomes.
Confidence interval (CI)	A way of expressing certainty about the findings from a study or group of studies, using statistical techniques. A wide confidence interval indicates a lack of certainty or precision about the true size of the clinical effect and is seen in studies with too few patients. Where confidence intervals are narrow they indicate more precise estimates of effects and a larger sample of patients studied. It is usual to interpret a '95%' confidence interval as the range of effects within which we are 95% confident that the true effect lies.
Consensus standards group (CSG)	A multidisciplinary group of members convened by CMACE to develop standards of care for women with obesity in pregnancy.
Consensus statement	A statement advising a course of action in relation to a particular clinical topic, based on the collective views of a body of experts.
Deep vein thrombosis (DVT)	A condition in which a blood clot (thrombus) forms in the muscle of the leg, usually the calf.
Delphi technique	A method of systematically collecting and aggregating informed judgements from a group of experts on a specific topic and is particularly suitable for developing clinical guidelines when there is limited research evidence.
Diabetes mellitus	A disease with familial tendency in which there is defective metabolism of carbohydrates due to reduction in the secretion of insulin.
Early neonatal death	Death of a live born baby occurring before seven completed days after birth.
Eclampsia	The occurrence of one or more convulsions superimposed on pre-eclampsia.
Evidence-based	The process of systematically finding, appraising and using research findings as the basis for clinical decisions.
Evidence table	A table summarising the results of a collection of studies on a particular topic.
External advisory group (EAG)	A multidisciplinary group of ten members with expert knowledge in the area of obesity in pregnancy. The group, who is external to CMACE, provide advice relating to the project.
Extrapolation	The application of research evidence based on studies of a specific population to another population with similar characteristics.



Freestanding midwifery unit	An NHS clinical location offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care. General Practitioners may also be involved in care. During labour and birth, diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care, are not immediately available but are located on a separate site should they be needed. Transfer will normally involve car or ambulance.
Gestational diabetes mellitus (GDM)	Any degree of glucose intolerance with its onset (or first diagnosis) during pregnancy and usually resolving shortly after delivery.
Good practice point	Recommended good practice based on the expert experience of a group of individuals. A 'Good practice point' recommendation may be made on an important topic when there is a lack of research evidence.
Grade of evidence	A code (e.g. A, B, C, D) linked to a guideline recommendation, indicating the strength of the evidence supporting that recommendation (see Appendix D).
Index of multiple deprivation (IMD)	This combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England. This allows each area to be ranked relative to one another according to their level of deprivation
Interquartile range (IQR)	The distance between the 75th percentile and the 25th percentile. The IQR is essentially the range of the middle 50% of the data.
Intrapartum stillbirth	A stillborn baby that was alive at the onset of labour.
Late neonatal death	Death of a live born baby occurring from the seventh day and before 28 completed days after birth.
Large for gestational age (LGA)	A baby that has a birth weight more than the 10th percentile of all babies with the same gestational age.
Level of evidence	A code (e.g. 1a, 1b) linked to an individual study, indicating where it fits into the hierarchy of evidence and how well it has adhered to recognised research principles (see Appendix D).
Literature review	A process of collecting, reading and assessing the quality of published (and sometimes unpublished) articles on a given topic.
Live birth	Delivery of an infant, which, after complete separation from its mother, shows sign of life.
Low molecular weight heparin (LMWH)	Pharmacological thromboprophylaxis.
Macrosomia	A newborn with an excessive birth weight.
Maternities	Pregnancy resulting in a live birth at any gestation or stillbirth occurring at 24 weeks' gestation onwards, with multiple births being counted only once.
Miscarriage	The loss of a pregnancy that occurs during the first 23+6 weeks.
Maternal obesity	Obesity (BMI ≥ 30) during pregnancy.

Morbidity	A disease, medical condition or symptom.
Mortality	Death
Neonatal services	
<i>Level 1</i>	Special care unit.
<i>Level 2</i>	High dependency unit.
<i>Level 3</i>	Intensive care unit.
Neonatal unit admission	Admission of a baby to a neonatal unit. For the purpose of this report, admissions within 48 hours of being born were assessed.
Obesity	Body mass index (BMI) ≥ 30
<i>Class I</i>	BMI 30.0 – 34.9
<i>Class II (Severe obesity)</i>	BMI 35.0 – 39.9
<i>Class III (Morbid obesity)</i>	BMI ≥ 40.0
<i>Super-morbid obesity</i>	BMI ≥ 50.0
Observational study	In research about diseases or treatments, this refers to a study in which nature is allowed to take its course. Changes or differences in one characteristic (e.g. whether or not people received a specific treatment or intervention) are studied in relation to changes or differences in other(s) (e.g. whether or not they died), without the intervention of the investigator.
Obstetric unit	An NHS clinical location in which care is provided by a team, with obstetricians taking primary professional responsibility for women at high risk of complications during labour and birth. Midwives offer care to all women in an obstetric unit, whether or not they are considered at high or low risk, and take primary responsibility for women with straightforward pregnancies during labour and birth. Diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care, are available on site, 24 hours a day.
Odds ratio (OR)	Odds are a way of representing probability. They provide an estimate (usually with a confidence interval) for the effect of a treatment. Odds are used to convey the idea of 'risk' and an odds ratio of 1 between two treatment groups would imply that the risks of an adverse outcome were the same in each group. For rare events the odds ratio and the relative risk (which uses actual risks and not odds) will be very similar.
Parity	The classification of women according to the number of times they have given birth to a baby of more than 24 weeks' gestation.
Perinatal death	Death of a fetus or a newborn in the perinatal period that commences at 24 completed weeks' gestation and ends before seven completed days after birth.
Perinatal mortality rate	The proportion of stillbirths and early neonatal deaths per 1000 total births (live births and stillbirths).
Postpartum haemorrhage (PPH)	Blood loss of 500ml or more from the genital tract up to 6 weeks after labour.



Preeclampsia	Pregnancy-induced hypertension in association with proteinuria (> 0.3 g in 24 hours) ± oedema.
Pregnancy induced hypertension (PIH)	A generic term used to define a significant rise in blood pressure during pregnancy, occurring after 20 weeks' gestation.
Preterm	A birth before 37 weeks' gestation.
Prevalence	Prevalence is a frequently used epidemiological measure of how commonly a disease or condition occurs in a population at a particular point in time. The prevalence is calculated by dividing the number of persons with the disease or condition at a particular time point by the total number of individuals examined.
Primary postpartum haemorrhage	Blood loss of 500ml or more, occurring within 24 hours of birth.
Professional Judgement cases	Women within the CMACE cohort study and clinical audit that had no known BMI or weight but were judged by health professionals to have a BMI ≥35 in pregnancy.
Pulmonary embolism (PE)	A blockage of one of the arteries in the lung by a blood clot.
Small for gestational age (SGA)	A baby that has a birth weight less than the 10 th percentile of all babies with the same gestational age.
Stillbirth	A baby delivered without signs of life after 23+6 weeks of pregnancy.
Stillbirth rate	The proportion of stillbirths per 1000 total births (live births and stillbirths).
Strategic Health Authority (SHA)	SHAs are part of the structure of the National Health Service in England. Each of the 10 SHAs is responsible for enacting the directives and implementing fiscal policy as dictated by the Department of Health at a regional level. In turn, each SHA area contains various NHS trusts which take responsibility for running or commissioning local NHS services. The SHA is responsible for strategic supervision of these services.
Thromboprophylaxis	Prevention of thromboembolic disease.
Type 1 diabetes	A form of diabetes that usually develops during childhood or adolescence and is characterised by a severe deficiency of insulin secretion which causes hyperglycaemia.
Type 2 diabetes	A common form of diabetes that usually develops in adulthood and most often in obese individuals. It is characterised by hyperglycaemia resulting from impaired insulin utilisation coupled with the body's inability to compensate with increased insulin production.
Vaginal birth after caesarean (VBAC)	A vaginal birth after a previous caesarean section.
Venous thromboembolism (VTE)	A condition in which a blood clot (thrombus) forms in a vein, which in some cases then breaks free and enters the circulation as an embolus, finally lodging in and completely obstructing a blood vessel, e.g., in lungs causing a pulmonary embolism (PE). The term encompasses both DVT and PE.

Foreword

Obesity is arguably the biggest challenge facing maternity services today. It is a challenge not only because of the magnitude of the problem as almost one in five of pregnant women in the UK are obese, but also because of the impact that obesity has on women's reproductive health and that of their babies. Complication rates for women with obesity are substantially higher than in those without obesity, and these rates can potentially be reduced with high quality care. There are higher rates of miscarriage, fetal abnormality, blood pressure problems, diabetes, thrombosis, difficulty in delivery leading to higher caesarean rates, and infection following delivery. These complications pose particular challenges to aspects of our maternity services with increased need for appropriate facilities, resources to reduce, minimise and manage the higher frequency of complications and greater demands on midwives, obstetricians and anaesthetists who manage the complications. Of course the cost of this places an increased burden on our limited resources for maternity service. However, the overall solution lies more in the public health arena as the critical time to influence this is before pregnancy, thus the challenge of obesity is also high on our public health agenda in the UK, where reducing rates of obesity in the population will have significant impact on health in general and pregnancy in particular.

Because of these challenges, we welcome the results of this CMACE project and this timely report. It highlights the extent of the problem, identifies where we need to develop service provision and specific resource, and for the first time in the UK creates an integrated clinical guideline setting standards of maternity care for this population. Further, the assessment of existing care against these standards allows us to target the areas where action is needed to ensure high quality care for women with obesity who are pregnant. This report will influence maternity care for the better and inform the public health agenda as we strive to ensure that our services in the UK meet the growing challenge of obesity in pregnancy.



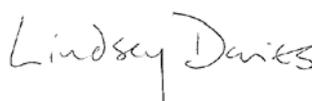
Dr Anthony Falconer
President, RCOG



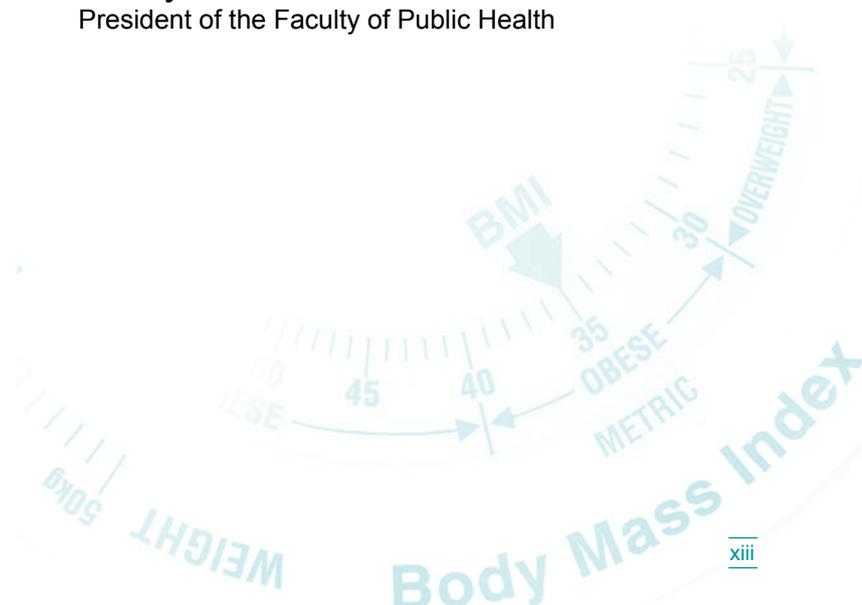
Professor Sir Sabaratnam Arulkumara
Immediate Past President, RCOG



Cathy Warwick
General Secretary, RCM



Lindsey Davies
President of the Faculty of Public Health



1. Key findings and recommendations

In 2008, the Confidential Enquiry into Maternal and Child Health (CEMACH), now known as the Centre for Maternal and Child Enquiries (CMACE), commenced a 3-year UK-wide Obesity in Pregnancy project. The project was initiated in response to a number of factors. At the time, these included: i) growing evidence that obesity is associated with increased morbidity and mortality for both mother and baby, ii) evidence from the CEMACH 'Saving Mothers' Lives' report showed that women with obesity were over-represented among those who died of direct deaths compared to those who died of indirect deaths,¹ iii) unknown national and regional prevalence rates of maternal obesity, and iv) the need for a national clinical guideline for the care of women with obesity in pregnancy. The project included four main modules:

- The development of national standards of care based on evidence and formal consensus methods
- A national survey of maternity services for women with obesity
- A national cohort study of 5068 women with maternal obesity (BMI ≥ 35) who gave birth in the UK during March and April 2009
- A national clinical audit of maternity care received by 905 women with a BMI ≥ 35 .

The project has identified a number of key findings, which are summarised below.

1.1. Key findings

1.1.1. Prevalence of Class II, Class III and super-morbid obesity in pregnancy

The UK prevalence of women with a known BMI ≥ 35 (Class II and Class III obesity) at any point in pregnancy, who give birth $\geq 24+0$ weeks' gestation, is 4.99%. This translates into approximately 38,478 maternities each year in the UK. The prevalence of women with a pregnancy BMI ≥ 40 (Class III obesity) in the UK is 2.01%, while super-morbid obesity (BMI ≥ 50) affects 0.19% of all women giving birth*.

The prevalence of maternal obesity varies between the UK nations and Crown Dependencies (Channel Islands and Isle of Man). Wales was found to have the highest overall prevalence of women with a pregnancy BMI ≥ 35 , with a rate of 6.5%, equivalent to 1 in 15 maternities. Wales had the highest rates of both Class II and Class III maternal obesity, while England had the lowest rates of maternal obesity. Super-morbid maternal obesity was not significantly different between UK nations.

1.1.2. Socio-demographic characteristics

An Index of Multiple Deprivation (IMD) score,² based on postcode of residence, was assessed in relation to quintiles of deprivation derived for the entire population of England. The most deprived quintiles were over-represented by the obese cohort compared to maternities in the general population. Thirty-four percent of pregnant women living in England with a BMI ≥ 35 were in the most deprived quintile, which compares to 27.6% for all maternities. These data support previously published findings that show social deprivation is associated with maternal obesity.³

Black and Minority Ethnic (BME) groups represented 14% of the cohort; BME groups represent 20% of the general maternity population.⁴ Women with a BMI ≥ 35 from BME groups were 3.5 times more likely to have type 2 diabetes and 1.6 times more likely to have gestational diabetes than White women with a BMI ≥ 35 . Even after controlling for diabetes, BME women were also more likely to have a caesarean section, have

* Total number of women giving birth in the UK during March and April 2009 (denominator) was 769740

their baby before 37 weeks' gestation and to stay in hospital for longer after both vaginal deliveries and caesarean sections.

The proportion of women aged 35 years or more increased with each increasing BMI group, with 31% of women with super-morbid obesity aged ≥ 35 years. Twenty percent of women in the general maternity population are aged ≥ 35 , which is significantly lower than the proportion of women with a BMI ≥ 40 who are aged ≥ 35 years.⁴ Age ≥ 35 was a risk factor for a number of co-morbidities among women in the cohort, including type 2 diabetes, gestational diabetes, pregnancy induced hypertension (PIH) and pre-eclampsia.

1.1.3. Clinical characteristics

Among the cohort of women in the observational study, 1103 (21.8%) had at least one morbidity (a disease or medical condition), in addition to obesity, diagnosed prior to the pregnancy, and 1180 (23.3%) women had a condition diagnosed during the pregnancy. A total of 38% of women within the cohort had at least one co-morbidity diagnosed prior to and/or during pregnancy. The most frequently reported conditions were pregnancy-induced hypertension and gestational diabetes, which were diagnosed in 9% and 8% of the cohort of women with a BMI ≥ 35 , respectively. The prevalence of these conditions was higher among each incremental BMI category ($P < 0.01$). Differences between BMI categories were also significant for the incidence of type 2 diabetes, pre-eclampsia and severe pre-eclampsia.

Ninety-eight percent of women with a BMI ≥ 35 gave birth in an obstetric unit. Under half of the women (47%) laboured spontaneously, 33% underwent an induction of labour and 20% had a caesarean section prior to labour. The spontaneous labour and induction rate in the general maternity population is 69% and 20%, respectively.⁵ Among women with a BMI ≥ 35 who laboured prior to delivery, each unit increase in BMI was associated with a 3% increased risk of induction of labour. Six percent of women with singleton pregnancies gave birth prematurely (< 37 weeks' gestation), which is similar to the preterm rate in the general population.

Only 55% of women with a BMI ≥ 35 had a spontaneous vaginal delivery without the use of instruments. Caesarean sections accounted for 37% of all singleton deliveries. This rate is substantially higher than the caesarean rate of 25% in the general maternity population in England.⁵ Caesarean section was more common in each increasing BMI category, with 46% of women with a BMI ≥ 50 delivering this way. Planned caesarean sections (Grade 4) represented 45% of all caesarean deliveries within the cohort. The ratio of elective to emergency caesarean section did not differ between BMI categories; however, the planned caesarean rate is higher than the national average rate of 40% in England.⁵ General anaesthesia was administered in 7.7% of all caesarean sections; this is also higher than the 5.5% rate in the general obstetric population.⁵

The incidence of primary postpartum haemorrhage (PPH) (defined as $\geq 500\text{ml}^{6,7}$) was 38% for women with a BMI ≥ 35 . This is almost four times higher than the rate in the general obstetric population.⁵ Pre-eclampsia, birth weight $> 4\text{kg}$, and caesarean section were all risk factors for PPH. After controlling for these, each BMI unit increment in women with a BMI ≥ 35 was associated with a 2.6% increase in risk of PPH. The incidence of major PPH ($> 1000\text{ml}$) was 5%. Low molecular weight heparin (LMWH) use in pregnancy was also associated with PPH; women receiving antenatal LMWH were 9.2 times more likely to have a major PPH than those not receiving LMWH in pregnancy. This differs from data in a systematic review of LMWH in pregnancy where low rates of PPH are encountered, raising the possibility of an interaction between LMWH use and obesity with regard to risk of PPH.⁸

Seventy-four percent of women having spontaneous vaginal births in the general maternity population spend one day or less in hospital.⁵ The rate of 58% in women with a BMI ≥ 35 is much lower in comparison. Women with a BMI ≥ 35 were also more likely to stay in hospital for seven days or longer after childbirth compared to the general maternity population, even after adjusting for mode of delivery.⁵

1.1.4. Poor pregnancy outcomes

The babies of women with a pregnancy BMI ≥ 35 have an increased risk of perinatal mortality compared with those of the general maternity population in the UK.⁹ There were 43 stillbirths in the cohort (median gestation 37.1 weeks, range 24.6-42.3), corresponding to a rate of 8.6 stillbirths per 1000 singleton births. This rate is substantially higher than the general population rate of 3.9 per 1000 total births[†], and supports other studies, which indicate that obese women are approximately twice as likely to have a stillborn baby as women with a healthy BMI.^{10 11} The stillbirth rate increased with increasing BMI. BMI categories 35.00-39.99, 40.00-49.99 and ≥ 50 had stillbirth rates of 7.9, 8.8 and 15.8 per 1000 singleton births, respectively. Among women with a BMI ≥ 35 , each unit increase in BMI was associated with a 7% increased risk of stillbirth.

Intrapartum stillbirths accounted for 11.9% of the cohort's singleton stillbirths (1.0 per 1000 births). This is much higher than the rate in the general population (8.4%) in England, Wales and Northern Ireland (0.33 per 1000 births).⁹

Approximately 20% of the singleton babies were large for their gestational age (LGA), defined by weight $\geq 90^{\text{th}}$ percentile for gestation, which is twice as high as expected in the general population of births. LGA babies were more common among each increasing BMI group, with one third of women with a BMI ≥ 50 having a LGA baby, compared to 16% born to women with a BMI 35-39.9. Women with diabetes were also more likely to have a LGA baby than women without diabetes (40% vs. 17%). There was an interaction between BMI group and diabetes status, and, although a greater proportion of women with diabetes had a LGA baby, the relationship between BMI and LGA was more pronounced among women without diabetes.

Neonatal unit admissions (within 48 hours of birth) correlated directly with maternal BMI. Among babies born at term (37-42 weeks' gestation), the neonatal unit admission rate was 4.2%, 5.9% and 9.9% for those born to mothers with a BMI 35-39.9, BMI 40-49.9 and BMI ≥ 50 , respectively. Babies born to mothers with a BMI ≥ 50 were almost twice as likely to be admitted to the neonatal unit as babies born to mothers with a BMI 35-39.9, even after adjusting for maternal age, parity, maternal diabetes and gestation at delivery.

1.1.5. Preconception care

The CMACE/RCOG Joint Guideline on the management of women with obesity in pregnancy (2010)¹² recommends that women of childbearing age with a BMI ≥ 30 should receive information and advice about the risks of obesity during pregnancy and childbirth, and they should be supported to lose weight before conception. In the organisational survey of all maternity units in the UK, only 12 (6%) obstetric units reported providing preconception care and advice to obese women. While this does not take into account advice given in primary care or in the community, this finding does highlight that appropriate preconception services provided by maternity units are not yet readily available to women with obesity.

[†] UK national stillbirth rate adjusted after removing terminations of pregnancy and babies born <24 weeks' gestation. This rate is lower than the rate published in the CMACE 2008 Perinatal Mortality Report, which included babies born <24 weeks' gestation.

Women with a BMI ≥ 30 wishing to become pregnant should be advised to take 5mg of folic acid supplementation daily, starting at least one month before conception and continuing during the first trimester of pregnancy, in order to reduce the risk of neural tube defects, which are more prevalent among women with obesity[‡].¹²

The CMACE national clinical audit, which preceded the national recommendation for 5mg of folic acid supplementation in women with obesity, found that both the use and dosage of folic acid supplementation was poorly documented within maternity notes, particularly for the pre-pregnancy period. Folic acid use before pregnancy was documented in just over half of all audited cases. Of these, 71% of women had not taken folic acid, 21% had taken folic acid but the dosage had not been documented, 7% had supplemented with 400 micrograms and 1.4% was known to have supplemented with the recommended 5mg dose prior to pregnancy. This latter figure rose to 2.1% in the first trimester of pregnancy.

1.1.6. Clinical care during pregnancy

1.1.6.1. Measuring height, weight and calculating body mass index

Ninety-seven percent of all women reported to CMACE during the observational cohort study had an antenatal weight recorded, while 96% had both weight and height recorded, thereby allowing a calculation of BMI. The gestation at which the weight measures were recorded was known for 91% of the cohort. Of these, 85% had a weight recorded at booking, representing 77% of the study cohort. A further 3.4% had a weight recorded within two weeks of booking, 2.8% between two and four weeks of booking, and 6.5% >4 weeks from booking but before delivery. A small proportion of women (2.5%) had a pregnancy weight that was documented prior to the booking appointment.

1.1.6.2. Provision of information

Evidence of providing information about the risks associated with obesity in pregnancy was documented in fewer than one fifth of the cases audited. Information was more likely to be given to women with a BMI ≥ 40 compared to women with a BMI 35.00-39.99 (24% vs. 13%).

1.1.6.3. Thromboprophylaxis

The documentation of venous thromboembolism (VTE) risk at booking was poor, even for women identified as being at high risk, according to the RCOG Clinical Green-top Guideline No. 37.¹³ Of the 14 women in the audit cohort who had a moderate or high risk of VTE, three had this risk noted at booking and six were offered LMWH antenatally. The RCOG guideline recommends that women identified as having a lower level of elevated risk, based on the presence of certain risk factors, should also be considered for LMWH. Of the 849 women identified in the lower level of elevated risk category, only 10% had VTE risk documented at booking and only 3.3% were offered LMWH. A further 15 women were prescribed low dose aspirin for thromboprophylaxis (which is not recommended for this purpose).

Eighty-five percent of women receiving antenatal LMWH were prescribed doses considered insufficient for their body weight according to guidelines that were current at the time of care.¹⁴ Just 3% were prescribed a higher prophylactic dose. No women had documented evidence of a therapeutic dose of LMWH.

[‡] The Department of Health advise that all pregnant women (including those with a BMI >30) take a folic acid supplement at the usual dose of 400 micrograms/day from before pregnancy until the 12th week of pregnancy.

1.1.6.4. Antenatal anaesthetic review

All women with a BMI ≥ 40 should have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties can be identified, and an anaesthetic management plan for labour and delivery should be documented in the records.¹² Forty-five percent of women with a BMI ≥ 40 had a written anaesthetic management plan. A further 15% of women were offered a consultation but did not have a written plan, which was considered to indicate that the consultation did not take place.

1.1.6.5. Manual handling requirements and tissue viability issues

Despite 53% of surveyed maternity units reporting that they use a risk assessment tool to assess the risk of pressure damage, only 10% of women with a BMI ≥ 40 whose notes were audited had a documented assessment for tissue viability. An assessment for manual handling requirements was documented in only 14% of cases with a BMI ≥ 40 .

1.1.7. Clinical care during labour and delivery

It is recommended that an obstetrician and an anaesthetist both at Speciality Trainee year 6 (ST6) and above should be informed and available to care for women with a BMI ≥ 40 during labour and delivery, including attending any operative vaginal or abdominal delivery.¹² The clinical audit found that an obstetrician, of ST6 or above, attended 67% of instrumental vaginal and caesarean deliveries among women with a BMI ≥ 40 . The anaesthetist, also at ST6 or above, attended 61% of these deliveries.

1.1.8. Postpartum care and follow-up

1.1.8.1. Thromboprophylaxis

Postnatal thromboprophylaxis was underused, both in terms of it being offered and in terms of the duration for which it was prescribed. Women with a high or moderate risk of VTE should receive LMWH for six weeks after giving birth. Of the fourteen women with a high or moderate risk, eight were prescribed LMWH. The duration of LMWH use was insufficient, in terms of the recommendations in the applicable guideline, in five cases and not documented in three cases. The RCOG Guideline No. 37 (2004) recommends LMWH for three to five days for women in the VTE lower 'at risk' category. Of the 784 women identified in this category, 49% were offered LMWH and 20% (n=158) received it for ≥ 3 days.

Women with a BMI ≥ 40 should be offered postpartum thromboprophylaxis, regardless of their mode of delivery.^{12 13} Postpartum LMWH was offered to 55% of women with a BMI ≥ 40 . Women having caesarean sections were much more likely to receive LMWH compared to women giving birth vaginally (94% vs. 30%) (caesarean section is recognised as a specific risk factor for VTE in addition to obesity).

1.1.8.2. Nutritional advice

All women with a booking BMI ≥ 30 should continue to receive nutritional advice following childbirth from an appropriately trained professional, with a view to weight reduction.¹² However, documented evidence of a postnatal referral to a dietician or nutritionist was found for only 4% of women.

1.1.8.3. Follow-up tests for women with gestational diabetes

Evidence of a referral for a test of glucose tolerance within two months of giving birth was documented for two thirds of women with gestational diabetes mellitus (GDM). As this is a modifiable risk factor for long term health issues, it is important to emphasise the need for such screening after delivery.

1.1.9. Facilities and equipment in maternity units

The availability of appropriate equipment in the event of an unplanned admission to a maternity unit of a woman with super-morbid obesity was generally inadequate. Approximately two thirds of units in the UK reported not having immediate access to appropriate extra-wide wheelchairs, examination couches, trolleys or ward beds. Furthermore, the majority of facilities and equipment in maternity units did not have the minimum safe working load of 250kg recommended by the CMACE/RCOG guideline for the management of women with obesity in pregnancy.¹² Facilities such as weighing scales, which are essential to ensure correct doses of medication such as thromboprophylaxis,¹³ were mainly concentrated in outpatient areas which may not be easily accessible out-of-hours.

1.2. Key recommendations

Key recommendations have been developed based on the main findings arising from this national project. These recommendations are proposals made by CMACE for an appropriate course of action to be taken by external organisations and/or individuals in relation to a specific area of health care. These comply with the CMACE recommendation policy, which aims to ensure a consistent and transparent approach to the development of recommendations, enabling stakeholders and users of CMACE reports to have a full understanding of, and confidence in, the process by which recommendations have been made. A copy of the policy is available from CMACE, and the process used to develop these recommendations is described in Chapter 3 of the report.

Recommendation 1: Pre-pregnancy counselling

Preconception counselling and support, both opportunistic and planned, should be provided for women of childbearing age with a BMI ≥ 30 . This advice and support should be available in both Primary care and Secondary care. Pre-pregnancy counselling should include:

- Accurate height and weight measurement and BMI calculation
- Consideration given to screening for type 2 diabetes
- Provision of information about the risks of obesity in pregnancy and childbirth
- Advice and support to lose weight prior to conception
- Advice on appropriate supplementation prior to conception (5mg folic acid[§] and 10µg vitamin D), as recommended by NICE.¹⁵

Recommendation type: Good practice point

[§] The Department of Health advise that all pregnant women (including those with a BMI >30) take a folic acid supplement at the usual dose of 400 micrograms/day from before pregnancy until the 12th week of pregnancy.

Supporting evidence

Women with obesity have an increased risk of pregnancy-related complications and adverse outcomes compared to women with a healthy BMI, and findings from the CMACE observational study show that increasing levels of obesity are associated with increasing levels of fetal abnormality, hypertensive disorders, gestational diabetes mellitus, induction of labour, caesarean section, postpartum haemorrhage, stillbirth, large for gestational age and neonatal unit admissions.

A Swedish population-based observational study of 151,025 women examined the association of change in BMI between successive pregnancies with adverse outcomes during the second pregnancy. The risk of pre-eclampsia, gestational diabetes mellitus (GDM), large for gestational age babies, caesarean section and stillbirth was linearly related to inter-pregnancy weight gain.¹⁶

Observational evidence shows that pre-pregnancy BMI is inversely associated with serum vitamin D and folate concentrations among pregnant women, and women with obesity (BMI ≥ 30) are at increased risk of vitamin D and folate deficiency compared to women with a healthy BMI (BMI < 25).^{17, 18} Cord serum vitamin D levels in babies of women with obesity have also been found to be lower than babies born to non-obese women.¹⁷

Rationale

It is important that women are aware of the increased risk of maternal and fetal complications associated with obesity, and they should have the opportunity to minimise the risk of these complications prior to pregnancy.

Only 6% of obstetric units in the UK reported providing preconception care and advice to women with obesity. While this does not take into account advice given in primary care or in the community, appropriate preconception services provided by maternity units are not yet readily available to women with obesity.

Targeting women with obesity at opportunistic times before a pregnancy (e.g. during family planning appointments and weight management clinics), may allow them time to lose sufficient weight to lower their risk prior to conception.

Brief interventions can be delivered by all healthcare professionals involved in preconception care, in all settings, and are an evidence-based method towards behaviour change and lifestyle improvement.

Recommendation 2: Folic acid supplementation

Women with obesity have an increased risk of having a baby with congenital malformations, including neural tube defects.¹⁹ Women with a BMI ≥ 30 wishing to become pregnant should be advised to take 5mg folic acid supplementation daily, starting at least one month before conception and continuing during the first trimester of pregnancy, as recommended by the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹²

Awareness of the importance of supplementing with high-dose folic acid should be raised at opportunistic times, even prior to a woman planning a pregnancy.

Folic acid use both before and during pregnancy should be documented in the antenatal notes. Women with a BMI ≥ 30 who are not taking 5mg folic acid supplementation daily at the time of booking should be advised to do so for the first trimester[†].

Recommendation type: Clinical care and service provision

[†] The Department of Health advise that all pregnant women (including those with a BMI > 30) take a folic acid supplement at the usual dose of 400 micrograms/day from before pregnancy until the 12th week of pregnancy.

Supporting evidence

Women with obesity are at increased risk of having a baby with a neural tube defect.¹⁹ There is high-level evidence (Level 1++) showing that folic acid deficiency is associated with neural tube defects.²⁰ In women at high risk of fetal NTD (due to previous pregnancy with NTD), high doses of folic acid supplementation reduce the risk of a subsequent NTD-affected pregnancy by 72%.²¹

The CMACE national clinical audit found that both the use and dosage of folic acid supplementation was poorly documented within maternity notes, particularly for the pre-pregnancy period. Folic acid use before pregnancy was documented in just over half of all audited cases. Of these, under one third of women with a BMI ≥ 35 supplemented with folic acid prior to pregnancy and only 1.4% are known to have supplemented with the recommended 5mg dose. These findings lend support to previous research that found women with obesity are less likely to use nutritional supplements than women with a healthy BMI.¹⁸

Rationale

High dose folic acid supplementation is recommended for women with obesity in order to minimise the risk of NTDs.¹² A 5mg dose has previously been recommended for women with diabetes, as diabetes is also associated with an increased risk of NTD-affected pregnancy, and also for women with a history of NTD-affected pregnancies.²² Few women with a BMI ≥ 35 currently supplement with this high dose, and the importance of taking 5mg of folic acid should be highlighted.

Recommendation 3: Antenatal care

Obesity in pregnancy is associated with an increased risk of a number of pregnancy-related complications and adverse outcomes. Women with obesity should therefore receive routine care supplemented by specialist services and facilities that are specific to their needs. Specialist midwives, senior anaesthetic expertise and a review by a senior team in the antenatal clinic may be required.

Recommendation type: Clinical care and service provision

Supporting evidence

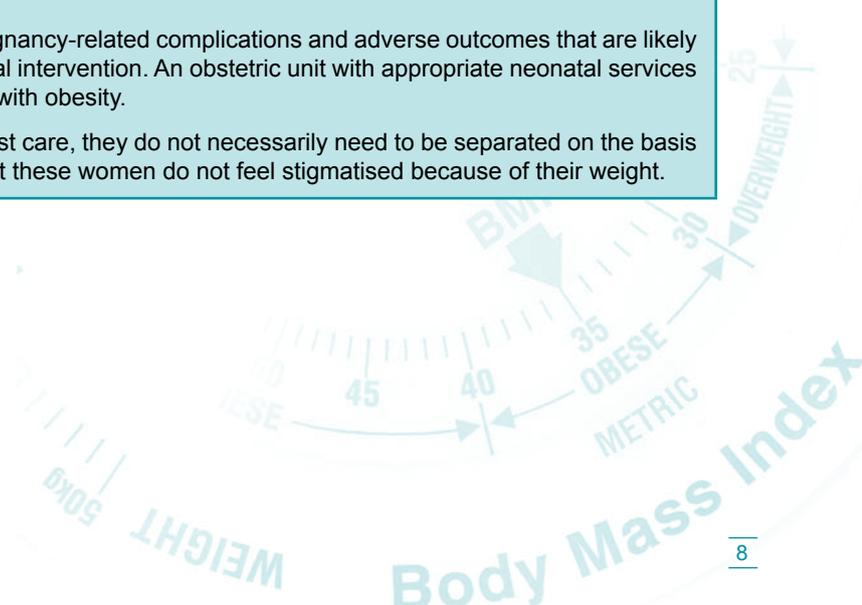
Obesity in pregnancy is associated with an increased risk of a number of pregnancy-related complications and serious adverse outcomes, including miscarriage,²³ fetal congenital anomaly,¹⁹ thromboembolism,^{24 25} gestational diabetes,²⁶ pre-eclampsia,²⁷ dysfunctional labour,²⁸ postpartum haemorrhage,²⁶ wound infections,²⁶ stillbirth^{10 29} and neonatal death.^{11 29 30} There is also a higher caesarean section rate³¹ and lower breastfeeding rate³² among women with obesity compared to women with a healthy BMI.

Findings from the CMACE observational study show that, among women with a BMI ≥ 35 , increasing levels of obesity are associated with increasing levels of fetal abnormality, hypertensive disorders, gestational diabetes mellitus, induction of labour, caesarean section, postpartum haemorrhage, stillbirth, large for gestational age and neonatal unit admissions.

Rationale

Women with obesity have an increased risk of pregnancy-related complications and adverse outcomes that are likely to require specialist facilities, expertise and medical intervention. An obstetric unit with appropriate neonatal services is best placed to provide suitable care for women with obesity.

Although women with obesity may require specialist care, they do not necessarily need to be separated on the basis of obesity, and care should be taken to ensure that these women do not feel stigmatised because of their weight.



Recommendation 4: Measuring height, weight and calculating body mass index

All pregnant women should have their weight and height measured using appropriate equipment, and they should have their body mass index (BMI) calculated accurately at the antenatal booking visit, as recommended by the Joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹² Measurements should be recorded in the handheld notes and electronic patient information system.

Maternal weight should be re-measured in the third trimester to allow appropriate plans to be made for equipment and personnel required during labour and delivery.

Re-measurement of weight on admission to delivery suite will facilitate dose calculation of drugs required during labour. A weight after delivery may also be necessary to guide dose calculation for women requiring postnatal medication (e.g. thromboprophylaxis). Weighing scales should be routinely accessible in all delivery settings to enable the assessment of weight.

Self-reported weights and heights should not be used as a substitute for accurate weight and BMI assessment.

Recommendation type: Clinical care and service provision

Supporting evidence

In response to the CMACE survey, 16% of maternity units in the UK reported most frequently documenting a weight that was self-reported by the woman. Self-reported weight is often underestimated, particularly in obese women,³³ which may lead to an inaccurate risk assessment during pregnancy.

Approximately 20% of women in the CMACE observational study did not have their weight documented in the notes at the booking appointment, and only 31% of women with at least one antenatal weight had it measured on at least two separate occasions during pregnancy.

The CMACE study found that, of the 1759 women receiving anaesthesia during delivery, only one third had a weight recorded in the third trimester.

Some women in the observational cohort gained up to 30kg during their pregnancy. This highlights the critical importance of calculating appropriate medication dosage using an accurate and current weight.

Rationale

Appropriate management of women with maternal obesity can only be possible with consistent identification of those women who are at increased risk of complications.

The process of accurate measurement, and sensitive communication, of BMI in pregnancy constitutes a key time when a brief intervention can be most effective in precipitating behaviour and lifestyle change.

Weight re-measurement and BMI calculation is important as gestational weight gain varies between individuals and some women are known to gain up to 30 to 40 kg during pregnancy. This gain may represent a 10 to 15 unit increase in BMI, which may have implications for care during labour and delivery.

Recommendation 5: Information giving during pregnancy

All pregnant women with a booking BMI ≥ 30 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how these risks may be minimised. This is also recommended in the Joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹² Women should be given the opportunity to discuss this information with health professionals who have been trained in the management of maternal obesity.

The aim is to provide appropriate information sensitively, which empowers the woman to engage actively with health professionals and the services available to them. Relevant information should include:

- The increased risk of hypertensive disorders, gestational diabetes and fetal macrosomia requiring an increased level of maternal and fetal monitoring
- The potential for poor ultrasound visualisation of the baby and consequent difficulties in fetal surveillance and screening for anomalies
- The increased risk of induction of labour
- The potential for intrapartum complications, including difficulty with fetal monitoring, anaesthesia and caesarean section which would require senior obstetric and anaesthetic involvement and an antenatal anaesthetic assessment, and potential for emergency caesarean section
- The need to prioritise the safety of the mother at all times
- The importance of healthy eating and appropriate exercise during pregnancy for the management of weight gain
- The importance of breastfeeding and opportunities to receive additional breastfeeding support.

Nutritional advice by an appropriately trained professional may be useful early in the pregnancy.

Recommendation type: Good practice point

Supporting evidence

Findings from the CMACE observational study show that increasing levels of obesity are associated with increasing levels of pregnancy complications and adverse outcomes, including fetal abnormality, hypertensive disorders, gestational diabetes mellitus, induction of labour, caesarean section, postpartum haemorrhage, stillbirth, large for gestational age and neonatal unit admissions.

Eighteen percent of maternity units in the UK reported providing printed information for women specifically focused on the issue of obesity and pregnancy and 33% reported providing specific dietetic advice to all women with obesity.

The CMACE audit found documented evidence of providing information about the risks associated with obesity in pregnancy in fewer than one fifth of audited cases.

Documented evidence of discussions relating to potential intrapartum complications associated with obesity was also found in fewer than one fifth of audited cases. Only 55% of women with singleton pregnancies had a spontaneous vaginal delivery and 21% had an emergency caesarean section.

Rationale

While preconception advice and care is the ideal scenario for women with obesity, those women presenting for the first time during pregnancy should be given an early opportunity to discuss potential risks and management options with a healthcare professional and those who have had pre-pregnancy counselling should receive further advice on these risks. The purpose is to encourage women to have realistic expectations for their pregnancy and birth experience and to understand the need for increased levels of medical surveillance and intervention. Additionally, it is anticipated that by providing this important information sensitively, women will feel more empowered to actively engage with health professionals and the services available to them.

Every contact between a healthcare professional and a pregnant woman with obesity offers the opportunity for a brief intervention on weight management to be delivered in an effective and opportunistic way.



Recommendation 6: Surveillance and screening

Women with obesity have an increased risk of gestational diabetes mellitus, pre-eclampsia and fetal abnormalities, and they should have surveillance and screening according to existing guidance.^{34 35}

The Pre-eclampsia Community Guideline³⁴ outlines appropriate surveillance and recommends:

- Women with a booking BMI ≥ 35 who also have at least one additional risk factor for pre-eclampsia should have referral early in pregnancy for specialist input to care.

Additional risk factors include:

- first pregnancy
 - ≥ 10 years since last baby
 - ≥ 40 years of age
 - multiple pregnancy
 - previous pre-eclampsia
 - family history of pre-eclampsia
 - diastolic BP ≥ 80 mmHg at booking
 - proteinuria $\geq 1+$ on more than one occasion or ≥ 0.3 g/24 hours
 - certain underlying medical conditions such as antiphospholipid antibodies or pre-existing hypertension, renal disease or diabetes.
- Women with a booking BMI ≥ 35 with no additional risk factor are suitable for community monitoring for pre-eclampsia at a minimum of 3-weekly intervals between 24 and 32 weeks gestation, and 2-weekly intervals from 32 weeks to delivery.

The NICE Clinical Guideline No. 63 (Diabetes in Pregnancy)³⁵ recommends that women with a BMI ≥ 30 have a 2-hour 75g oral glucose tolerance test (OGTT) at 24-28 weeks, using the criteria defined by the World Health Organisation.

Recommendation type: Clinical care and service provision

Supporting evidence

A number of good quality observational studies have shown clearly that obesity is associated with an increased risk of pre-eclampsia.^{11 26 27 36-41}

Maternal obesity is known to be an important risk factor for gestational diabetes mellitus (GDM), with a number of large cohort studies reporting a three-fold increased risk compared to women with a healthy BMI.^{26 36-38 41}

The CMACE observational study found that 13% of the cohort had hypertensive disorders diagnosed during their pregnancy and 8% had GDM. In the general maternity population in England, these conditions are diagnosed in approximately 4% and 2.5% of women, respectively.⁵

A randomised controlled trial of 1000 women with GDM found that treatment, comprising dietary advice, blood glucose monitoring and insulin therapy as needed, significantly reduced the risk of a composite measure of serious adverse perinatal outcome (death, shoulder dystocia, bone fracture, and/or nerve palsy) compared to routine care, where women and their care providers were unaware that GDM was present (adjusted RR 0.33, 95% CI 0.14–0.75).⁴²

The CMACE audit revealed that 73% of women with a BMI ≥ 35 were offered a test for GDM and not all of these had an OGTT performed.

Rationale

Women with obesity are at increased risk of co-morbidities. Hypertensive disorders and GDM appear to be the most common co-morbidities in this population of women. These conditions are associated with an increased risk of adverse pregnancy-related outcomes, and screening and surveillance is necessary so that these conditions can be managed appropriately and effectively.

Recommendation 7: Anaesthesia in pregnancy and labour

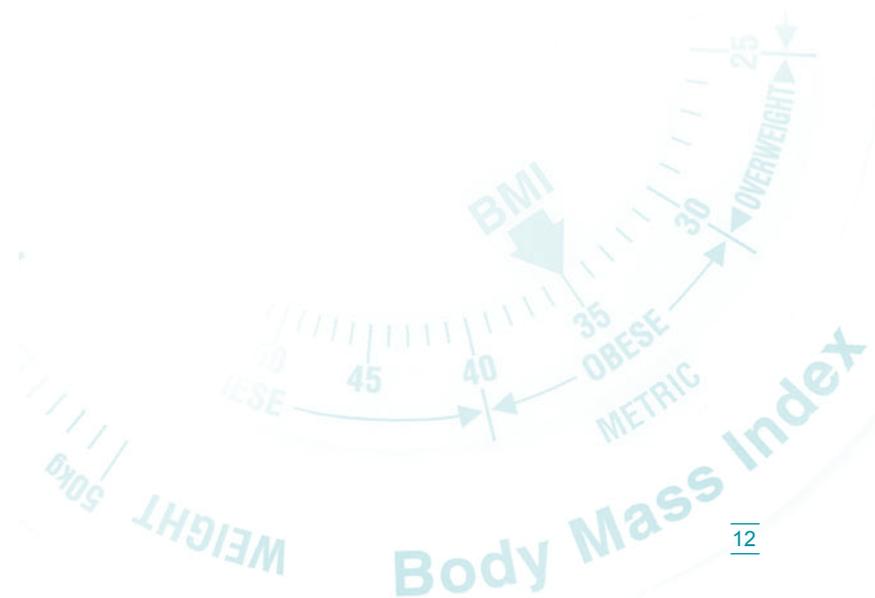
Pregnant women with a booking BMI ≥ 40 should have an antenatal anaesthetic consultation with an obstetric anaesthetist, as recommended by the Joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹² An anaesthetic consultation should allow potential difficulties with venous access, regional or general anaesthesia to be identified and anticipated.

Women with a BMI < 40 with anticipated problems relating to co-morbidities, airway management, vascular access and regional anaesthetic techniques may also require an antenatal anaesthetic consultation.

Maternity services may decide to use a lower BMI threshold, taking into consideration the local prevalence of maternal obesity.

Consideration should be given to the timing of an epidural, particularly for women with a BMI ≥ 40 .^{43 44}

Recommendation type: Clinical care and service provision



Supporting evidence

Pregnant women with obesity are at higher risk of anaesthesia-related complications than women with a healthy BMI, and obesity has been identified as a significant risk factor for anaesthesia-related maternal mortality.^{1,45}

The CMACE audit found that only 45% of women with a BMI ≥ 40 had a written anaesthetic management plan for delivery. This highlights the need to make anaesthetic consultations more widely available to women at increased risk of anaesthesia-related complications.

Rationale

Epidural re-site rates have been reported to increase with increasing BMI,²¹ and the initial failure rate of epidural cannulation in parturients with morbid obesity has been reported to be as high as 42% in one hospital.³⁹ For these reasons, an early epidural may be advisable.

Anaesthetic challenges may lead to increased decision to delivery time if emergency operative delivery is required, and they may increase anaesthetic morbidity. Advanced warning of such challenges may influence the planned mode of delivery and allow appropriate staff to be made available.

The risk of anaesthesia-related complications increases with increasing BMI. A BMI cut-off ≥ 40 has been recommended after consideration given to the balance of medical intervention versus risk, prevalence and resource implications.

If general anaesthesia is required, pre-oxygenation should be performed in the reversed Trendelenberg position (a 25 degree head up tilt) in order to delay the onset of hypoxia after induction of anaesthesia,^{46,47} and intubation should be performed in the ramped position to aid endotracheal intubation and reduce the risk of failed intubation.⁴⁸ The ramped position involves extending the neck and the atlo axial joint until the external auditory meatus is in a horizontal plane with the sternal notch.

Recommendation 8: Thromboembolism and thromboprophylaxis

Health professionals must be aware that women are at risk of thromboembolism from the very beginning of pregnancy, and that this risk increases significantly for women with obesity.

At booking, a full risk and needs assessment must be undertaken and documented clearly in the maternity notes. Women with a BMI ≥ 30 should be assessed throughout pregnancy for the risk of thromboembolism.

Antenatal and postnatal thromboprophylaxis should be considered in accordance with the RCOG Clinical Green-top Guideline No. 37.¹³

The RCOG Clinical Green-top Guideline No. 37 advises that:

- A woman with a BMI ≥ 30 who also has two or more additional risk factors for thromboembolism should be considered for prophylactic LMWH antenatally. This should begin as early in pregnancy as practical.
- All women receiving LMWH antenatally should usually continue prophylactic doses of LMWH until six weeks postpartum, but a postnatal risk assessment should be made.
- All women with a BMI ≥ 40 should be offered postnatal thromboprophylaxis regardless of their mode of delivery.
- Women with a booking BMI ≥ 30 requiring pharmacological thromboprophylaxis must be prescribed doses appropriate for their current weight:¹³

Weight(kg)	Doses
91-130	60 mg Enoxaparin; 7500 units Dalteparin; 7000 units Tinzaparin daily
131-170	80 mg Enoxaparin; 10000 units Dalteparin; 9000 units Tinzaparin daily
>170	0.6 mg/kg/day Enoxaparin; 75 units/kg/day Dalteparin; 75 units/kg/day Tinzaparin

Recommendation type: Clinical care and service provision

Supporting evidence

Maternal obesity is associated with a significant risk of thromboembolism during both the antenatal and postnatal period. A retrospective case-control study in Denmark, including 129 women with deep vein thrombosis (DVT) or pulmonary embolism (PE) during pregnancy or the puerperium and 258 controls (pregnant women with no venous thromboembolism), showed a significant association between venous thromboembolism and BMI ≥ 30 (adjusted OR (aOR) 5.3, 95% CI 2.1–13.5).²⁵ More recently, a national matched case-control study conducted by the United Kingdom Obstetric Surveillance System (UKOSS) reported that a BMI ≥ 30 was associated with an aOR of 2.65 (95% CI 1.09–6.45) for antenatal pulmonary thromboembolism (PTE).⁴⁹

The CMACE audit found that the documentation of venous thromboembolism (VTE) risk at booking was poor, even for women identified by CMACE as being at high risk, according to the RCOG Green-top Guideline No 37.¹³

NICE estimates that LMWH reduces VTE risk in medical and surgical patients by 60% and 70%, respectively.⁵⁰ It is reasonable, therefore, to assume that it may reduce the risk of VTE in obstetric patients by a similar magnitude.

LMWH was under-prescribed in the cases audited by CMACE. Fewer than 50% of women classified as having a moderate or high risk of VTE received LMWH antenatally and only 9% of women with obesity and two or more additional risk factors received LMWH. LMWH was also under-prescribed postnatally, and the duration of LMWH use was insufficient for almost all women, regardless of their level of risk. Additionally, 84% of women with LMWH were prescribed doses considered insufficient for their body weight.

Rationale

Maternal obesity is associated with a significant risk of thromboembolism during both the antenatal and postnatal period,^{25 49} and thromboembolism is the most common cause of direct maternal death.¹

The CMACE findings highlight the importance of ensuring that all maternity staff members are aware of how to assess thromboembolism risk according to the RCOG Green-top Guideline No 37. Appropriate referrals must be made and LMWH should be prescribed appropriately in order to manage risk.

Recommendation 9: Place and mode of birth

The risk of complications and adverse pregnancy-related outcomes increases with increasing BMI. Women with a BMI ≥ 35 should give birth in a consultant-led obstetric unit with appropriate neonatal services, as recommended by the NICE Clinical Guideline No. 55 (Intrapartum Care)⁵¹ and Joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy,¹² so that immediate intervention is available in the event of intrapartum and postpartum complications and emergencies. An individual risk assessment regarding planned place of birth for women with a booking BMI 30-34.9 should be performed.

On admission for delivery, all women with a BMI ≥ 40 should be assessed by midwives, obstetricians and anaesthetists to identify any extra staff, equipment and facilities that may be required during childbirth.¹² These requirements need to be prepared in anticipation of the need for emergency operative delivery.

To minimise the risk of complications, venous access should be established early on in labour, and an obstetrician and an anaesthetist at Speciality Trainee year 6 and above, or with equivalent experience in a non-training post, should be informed and available for the care of women with a BMI ≥ 40 during labour and delivery.

1. Key findings and recommendations

Women with obesity require an individual assessment regarding the best mode of delivery. This assessment should take in to account previous pregnancies, pregnancy complications and co-morbid conditions, in view of the risk of labour complications requiring emergency caesarean section with anaesthetic and surgical challenges associated with increased morbidity.

The decision for mode of delivery should therefore be taken only after careful consideration of the individual circumstances and in conjunction with the full multidisciplinary team and the woman herself. In the absence of obstetric or medical indications, labour and vaginal delivery should be encouraged for women with obesity.

Attempts should be made as soon as possible to initiate breastfeeding, regardless of mode of delivery or place of birth.

All plans should be clearly documented in the maternity notes.

Recommendation type: Clinical care and service provision

Supporting evidence

Observational studies have shown that there is a higher incidence of intrapartum complications among women with obesity compared to women with a healthy BMI. There is an increased risk of slow labour progression,^{26 37} shoulder dystocia,^{11 52} emergency caesarean section,^{26 52} and an increased risk of primary postpartum haemorrhage.^{26 52} Immediate obstetric intervention may therefore be vital. In addition, babies born to mothers with obesity are up to 1.5 times more likely to be admitted to a neonatal intensive care unit than babies born to mothers with a healthy BMI.^{26 37 52} The odds of admission have been shown to increase with each increasing BMI category, similar to those defined by WHO.³⁸

The correlation between BMI and caesarean section is supported by findings from the CMACE observational study. Caesarean sections accounted for 37% of all singleton deliveries among women with a BMI ≥ 35 . Caesarean section was more common in each increasing BMI category. The ratio of elective to emergency caesarean section did not differ between BMI categories, indicating increasing BMI is associated with increasing risk for emergency caesarean delivery.

The CMACE observational study also found a direct correlation between maternal BMI and neonatal unit admissions, with admission rates of 4.2%, 5.9% and 9.9% for babies born to mothers with a BMI 35-39.9, 40-40.9 and ≥ 50 , respectively.

Despite the risk of intrapartum complications requiring urgent medical intervention, the CMACE audit found that 41% of women who laboured prior to delivery did not have venous access established.

Rationale

Both the NICE Clinical Guideline No. 55⁵¹ and the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy¹² recommend that women with a BMI ≥ 35 should be advised to give birth in an obstetric unit with appropriate neonatal services, so that immediate care can be provided in the event of a complication or emergency. Immediate access to appropriate care and intervention may lower the risk of adverse outcomes, and appropriate assessment by midwives, obstetricians and anaesthetists on admission for delivery should avoid delays in performing required medical interventions.

Women with obesity have a high caesarean section rate and, specifically, a high caesarean rate in labour because of complications. Careful consideration should therefore be given to the decision for mode of delivery.

Breastfeeding rates among women with obesity are lower than rates among women with a healthy BMI. Women with obesity may therefore benefit from additional breastfeeding support, both antenatally and postnatally.

Recommendation 10: Service organisation

Links with existing public health services for effective weight management should be made at local levels, and pathways for referral into these services incorporated into local maternity guidelines for preconception, antenatal and postnatal care.

Recommendation type: Providers and/or commissioners

Rationale

In order to meet the needs of pregnant women with obesity, maternity services should consider the transition of care between pregnancy and the postnatal period, improve communication between hospital and public health services, and develop services that will engage pregnant women to address their obesity.⁵³

Results from the CMACE report show a low rate of referrals (4%) to dietitians and nutritionists postnatally for women with a BMI ≥ 35 . Maternity service provision should be linked to care pathways as recommended by NICE.⁵⁴ Such pathways would facilitate assessment by dieticians and nutritionists postnatally.

Recommendation 11: Areas for further research

Further research is required in the following areas:

- Effective communication of risks associated with obesity
- Weight management and behavioural change regarding diet and exercise
- Optimal weight gain during pregnancy for women in different BMI categories
- Effective interventions for weight management during pregnancy and after pregnancy
- Causes of stillbirth in women with obesity
- Factors predicting optimal timing and mode of delivery
- Optimal way to deliver specialist services.

Recommendation type: Further research

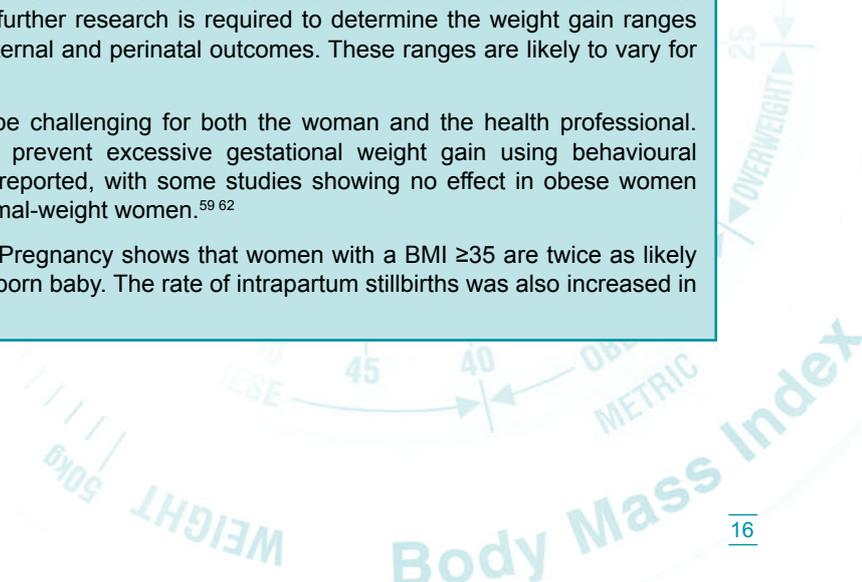
Supporting evidence

The difficulties faced by midwives in addressing the issue of obesity in pregnancy have been identified in research.⁵⁵

The risk of pre-eclampsia, instrumental delivery, caesarean section and macrosomia has been found to increase with increasing gestational weight gain.⁵⁶⁻⁵⁷ However, further research is required to determine the weight gain ranges associated with lowest overall risk of adverse maternal and perinatal outcomes. These ranges are likely to vary for each BMI category.

Achieving appropriate weight management can be challenging for both the woman and the health professional. Several intervention studies have attempted to prevent excessive gestational weight gain using behavioural programmes.⁵⁸⁻⁶³ Inconsistent results have been reported, with some studies showing no effect in obese women compared to significantly lower weight gain in normal-weight women.⁵⁹⁻⁶²

Evidence from the CMACE project on Obesity in Pregnancy shows that women with a BMI ≥ 35 are twice as likely as women in the general population to have a stillborn baby. The rate of intrapartum stillbirths was also increased in women with obesity.



2. Introduction

2.1. Context

Obesity is a condition in which excess body fat has accumulated to such an extent that health may be adversely affected.⁶⁴ The worldwide prevalence of obesity has increased markedly over the past few decades, and the World Health Organisation (WHO) has described this trend as a 'global epidemic' posing a serious threat to public health.⁶⁴ The prevalence of obesity in the general population in England has increased markedly since the early 1990s and currently affects an estimated 25% of adults and 18.5% of women of childbearing age.⁶⁵

Body mass index (BMI) offers a useful measure of obesity and is a simple index of weight-for-height used to classify underweight, overweight and obesity in adults. BMI is calculated by dividing a person's weight in kilograms by the square of their height in metres (kg/m²). Table 2.1 shows a widely accepted classification published by both the WHO⁶⁴ and the National Institute for Health and Clinical Excellence (NICE).⁶⁶ The classification has been based largely on the association between BMI and mortality, and it therefore allows the identification of individuals or groups at increased risk.

Table 2.1. Classification of weight status according to BMI^{64 66}

BMI (kg/m ²)	Classification
<18.5	Underweight
18.5-24.9	Normal ¹ /Healthy ⁶
25.0-29.9	Overweight
30.0-34.9	Obese I
35.0-39.9	Obese II
≥40	Obese III

Obesity in pregnancy is widely defined as a maternal BMI of 30 or more, usually at the time of the first antenatal consultation. Until now, no national-level data on the prevalence of obesity in pregnancy have been available in the UK. Recently, however, nationally-representative data collected from 37 maternity units in England indicate that the prevalence of maternal obesity (BMI ≥30) increased from 7% in 1990 to 16% in 2007.⁶⁷

Obesity carries considerable human cost. In the general population it is associated both with an increased risk of mortality from all causes and with specific increased risks of coronary heart disease, stroke, type 2 diabetes, some types of cancer, respiratory problems and musculoskeletal disorders.⁶⁸ In women of childbearing age, obesity is also associated with subfertility and fertility treatment is less successful among women with obesity compared to women with a healthy BMI.^{69 70} Difficulties in conceiving may contribute to older age at first pregnancy, which may further increase the risk of complications and adverse outcomes.

Obesity in pregnancy carries significant additional risks for both mother and baby.⁷¹ Compared to women with a healthy BMI, women with obesity are at an increased risk of miscarriage,²³ gestational diabetes,²⁶ pre-eclampsia,²⁷ venous thromboembolism,^{24 25} induced labour,⁵² dysfunctional labour,²⁸ caesarean section,³¹ anaesthetic complications,^{43 72} postpartum haemorrhage²⁶ and wound infections,²⁶ and they are less likely to initiate or maintain breastfeeding.³² Obesity may also be a risk factor for maternal death: the Confidential Enquiry into Maternal and Child Health's report on maternal deaths in the 2003–2005 triennium showed that 28% of mothers who died were obese,¹ which is substantially higher than the recently published maternal obesity prevalence rate of 16%,⁶⁷ indicating that women with obesity were over-represented among those who died.

Babies of mothers with obesity are at increased risk too. These risks include stillbirth,^{10 29} congenital anomalies,¹⁹ prematurity,³⁸ macrosomia^{11 26 52} and neonatal death.^{11 29 30} Intrauterine exposure to maternal obesity is also associated with an increased risk of the infant developing obesity and metabolic disorders in childhood.⁷³

Since obesity is associated with increased risk of multiple adverse pregnancy-related outcomes, the condition is now considered one of the most commonly occurring risk factors in obstetric practice, and obstetricians and midwives are increasingly required to care for women with obesity.

It is clear that the prevalence of maternal obesity has increased significantly over time, and also that women with obesity pose particular management problems relating both to the increased risks of specific complications in pregnancy, as well as the medical, surgical and technical challenges in providing safe maternity care. Despite these well-documented issues, there has been limited evidence on which to develop recommendations for appropriate management strategies, and it has only been in the last year that national guidance on maternal obesity has become available.^{12 54} The introduction of this guidance means that appropriate standards of care for the management of women with obesity in pregnancy can be implemented, with clear policies and guidelines for care available.

2.2. Aims and objectives of the national project

The overall aim of the project was to review maternal obesity in the UK.

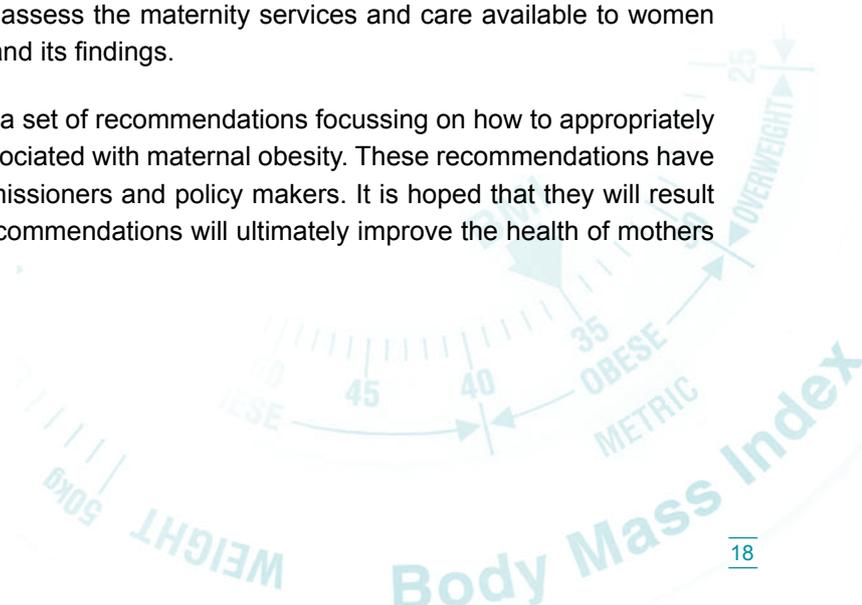
The specific objectives were to:

- develop standards of care for women with obesity in pregnancy;
- determine the prevalence of women with a BMI ≥ 35 during pregnancy in the UK;
- assess how maternity services are organised for the care of women with obesity in pregnancy;
- provide UK national rates of pregnancy-related outcomes among women with a BMI ≥ 35 ;
- assess the degree to which clinical standards of care for women with obesity in pregnancy are being met.

2.3. Improving services and care

The presence of maternal obesity is an increasing problem for maternity units. The increased risks that obesity pose for both the mother and baby have been well-documented. The CMACE project was designed to investigate the scale of the problem and to assess the maternity services and care available to women with obesity. This report describes the project and its findings.

A key output of this project is the production of a set of recommendations focussing on how to appropriately manage the problems and reduce the risks associated with maternal obesity. These recommendations have been produced for healthcare providers, commissioners and policy makers. It is hoped that they will result in improved services and care, and that the recommendations will ultimately improve the health of mothers and babies exposed to obesity.



3. Methods

3.1. Consensus standards

One of the main objectives of the CMACE project was to develop standards for clinical care that would help to minimise the risk of pregnancy-related complications among women with obesity and, ultimately, to improve pregnancy outcomes. While clinical standards should be derived from the highest level of available research evidence, it is recognised that in practice there may be particular areas where there is insufficient evidence on which to formulate standards. In these circumstances, it is necessary to develop standards based on a robust process gathering together expert opinion and experience. Formal consensus methods offer a means of synthesising and collating a number of individual judgements, and they are increasingly being employed to develop guidelines in the health sector in situations where there is a relatively limited evidence-base for practice.⁷⁴

The development of standards included searching for and preparing scientific evidence, consulting with stakeholders, establishing an expert multidisciplinary group, and developing standards through a formal consensus process, which has been described in detail elsewhere.⁷⁵

3.1.1. Searching the scientific evidence

Medline, EMBASE and the Cochrane Database of Systematic Reviews were searched using terms relating to obesity, pregnancy, services and interventions. Searches were limited to humans and restricted to the titles of English language articles published between January 1998 and January 2008. Meta-analyses, systematic reviews, intervention studies and observational studies were selected if they: 1) related to general care issues for pregnant obese women, 2) focused on the management of obesity or obesity-related complications in pregnancy, or 3) focused on the relationship between maternal BMI and pregnancy-related outcomes. A list of articles meeting the selection criteria was reviewed by the CMACE Obesity Project's External Advisory Group (EAG) (see Appendix I for a list of members), a multidisciplinary group of nine senior healthcare professionals with expertise in pregnancy and obesity and one lay representative. Additional articles recommended by the EAG were located and assessed according to the criteria above.

All articles that met the selection criteria were tabulated and organised into categories according to the clinical focus and outcomes of the study. These tables formed the evidence base for the consensus process described in section 3.1.4.

The National Guidelines Clearing House, the National Electronic Library for Health, OMNI, TRIP and E guidelines were also searched for relevant guidelines.

3.1.2. Stakeholder consultation

Forty-four stakeholder organisations representing healthcare professionals, researchers or patients with an interest in the area of obesity in pregnancy were identified and invited to suggest aspects of care or service provision that should be addressed by the standards. Twelve organisations responded during the 4-week consultation period in February 2008 (see Appendix A). Thirty broad areas of care were identified and subsequently presented to the Consensus Standards Group (see below) for consideration.

3.1.3. Multidisciplinary consensus standards group

A multidisciplinary group (Consensus Standards Group, CSG) was convened (see Appendix B for members and disciplines) to develop standards of care. The group comprised 23 members representing disciplines relevant to obesity and pregnancy and two lay representatives with personal experience of obesity and pregnancy. The group included representation from six relevant Royal Colleges: the Royal College of Anaesthetists (RCoA), the Royal College of General Practitioners (RCGP), the Royal College of Midwives (RCM), the Royal College of Obstetricians and Gynaecologists (RCOG), the Royal College of Physicians (RCP) and the Royal College of Paediatrics and Child Health (RCPCH).

3.1.4. Consensus process

Evidence tables and the proposed process for developing standards were sent to all CSG members in advance of the first meeting. During the meeting the group agreed: 1) the broad areas for the standards, 2) the iteration process for achieving consensus, and 3) the scoring system to include or exclude standards. The process for developing the standards, using a modified Delphi approach,⁷⁶ is illustrated in Appendix C.

3.1.4.1. Phase 1: First iteration

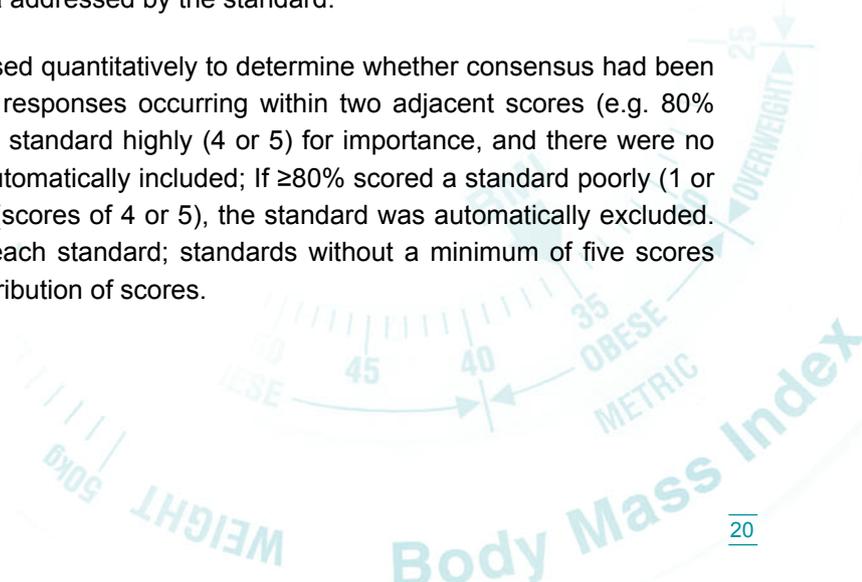
After the first meeting, members submitted draft standards within their area of expertise, together with the rationale for the standard and references for the supporting evidence. A total of 498 standards were proposed by the group.

Draft standards were sorted and categorised according to common themes by a researcher and senior clinician based at CMACE. Duplicate standards were removed and the remaining 198 standards then edited by CMACE. The CSG provided feedback on any essential re-wording prior to the second iteration.

3.1.4.2. Phase 2: Second iteration

The CSG was sent the 198 standards with anonymised supporting rationales and references. Group members were requested to: 1) score each standard on importance (based on potential clinical impact and level of available evidence) and feasibility (based on likelihood of successful implementation), 2) provide a rationale for their scores, 3) consider auditability of the standard, and 4) consider the most appropriate BMI cut-off for specific standards. Importance and feasibility scoring was on a 5-point scale (1=not at all important/feasible; 5=extremely important/feasible). Members had the option of not scoring if they considered they lacked sufficient knowledge in the specific area addressed by the standard.

Responses to the second iteration were analysed quantitatively to determine whether consensus had been reached. Consensus was defined as 80% of responses occurring within two adjacent scores (e.g. 80% scoring 4 or 5). If $\geq 80\%$ of members scored a standard highly (4 or 5) for importance, and there were no outliers (scores of 1 or 2), the standard was automatically included; If $\geq 80\%$ scored a standard poorly (1 or 2) for importance, and there were no outliers (scores of 4 or 5), the standard was automatically excluded. A minimum of five scores were required for each standard; standards without a minimum of five scores remained in the process, regardless of the distribution of scores.



3.1.4.3. Phase 3: Third iteration

The CSG was provided with bar charts showing the distribution of importance and feasibility scores from the second iteration, and all anonymised comments made to support each importance score. Individual scores were fed back to those who had submitted them so that members were able to review their own scores in comparison to all responses.

For those standards that did not meet the inclusion or exclusion criteria after the first scoring round, members were requested to: 1) re-score each standard for importance and feasibility, 2) provide any comments that had not been made previously in order to support their scores, and 3) where relevant, re-select the appropriate BMI cut-off. During this round, members were also asked to suggest how each of the standards which had already met the inclusion criteria could be audited. Responses to the third iteration were analysed using the methodology described above and the distribution of scores and members' anonymised comments fed back to the group.

3.1.4.4. Phase 4: Agreement of standards

Twenty-two CSG members representing all the disciplines in Appendix B attended a second meeting. Standards that had not yet met either the inclusion or exclusion criteria were reviewed at the meeting and consensus reached for each standard. CSG members were given the opportunity to suggest essential re-wording of the final agreed standards to maximise clarity. This feedback was reviewed by the project researcher and the senior clinician at CMACE, who were responsible for final editing.

The number of standards at each phase of the CMACE consensus process is shown in Table 3.1.

Table 3.1. Number of standards at each phase of the CMACE consensus process

Phase	Number of standards
Phase 1	498 standards proposed by CSG
Phase 2	189 standards circulated for scoring; 29 met inclusion criteria; 0 met exclusion criteria
Phase 3	160 standards circulated for scoring; 6 met inclusion criteria [35 in total]; 1 met exclusion criteria
Phase 4	153 standards discussed at meeting; 3 included [38 in total]; 150 excluded

Aggregated total included standards shown in [brackets]

3.1.4.5. Phase 5: Levels of evidence

Levels of evidence were provisionally assigned to each standard based on supporting evidence cited by CSG members during the consensus process. The levels and grades of evidence were assigned according to the guidance for the development of RCOG Green-top Guidelines.⁷⁷ Since all standards were derived through a process of formal consensus, which corresponds to evidence level 4, the lowest assigned grade of recommendation was D (see Appendix D). CSG members reviewed the provisional levels and grades of evidence via an online questionnaire. Members logging any disagreement were prompted to recommend a revised level and/or grade of evidence, together with references supporting the revision(s).

All responses were reviewed by CMACE, and levels and grades of evidence were revised where relevant in light of any new supporting evidence. Any changes to the levels of evidence were reviewed and approved by the project's EAG.

3.1.4.6. RCOG Guideline Committee role

The final consensus standards were used to develop a CMACE/RCOG Joint Guideline on the management of women with obesity in pregnancy. The 38 consensus standards developed by the CMACE CSG were reviewed by the Royal College of Obstetricians and Gynaecologists (RCOG) Guideline Committee. Revisions were made to the supporting text according to the committee's feedback and two additional standards, identified from existing guidelines relevant to women with obesity, were included in the Joint CMACE/RCOG guideline in order that the guideline on obesity was comprehensive in drawing all the existing recommendations together. The guideline,¹² published in March 2010, comprised a total of 40 standards (see Appendix E).

3.2. Survey of maternity units

A national organisational survey was conducted to assess how well maternity services in the UK are equipped to identify and care for women with obesity. The survey used key elements of the Total Design Method,⁷⁸ which is a systematic approach to the process of designing and implementing a survey.

3.2.1. Sample

The survey population included all 364 maternity units (obstetric, alongside midwifery and freestanding midwifery) in England, Wales, Northern Ireland, Scotland and the Crown Dependencies (Channel Islands and Isle of Man).

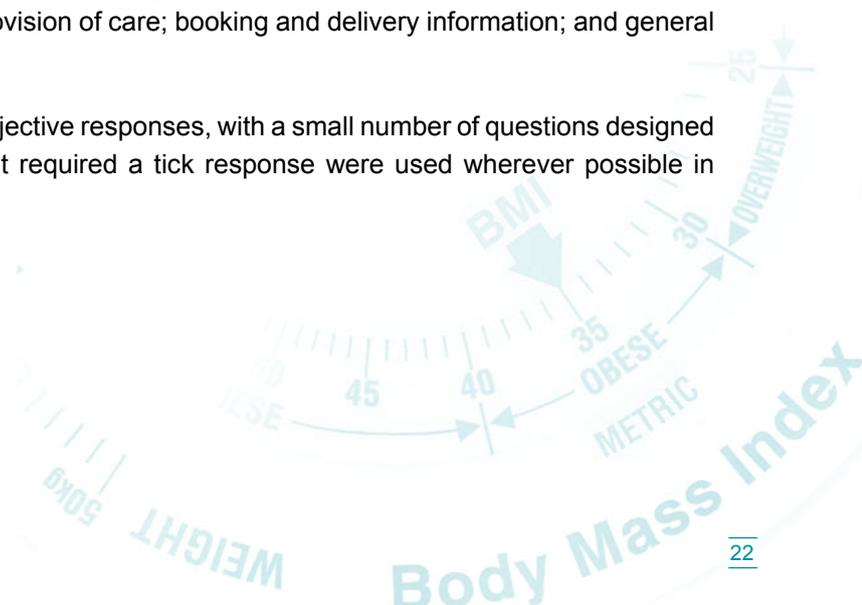
3.2.2. Development of the survey instrument

A structured questionnaire was developed to answer the following questions:

- What physical facilities and equipment do maternity units have to care effectively for women with obesity?
- What clinical care and management processes do maternity units have to care for women with obesity?
- Are maternity units actively planning for the effective care of women with obesity?
- What is the perceived level of awareness in units of obesity as a major health risk in the maternity population?
- What, if any, are the perceived barriers to the provision of effective care for women with obesity?
- What is the prevalence of maternal obesity?

The questionnaire consisted of seven sections covering: equipment and facilities; provision of information to women and care providers; staff and care structures; training and audit; subjective views on recent trends in maternal obesity prevalence and barriers to provision of care; booking and delivery information; and general unit information (see Appendix F).

The survey questions were designed to elicit objective responses, with a small number of questions designed to elicit opinions. Closed-ended questions that required a tick response were used wherever possible in order to minimise the burden on respondents.



3.2.3. Pilot of survey questionnaire

The survey was piloted with 15 maternity units from the South East of England. The survey was revised according to feedback and the final version was re-piloted with three additional maternity units within the London and South East Region prior to the survey's national distribution.

3.2.4. Administration of survey questionnaire

A pre-approach letter was sent to the Head of Midwifery (HoM) in all maternity units three weeks before the planned distribution of the survey. The HoM was the designated lead respondent because of their role in the provision of maternity services within each unit; however it was specified that the maternity unit's response was anticipated to require a multidisciplinary effort.

The survey (see Appendix F), together with a cover letter and a pre-addressed return envelope, was sent to every maternity unit in the UK, Channel Islands and Isle of Man during April 2008. HoMs were requested to complete and return the survey within two weeks. The option of completing and returning the survey electronically was also available to recipients. Non-responding units were followed up a maximum of three times over six weeks following the initial survey deadline.

3.2.5. Analyses

All survey responses were analysed using PASW V18. Unless otherwise stated, reported percentages and frequencies have been calculated after excluding missing data.

3.3. An observational study of mothers with a BMI ≥ 35 and their babies

A national cohort study of births within a two-month period during 2009 was conducted to i) determine the UK prevalence of Class II (BMI 35.00-39.99) and Class III (BMI ≥ 40) maternal obesity, and ii) assess the social demographics and clinical characteristics of women with maternal obesity (BMI ≥ 35) and the characteristics and outcomes of their pregnancies. CMACE did not collect data on women with a BMI 30-34.99 (Class I obesity) because it was considered that the added burden on maternity units resulting from reporting the relatively large numbers of women in this category may have compromised the collection of data on women with a BMI ≥ 35 . Pregnancy-related complications and adverse outcomes are known to increase with increasing obesity severity, and quantifying the proportion of women at most risk was prioritised, since these women are likely to require additional services and specialist care compared to women with lower levels of obesity.

3.3.1. Sample

The study sample was made up of all women giving birth ≥ 24 weeks' gestation in the UK and Crown Dependencies during March and April 2009 who had:

- a recorded pregnancy BMI ≥ 35 at any time in pregnancy, or
- no known BMI but a recorded pregnancy weight ≥ 100 kg, or
- no known BMI or weight, but was judged by health professionals to have a BMI ≥ 35 or weight ≥ 100 kg.

The inclusion criteria were designed to be as inclusive as possible in case some maternity units did not routinely weigh women and calculate and record their BMI or in case some women declined to be weighed.

3.3.2. Development of the data collection form

The audit notification form included information on the woman's weight and BMI, demographic characteristics, co-morbidities, labour and delivery characteristics and pregnancy outcomes.

3.3.3. Pilot of data collection form

The audit notification form was piloted prior to its national implementation. Each CMACE regional office and affiliated office recruited up to two maternity units to pilot the form. A total of 11 units, including six obstetric units, two alongside midwifery units and three freestanding midwifery units, from across the UK participated in the pilot. Pilot units were requested to complete up to five forms using maternity notes from women with a pregnancy BMI ≥ 35 . The audit notification form was revised according to pilot feedback and the final version (see Appendix G) was approved by the project's EAG.

3.3.4. Data collection process

Six months prior to data collection, each maternity unit nominated a local co-ordinator responsible for raising awareness of the project within his/her trust and unit(s) and ensuring that appropriate processes were established locally so that all eligible women giving birth were notified to CMACE. In February 2009, each maternity unit was provided with a labour ward log and multiple notification forms for use during March and April 2009. The log was used by maternity staff to record the patient name, hospital number, and date of delivery for each eligible case. It was also used by the maternity unit to match the assigned ID/notification number to a particular woman, since CMACE did not collect any patient-identifiable information. The log was retained by the maternity unit as a reference for all cases.

All 364 UK maternity units were requested to notify CMACE of every woman who gave birth during March and April 2009 who met the study inclusion criteria. The local co-ordinator for the maternity unit completed an audit notification form for each eligible woman within seven days of her giving birth. Notification forms, containing patient non-identifiable information only, were returned to CMACE on a case-by-case basis. Units were requested to keep copies of all completed notification forms in the event that the original form was not received by CMACE. In order to optimise case ascertainment, unit co-ordinators were contacted at regular intervals during the study and asked to confirm all identified eligible cases. Data collection was co-ordinated, validated and entered on to a centralised database at a regional level.

As this study was part of a national clinical audit and did not collect any patient-identifiable information, ethical approval and patient consent were not required.

3.3.5. Analyses

3.3.5.1. Data validation and cleaning

Logical and systematic data cleaning was undertaken by CMACE Central Office to identify any potential data errors. Data queries were initially checked against the original notification forms in order to identify and correct any data-entry errors. All remaining data queries were followed up with unit co-ordinators who were asked to provide any missing items and to check any responses identified by CMACE as potential errors. All modified responses were entered on to the centralised database at a regional level. Any responses that were invalid were coded as 'missing'.

3.3.5.2. Data reporting and analysis

All eligible notifications received for mothers delivering $\geq 24+0$ weeks' gestation from 1st March to 30th April were analysed to determine the prevalence of maternal BMI ≥ 35 at any point during pregnancy. Obesity

subgroups were also analysed to determine the prevalence of Class II, Class III and super-morbid obesity, which correspond to BMI groups 35.00-39.99, 40.00-49.99 and ≥ 50 , respectively. Maternal obesity prevalence was calculated pragmatically based on the reported weight at any point during pregnancy. Women with more than one antenatal weight measurement and BMI calculation were assigned to the BMI group corresponding to their maximum reported weight. The prevalence of maternal obesity (BMI ≥ 35) in the first trimester has also been calculated. The first trimester prevalence was based on the first reported antenatal weight. Cases were excluded when the gestation at which the antenatal weight measurement was recorded could not be calculated or when it was unrealistic (< 2 weeks' gestation).

Complete data for all eligible women delivering $\geq 24+0$ weeks' gestation from 15th March to 30th April were analysed to assess the social demographics and clinical characteristics of women with a pregnancy BMI ≥ 35 and to provide UK national rates for pregnancy-related outcomes for these women.

Data from the observational study are presented by BMI group (35.00-39.99, 40.00-49.99 and ≥ 50). Women with more than one antenatal weight measurement and BMI calculation were assigned to the BMI group corresponding to their maximum reported weight. Cases without a known weight but judged by health professionals to have a BMI ≥ 35 are presented separately, unless otherwise stated. Cases with a known weight ≥ 100 kg but no known height to allow the calculation of BMI are included in the analyses of the whole cohort only, as there are too few cases to enable any meaningful separate analyses of this group of women. Data pertaining to labour, delivery and pregnancy outcomes have been analysed separately for singleton and multiple pregnancies.

Classification of deprivation was derived from an Index of Multiple Deprivation (IMD) score.² This was based on the postcode of residence and the corresponding Super Output Area, as defined by the Office for National Statistics and is based on the entire population of England. These deprivation scores have been ranked and quintiles of deprivation derived for the national population. Cases from the cohort study were allocated to the appropriate quintile based on the deprivation score cut-points derived for the national population, and then compared to the general maternity population using data provided by the Office for National Statistics (ONS).

Stillbirth and perinatal mortality rates are reported per 1000 total births and neonatal mortality rates are reported per 1000 live births.

Large for gestational age (LGA) and small for gestational age (SGA) has been calculated using gestational age and birth weight, which has been compared to a table of expected values from a British population in 1990.⁷⁹ A baby whose birth weight was equal to or greater than the 90th percentile for gestation was considered LGA. A baby whose birth weight was equal to or less than the 10th percentile for gestation was considered SGA.

The level of neonatal services is defined by the British Association of Perinatal Medicine (BAPM) in its Standards for Hospitals Providing Neonatal Intensive and High Dependency Care (Second edition).⁸⁰ This definition is based on criteria such as gestation at birth and current weight of the infants to be cared for, staffing levels in the unit (e.g. need for 1:1 care) and types of procedures and treatments available. The neonatal services are categorised as Level 3 (intensive care unit), Level 2 (high dependency unit), Level 1 (special care unit) or no neonatal services. From November 2009, the definitions have been updated according to the Department of Health's Toolkit for High-Quality Neonatal Services.⁸¹

To categorise the level of neonatal services for this project, a list of units were sent to the relevant contacts at each of the 24 Neonatal Networks in England, Neonatal Intensive Care Outcomes Research and Evaluation (NICORE) in Northern Ireland, the All Wales Perinatal Survey in Wales, and NHSQIS in Scotland. These confirmed the appropriate designation of each unit for the data collection period (March to April 2009) based on the BAPM definitions.

Denominator data on the number of women giving birth to singleton and multiple babies, as well as the total number of live births and stillbirths, were provided by all maternity units in the UK nations and Crown Dependencies. Denominator data were used to calculate national and Strategic Health Authority prevalence rates for different degrees of maternal obesity. The prevalence of Class II, Class III and super-morbid maternal obesity was calculated by dividing the total number of women with a pregnancy BMI 35.00-39.99, BMI 40-49.99 and BMI ≥ 50 , respectively, who were notified to CMACE as delivering in March and April 2009, by the total number of women reported to have delivered during the same time period (denominator data).

Descriptive statistics include mean and standard deviation for normally-distributed continuous variables, median and range for non-parametric variables, and numbers and percentages for categorical data. Differences in the incidence of conditions or outcomes for different exposure groups were assessed using the χ^2 test. Logistic regression analyses were performed to estimate odds ratios. Univariate logistic regression models were used to examine crude associations in the first instance. These associations were further examined in multivariable logistic regression models controlling for demographic covariates (age, deprivation, ethnicity), co-morbidities (both pre-existing and pregnancy-related) and pregnancy-related characteristics (onset of labour, mode of delivery, grade of caesarean section, type of anaesthesia, gestation) that were associated with both the exposure and outcome variables. BMI was considered as both a categorical and continuous variable in multiple logistic regression analyses. For categorical analyses, maternal BMI was divided into recognised BMI groups corresponding to different obesity classes.^{64 66} Ninety-five percent confidence intervals were constructed for the adjusted odds ratios. A *P* value < 0.05 was considered significant. All analyses were conducted in PASW V18.0.

3.4. Clinical audit

The assessment of clinical care in the audit was based on information documented in the maternity and hospital notes.

3.4.1. Sample

A sample of 1049 (20.7%) women giving birth between 15th March and 30th April 2009 who were notified to CMACE during the observational cohort study was selected for the retrospective audit study. Of these, 959 women had a calculated BMI ≥ 35 at any point during pregnancy and 90 women had an unknown BMI or weight during pregnancy but were judged by health professionals at delivery to have had a pregnancy BMI ≥ 35 .

Case selection was stratified by geographic region to ensure that a nationally and geographically representative sample was obtained. Each region's audit sample consisted of ~20% of its cases that were eligible for inclusion in the audit (Calculated BMI ≥ 35 and professional judgement). Selected cases were notified from a total of 214 obstetric units and four alongside midwifery units.

3.4.2. Development of the data collection form

The audit proforma was designed to assess, based on information documented within maternity notes, the extent to which CMACE consensus standards of care for maternal obesity were being met. The proforma was developed by a CMACE researcher and clinician, with input from CMACE Regional staff who were responsible for collecting the data. Instructions for completing the proforma were also developed by CMACE Central Office in order to ensure that data ascertainment was consistent between auditors.

3.4.3. Pilot of data collection form

The audit proforma and instructions were piloted by CMACE Regional Office staff prior to use and were revised according to feedback. The final version of the proforma (see Appendix H) was approved by the project's EAG.

3.4.4. Data collection process

The CMACE obesity co-ordinator in each maternity unit was contacted and provided with a list of cases selected for the audit. Co-ordinators were requested to prepare patient non-identifiable records for clinically trained CMACE staff to audit on the hospital site. The records listed in Table 3.2 were requested to be available.

Table 3.2. Maternity records audited as part of the CMACE national maternal obesity audit

Hand held maternity records
GP referral letters
Pathology records
Inpatient drug charts
Outpatient drug charts
Anaesthetic records
Discharge summaries
Professional correspondence

3.4.5. Analyses

3.4.5.1. Data validation and cleaning

Logical and systematic data cleaning was undertaken by CMACE Central Office to identify any data errors. Data queries were checked against the original audit proformas in order to identify and correct any data-entry errors. All modified responses were entered on to the centralised database at a regional level. Any responses that were invalid were coded as 'missing'.

3.4.5.2. Data reporting and analysis

Of the audited cases, only mothers with a calculated BMI ≥ 35 based on the first reported antenatal weight, as well as cases categorised as 'Professional Judgement', were included for analysis. This cohort was chosen in order to best represent the women who would be eligible to receive the care recommended in the standards pertaining to early pregnancy, and to provide a consistent cohort for which to analyse all standards. The first BMI was taken at any time in pregnancy, due to the relatively high number of women who booked later than 12+6 weeks of pregnancy (24%); a pragmatic approach was considered best to include women as they would have presented to the health services. This resulted in 905 cases being included in the analysis.

Data from the audit are presented by BMI group (35.00-39.99, ≥ 40.00 and ≥ 35.00). Women with a BMI ≥ 50 are not presented separately due to small numbers. As previously stated, all BMIs are based on first recorded weight in pregnancy. Cases without a known weight but judged by health professionals to have a BMI ≥ 35 are presented separately (Professional Judgement category), unless otherwise stated. Where the standard specifies a BMI ≥ 40 , results are reported only for the ≥ 40 and Professional Judgement categories, unless there was specific interest in reporting results for the lower BMI group.

One standard defined the cohort of eligible women by weight rather than BMI, ('operating staff should be alerted regarding any woman whose weight exceeds 120kg and who is due to have an operative intervention in theatre'). To analyse the data for this standard only, women were categorised based on weight rather than BMI. Women with more than one antenatal weight measurement were assigned to the group corresponding to their maximum reported antenatal weight, as this particular standard pertained to care during labour and delivery.

All analyses include both singleton and multiple deliveries, unless otherwise stated.

Analyses are based on evidence documented in the maternal notes. Where specific medical records were not available or sections of the notes were left blank (e.g. section on folic acid use in handheld notes not completed), the response was coded as "missing". All unknown and missing answers were excluded when calculating percentages. Questions were answered as "no" when there was no documented evidence available in the maternity notes.

3.5. Developing recommendations

The term 'recommendation' is used by CMACE to refer to a proposal for an appropriate course of action that should be taken by external organisations and/or individuals in relation to a specific area of health care.

Recommendations made within CMACE reports aim at achieving real improvements in clinical care, organisation of services and health outcomes. Any recommendation is required to meet six minimum criteria, as shown in Table 3.3.

Table 3.3. Minimum criteria for CMACE recommendations

Valid	Supported by the findings of the project: recurring theme or statistically associated with health/clinical outcomes or is likely to have a substantial effect on health outcomes
Important	Will benefit the population to which the recommendation pertains
Specific	Defines a clear action that needs to be taken by individuals or organisations
Targeted audience	There is a clear and identifiable audience which has responsibility for implementing the recommendation e.g. obstetricians, anaesthetists, commissioners etc
Auditable	Implementation can be audited
Realistic and practicable	Can be implemented within current organisational and policy contexts

In addition, it is important that, for each recommendation, consideration should be given to:

- checking that the recommendation is consistent with existing national health care policies or guidelines
- whether there is any possibility that the recommendation may inadvertently cause harm.

CMACE and the project's EAG were responsible for developing the key recommendations according to an agreed process developed by CMACE. This process is illustrated in Figure 3.1.

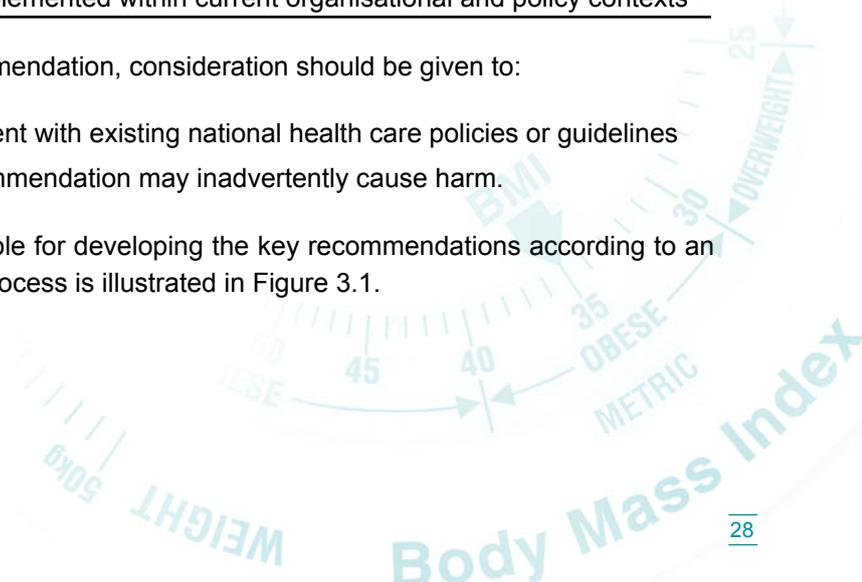
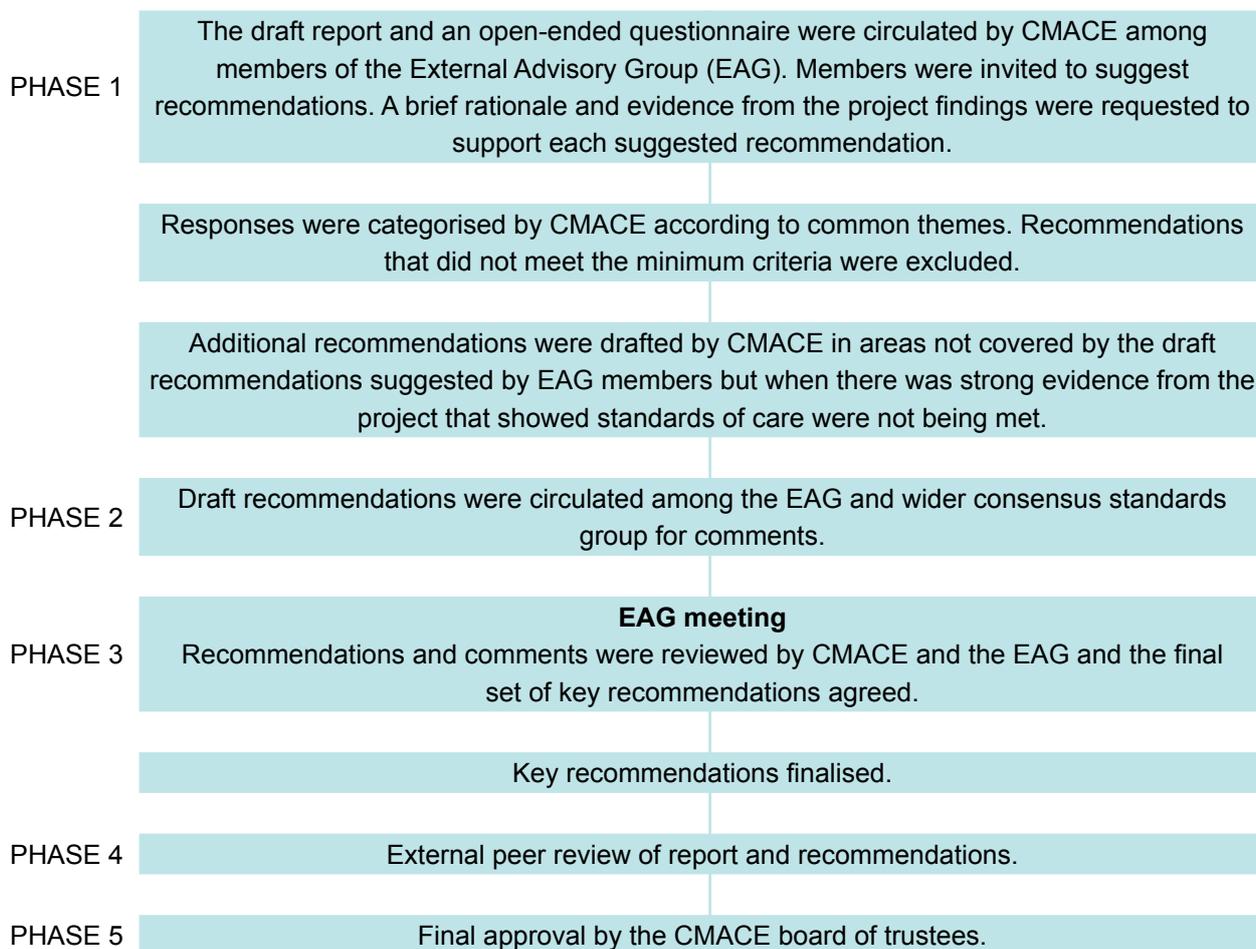


Figure 3.1. Flow chart of process to develop CMACE recommendations



3.5.1.1. Phase 1: First iteration

EAG members were invited to submit draft recommendations based on the main findings of the project. A total of 31 recommendations were proposed by the group.

Draft recommendations were sorted and categorised according to common themes by a senior researcher based at CMACE. Recommendations that did not meet the six minimum criteria were excluded. Duplicate recommendations were removed and further recommendations were drafted by CMACE in areas not covered by those recommendations suggested by the EAG, but where there was strong evidence from the project showing standards of care were not being met. A total of 12 draft recommendations were compiled into an online document for circulation.

3.5.1.2. Phase 2: Second iteration

A wider group, comprising members of the Consensus Standards Group (see section 3.1.3), was sent the 12 recommendations, as well as the anonymised supporting rationales and evidence statements. Group members were invited to comment on each draft recommendation. Comments related to concerns about the recommendation, wording/editing suggestions, or additional information for inclusion in the recommendation. Members were also invited to indicate whether they agreed with the provisionally assigned Type of recommendation (Clinical care and service provision, Health policy, Providers and/or commissioners,

Further research, Good Practice Point). Additionally, there was space at the end of the survey for members to provide general comments.

Anonymised responses to the second iteration were collated by CMACE and circulated among EAG members for consideration.

3.5.1.3. Phase 3: Agreement of key recommendations

Key recommendations were agreed at a meeting attended by EAG members. During the meeting, recommendations were revised according to the comments received during Phase 2, when considered appropriate by the EAG. Members were also given the opportunity to suggest essential re-wording of the agreed key recommendations in order to improve their clarity. Two of the 12 recommendations circulated in Phase 2 were combined into one recommendation, resulting in a total of 11 key recommendations.

3.5.1.4. Phase 4 and Phase 5: Peer-review and approval of key recommendations

The report and recommendations were peer-reviewed by three individuals external to CMACE and the project (see Acknowledgements for list of reviewers). The final version of the report, including the recommendations, was approved by the CMACE Board of Trustees (see Appendix I for list of members).



4. Maternity services for women with obesity

This chapter presents the findings from the national organisational survey of maternity units, which was administered in April 2008. The aim of the survey was to assess how maternity services in the UK are equipped and organised for the care of women with obesity.

4.1. Responses

Questionnaires were returned by 320 of the 364 maternity units in England, Wales, Northern Ireland, Scotland and the Crown Dependencies, giving a 88% overall response rate. Table 4.1 shows the response rate by type of unit. There was a low response rate from alongside midwifery units, and it was evident from comments written on some questionnaires that this was partly due to obstetric units responding on behalf of both themselves and the co-located midwifery unit within the same trust.

Table 4.1. Survey response from maternity units in the UK, Channel Islands and Isle of Man

Type of unit	Responding maternity units	
	n/N	(%)
Obstetric units	220/225	(98)
Alongside midwifery units	13/48	(27)
Freestanding midwifery units	87/91	(96)

Overall, 281 (88%) units reported that they routinely provided care to women with obesity. This included all obstetric units, seven (54%) alongside midwifery units and 54 (62%) freestanding midwifery units.

4.2. Service provision

Service provision was assessed against 12 relevant maternal obesity standards of care, published in the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹² The grade of evidence supporting each standard is indicated by the adjacent letter (see Appendix D for details). These were assigned according to the guidance for the development of RCOG Green-top Guidelines,⁷⁷ and they appear also in the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy. Unless otherwise indicated, the results below pertain to the 281 units that reported routinely providing care for women with obesity.

4.2.1. Preconception care and advice

Women of childbearing age with a BMI ≥ 30 should receive information and advice about the risks of obesity during pregnancy and childbirth, and be supported to lose weight before conception.

D

There were 22 (10%) obstetric units that reported usually providing preconception care to obese women. Units in Scotland were most likely to report providing this care (33%), compared to under 10% in England, Wales and Northern Ireland ($P < 0.01$).

Twelve (6%) units reported providing preconception care and advice to all obese women. There was no significant difference between the UK nations.

4.2.2. Provision of information for women

All pregnant women with a booking BMI ≥ 30 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how they may be minimised. Women should be given the opportunity to discuss this information.

D

Forty-eight (18%) maternity units provided printed information for women which specifically focused on the issue of obesity and pregnancy. The provision of verbal information about risks related to obesity was not assessed in the organisational survey.

One third of obstetric units reported providing specific dietetic advice to all women with obesity. This was more common among units in Northern Ireland and Wales, with 60% and 54% of units reporting the availability of this service, respectively. In contrast, dietary advice was offered to all women with obesity in just 11% of units in Scotland. Thirty-three percent of obstetric units in England provided specialist dietary advice. The difference between UK nations was statistically significant ($P < 0.05$).

4.2.3. Measuring and recording height, weight and body mass index

All pregnant women should have their weight and height measured using appropriate equipment, and their body mass index calculated at the antenatal booking visit. Measurements should be recorded in the handheld notes and electronic patient information system.

D

Two-hundred and eighteen (99%) units reported recording both maternal height and weight in the handheld notes, while 63% reported entering both on to the electronic system. Almost all units (98%) recorded BMI in the notes and just over half (55%) entered BMI on the electronic system.

Units were asked to report the most common method of obtaining a woman's weight. While the majority of units (82%) reported most commonly weighing women, 50 (16%) units relied on women to self-report their weight and five (2%) units most frequently recorded a weight reported by the woman's GP. The method of obtaining a woman's height was not assessed in the survey.

Two-hundred and eleven (98%) units reported recording BMI in the notes, while 108 (61%) recorded it on an electronic system.

4.2.4. Risk assessment during pregnancy

Pregnant women with a booking BMI ≥ 40 should have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties with venous access, regional or general anaesthesia can be identified. An anaesthetic management plan for labour and delivery should be discussed and documented in the medical records.

D

Out of 216 obstetric units (98%) reporting the availability of an antenatal anaesthetic review, 107 (50%) reported that a review was always available for obese women, while a further 103 (47%) arranged this sometimes. There was a significant difference between UK nations, with approximately 50% of units in England, Wales and Northern Ireland always offering an anaesthetic review for obese women compared to only 41% of obstetric units in Scotland ($P < 0.05$).

4. Maternity services for women with obesity

Women with a booking BMI ≥ 40 should have a documented assessment in the third trimester of pregnancy by an appropriately qualified professional to determine manual handling requirements for childbirth and consider tissue viability issues.

D

One-hundred and forty-two (53%) maternity units, including 127 (59%) obstetric units, 11 (24%) freestanding midwifery units and four alongside midwifery units, reported using a risk assessment tool to assess the risk of pressure damage.

4.2.5. Breastfeeding

Obesity is associated with low breastfeeding initiation and maintenance rates. Women with a booking BMI ≥ 30 should receive appropriate specialist advice and support antenatally and postnatally regarding the benefits, initiation and maintenance of breastfeeding.

B

A total of 33 (15%) obstetric units, eight (16%) freestanding midwifery units and two alongside midwifery units reported providing additional breastfeeding support to all women with obesity.

Breastfeeding support, that was additional to support offered to the general maternity population, was more likely to be provided in Northern Ireland and Wales, with 40% and 39% of obstetric units reporting this additional support. This compares to just 13% of units in England and 11% of units in Scotland (P=0.01).

4.2.6 Local guidelines

Management of women with obesity in pregnancy should be integrated into all antenatal clinics, with clear policies and guidelines for care available.

D

All maternity units should have accessible multidisciplinary guidelines which are communicated to all individuals and organisations providing care to pregnant women with a booking BMI ≥ 30 . These guidelines should include consideration of:

- Referral criteria
- Facilities and equipment
- Care in pregnancy
- Place of birth and care in labour
- Provision of anaesthetic services
- Management of obstetric emergencies
- Postnatal advice

D

One-hundred and thirty-five (53%) maternity units had a local guideline for the care and management of women with obesity. Of these, 106 (41% of all units) had a hardcopy of the guideline and 96 (38% of all units) had the guideline in an electronic format.

4.2.7. Equipment and facilities

All maternity units should have a documented environmental risk assessment regarding the availability of facilities to care for pregnant women with a booking BMI ≥ 30 . This risk assessment should address the following issues:

- Circulation space
- Accessibility including doorway widths and thresholds
- Safe working loads of equipment (up to 250kg) and floors
- Appropriate theatre gowns
- Equipment storage
- Transportation
- Staffing levels
- Availability of, and procurement process for, specific equipment:
 - large blood pressure cuffs
 - sit-on weighing scale
 - large chairs without arms
 - large wheelchairs
 - ultrasound scan couches
 - ward and delivery beds
 - theatre trolleys
 - operating theatre tables
 - lifting and lateral transfer equipment

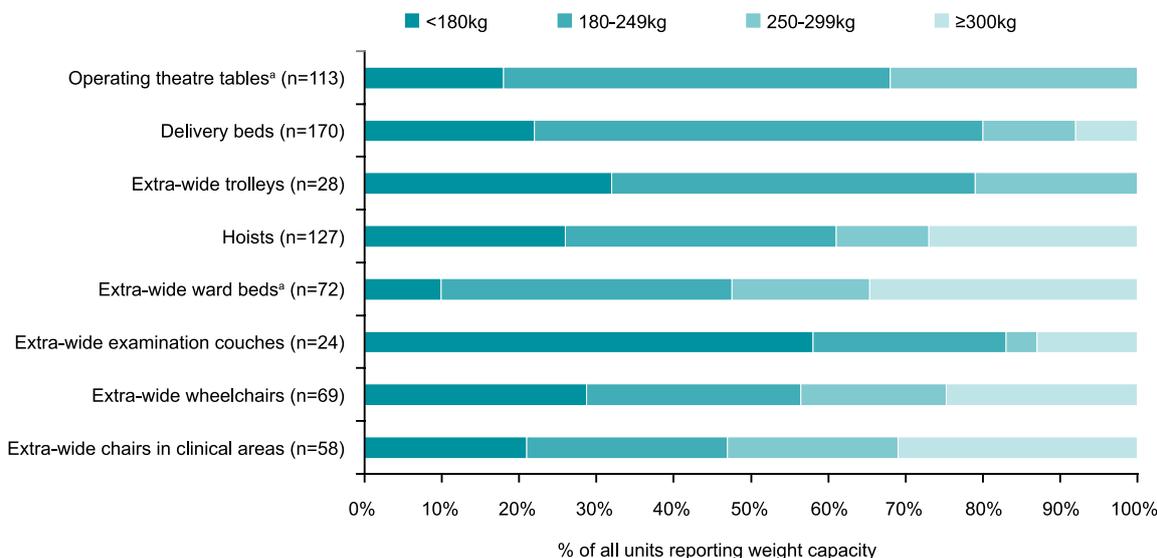
D

Maternity units were asked if they had immediate access to specific equipment in the event of an unexpected admission of a woman with a high BMI and were also asked about the safe working load of such equipment. Two-hundred and three (72%) maternity units reported that they did not have extra wide chairs in clinical areas, and 187 (67%) units did not have extra-wide wheelchairs. Two-hundred and thirty-five (84%) units did not have extra-wide examination couches and 215 (77%) did not have extra-wide trolleys available. There were 121 (43%) and 88 (31%) maternity units without immediate access to hoists and suitable delivery beds, respectively. One-hundred and thirty-five (61%) obstetric units did not have immediate access to extra-wide ward beds and 27 (12%) did not have immediate access to an appropriate operating theatre table in the event of an unplanned admission of a woman with a very high BMI.

Of the maternity units who provided information on safe working loads of equipment, approximately half reported extra-wide chairs, wheelchairs and ward beds with a safe working load of at least 250kg. Less than one quarter of units who reported safe working loads had delivery beds, extra-wide examination couches and extra-wide trolleys with a safe working load of at least 250kg (Figure 4.1).



Figure 4.1. Maximum weight capacity of equipment immediately accessible to maternity units in the UK, Channel Islands and Isle of Man, 2008



^aObstetric units only (n=220)

Although under one third of units reporting the safe working load of their operating theatre tables had one of at least 250kg, 151 (71%) obstetric units reported that they had an operating theatre that was always equipped for women with obesity.

Two-hundred and sixty-seven (99%) responding units reported that they had large blood pressure cuffs available. Eighty-two (31%) and 17 (7%) maternity units had step-on and sit-on weighing scales, respectively, with a safe working load of ≥300kg. Units were not asked about the availability of scales with a safe working load <300kg.

The majority of obstetric units had large blood pressure cuffs available in all clinical areas. Obstetric units who had weighing scales with a safe working load of 300kg reported that these were mainly located in outpatient areas.

Maternity units should have a central list of all facilities and equipment required to provide safe care to pregnant women with a booking BMI ≥30. The list should include details of safe working loads, product dimensions, where specific equipment is located and how to access it.

D

One-hundred and eight (40%) maternity units providing care for women with obesity, including 89 (42%) obstetric units, 16 (34%) freestanding midwifery units and three alongside midwifery units, reported that they had a central list of manual handling equipment suitable for obese patients, which included the weight limits and location of each item.

4.2.8. Education of healthcare professionals

All health professionals involved in the care of pregnant women should receive education about maternal nutrition and its impact on maternal, fetal and child health.

D

In the 12 months prior to the survey, 23 (11%) units reported having had an educational meeting about obesity and pregnancy for maternity staff of any discipline.

All health professionals involved in maternity care should receive training in manual handling techniques and the use of specialist equipment which may be required for pregnant and postnatal women with obesity.

D

One-hundred and eighty-eight (95%) units had provided at least one manual handling training session for staff within the previous 12 months. In the same time period, 42 (21%) obstetric units had provided a training session on using specialist bariatric equipment.

4.3. Discussion

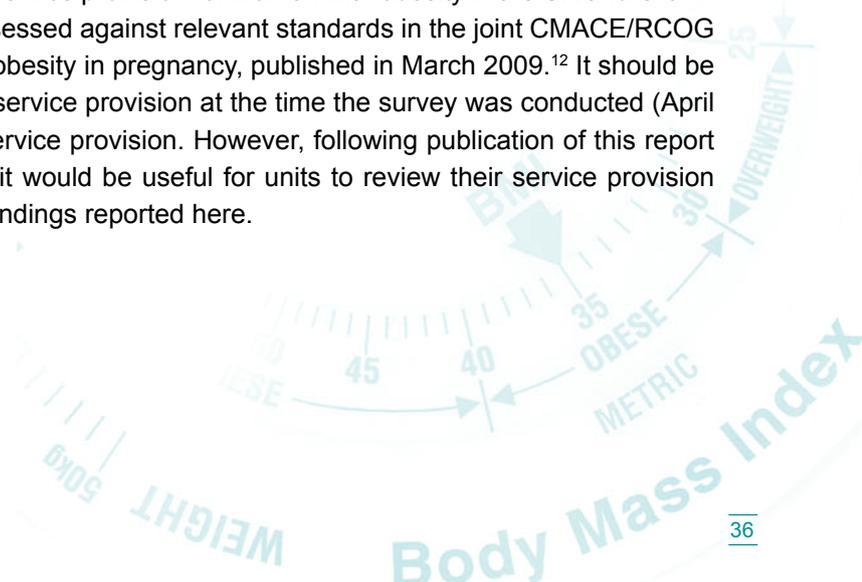
This is the first national survey in the UK of maternity services for women with obesity. The overall response rate was 88%. The 98% response rate from obstetric units was very high, particularly in comparison to the poor response rate from the 48 alongside midwifery units in the UK. This is likely to reflect the fact that many obstetric units included their co-located midwifery unit in the trust in their response. For this reason, it is not appropriate to compare the three different types of maternity units.

The findings highlight a number of gaps in service provision. The majority of facilities and equipment in maternity units did not have the minimum safe working load of 250kg recommended by the CMACE/RCOG Guideline for the management of women with obesity in pregnancy.¹² Facilities such as weighing scales, which are essential to ensure correct doses of medication such as thromboprophylaxis,¹³ were mainly concentrated in outpatient areas which may not be easily accessible out-of-hours.

The availability of appropriate equipment in the event of an unplanned admission of a woman with super-morbid obesity was generally inadequate. Furthermore, a significant proportion of obstetric units did not have a theatre that is always appropriately equipped for an obese patient, yet 71% reported that they did.

The finding that the majority of units recorded maternal height, weight and BMI is encouraging. There are, however, still a number of units that rely on self-reported weights. Although a self-reported weight is better than no record of weight, health professionals should always aim to weigh women using appropriate equipment. Booking appointments conducted in the community may pose a challenge; however, the majority of women do attend appointments for ultrasound scans around 12 weeks' gestation, and this may present an opportunity to obtain an accurate height and weight.

This survey provides an overview of maternity service provision for women with obesity in the UK and Crown Dependencies. Service provision has been assessed against relevant standards in the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy, published in March 2009.¹² It should be noted that the survey findings reflect reported service provision at the time the survey was conducted (April 2008) and do not necessarily reflect current service provision. However, following publication of this report and the CMACE/RCOG Guideline on obesity it would be useful for units to review their service provision against the standards taking into account the findings reported here.



5. Prevalence of Class II, Class III and super-morbid obesity in pregnancy

One of the main objectives of the national cohort study was to calculate and provide national and regional prevalence rates for maternal obesity (BMI ≥ 35). Every maternity unit in the UK and Crown Dependencies was requested to notify CMACE of all women giving birth between 1st March and 30th April 2009 with a known BMI ≥ 35 at any point in pregnancy. In total, 250 maternity units (98% of obstetric units, 35% of alongside midwifery units and 16% of freestanding units) in the UK notified CMACE of eligible women giving birth during the two-month period. Denominator data, representing all women giving birth in the same period regardless of their BMI, were obtained from all 358 (100%) UK maternity units.

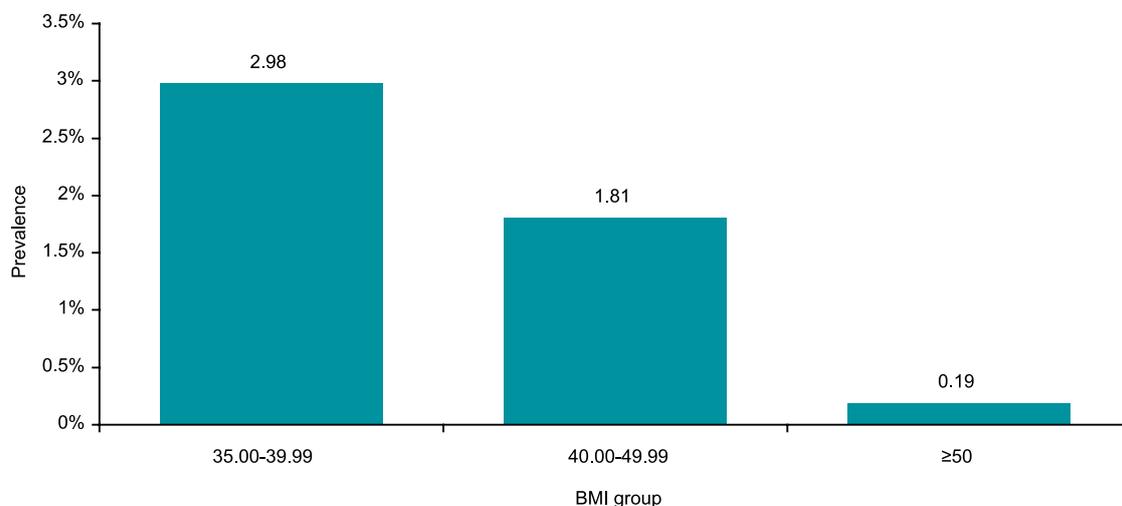
This chapter describes the national and regional prevalence rates for different classes of maternal obesity ≥ 35 . Women were assigned to a region based on the hospital of delivery rather than the maternal postcode of residence. Births occurring outside of maternity units have been assigned to the hospital that reported the case. While obesity is generally defined as a BMI ≥ 30 , it can be further categorised into Class I (BMI 30.0-34.9), Class II (BMI 35.0-39.9) and Class III obesity (BMI ≥ 40). A BMI ≥ 50 may also be used to define super-morbid obesity. Prevalence rates for the latter three groups are presented. CMACE did not collect data on women with a BMI 30-34.99 (Class I obesity) because it was considered that the added burden on maternity units resulting from reporting the relatively large numbers of women in this category may have compromised the collection of data on women with a BMI ≥ 35 . Pregnancy-related complications and adverse outcomes are known to increase with increasing obesity severity, and quantifying the proportion of women at most risk was prioritised, since these women are more likely to require additional services and specialist care compared to women with lower levels of obesity.

5.1. UK national prevalence

The prevalence of different degrees of maternal obesity was calculated based on data collected from every maternity unit in the UK. Out of a total of 128,290 women reported to have given birth (≥ 24 weeks' gestation) in the UK and Crown Dependencies between 1st March and 30th April 2009, 6413 were identified as having a BMI ≥ 35 at any time during pregnancy. The gestation at which weight was recorded was known for 6032 (90%) women. Of these, 4394 (73%) had their weight recorded in the first trimester, while 23% and 4% had their first antenatal weight recorded in the second and third trimester, respectively. Thus, 66% of women within the observational study had a recorded weight in the first trimester of pregnancy.

This UK prevalence rate of women with a BMI ≥ 35 at any time during pregnancy is 4.99%. It is important to emphasise that the BMI threshold of ≥ 35 is higher than the standard threshold for obesity which is $\geq 30\text{kg/m}^2$. The median maximum reported pregnancy BMI for women within the cohort was 39.1 (range 35.0 to 79.9). A total of 2581 women had a reported BMI ≥ 40 (morbid obesity) during pregnancy, corresponding to a prevalence rate of 2.01%. There were 245 women with a BMI ≥ 50 (super-morbid obesity), and these accounted for 0.19% of all women delivering during the two-month period. Figure 5.1 shows the UK prevalence of maternal obesity by BMI category.

Figure 5.1. Prevalence of maternal obesity by body mass index category



Obesity prevalence by type of unit was calculated using denominator data provided by 214 obstetric units, 49 alongside midwifery units and 83 freestanding units. A further 12 obstetric units reported combined denominator data representing the total number of women delivering in both their obstetric and alongside midwifery units. These 12 units reported a total of 8062 women with a pregnancy BMI ≥ 35 , and have been excluded from the unit prevalence figures in Table 5.1.

Table 5.1. Prevalence of maternal obesity by type of maternity unit

Unit type	Total number of women giving birth ^a (N)	BMI category (%)			
		≥ 35	35-39.99	40-49.99	≥ 50
Obstetric	113416	4.38	2.57	1.63	0.18
Alongside midwifery	4296	1.56	1.28	0.28	0.00
Freestanding	2468	0.65	0.65	0.00	0.00

^a Total number of women reported to have given birth during March and April 2009

5.2. Prevalence of obesity in the UK nations and crown dependencies

Figure 5.2 shows the variations in maternal obesity severity between the UK nations and Crown Dependencies. Wales had the highest overall prevalence of women with a BMI ≥ 35 at any time during pregnancy, with a rate of 1 in 15 maternities ($P < 0.001$). When examined by BMI category, Wales had the highest rates of Class II and Class III maternal obesity, while England had the lowest rates ($P < 0.001$ and $P = 0.002$, respectively). Super-morbid obesity did not differ significantly between the UK nations.

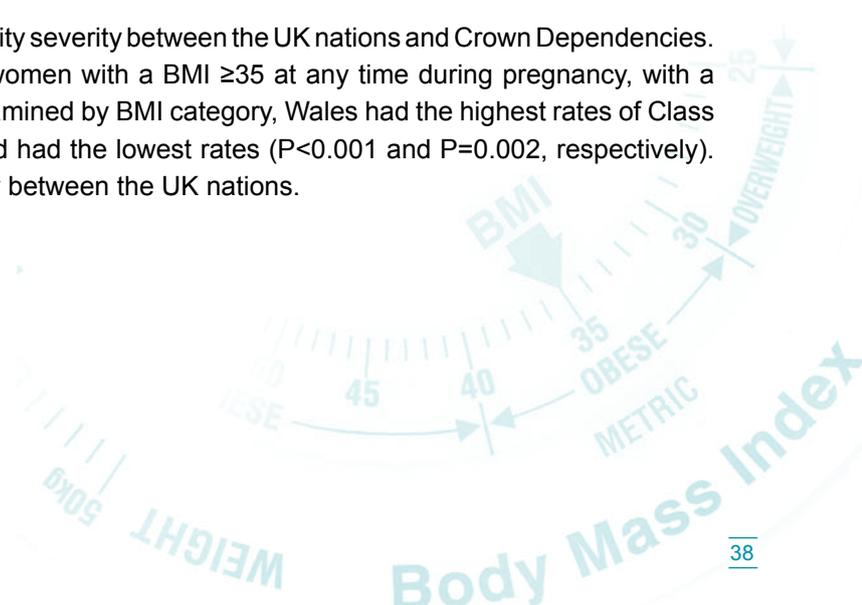
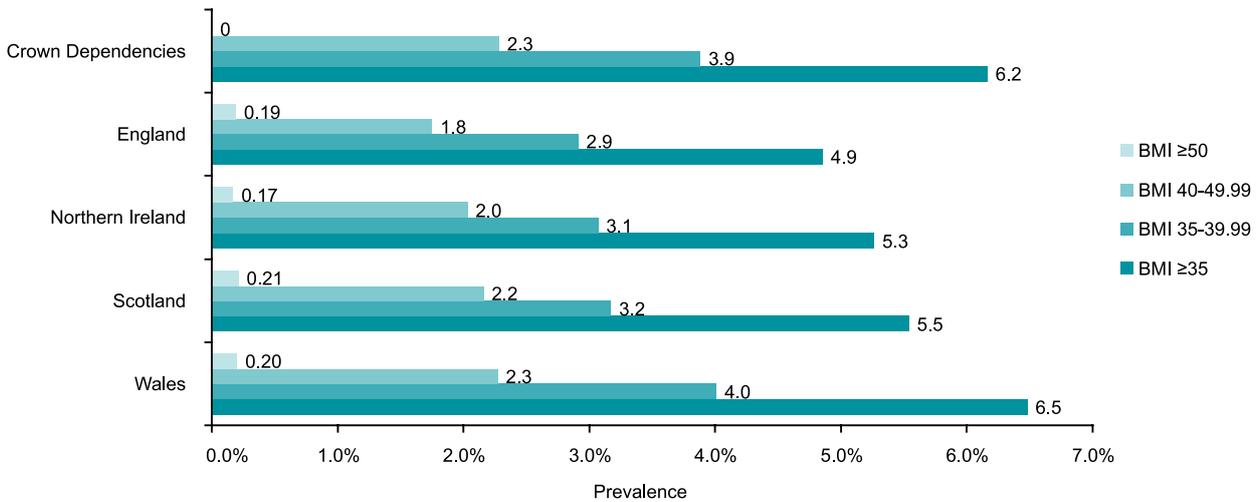


Figure 5.2. Prevalence of maternal obesity by UK nations and Crown Dependencies



5.3. Prevalence of obesity by Strategic Health Authorities (England)

Strategic Health Authorities (SHAs) were set up in 2002 to manage the NHS at a regional level. SHAs are responsible for ensuring the quality and performance of local health services and integrating national priorities. There are currently 10 SHAs in England. Table 5.2 shows the rates of maternal obesity for each SHA and Figure 5.3 illustrates the regional variation in the prevalence of women with a BMI ≥35 in pregnancy.

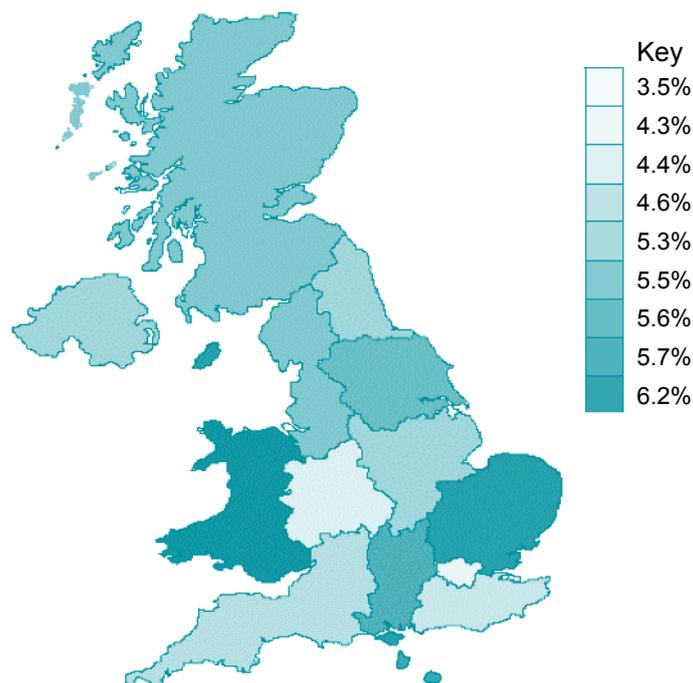
Table 5.2. Prevalence of maternal obesity by Strategic Health Authority

SHA	Total number of women giving birth ^a (N)	BMI category (%)			
		≥35	35-39.99	40-49.99	≥50
East Midlands	7719	5.27	3.21	1.80	0.26
East of England	10544	6.23	3.53	2.41	0.29
London	22087	3.46	2.19	1.16	0.11
North East	4853	5.28	3.28	1.88	0.12
North West	14895	5.47	3.50	1.77	0.19
South Central	7814	5.66	3.39	2.00	0.27
South East Coast	8457	4.38	2.46	1.76	0.15
South West	9655	4.58	2.50	1.92	0.17
West Midlands	11379	4.32	2.57	1.57	0.18
Yorkshire and the Humber	11051	5.57	3.28	2.06	0.23

^a Total number of women reported to have given birth during March and April 2009

The East of England SHA had the highest overall rate of women with a BMI ≥35 at any point during pregnancy (P<0.001) and also the highest prevalence of each obesity category (BMI 35-39.9, P<0.001; BMI 40-49.9, P<0.001; BMI ≥50, P=0.002). London had the lowest reported prevalence of obesity.

Figure 5.3. Regional variation in BMI ≥ 35 during pregnancy



5.4. Prevalence of obesity identified in the first trimester

A total of 3882 women who gave birth in March and April 2009 had a known first trimester BMI ≥ 35 . This represents 3.0% of the total number of women giving birth in the UK during the same time period. Of all women giving birth, 1.93%, 1% and 0.09% were identified in their first trimester as having Class II, Class III and super-morbid obesity, respectively.

These figures undoubtedly underestimate the true prevalence of obesity in the first trimester, since only two thirds of the study cohort was used to produce the first trimester obesity rates, and the proportion of women in the general maternity population with a recorded weight in the first trimester is unknown. If the proportion of women with a known first trimester weight in this cohort is extrapolated to the general maternity population, thereby assuming that 65% of women have their weight recorded in the first 12 weeks of pregnancy, the estimated prevalence rates of BMI ≥ 35 , Class II, Class III and super-morbid obesity in the first trimester are 4.66%, 2.98%, 1.54%, 0.14%, respectively, which is not substantially different to the prevalence rates based on BMI measures taken at any point during pregnancy.

5.5. Discussion

Obesity is a major public health problem in the UK, which affects approximately 25% of the adult population. Among women of child-bearing age in England, the prevalence of obesity (BMI ≥ 30) is estimated to be 19% and the prevalence of morbid obesity (BMI ≥ 40) is just over 2%.⁸² The CMACE project found a national prevalence rate of 5% for women delivering in 2009 with a BMI ≥ 35 at any time in pregnancy. Using the two-month data received from all maternity units in the UK and extrapolating these to obtain annual figures, it is estimated that there would be approximately 38,478 women giving birth in the UK each year with a BMI ≥ 35 ; this equates to 1 in 20 maternities. Of these, 22,986 would have a BMI 35-39.9 (1 in 33 maternities), 14,022 would have a BMI 40-49.9 (1 in 55 maternities), and 1470 would have a BMI ≥ 50 (1 in 524 maternities).

The lower rate in the maternity population is perhaps not surprising, since obesity is known to be associated with subfertility^{69 70} and miscarriage.²³ Understanding the needs of women with maternal obesity and quantifying the number of pregnancies affected by the condition is important for the planning and allocation of resources for services. Knowledge of the proportion of women with more severe degrees of obesity may be even more important, since the risk of complications increases with increasing BMI, and women with super-morbid obesity may pose additional challenges to maternity units, as they are likely to require specialist services and equipment.

Until very recently, there have been no national level data on maternal BMI in the UK. The best indicators of maternal obesity prevalence were based on reported rates from three UK local maternity populations.^{3 26 83} Within the last year, nationally representative data collected from 37 maternity units in England have been published.⁶⁷ Retrospective data were obtained over 19 years of study and showed the proportion of women with obesity (BMI ≥ 30) in England to have doubled from 7.6% in 1989 to 15.6% in 2007. When broken down by BMI category, prevalence rates were 3.81%, 1.61% and 0.18% for first trimester BMI 35.0-39.9, BMI 40.0-49.9, and BMI ≥ 50 , respectively. These rates are higher than the first trimester rates calculated using data for the CMACE cohort. This is not surprising, however, given that prevalence rates in the nationally-representative study were calculated by taking into account only women with a first trimester BMI calculation. In contrast, CMACE prevalence rates have been calculated based on all women giving birth, regardless of whether a weight was recorded and BMI calculated during pregnancy.

Our rates of maternal super-morbid obesity (BMI ≥ 50) are considerably higher than those found in the recently published study of extreme obesity (BMI ≥ 50 at any point in pregnancy) in the UK, conducted by the UK Obstetric Surveillance System (UKOSS).⁸⁴ While the UKOSS study reported a prevalence of 8.7 per 10,000 deliveries, the cases notified to CMACE indicate a prevalence rate of 18.8 per 10,000 deliveries^{**}. These differences may be due to differences in case ascertainment resulting from the use of different methodologies. UKOSS studies are conducted through a monthly mailing to nominated clinicians in every hospital with a consultant-led maternity unit in the UK. These mailings consist of a report card which lists the conditions under surveillance by UKOSS at that particular time. Clinicians report the total number of cases within the previous month. UKOSS then despatches an appropriate number of study-specific data collection forms, which are to be completed by the clinicians. These data are then used to report incidence, risk factor, management and outcome information.⁸⁵

The data reported within this chapter highlight the geographic variations in Class II and Class III maternal obesity. Wales was found to have the highest reported levels of maternal obesity and London had the lowest levels. These geographic variations are likely, at least in part, to be attributable to socio-demographic factors as obesity is more common in areas of high social deprivation (see section 6.1.2) and areas where the local population is predominately White. Indeed, these data reflect similar geographic patterns in obesity prevalence within the general population⁸⁶ which is consistent with this possibility. However, it is also possible that some of the variation seen is due to regional differences in ascertainment. In terms of SHA regions, maternal obesity (BMI ≥ 35) rates were higher than the national average in the East of England, South Central, Yorkshire and the Humber, North West, North East and East Midland areas. With the exception of the North West region, these areas also have obesity (BMI ≥ 30) rates that are higher than the national average rates in the general population of women.⁸⁷

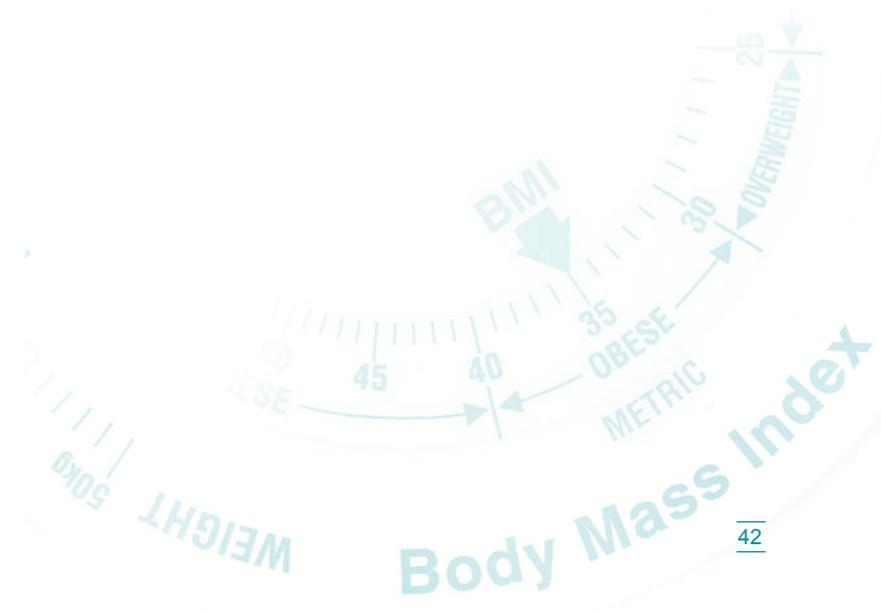
This study is the first to provide prevalence rates of maternal obesity (BMI ≥ 35) for the UK nations and Crown Dependencies. The strengths of the study lie in the scale of the data collection and case ascertainment. All UK maternity units participated in this study and denominator data were obtained from all of them. Data were collected over two months and there were no significant differences in the number of notified cases between

^{**} This figure reflects deliveries and not women, in order to compare directly with UKOSS.

each week (data not shown) of the study period, suggesting that cases were not underreported during the initial data collection period, a problem that sometimes occurs, particularly with large-scale studies.

This study has several limitations. One limitation is the dependence on units self-reporting eligible cases. It was not possible to find an alternative source of data against which to validate the number of women with obesity giving birth within the study period. As such, the potential levels of under-ascertainment cannot be quantified. Additionally, prevalence rates have been calculated based pragmatically on all women giving birth, regardless of whether a weight was recorded and BMI calculated during pregnancy. Furthermore, CMACE has included only women with a pregnancy lasting at least 24 weeks' gestation. Women suffering miscarriages have not been included (this is relevant as women with obesity are at higher risk of miscarriage²³). These limitations may have led to the reported prevalence rates underestimating the true proportion of pregnant women in the UK with a BMI ≥ 35 .

Despite these recognised limitations, to date this study provides the best and most comprehensive indicator for current national prevalence rates of maternal obesity (BMI >35) in the UK nations and Crown Dependencies, and establishes for the first time the scale of the challenge facing maternity services across the country in caring for these women.



6. Maternal obesity: Socio-demographics, clinical characteristics and pregnancy outcomes

This chapter describes the social demographic and clinical characteristics of women giving birth from 15th March to 30th April 2009, who were notified to CMACE during the national cohort study. The study involved the national identification of all women with a pregnancy BMI ≥ 35 giving birth ≥ 24 weeks' gestation. The study also included women who weighed ≥ 100 kg without a known height, as well as women without a known weight or BMI, but who were considered by health professionals to have a BMI ≥ 35 .

The outcomes of the pregnancies notified to CMACE are described in the second part of this chapter.

Complete data were available for a total of 5068 eligible women who were identified at the point of delivery. The number of women meeting each inclusion criterion is shown in Table 6.1. Seventy-seven of these women (1.5%) were pregnant with twins. There were no higher order multiple births. The multiple birth rate in the cohort of women is not different to the 1.3% rate in the general maternity population.⁵

Table 6.1. Number of women meeting the study inclusion criteria

Study inclusion criteria	Number of women (% of all eligible notifications) N=5068
Pregnancy BMI ≥ 35 kg/m ²	4869 (96.1)
No BMI or height, but pregnancy weight ≥ 100 kg	45 (0.9)
No known BMI or weight, but judged by health professionals to have a BMI ≥ 35 or weight ≥ 100 kg	154 (3.0)

Since there were so few women notified to CMACE without a known height or BMI but with a weight ≥ 100 kg, these cases have only been included in analyses of the whole cohort and not when cases have been analysed separately according to BMI status. They are therefore not included in the tables below.

6.1. Socio-demographic characteristics

6.1.1. Maternal weight and body mass index

The anthropometric characteristics of women in the study cohort are described in Table 6.2.

Table 6.2. Anthropometric characteristics of women with a pregnancy BMI ≥ 35

	N	Median (range)
First antenatal weight (kg)	4907	103.5 (54.0-192.0)
First antenatal BMI (kg/m ²)	4865	38.1 (24.7-79.9) ^a
Gestation at first weight (weeks)	4618	10.9 (2.3-42.0)

^a Women with a BMI < 35 were included if a later pregnancy BMI was ≥ 35

Of the 4907 women with a reported pregnancy weight, 1505 (30.9%) had their weight measured and documented in the maternity notes on at least two separate occasions. Women with more than one pregnancy BMI measurement were assigned to the BMI group corresponding to their highest reported BMI. There were 2824 women with Class II maternal obesity (35.00-39.99), accounting for 58.0% of the study cohort; 1852 women were identified with Class III obesity and 193 with super-morbid obesity, accounting for 38.0% and 4.0% of the cohort, respectively.

6.1.2. Social deprivation

Deprivation was explored by the application of an Index of Multiple Deprivation (IMD) score based on postcode of residence,² as described in Chapter 3. The proportion of women in each deprivation quintile is shown in Table 6.3. For comparison, the quintile proportions for the general maternity population are also presented. Quintiles in the general maternity population are known only for women resident in England: women with obesity who were resident in Wales, Northern Ireland and Scotland have therefore been excluded from this table.

Table 6.3. Maternities by deprivation quintiles for England and BMI group

IMD quintiles	n (%)				
	All maternities in England ^a	BMI 35-39.9 N=2298	BMI 40-49.9 N=1484	BMI ≥50 N=157	Professional Judgement N=108
Least Deprived 1	15.7	11.3	11.0	10.2	6.5
2	16.3	14.0	12.0	9.6	13.9
3	18.3	17.2	17.9	17.2	16.7
4	22.0	23.0	25.3	27.4	22.2
Most Deprived 5	27.6	34.6	33.8	35.7	40.7

^a Data for general maternity population were obtained from ONS

These data show that the most deprived quintiles are over-represented by the obese cohort compared to maternities in the general population ($P < 0.0001$), and they support previously published findings showing that social deprivation is associated with maternal obesity.³ This was consistent across all BMI groups and differences between BMI groups were not significant.

6.1.3. Ethnicity

The proportion of women with a BMI ≥ 35 within each ethnicity group is shown in table 6.4. Comparison data for the general maternity population in England have been provided. Non-white ethnicity is associated with an increased risk of poor pregnancy outcomes in the UK.⁸⁸ Data from HES show that, in 2008/09, 20.5% of all maternities in England were from black and minority ethnic (BME) groups.⁴ These groups represented a smaller proportion (17.6%) of the obese cohort in England ($P < 0.0001$). Data were not available to examine comparisons with UK-wide maternity data; however, within the CMACE obese cohort, BME groups were represented by an even smaller proportion (15.1%).

Table 6.4. Maternities by ethnic group

Ethnicity	n (%)		
	All maternities in England ^a %	All maternities with BMI ≥ 35 in England N=4098	All maternities with BMI ≥ 35 in UK N=5013
White	79.5	3377 (84.9)	4270 (84.9)
Black	5.5	51 (1.1)	53 (1.1)
Asian	10.1	291 (6.0)	300 (6.0)
Chinese	0.6	30 (0.6)	31 (0.6)
Mixed	1.5	222 (4.6)	229 (4.6)
Other	2.8	94 (1.9)	97 (1.9)
Not known	-	33 (1.0)	51 (1.0)

^a Data for the general maternity population were obtained from HES 2008-2009

6.1.4. Age

Maternal age less than 20 years and over 35 years is known to be a risk factor for poor pregnancy outcomes.⁹ In the general obstetric population, 20% of women are aged ≥ 35 years. The proportion of women aged ≥ 35 years is significantly higher among women with a BMI 40.0-49.9 ($p=0.01$) and ≥ 50 ($P=0.002$) compared to general maternities (Table 6.5). These data are consistent with previous reports suggesting that age over 35 years is a predictive factor for maternal obesity.³

Table 6.5. Maternities by age and BMI group

Age (years)	All maternities in England ^a %	n (%)			Professional Judgement N=154
		BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥ 50 N=193	
Younger than 20	6.3	102 (3.7)	56 (3.1)	5 (2.6)	6 (4.1)
20-34.9	73.7	2147 (76.8)	1368 (74.5)	128 (66.7)	112 (75.7)
35 or older	20.0	545 (19.5)	412 (22.4)	59 (30.7)	30 (20.3)

^a Data for the general maternity population were obtained from HES 2008-2009; N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data; -, proportion unknown for all maternities in England

6.2. Clinical characteristics

6.2.1. Co-morbidities

A total of 1103 (21.8%) women had at least one morbidity (a disease or medical condition) diagnosed prior to their pregnancy. There were 1180 (23.3%) women who had a condition diagnosed during their pregnancy. The medical conditions of the women in the cohort are described in Table 6.6. The most frequently reported condition was pregnancy-induced hypertension (PIH), which affected 9% of the cohort. The second most common condition was gestational diabetes mellitus (GDM), which was diagnosed in 7.8% of the study population. These conditions affect 1.9% and 2.5% of the general maternity population, respectively.⁵ Within the CMACE cohort, 13% of women had pregnancy-related hypertensive disorders (PIH, pre-eclampsia or severe pre-eclampsia/eclampsia); 23.7% of women with PIH developed pre-eclampsia, and 2.5% progressed to severe pre-eclampsia or eclampsia.

Table 6.6. Medical conditions among pregnant women by BMI group

	All maternities in England ^a %	n (%)			Professional Judgement N=154
		BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥50 N=193	
Pre-existing & past medical conditions					
Type 1 diabetes	-	21 (0.8)	14 (0.8)	3 (1.6)	2 (1.4)
Type 2 diabetes	-	40 (1.4)	38 (2.1)	9 (4.7)	4 (2.7)
DVT and PE	-	22 (0.8)	10 (0.5)	3 (1.6)	1 (0.7)
Essential hypertension	-	116 (4.2)	83 (4.6)	11 (5.7)	7 (4.7)
Cardiovascular condition	-	41 (1.5)	19 (1.1)	3 (1.6)	1 (0.7)
'Other'	-	436 (17.9)	259 (16.2)	36 (21.4)	18 (14.1)
Medical conditions during pregnancy					
Gestational diabetes	2.5	178 (6.4)	175 (9.6)	26 (13.8)	8 (5.6)
DVT and PE	-	13 (0.5)	12 (0.7)	1 (0.5)	1 (0.7)
Essential hypertension	2.5	38 (1.4)	26 (1.5)	6 (3.2)	1 (0.7)
Pregnancy-induced hypertension	1.9	230 (8.3)	178 (9.7)	26 (13.8)	9 (6.3)
Pre-eclampsia	1.9	152 (5.5)	127 (7.0)	24 (12.7)	8 (5.6)
Severe pre-eclampsia/ eclampsia	0.1	11 (0.4)	14 (0.8)	4 (2.1)	5 (3.5)
Cardiovascular condition	-	11 (0.4)	10 (0.6)	0 (0.0)	2 (1.4)
'Other'	-	77 (3.2)	66 (4.1)	10 (6.0)	6 (5.0)

^a Data for the general maternity population were obtained from HES 2008-2009; N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data; -, proportion unknown for all maternities in England; DVT, deep vein thrombosis; PE, pulmonary embolism

With the exception of deep vein thrombosis (DVT) and cardiovascular conditions diagnosed during pregnancy, there was a higher incidence of all specified morbidities, diagnosed both prior to and during pregnancy, among the super-morbidly obese group compared to the lower BMI groups. Differences in the incidence rates were significant between BMI groups for type 2 diabetes (P=0.003), pregnancy-induced hypertension (PIH) (P=0.021), pre-eclampsia (P<0.0001), and severe pre-eclampsia (P=0.007).

6.2.2. Pregnancy-related characteristics

The pregnancy-related characteristics of the study cohort are shown in Table 6.7. Thirty-nine percent of the women were primigravid. The national target for England is for all pregnant women to book for antenatal care by 10 to 12 weeks' gestation.⁸⁹ Two thirds (67.8%) of the women in this cohort booked by 12 weeks. A further quarter (26.7%) booked by 20 weeks.

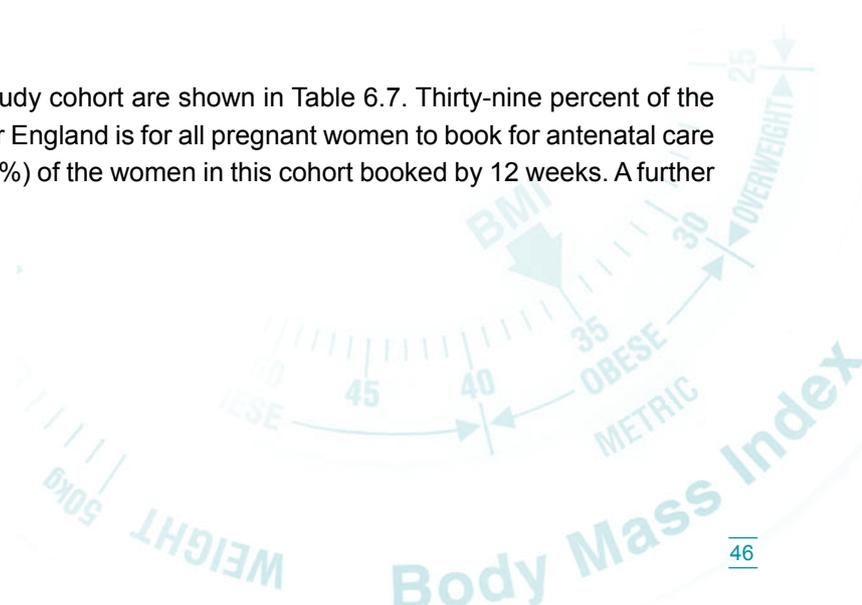


Table 6.7. Pregnancy-related characteristics by BMI group

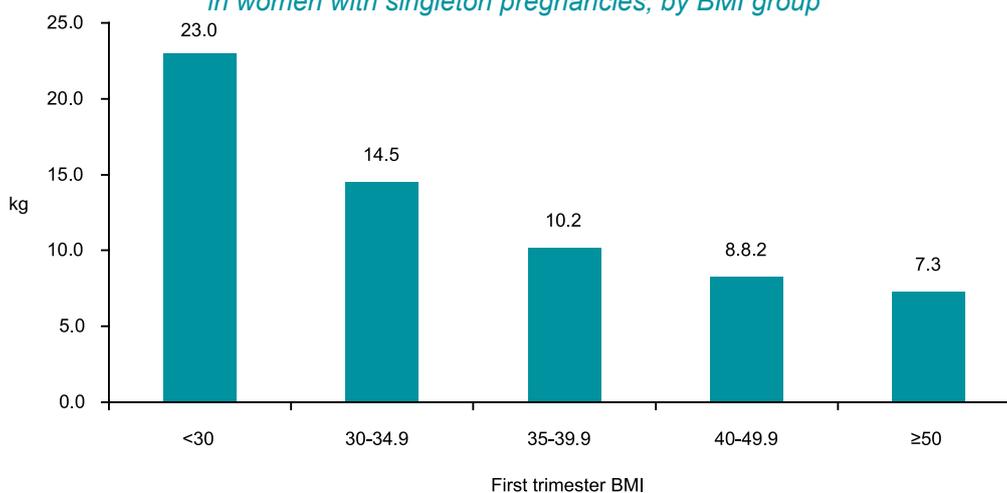
	n (%)			
	BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥50 N=193	Professional Judgement N=154
Booking				
<12+0 weeks	1881 (67.2)	1279 (69.5%)	127 (66.1)	80 (59.3)
12+0 to 19.6 weeks	762 (27.2)	468 (25.4)	58 (30.2)	39 (28.9)
≥20 weeks	158 (5.6)	93 (5.1)	7 (3.6)	14 (10.4)
Unbooked	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.5)
Other characteristics				
Previous miscarriages ≥1	773 (27.2)	559 (30.8)	51 (26.6)	43 (29.5)
Parity ≥1	1663 (59.7)	1138 (62.2)	123 (64.1)	86 (58.9)
Assisted conception	55 (2.0)	33 (1.8)	0 (0.0)	6 (4.0)
Multiple pregnancy	35 (1.2)	32 (1.7)	3 (1.6)	5 (3.2)

N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data; data for all maternities in England are not available

6.2.3. Gestational weight gain

Gestational weight gain was calculated for 1505 women who had their weight measured and documented in the maternity notes on at least two separate occasions during their pregnancy. The median weight change between the first and third trimester was 11.0 kg (range, -18 to 41.5 kg), while the median BMI change was 4.11kg/m² (range, - 8 to 14.03 kg/m²). Weight change was inversely correlated with first trimester BMI (see Figure 6.1), with women who started pregnancy with a BMI <30 gaining significantly more than those in all other obesity categories (P<0.001).

Figure 6.1. Mean weight change between the first and third trimester in women with singleton pregnancies, by BMI group



The gestation of both weights was known in 1384 cases, representing 28.2% of women with at least one antenatal weight (mean 24.8 ± 6.8 weeks between measurements). The majority of women (n=1013) with more than one antenatal weight had their first weight recorded in the first trimester and the final weight record in the third trimester. Table 6.8 shows the anthropometric characteristics of these women.

Table 6.8. Anthropometric characteristics of women with both a first trimester and third trimester weight measurement

	N	Median (range)
First trimester weight (kg)	1013	98.83 (60.30 - 178.00)
Third trimester weight (kg)	1013	111.72 (79.00 - 183.20)
Gestational weight change (kg)	1013	11.00 (-18.00 - 41.50)
First trimester BMI (kg/m ²)	1008	36.29 (24.66 - 79.11) ^a
Third trimester BMI (kg/m ²)	1008	40.40 (33.33 - 71.56) ^b
Gestational BMI change (kg/m ²)	1007	4.11 (-8.00 - 14.03)
Gestation at first weight	1013	9.7 (2.3 - 12.9)
Gestation at third trimester weight	1013	37.6 (28.0 - 43.3)
Weeks between recorded weights	1013	27.9 (15.9 - 36.1)

^a Women with a BMI <35 were included if a later pregnancy BMI was ≥35; ^b women with a third trimester BMI <35 were included if an earlier pregnancy BMI was ≥35

6.2.4. Onset of labour

Almost half (46.7%) of all women had a spontaneous onset of labour (Table 6.9). One third of the cohort (n=1677) were induced and approximately 20.1% were delivered by caesarean section prior to labour. Of the women who laboured (n=3994), 41.6% were induced. Onset of labour was significantly different between BMI groups, with higher induction rates with each increasing BMI category (OR 1.24, 95% CI 1.09 to 1.42 for women with a BMI 40-49.9 and OR 1.54, 95% CI 1.09 to 2.15 for women with a BMI ≥50, compared to women with a BMI 35-39.9). The induction rate in the general maternity population in England is 20.2%⁵ – a rate that is considerably lower than the one seen in the study cohort.

Just over one third (37.7%) of the 358 women delivering prematurely (<37 weeks) had a spontaneous onset of labour, while 26.5% were induced and 35.8% did not labour, consistent with pregnancy complications that required early delivery. Of the 226 women delivering at 42 weeks or beyond, 20.8% laboured spontaneously and 76.1% were induced.

Table 6.9. Onset of labour by BMI group

	n (%)				
	All maternities in England^a	BMI 35.0-39.9	BMI 40.0-49.9	BMI ≥50	Professional Judgement
	%	N=2824	N=1852	N=193	N=154
Spontaneous	68.8	1396 (49.7)	791 (42.9)	74 (38.3)	74 (48.7)
Induced	20.2	899 (32.0)	636 (34.5)	71 (36.8)	52 (34.2)
No labour	11.0	516 (18.4)	415 (22.5)	48 (24.9)	26 (17.1)

^a Data for the general maternity population were obtained from HES 2008-2009; N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

Among women who laboured, the induction rate was highest in Wales (49%) and lowest in Northern Ireland (38.1%) (P=0.02).

6.2.5. Place of delivery

In the general maternity population in England, approximately 93% of women give birth in consultant obstetric units, 3% in alongside midwifery units, 2% in freestanding midwifery units and 2% give birth at home.⁹⁰ In this cohort, 97.7% of singleton babies were born in obstetric units, while 1.2% and 0.3% were born in alongside midwifery units and freestanding midwifery units, respectively (Table 6.10). There were 33 (0.7%) home births; of these, 13 women (39.4%) were reported to have intended to deliver in an obstetric unit at the onset of labour, suggesting that these were unplanned home births.

Table 6.10. Intended and actual place of delivery by BMI group

	n (%)				
	All maternities in England ^a %	BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥50 N=193	Professional Judgement N=154
Intended place of birth at booking					
Obstetric unit	-	2534 (91.2)	1715 (94.8)	185 (97.4)	138 (93.2)
Alongside midwifery unit	-	104 (3.7)	25 (1.4)	1 (0.5)	1 (0.7)
Freestanding midwifery unit	-	34 (1.2)	8 (0.4)	0 (0.0)	1 (0.7)
Home	-	27 (1.0)	16 (0.9)	1 (0.5)	4 (2.7)
Other	-	2 (0.1)	2 (0.1)	0 (0.0)	0 (0.0)
Not known	-	78 (2.8)	44 (2.4)	3 (1.6)	4 (2.7)
Intended place of birth at onset of labour^b					
Obstetric unit	-	2165 (95.1)	1378 (97.7)	143 (100.0)	122 (98.4)
Alongside midwifery unit	-	66 (2.9)	13 (0.9)	0 (0.0)	0 (0.0)
Freestanding midwifery unit	-	20 (0.9)	3 (0.2)	0 (0.0)	0 (0.0)
Home	-	18 (0.8)	9 (0.6)	0 (0.0)	1 (0.8)
Other	-	2 (0.1)	1 (0.1)	0 (0.0)	0 (0.0)
Not known	-	5 (0.2)	6 (0.4)	0 (0.0)	1 (0.8)
Actual place of birth					
Obstetric unit	93.0	2695 (97.0)	1781 (98.6)	189 (99.5)	146 (98.6)
Alongside midwifery unit	3.0	46 (1.7)	13 (0.7)	0 (0.0)	0 (0.0)
Freestanding midwifery unit	2.0	15 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)
Home	2.0	20 (0.7)	13 (0.7)	1 (0.5)	0 (0.0)
Other	-	3 (0.1)	3 (0.2)	0 (0.0)	2 (1.4)

^a Data for the general maternity population were published by the Healthcare Commission, 2008⁹⁰; ^b excludes women who did not labour; N = all women, regardless of missing data; -, proportion unknown for general maternities in England; percentages have been calculated for each BMI group after excluding missing data

There were 48 women who, at booking, intended to give birth at home. Twenty-three (49%) still intended to give birth at home at the onset of labour, and 15 eventually gave birth at home, representing 31% who initially intended to do so. The remaining 33 women gave birth in obstetric units.

6.2.6. Mode of delivery

Spontaneous vaginal births represented 54.9% of all singleton deliveries (Table 6.11). The spontaneous vaginal birth rate was 54% in obstetric units and 91.5% in alongside midwifery units. All babies born in freestanding units were born vaginally without the use of instruments.

Table 6.11. Mode of delivery by BMI group

	n (%)				
	All maternities in England ^a %	BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥50 N=193	Professional Judgement N=154
Mode of delivery					
Spontaneous vaginal	62.4	1573 (56.6)	960 (52.9)	91 (47.9)	81 (55.1)
Instrumental vaginal	12.1	237 (8.5)	116 (6.4)	11 (5.8)	13 (8.8)
Vaginal breech	0.4	5 (0.2)	5 (0.3)	1 (0.5)	0 (0.0)
Caesarean section	24.6	964 (34.7)	733 (40.4)	87 (45.8)	53 (36.1)
Grade of caesarean section					
Grade 1 (Emergency)	} 60.2	102 (10.7)	82 (11.2)	7 (8.0)	6 (10.7)
Grade 2		316 (33.1)	222 (30.3)	31 (35.6)	21 (37.5)
Grade 3		105 (11.0)	97 (13.3)	11 (12.6)	11 (19.6)
Grade 4		39.8	428 (44.8)	329 (44.9)	38 (43.7)

^a Data for the general maternity population were obtained from HES 2008-2009; N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

Instrumental vaginal deliveries accounted for 7.6% of all singleton deliveries within the cohort of women. The rate in the general maternity population in England is 12.2%.⁵ The lower rate found in women with obesity is likely due to the high proportion of caesarean sections.

Caesarean sections were performed to deliver 1851 (37.2%) singleton babies. The rate found in this cohort is substantially higher than the 24.6% rate in the general maternity population in England (P<0.001).⁵ The mode of delivery by onset of labour is presented in Table 6.12, which shows an increasing caesarean section rate with each increasing BMI group, regardless of onset of labour.

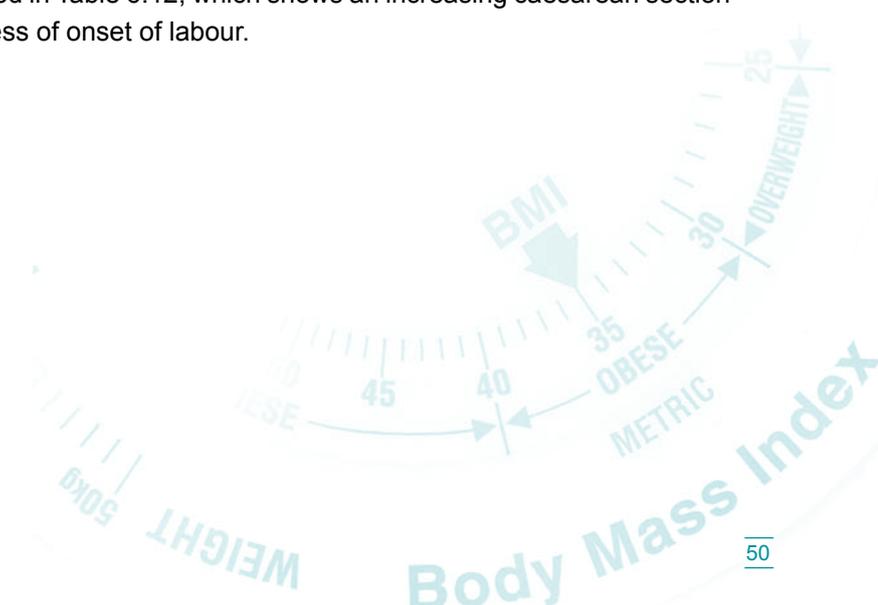


Table 6.12. Mode of delivery by onset of labour and BMI group

	n (%)		
	BMI 35.0-39.9 N=2767	BMI 40.0-49.9 N=1802	BMI ≥50 N=190
Spontaneous labour	1381 (49.9)	784 (43.5)	72 (37.9)
Vaginal delivery	1177 (85.2)	639 (81.5)	58 (80.6)
Caesarean section	204 (14.8)	145 (18.5)	14 (19.4)
Induction of labour	888 (32.1)	626 (34.7)	71 (37.4)
Vaginal delivery	631 (71.1)	436 (69.7)	45 (63.4)
Caesarean section	257 (28.9)	190 (30.4)	26 (36.2)
Never in labour	498 (18.0)	392 (21.8)	47 (24.7)
Vaginal delivery	-	-	-
Caesarean section	498 (100.0)	392 (100.0)	47 (100.0)

N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

There was a significant difference in caesarean section rates between the UK nations ($P < 0.001$); England had the lowest rate (35.6%), while Northern Ireland had the highest rate, with 50.9% of singleton babies delivered this way. Caesarean section rates in Wales and Scotland were 41.5% and 43.6%, respectively.

Caesarean section was more common in each increasing BMI category (OR 1.28, 95% CI 1.13 to 1.44 and OR 1.59, 95% CI 1.18 to 2.14, respectively, for BMI 40-49.9 and BMI ≥50, compared to women with a BMI 35-39.9), with 46% of women with a BMI ≥50 delivering this way. This rate is consistent with that described by Knight et al,⁸⁴ who reported a 50% caesarean section rate for women with a BMI ≥50.

Forty-four percent of the caesarean sections were Grade 4 (planned), and this did not differ significantly between BMI groups. The highest rate was seen in Northern Ireland (50.6%), while Wales and the Crown Dependencies had the lowest rates (~40%).

6.2.7 Anaesthesia

The type of anaesthesia administered was reported in 1774 (95.8%) caesarean section cases. General anaesthesia was used in 136 (7.7%) deliveries, representing 29.0%, 7.5%, 6.1% and 3.3% of Grade 1, Grade 2, Grade 3 and Grade 4 caesarean sections, respectively. The general anaesthesia rate in the CMACE cohort is higher than the 5.7% rate in the general population in England during 2008-09 ($P = 0.02$).⁵ General anaesthesia rates were highest among women with a spontaneous labour (14.9%) and lowest among women who had caesarean sections without labouring (4.9%) (Table 6.13). Although the use of general anaesthesia increased with each increasing BMI group, particularly among women undergoing a caesarean section after a spontaneous labour, between-group differences were not significant.

Table 6.13. Type of anaesthesia by onset of labour and BMI group among women with caesarean section

	All maternities in England ^a	n (%)			
		BMI 35.0-39.9 N=964	BMI 40.0-49.9 N=733	BMI ≥50 N=87	Professional Judgement N=50
	%				
Spontaneous labour	56.6	196 (21.2)	140 (19.9)	13 (16.3)	11 (22.5)
Regional	89.6	169 (86.2)	118 (84.3)	8 (61.5)	11 (100.0)
General	10.4	27 (13.8)	22 (15.7)	5 (38.5)	0 (0.0)
Induction of labour	16.6	245 (26.5)	184 (26.2)	22 (27.5)	17 (34.7)
Regional	90.9	229 (93.5)	166 (90.2)	22 (100.0)	15 (88.2)
General	9.1	16 (6.5)	18 (9.8)	0 (0.0)	2 (11.8)
Never in labour	9.0	485 (52.4)	379 (53.8)	45 (56.3)	21 (42.9)
Regional	94.6	463 (95.5)	363 (95.8)	41 (91.1)	18 (85.7)
General	5.4	22 (4.5)	16 (4.2)	4 (8.9)	3 (14.3)
All caesarean sections	100.0	927	706	80	50
Regional	92.2	862 (93.0)	650 (92.1)	71 (88.8)	45 (90.0)
General	7.8	65 (7.0)	56 (7.9)	9 (11.3)	5 (9.4)

^a Data for the general maternity population were obtained from HES 2008-2009; N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

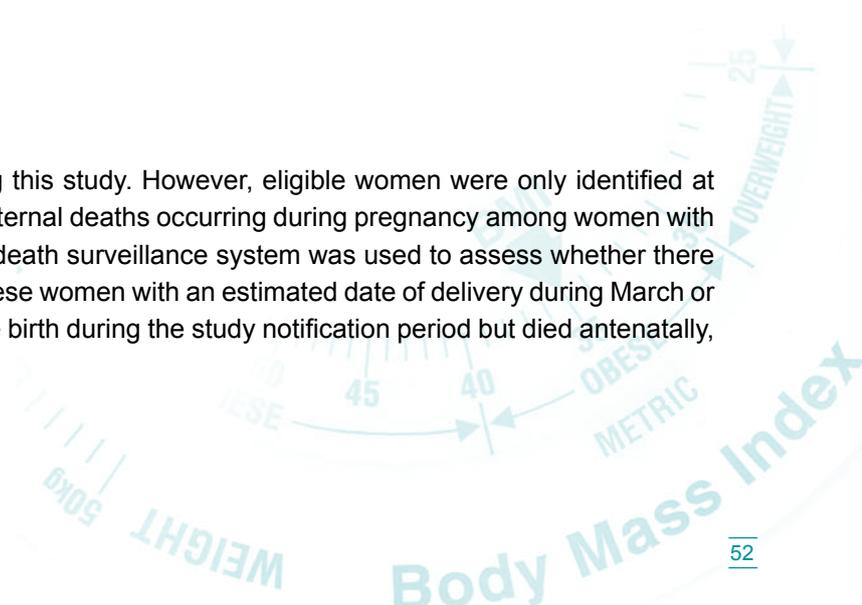
6.2.8. Length of stay in hospital

The median length of stay in hospital after vaginal deliveries was one day, for instrumental deliveries it was two days and for caesarean sections the median length of stay was three days. There was no difference between BMI groups. However, the length of time spent in hospital after childbirth was greater among this cohort of women with a BMI ≥35 than the general maternity population;⁵ 3.7% of women with a BMI ≥35 stayed in hospital for seven days or more, which compares to 2.2% in the general maternity population (P<0.001). The proportion of women in hospital for at least seven days after delivery was greater among the obese maternity population than the general maternity population, regardless of mode of delivery. Among women with a spontaneous vaginal delivery in the CMACE cohort, only 58% spent a day or less in hospital, compared to 74% in the general population (P<0.0001).⁵ These differences are likely to reflect the higher complication rates particularly postpartum problems such as infection.

6.3. Maternal outcomes

6.3.1. Maternal deaths

There were no maternal deaths notified during this study. However, eligible women were only identified at delivery, therefore this study did not identify maternal deaths occurring during pregnancy among women with obesity. To address this the CMACE maternal death surveillance system was used to assess whether there were any antenatal maternal deaths among obese women with an estimated date of delivery during March or April 2009. Of the women who were due to give birth during the study notification period but died antenatally, none had a recorded BMI ≥35.



Women who were eligible for inclusion in the study were notified to CMACE within seven days of delivery. The CMACE maternal death surveillance system was also used to identify all postpartum deaths (within 42 days of delivery) among women who gave birth during March and April 2009. None of the women who died had a recorded antenatal BMI ≥ 35 .

6.3.2. Postpartum haemorrhage

The RCOG⁶ and WHO⁷ define primary postpartum haemorrhage (PPH) as a blood loss ≥ 500 ml within 24 hours of giving birth. In the general maternity population in England, PPH (including both primary and secondary PPH) affects 10% of all deliveries.⁵ In this study cohort of women with a BMI ≥ 35 , 37.5% of women were reported to have had a blood loss ≥ 500 ml within 24 hours of giving birth (Table 6.14).

Table 6.14. Postpartum blood loss by BMI group among women with a singleton pregnancy

	n (%)			Professional Judgement N=154
	BMI 35.0-39.9 N=2824	BMI 40.0-49.9 N=1852	BMI ≥ 50 N=193	
Primary blood loss				
<500ml (no PPH)	1799 (64.9)	1078 (59.6)	104 (54.3)	93 (62.8)
500 to 1000ml (minor PPH)	848 (30.6)	621 (34.3)	76 (40.4)	52 (35.1)
1000 to 2000ml (Moderate Major PPH)	103 (3.7)	91 (5.0)	7 (3.7)	1 (0.7)
>2000ml (Severe Major PPH)	20 (0.7)	18 (1.0)	1 (0.5)	2 (1.4)
Mean blood loss (ml) (\pm SD)	442 \pm 423	485 \pm 419	488 \pm 364	423 \pm 375
Intervention for bleeding				
Blood transfusion	62 (2.2)	45 (2.5)	2 (1.1)	3 (7.0)
Operative intervention	34 (1.2)	24 (1.3)	1 (0.5)	1 (0.7)

N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

For women with a spontaneous vaginal birth, 12.1% had a reported blood loss ≥ 500 ml. Table 6.15 shows postpartum blood loss (within 24 hours of birth) by mode of delivery. Caesarean section was associated with the greatest volume of blood loss and had the highest rate of operative intervention for bleeding. Severe primary PPH, as defined by one European study as blood loss ≥ 1500 ml,⁹¹ was reported in 3% of singleton deliveries (30 per 1000 deliveries) within the study cohort. This is substantially higher than the rate of 4.6 per 1000 deliveries reported by the European study. These higher rates may reflect more problems with uterine atony. It has been reported that women with obesity may have a higher likelihood of inefficient uterine activity,⁹² which, as well as the higher intervention rate overall, could explain these higher rates of PPH. However, a more recent report did not find maternal obesity to influence uterine contractility in vitro.⁹³

Table 6.15. Postpartum blood loss by mode of delivery among women with a singleton pregnancy and BMI ≥ 35

	n (%)			
	Spontaneous vaginal N=2731	Instrumental vaginal N=380	Vaginal breech N=11	Caesarean section N=1851
Primary blood loss				
<500ml	2390 (87.9)	216 (57.0)	8 (72.7)	477 (25.9)
500 to 1000ml (minor PPH)	259 (9.5)	134 (35.4)	3 (27.3)	1215 (66.1)
1000 to 2000ml (Moderate Major PPH)	56 (2.1)	24 (6.3)	0 (0.0)	126 (6.9)
>2000ml (Severe Major PPH)	15 (0.6)	5 (1.3)	0 (0.0)	21 (1.1)
Intervention for bleeding				
Blood transfusion	39 (1.4)	19 (5.0)	0 (0.0)	56 (3.0)
Operative intervention	32 (1.2)	2 (0.5)	0 (0.0)	29 (1.6)

N = all women, regardless of missing data; percentages have been calculated for each column after excluding missing data

Among women in the audit cohort, LMWH was strongly associated with primary postpartum haemorrhage (estimated blood loss ≥ 500 ml within 24 hours of birth) (Table 6.16). Women with an estimated blood loss >1500 ml, which is considered to be a clinically significant amount, were almost five times more likely to receive postnatal LMWH. Women receiving LMWH both antenatally and postnatally were most likely to haemorrhage. While LMWH use is associated with minor bleeding such as wound haematoma, it is not usually associated with major bleeding; indeed PPH rates in a large systematic review were under 1%.⁸ Further, much postpartum blood loss is due to uterine atony rather than a haemostatic problem, but LMWH is not known to influence uterine contraction clinically. If the PPH reflects trauma, then LMWH could play a role, but high bleeding rates are not usually encountered in surgical situations such as orthopaedic or general surgery where the LMWH is given preoperatively. Because of concerns for epidural haematoma, LMWH is not usually given for at least 12 hours before a planned delivery, either vaginal or caesarean,¹³ and is usually withheld if a PPH has occurred until all bleeding is controlled, so that these women would not be likely to have significant LMWH levels or effects around the time of delivery or PPH. PPH is however a risk factor for thrombosis and so women with PPH would in turn be more likely to receive LMWH once the bleeding is controlled. In addition, although guidelines advocate intermediate doses of LMWH rather than the standard prophylactic dose in obese women, the majority of women in this cohort receiving LMWH did not receive the higher dose (see Chapter 7), making a dose related effect unlikely.

Retrospective data are well known to underestimate risk compared to prospective studies, and the systematic review cited applied to the general obstetric population reported rather than obese women. However the scale of the difference suggests that women with obesity may be more vulnerable to bleeding so raising the possibility of an interaction between LMWH and obesity. This is important to address as women with obesity are at risk of thromboembolic problems, related to obesity and co-morbid conditions or interventions such as caesarean delivery. Indeed very high levels of relative risk have been calculated; Jacobsen et al reported an aOR 62.3 (95% CI: 11.5 to 338.0) for thrombosis in pregnant women with BMI ≥ 25 and immobilisation compared to women with BMI <25 and mobilisation. Therefore it would be critical to determine the bleeding risk in order to balance this against the risk of thrombosis and particularly where higher doses of LMWH are being advocated.

While this study has found elevated levels of PPH risk associated with LMWH use among women in the CMACE cohort, it is important to emphasise the relatively small numbers in the higher blood loss group and

the wide confidence intervals for the reported odds ratios. Further, this study was not designed to address this association specifically, and a causative relationship cannot be concluded from these data; however, the finding does raise important questions that should be addressed for the management of these women in pregnancy by further evaluation of bleeding risk and the effects of LMWH on the haemostatic system of pregnant women with obesity, including their co-morbidities. In managing these women it would appear prudent to pay greater attention to haemostasis during surgical procedures and consider measures to reduce the risk of atonic PPH, such as a Syntocinon infusion.

Table 6.16. Adjusted odds of primary postpartum haemorrhage by LMWH status among women with a BMI ≥ 35

	No LMWH N=459	Antenatal & postnatal LMWH N=37		Postnatal LMWH only N=380	
	n (%)	n (%)	aOR (95% CI)	n (%)	aOR (95% CI)
Blood loss $\geq 500\text{ml}^a$	83 (18.2)	245 (65.3)	2.45 (1.60-3.77)	22 (59.5)	1.53 (0.68-3.45)
Blood loss $>1500\text{ml}^b$	3 (0.7)	13 (3.5)	4.96 (1.40-17.61)	5 (13.5)	25.13 (5.67-111.31)

N = all women, regardless of missing data, percentages have been calculated for each BMI group after excluding missing data; aOR, adjusted odds ratio; LMWH, low molecular weight heparin; data on LMWH was obtained during the audit and are available for ~20% of women within the observational cohort study; bold text denotes statistically significant associations; ^a adjusted for mode of delivery; ^b adjusted for macrosomia

6.4. Pregnancy outcomes

In total, 5145 babies were born to 5068 women who were notified to CMACE during the national cohort study. The tables below reflect data pertaining to the 4948 singleton babies born between 15th March and 30th April 2009 to women with a calculated BMI ≥ 35 and women without a known weight or BMI but judged by health professionals to have had a BMI ≥ 35 during pregnancy. In addition, there were 43 singleton babies born to women without a known BMI but weighing $\geq 100\text{kg}$ during their pregnancy. Since there were so few of these babies, they have been included in analyses of the whole cohort only, and not in the tables below.

There were 77 twin pregnancies. Seventy of the mothers had a calculated BMI ≥ 35 , two had no known BMI but weighed $\geq 100\text{kg}$, and five had no known BMI or weight, but were considered by health professionals to have a BMI ≥ 35 during pregnancy. The outcomes of twin pregnancies have been described separately.

6.4.1. Live births, stillbirths and early neonatal deaths

Stillbirth was defined as an in *utero* loss delivering after 24 completed weeks of gestation and early neonatal death as death of a live born baby within seven days of birth (born at any gestation). Table 6.17 shows the outcomes among the cohort of women with singleton pregnancies.

Forty-three singleton babies were stillborn (median gestation 37.1 weeks, range 24.6–42.3) to mothers with a pregnancy BMI ≥ 35 , giving a stillbirth rate of 8.6 per 1000 singleton births ≥ 24 weeks' gestation. This rate is significantly higher than the general population rate of 3.9 per 1000 total births ($P=0.0037$) in England, Wales and Northern Ireland^{††}, and supports other studies that indicate obese women are twice as likely to have a stillborn baby as women with a healthy BMI.^{10 11} Among women with a BMI ≥ 35 , each unit increase in BMI was associated with a 7% increased risk of stillbirth (OR 1.07, 95% CI 1.02 to 1.12).

^{††} Excluding terminations of pregnancy and babies born at less than 24 weeks' gestation. This rate is lower than the rate published in the CMACE 2008 Perinatal Mortality Report, which included terminations and babies born <24 weeks' gestation

Twenty-one of the stillborn babies (48.8%) were preterm (<37 weeks). This is lower than the 61.3% preterm rate for all stillbirths in England, Wales and Northern Ireland, indicating that a greater proportion of stillbirths among obese women occur at term. Three stillbirths (7.1%) occurred at or after 42 weeks' gestation.

Table 6.17. Neonatal outcomes of singleton pregnancies by maternal BMI group

	n (%)				
	Singleton births in England %	BMI 35.0-39.9 N=2789	BMI 40.0-49.9 N=1820	BMI ≥50 N=190	Professional Judgement N=154
Pregnancy outcome					
Live birth ^a	99.5	2755 (99.0)	1800 (99.1)	187 (98.4)	146 (98.6)
Stillbirth ^a	0.4	22 (0.8)	16 (0.9)	3 (1.6)	2 (1.4)
Early neonatal death ^a	0.1	5 (0.2)	1 (0.1)	0 (0.0)	0 (0.0)
Gestational age					
<37 weeks ^b	5.3	174 (6.2)	111 (6.1)	16 (8.4)	10 (6.8)
37 to 41+6 weeks	-	2486 (89.1)	1632 (89.7)	168 (88.4)	127 (85.8)
≥42 weeks	-	130 (4.7)	76 (4.2)	6 (3.2)	11 (7.4)
Mean age (wks) (±SD)	-	39.7 ± 2.0	39.6 ± 2.0	39.4 ± 2.5	39.5 ± 2.5
Birth weight					
Small for gestational age (≤10 th)	-	200 (7.2)	114 (6.3)	12 (6.3)	10 (6.8)
Large for gestational age (≥90 th)	-	441 (15.9)	420 (23.2)	62 (32.6)	28 (19.0)
Mean birth weight (g) (±SD)	-	3515 ± 594	3610 ± 626	3655 ± 721	3519 ± 675
Congenital anomalies	-	39 (1.4)	19 (1.1)	5 (2.6)	3 (2.1)
Neonatal unit admission within 48hrs	-	194 (7.2)	152 (8.6)	24 (13.3)	14 (10.1)

^a Data for all singleton births in England, Wales and Northern Ireland were from CMACE 2008; ^b data for all births in England were obtained from CMACE 2008; N = all women, regardless of missing data; -, proportion unknown for all births in England; percentages have been calculated for each BMI group after excluding missing data

One stillborn baby was born in an AMU unit and the remaining 42 were delivered in an obstetric unit. Of those with a known intended place of delivery at the start of labour (85.7%), all mothers had intended to deliver in an obstetric unit.

Five of the stillborn babies were alive at the start of labour. This represents 11.6% of the cohort's singleton stillbirths, which compares to 8.4% of all stillbirths in the general population occurring due to intrapartum causes.⁴ The intrapartum stillbirth rate was 1.0 per 1000 births of mothers with a BMI ≥35, which is more than three times as high as the rate of 0.3 per 1000 births in the general maternity population. Of the intrapartum stillbirths reported during this cohort study, one was born at 25 weeks' gestation and one born just after 42 weeks; all others were born between 37 and 41 weeks' gestation.

Four (9.3%) out of the 43 stillborn babies had confirmed major congenital anomalies and were reported to have died prior to labour. This is not different to the 9.1% rate in the general population.⁴ Thirty-one percent of stillborn babies were born SGA, which compares to 6.5% of live born babies (P<0.0001). SGA babies were over six times more likely to be stillborn than babies weighing >10th percentile for their gestation (OR 6.39, 95% CI 3.29 to 12.42).

There were six early neonatal deaths, corresponding to a neonatal mortality rate of 1.2 per 1000 live births, and is not different to rates in the general neonatal population (1.3 per 1000 live births). Two were born preterm (28 weeks and 34 weeks' gestation) and one baby had a major congenital anomaly. The perinatal mortality rate for singleton babies born to women with a BMI ≥ 35 was 9.8 per 1000 total births and is almost twice the perinatal mortality rate of 5.2 per 1000 total births in the general population in England, Wales and Northern Ireland.

Of the 77 twin pregnancies, there was one antepartum stillbirth, and, in one set of twins, an intrapartum stillbirth and an early neonatal death, corresponding to a perinatal mortality rate of 19.5 per 1000 births among twin pregnancies. In the general maternity population, the twin perinatal mortality rate was 15.6 per 1000 births in 2008.⁴ Due to the small number of twin pregnancies, comparing the rate in the study cohort with the rate in the general population is not recommended. Four babies had confirmed congenital anomalies and 53 (34.4%) babies were admitted to a neonatal unit within 48 hours of birth.

6.4.2. Gestational age

Almost 90% of singleton babies were born at term (37 to 41+6 weeks). A total of 6.3% (n=316) of babies were born preterm (<37 weeks) and 4.5% (n=226) were at or after 42 weeks. The proportion of babies born preterm was slightly higher (8.4%) in the super-morbidly obese group (BMI ≥ 50) compared to the lower BMI groups, however this difference was not significant, possibly because of the small numbers in the BMI ≥ 50 group. Babies classed as LGA were more likely to be born before 37 weeks' gestation than babies weighing below the 90th centile for gestational age (aOR 1.66, 95% CI 1.28 to 2.16); this was also the case for babies born to mothers with diabetes (aOR 2.12, 95% CI 1.56 to 2.87).

6.4.3. Fetal congenital anomalies

Data are presented in this report for anomalies that were confirmed antenatally or soon after delivery. There were 68 singleton babies with confirmed congenital anomalies, corresponding to a rate of 14 per 1000 births. Anomalies ranged in severity. Based on information provided by maternity units, which was then coded by CMACE, 44 (65.7%) were classed as minor, 11 (16.4%) were classed as major anomalies, and 12 (17.9%) had insufficient information to enable severity to be classified. One baby with a confirmed anomaly did not have any information provided. The most common type of anomalies were those affecting limbs (Table 6.18).

Table 6.18. Confirmed congenital anomalies in babies born to women with a BMI ≥ 35

	n (%)		
	All N=57	Minor ^a N=42	Major ^a N=10
Chromosome	4 (7.0)	0 (0.0)	4 (40.0)
Congenital heart	7 (12.3)	4 (9.5)	3 (30.0)
Digestive system	1 (1.8)	0 (0.0)	0 (0.0)
Eye	2 (3.5)	2 (4.8)	0 (0.0)
Genital	7 (12.3)	7 (16.7)	0 (0.0)
Heart	1 (1.8)	0 (0.0)	0 (0.0)
Limb	21 (36.8)	20 (47.6)	1 (10.0)
Nervous system	3 (5.3)	2 (4.8)	0 (0.0)
Neural tube defect	1 (1.8)	0 (0.0)	1 (10.0)
Oro facial	4 (7.0)	3 (6.8)	1 (10.0)
Skin	2 (3.5)	2 (4.8)	0 (0.0)
Urinary	4 (7.0)	2 (4.8)	0 (0.0)

^a Anomalies that could not be classified as either minor or major in severity have been omitted from these columns

Four (5.9%) of the babies with confirmed congenital anomalies were stillborn and one (1.5%) died within seven days of birth (early neonatal death). All of these had major anomalies, which were classified as chromosomal (n=1), congenital heart (n=2), digestive system (n=1) or neural tube defect (n=1).

6.4.4. Neonatal unit admissions

Of the singleton pregnancies within the cohort, there were a total of 390 (8.1%) reported neonatal unit admissions within 48 hours of birth (median gestation 38, range 24.6 to 43.3). Of these, 158 (49.5%) were born before 37 weeks (preterm), representing a 54% admission rate (within 48 hours of birth) for babies born preterm. The admission rate for babies born at term (≥ 37 weeks) was 5%. Admissions to the neonatal unit were positively associated with maternal BMI ($P < 0.01$) and babies born to mothers with a BMI ≥ 50 were almost twice as likely to be admitted to the neonatal unit as babies born to mothers with a BMI 35.0-39.9, even after controlling for maternal age, parity, maternal morbidities and gestation at delivery (OR 2.02, 95% CI 1.20 to 3.38). Babies born to mothers with a BMI 40-49.9 were also more likely to be admitted, compared to women with a BMI 35.0-39.9 (OR 1.30, 95% CI 1.02 to 1.67).

Out of the UK nations, Scotland had the highest rate of neonatal unit admissions, with 11.8% of singleton babies being admitted within 48 hours. Northern Ireland had the lowest rate, with just 4.7% of babies admitted to the neonatal unit. These differences were not accounted for by maternal BMI prevalence.

6.4.5. Large for gestational age and small for gestational age

Babies were defined as LGA when their weight was greater or equal to the 90th percentile for their gestation.⁹⁴ A total of 959 (19.3%) singleton babies in the cohort were categorised as LGA. The proportion of LGA babies increased significantly with each increasing maternal BMI category ($P < 0.001$). Almost one third of babies born to women with a BMI ≥ 50 were LGA, compared to 16% born to women with a BMI 35-39.9 (OR 2.57, 95% CI 1.87 to 3.54).

Among women with obesity, those with diabetes were more likely to have a LGA baby than women without diabetes (40% vs. 17%, OR 3.30, 95% CI 2.71 to 4.03) (Figure 6.2). There was an interaction between BMI group and diabetes status, and the relationship between BMI and LGA was more pronounced among women without diabetes, as shown in Table 6.19, despite the higher LGA rates in those with diabetes. This may reflect the benefit of better overall metabolic control, rather than just glycaemic control, in women with diabetes.⁹⁵

Figure 6.2. Proportion of babies born large for gestational age by maternal diabetes status and BMI group

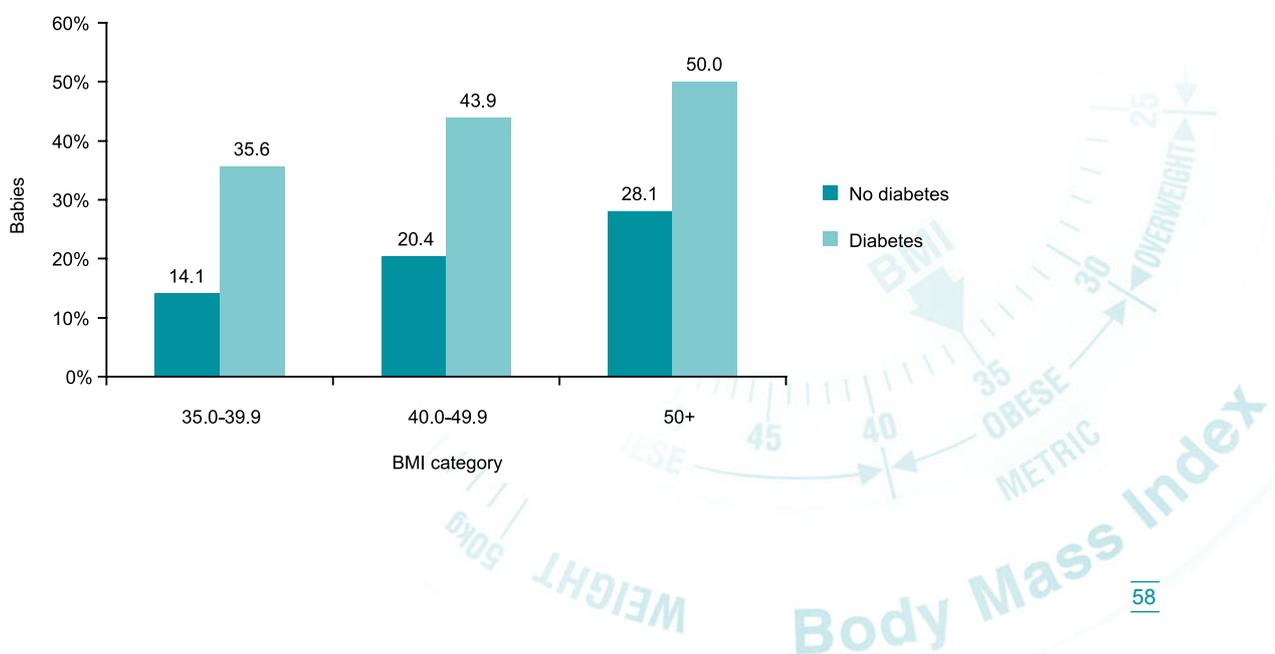


Table 6.19. Adjusted odds of women with and without diabetes having a LGA baby, by BMI group

	BMI 35.0-39.9 ^a	BMI 40.0-49.9		BMI ≥50	
	N=2787	N=1815		N=190	
	n (%)	n (%)	OR (95% CI)	n (%)	OR (95% CI)
Diabetes	79 (35.6)	93 (44.1)	1.43 (0.97 – 2.10)	18 (50.0)	1.81 (0.89 – 3.68)
No diabetes	358 (14.1)	324 (20.4)	1.55 (1.32 – 1.83)	43 (28.1)	2.37 (1.64 – 4.43)

N = all women within each BMI category, n=women with a LGA baby; percentages reflect the proportion of women within each group that have a LGA baby, after excluding missing data; ^aodds ratios calculated using BMI 35.0-39.9 as the reference group; CI, confidence interval; bold text denotes statistically significant associations

Almost half (49.0%) of all singleton babies that were LGA were born by caesarean section. This compares to 34.4% of babies below the 90th centile for gestational age. Planned caesarean sections were more common in women with LGA babies than in women with babies <90th centile (55.6% vs. 40.5%, P<0.001).

Babies were defined as being SGA if their weight was below or equal to the 10th percentile for their gestation. Three hundred and thirty-six singleton babies had a birth weight that was within the bottom 10 percent of the general population, representing 6.3% of the singleton babies within the study cohort. There was no difference between BMI groups.

6.4.6. Feeding practices

It is recognised that women with obesity are less likely to breastfeed, possibly due to social factors, difficulty in latching on or to endocrine disturbance. The intentional and actual feeding practices of the women within the cohort who had singleton pregnancies are shown in Table 6.20.

Table 6.20. Feeding practices by BMI group, among women with a singleton pregnancy

	n (%)			
	BMI 35.0-39.9 N=2789	BMI 40.0-49.9 N=1820	BMI ≥50 N=190	Professional Judgement N=149
Intention at booking				
Breastfeeding	1554 (56.3)	944 (52.5)	94 (50.0)	66 (45.5)
Formula	840 (30.4)	602 (33.5)	57 (30.3)	49 (33.8)
Breastfeeding and formula	55 (2.0)	36 (2.0)	6 (3.2)	4 (2.8)
Not known	311 (11.3)	215 (11.8)	31 (16.5)	26 (17.9)
Method of first feed				
Breastfeeding	1570 (57.3)	931 (52.2)	96 (52.5)	67 (46.2)
Expressed milk	32 (1.2)	19 (1.1)	1 (0.5)	3 (2.1)
Formula	1010 (36.9)	729 (40.9)	72 (39.3)	56 (38.6)
Not known	127 (4.6)	104 (5.8)	14 (7.7)	19 (13.1)
Feeding at discharge				
Breastfeeding	1270 (46.9)	740 (42.1)	77 (42.5)	55 (38.7)
Formula	1138 (42.1)	805 (45.8)	81 (44.8)	69 (48.6)
Breastfeeding and formula	209 (7.7)	137 (7.8)	16 (8.8)	9 (6.3)
Not known	89 (3.3)	77 (4.4)	7 (3.9)	100 (142)

N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data

Just over half (54.6%) of all women with a BMI ≥ 35 had reported at booking that they intended to exclusively breastfeed. A similar proportion (55.2%) actually breastfed for the first feed and a further 1.1% expressed breast milk. At discharge from hospital, exclusive breastfeeding had dropped by over 10% to 44.9%. A larger proportion of women in the lower BMI group breastfed compared to women with a BMI 40.0-49.9 and BMI ≥ 50 ($P < 0.05$). The difference in feeding intention between BMI groups was borderline significant ($P = 0.054$).

Among the mothers of twins, 33 (42.9%) intended to exclusively breastfeed their babies. Twenty-seven (36.0%) breastfed for the first feed and a further three (4.0%) expressed their milk. Upon discharge from hospital, just 16 mothers (22.5%) were exclusively breastfeeding and a further 16 (22.5%) were mixed feeding.

6.5. Risk factors for pregnancy-related complications and outcomes among women with obesity

The main maternal characteristics associated with pregnancy-related complications and outcomes among women with obesity are described below. To illustrate the potential magnitude of this association, we have shown the potential change in risk for each unit increase in BMI. As the study was not designed to address this, and as the cohort has limitations such as addressing only women with a BMI ≥ 35 and with no normal BMI controls, these data are not conclusive but rather informative for future investigations

6.5.1. Maternal body mass index

Maternal BMI was a significant risk factor for almost all of the pregnancy-related complications and outcomes examined as part of this study, even after adjustment for potentially confounding variables (Table 6.21). Among women with a BMI ≥ 35 , each unit increase in maternal BMI was associated with a 7% increased risk of type 2 diabetes, a 5% increased risk of GDM and an 8% increase in risk of severe pre-eclampsia or eclampsia. BMI was the only factor predicting risk of hypertensive disorders in pregnancy among those examined within the study.

Increasing BMI was also associated with an increased risk of intrapartum-related complications, with a 2-3% increased risk of induction of labour, caesarean section and primary postpartum haemorrhage (blood loss ≥ 500 ml within 24 hours) with each BMI unit increment.

BMI was associated with the risk of perinatal mortality. Among the women in the cohort, each BMI unit increment was associated with a 6% increased risk of stillbirth, and the increased risk of perinatal mortality (stillbirth or early neonatal death) was 5%. Perinatal mortality was largely explained by severe congenital malformations; babies with severe malformations were 51 times more likely to be stillborn or die within seven days of birth than babies without severe malformations (aOR 51.24, 95% CI 13.38 to 196.20). However, after excluding babies with confirmed congenital anomalies, BMI remained a significant predictor of stillbirths. Small for gestational age (defined as weight $< 10^{\text{th}}$ percentile for gestational age) was also a risk factor, which was associated with a 21% increased risk of perinatal mortality compared to a weight $> 10^{\text{th}}$ percentile for gestational age (aOR 0.21, 95% CI 0.11 to 0.41). BMI was not significantly associated with either congenital malformations or SGA, a finding that differs from other studies.⁹⁶ This lack of association may reflect the small number of fetal abnormalities coupled with the identification of the cohort at delivery which excludes women who had a termination of pregnancy for fetal abnormality in the first half of pregnancy.

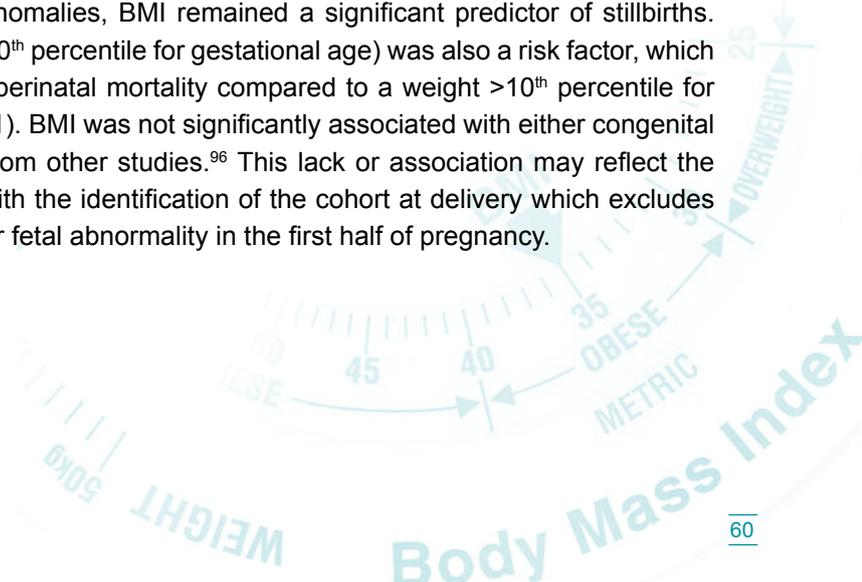


Table 6.21. Adjusted odds of co-morbidities, pregnancy-related complications and adverse outcomes for women with a pregnancy BMI 40-49.9 and ≥50 in comparison to women with a BMI 35-39.9

	aOR (95% CI)	
	BMI 40.0-49.9	BMI ≥50
Co-morbidities		
Type 2 diabetes ^a	1.50 (0.93 to 2.32)	3.13 (1.47 to 6.67)
Gestational diabetes ^b	1.56 (1.25 to 1.95)	2.15 (1.38 to 3.37)
Pregnancy-induced hypertension (PIH) ^c	1.19 (0.96 to 1.46)	1.73 (1.12 to 2.68)
Pre-eclampsia ^d	1.32 (1.03 to 1.36)	2.58 (1.62 to 4.10)
Severe pre-eclampsia/eclampsia	1.94 (0.88 to 4.29)	5.45 (1.72 to 17.28)
Hypertensive disorders in pregnancy ^d	1.31 (1.10 to 1.57)	1.80 (1.22 to 2.64)
Intrapartum-related complications		
Induction of labour ^e	1.12 (0.97 to 1.29)	1.27 (0.88 to 1.83)
Caesarean section ^f	1.28 (1.03 to 1.60)	1.63 (1.00 to 2.67)
Primary postpartum haemorrhage (>=500ml) ^g	1.24 (1.07 to 1.44)	1.25 (0.87 to 1.80)
Adverse pregnancy-related outcomes		
Stillbirth	1.11 (0.58 to 2.13)	2.01 (0.60 to 6.78)
Perinatal mortality (stillbirth or early neonatal death)	1.00 (0.54 to 1.85)	1.70 (0.51 to 5.67)
Large for gestational age ^h	1.19 (0.92 to 1.55)	1.03 (0.59 to 1.82)
Neonatal unit admission (within 24hrs) ⁱ	1.04 (0.83 to 1.30)	1.66 (1.05 to 2.62)
Congenital anomaly	0.75 (0.43 to 1.29)	1.89 (0.74 to 4.85)

aOR, adjusted odds ratio; CI, confidence interval; hypertensive disorders in pregnancy include PIH, pre-eclampsia, severe pre-eclampsia and eclampsia; bold text denotes statistically significant ($P < 0.05$) aOR; ^a adjusted for ethnicity, age, Index of multiple deprivation (IMD); ^b adjusted for ethnicity, age; ^c adjusted for age; ^d adjusted for age and parity; ^e adjusted for ethnicity, diabetes, PIH, pre-eclampsia, severe pre-eclampsia or eclampsia; ^f adjusted for age, ethnicity, parity, diabetes, gestational weight gain, large for gestational age (LGA); ^g adjusted for IMD, caesarean section (CS); ^h adjusted for age, diabetes, gestational weight gain; ⁱ adjusted for diabetes, emergency CS

6.5.2. Maternal age

Age ≥35 years is an independent risk factor for a number of co-morbidities, including type 2 diabetes (aOR 2.36, 95% CI 1.51 to 3.67), gestational diabetes (aOR 1.92, 95%CI 1.43 to 2.42) and PIH (aOR 1.35, 95% CI 1.08 to 1.70). During the intrapartum period, women aged ≥35 were more likely to have a caesarean section (aOR 1.66, 95% CI 1.43 to 1.93) and give birth to a LGA baby (aOR 1.46, 95% CI 1.23 to 1.73). While women aged ≥35 were 26% more likely to be induced than women under the age of 35 years, this increased risk was due primarily to the presence of diabetes. Although older maternal age generally predicted complications, women aged ≥35 years were almost 50% more likely to be exclusively breastfeeding upon discharge from hospital than their younger counterparts (aOR 1.48, 95% CI 1.27 to 1.72).

6.5.3. Maternal ethnicity

Type 2 diabetes and gestational diabetes were much more prevalent in women from black and minority ethnic (BME) groups compared to White women (4.6 vs. 1.3 ($P < 0.001$) and 11.4 vs. 7.2 ($P < 0.001$), respectively), which is consistent with trends in the general population.⁹⁷ After controlling for BMI and weight gain, BME groups were almost four times more likely to have type 2 diabetes (aOR 3.97, 95% CI 1.73 to 9.09) and twice as likely to have gestational diabetes than White women (aOR 2.23, 95% CI 1.42 to 3.50).

While BME women were less likely to be induced than White women (aOR 0.64, 95% CI 0.52 to 0.78), they were more likely to have their baby before 37 weeks' gestation (aOR 1.45, 95% CI 1.08 to 1.94) and to stay in hospital for longer after both vaginal deliveries ($P=0.009$) and caesarean sections ($p<0.001$). Although caesarean section was more common in BME women compared to White women (42.7% vs. 36.4%), after adjusting for BMI, weight gain and diabetes, ethnicity was no longer a significant predictor of delivery mode. Exclusive breastfeeding upon discharge from hospital was more common among BME women than White women (aOR 1.67, 95% CI 1.40 to 1.99).

6.5.4. Maternal co-morbidities

There was no significant difference in the maternal and fetal outcomes between women with type 1 diabetes, type 2 diabetes or gestational diabetes. Diabetes was a significant predictor for a number of pregnancy-related complications and adverse outcomes among women with obesity (Table 6.22); however, data from this study did not show an increased risk of perinatal mortality or congenital anomalies among babies born to obese mothers with diabetes compared to those born to obese mothers without diabetes.

Table 6.22. Adjusted odds of pregnancy-related complications and adverse outcomes by diabetes status

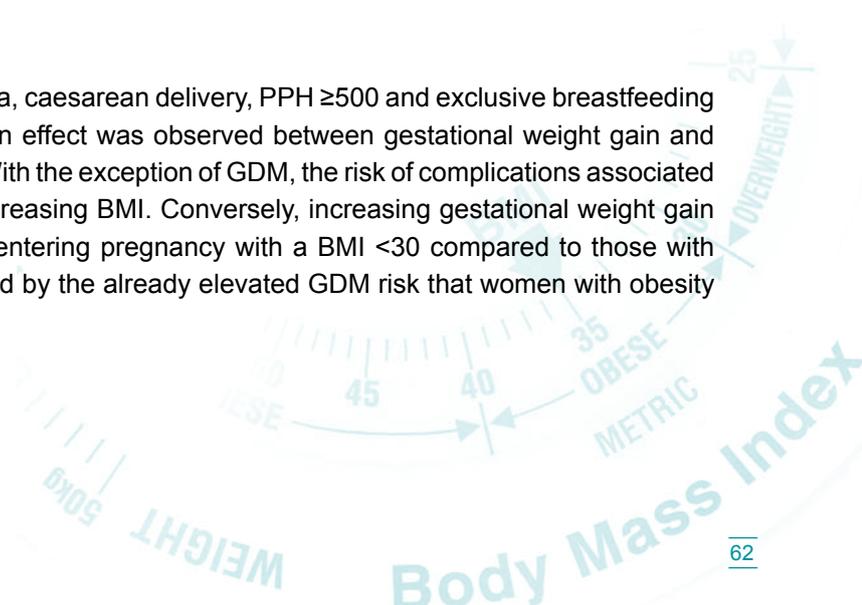
Complications & adverse outcomes	n (%)		aOR	(95% CI)
	No diabetes N=4459	Diabetes N=484		
Induction of labour ^a	1415 (31.7)	234 (48.3)	4.43	(3.39 to 5.80)
Caesarean section ^b	1568 (35.2)	266 (55.0)	1.90	(1.55 to 2.32)
PPH ^c	1049 (23.7)	162 (33.5)	1.44	(1.17 to 1.77)
LGA (weight >90th centile for gestation) ^c	757 (17.0)	195 (40.4)	2.79	(2.27 to 3.43)
Neonatal unit admission (<48hr) ^d	306 (7.1)	78 (16.5)	2.45	(1.86 to 3.24)
Exclusive breastfeeding ^e	1980 (47.6)	171 (38.4)	.59	(0.48 to 0.73)

N = all women, regardless of missing data; percentages have been calculated for each BMI group after excluding missing data; aOR, adjusted odds ratio; bold text denotes statistically significant associations; ^a adjusted for ethnicity, PIH, pre-eclampsia, severe pre-eclampsia, BMI; ^b adjusted for ethnicity, age, previous deliveries, BMI; ^c adjusted for age, BMI; ^d adjusted for BMI; ^e adjusted for ethnicity, age, BMI

Pregnancy-related hypertensive disorders (PIH, pre-eclampsia and severe pre-eclampsia/eclampsia) among women with obesity increased the risk of induction (aOR 2.49, 95% CI 2.05 to 3.02), having a baby before 37 weeks' gestation (aOR 1.94, 95% CI 1.48 to 2.54) and having a baby admitted to the neonatal unit with 48 hours of birth (aOR 1.48, 95% CI 1.10 to 2.01). There was no difference in the odds of these complications between different pregnancy-related hypertensive disorders.

6.5.5. Maternal gestational weight gain

Gestational weight gain predicted pre-eclampsia, caesarean delivery, PPH ≥ 500 and exclusive breastfeeding among women within the cohort. An interaction effect was observed between gestational weight gain and early pregnancy BMI on risk of complications. With the exception of GDM, the risk of complications associated with gestational weight gain increased with increasing BMI. Conversely, increasing gestational weight gain posed the greatest GDM risk among women entering pregnancy with a BMI <30 compared to those with higher initial BMIs. This may be partly explained by the already elevated GDM risk that women with obesity have at the onset of pregnancy.



6.6. Discussion

This study included over 5000 pregnant women with a BMI ≥ 35 , and it is the first UK-wide study on Class II and Class III maternal obesity. The cohort study examined the extent to which pregnancies among women with a BMI ≥ 35 are burdened by co-morbidities, complications and poor outcomes.

The majority (96%) of women notified to CMACE as part of the observational study had a weight, height and BMI documented. Almost a third of these women had their weight re-measured at a later point in pregnancy. Forty-two percent of the women in the cohort had a BMI ≥ 40 , highlighting that a significant proportion of pregnant women with a BMI ≥ 35 are morbidly obese. Seven percent of the women in the study had a BMI < 30 at the start of their pregnancy. These women gained sufficient weight for their BMI to increase to ≥ 35 later on in pregnancy.

The women in the cohort were more likely to live in the most deprived areas compared to women in the general maternity population,⁴ and women with severe degrees of obesity were more likely to be older than women with more moderate degrees of obesity. These findings support previously published literature showing that social deprivation and age are associated with maternal obesity.³

Increasing BMI was directly correlated with almost all of the pregnancy-related complications examined as part of this study. This supports the majority of other observational studies examining risks associated with obesity in pregnancy.^{71 84 98} Pre-existing conditions, such as essential hypertension and diabetes were more prevalent in pregnant women with a BMI ≥ 35 than in the general pregnant population.⁵ Almost a quarter of women in the cohort had at least one condition diagnosed during the pregnancy. Pregnancy-induced hypertension (PIH) and gestational diabetes mellitus (GDM) were the most common conditions, affecting 9% and 8% of women with a BMI ≥ 35 , which is considerably higher than the respective 2% and 2.5% rate in the general maternity population.⁵ Women with obesity without co-morbidities are at an increased risk of complications during pregnancy, and the presence of co-morbidities will place these women at even greater risk by adding to their already elevated risk profile.

In the general maternity population, diabetes is associated with increased perinatal mortality.⁹⁹ Although the risk of medical intervention was higher among women in the cohort with co-morbidities, compared to those without co-morbidities, this study did not find an increased risk of perinatal mortality in women with obesity and diabetes compared to women with obesity alone. While it is possible that the cohort was not large enough to examine differences between subgroups in reasonably rare outcomes, it is also possible that the increased risk diabetes poses to the baby may be mediated through common metabolic pathways rather than through glycaemic disturbance alone. This area may warrant further research in order to better understand the mechanisms underlying the relationship between diabetes, obesity and perinatal mortality.

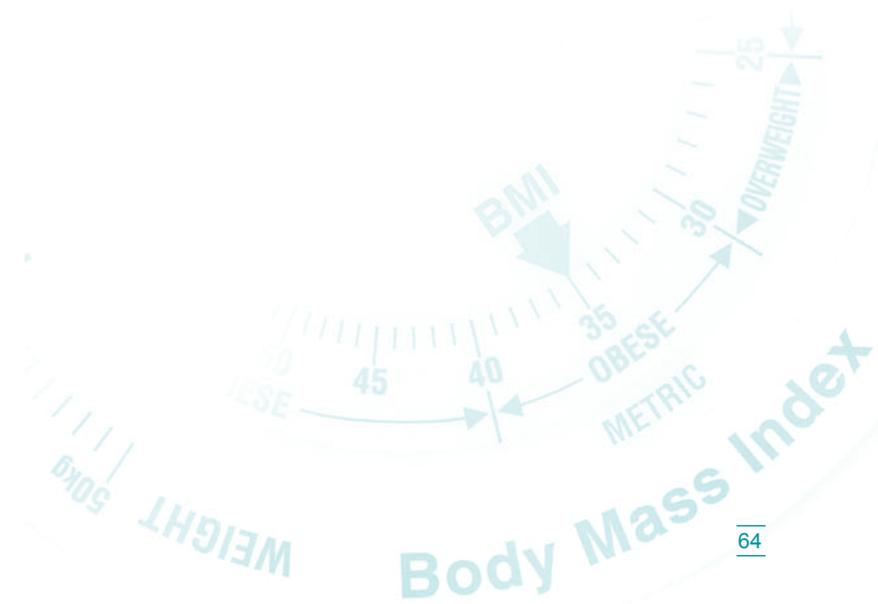
Gestational weight gain was inversely correlated with BMI at the start of pregnancy. The mean weight gain among women who entered a singleton pregnancy with a BMI < 30 was over three times the gain observed in women with morbid obesity. Although this will not represent average gestational weight gain among non-obese women in the UK, since eligibility for the study was a BMI ≥ 35 at any point in pregnancy, this finding highlights that non-obese women are at risk of gaining significant amounts of weight during pregnancy, and that these women may become obese or severely obese by the third trimester, and thus have a very different risk profile towards the end of their pregnancy compared to the beginning. This is important, since the study found that gestational weight gain predicted a number of pregnancy-related complications, including pre-eclampsia, caesarean section, large for gestational age (LGA) and primary postpartum haemorrhage (PPH). Interestingly, weight gain was positively associated with exclusive breastfeeding.

Under half of women with a pregnancy BMI ≥ 35 laboured spontaneously, 33% underwent an induction of labour and 20% had a caesarean section prior to labour. The spontaneous labour and induction rate in the

general maternity population is 69% and 20%, respectively.⁵ Caesarean section rates were also much higher in the obese cohort compared to the general maternity population, as were the rates of PPH, even after adjusting for caesarean deliveries. These findings clearly indicate that women with obesity are at increased risk of medical intervention during their pregnancy and particularly during their labour and delivery. Women with a BMI ≥ 35 also spend longer in hospital after giving birth, regardless of their mode of delivery; this indicates they take longer to recover after childbirth and are more susceptible to birthing and postpartum complications than women with a healthy BMI.

Poor infant outcomes were also more prevalent with increasing BMI. The proportion of babies born LGA increased with BMI, and one third of all babies born to women with a BMI ≥ 50 were LGA. This is significant, as LGA predisposes infants to birth injuries, perinatal asphyxia and problems such as neonatal respiratory distress and metabolic instability.¹⁰⁰ Maternal diabetes also predicted birthweight, and there was an interaction between diabetes and BMI, whereby the relationship between maternal BMI and LGA was stronger among women without diabetes than among those with diabetes, possibly due to treatment of diabetes impacting on birthweight. Babies born to women with obesity also have an increased risk of mortality, and each unit increase in maternal BMI beyond 35 is associated with a 7% increased risk of stillbirth. For live born babies, increased maternal BMI increases the risk of neonatal unit admission. The lack of association between BMI and congenital anomalies is likely due to the lack of power to detect associations with rare outcomes, as several large cohort studies and a recent systematic review have reported an increased risk of a range of structural anomalies associated with obesity.⁹⁶

The findings from this national observational study demonstrate that increasing maternal obesity is associated with an increased risk of maternal co-morbidity, pregnancy-related complications and fetal morbidity and mortality. The rates of pregnancy-related complications and adverse outcomes in women with a BMI ≥ 35 are significantly higher than the rates in the general population.⁵ While some women with obesity will have uncomplicated pregnancies and births, many will not. As a result, pregnancies among women with obesity require increased surveillance and medical intervention, and the increased risks associated with these pregnancies demonstrate the need not only for specific antenatal assessment, but also for specific planning of delivery and optimal fetal monitoring.

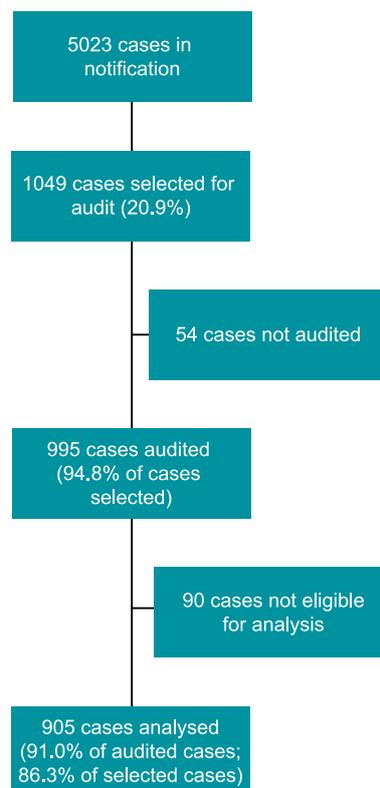


7. Standards of care for women with Class II and Class III maternal obesity

This chapter presents the findings from the national audit, which involved assessing evidence documented in the maternity notes of women with maternal obesity (BMI ≥ 35) against standards of care developed by CMACE and recently published in the joint CMACE/RCOG Guideline on the management of women with obesity in pregnancy.¹²

There were 1049 cases randomly selected from those identified in the observational cohort study. A total of 995 (94.9%) cases were actually audited (see Figure 7.1). These included 79 women without a known pregnancy weight or BMI but judged by health professionals to have a BMI ≥ 35 and 916 women with a calculated BMI ≥ 35 at any point during pregnancy.

Figure 7.1. Number of cases audited by CMACE



Fifty-four cases were not audited. Maternity notes were not available for 33 cases; incorrect notes were provided in four cases; eight cases were found to be ineligible because their BMI was less than 35; one case was a duplicate of another audited case; and one unit was unable to identify the correct woman in order to request the appropriate maternity notes. Three cases were not audited because of insufficient time and there were four cases where no reason was given by the auditor.

7.1. Preconception care and advice

Women with a BMI ≥ 30 wishing to become pregnant should be advised to take 5mg folic acid supplementation daily, starting at least one month before conception and continuing during the first trimester of pregnancy.

B

The dosage and timing of documented folic acid supplementation was examined in the maternity records. Documentation regarding both use of and dosage of folic acid supplementation was poor, particularly in the pre-pregnancy period (Table 7.1). Of those women with use and dosage recorded, very few took the recently recommended dose of 5mg, but the majority were on some form of folic acid supplement in the first trimester^{##}.

Table 7.1. Dosage of reported folic acid supplementation before and during pregnancy

	n (%)	
	BMI ≥35 N=826	Professional Judgement N=79
Folic acid anytime before or during pregnancy		
400 micrograms	111 (16.4)	9 (13.8)
4mg	5 (0.7)	0 (0.0)
5mg	14 (2.1)	1 (1.5)
Unknown dosage	452 (67.0)	45 (69.2)
None	93 (13.8)	10 (15.4)
<i>Not recorded / Missing</i>	151	14
Folic acid anytime before pregnancy		
400 micrograms	28 (6.6)	2 (5.1)
4mg	0 (0.0)	0 (0.0)
5mg	6 (1.4)	1 (2.6)
Unknown dosage	90 (21.3)	11 (28.2)
None	299 (70.7)	25 (64.1)
<i>Not recorded / Missing</i>	403	40
Folic acid anytime during 1st trimester		
400 micrograms	112 (19.5)	8 (14.3)
4mg	5 (0.9)	0 (0.0)
5mg	12 (2.1)	0 (0.0)
Unknown dosage	349 (60.7)	37 (66.1)
None	97 (16.9)	11 (19.6)
<i>Not recorded / Missing</i>	251	23

Almost half of all women audited did not have any documentation in the notes regarding preconception folic acid use. Of those that did have this recorded, less than a third were noted as having taken folic acid anytime before pregnancy (29.3% of women with a BMI ≥35 and 34.9% of women in the Professional Judgement group). Only seven women audited (1.5%) were known to have taken an increased dose of folic acid (two women had a BMI 35-39.9, four women had a BMI ≥40, and one woman was in the Professional Judgement group). Most women who were recorded as having taken folic acid before pregnancy did not have a dosage recorded.

More women were recorded as having taken folic acid anytime during the first trimester of pregnancy than prior to conception. Thirty percent of women had no documentation regarding folic acid use during the first trimester of pregnancy. Of those that did have folic acid use recorded, 83% of women with a BMI recorded and 80% of women in the Professional Judgement group used folic acid.

^{##} The Department of Health advise that all pregnant women (including those with a BMI >30) take a folic acid supplement at the usual dose of 400 micrograms/day from before pregnancy until the 12th week of pregnancy.

Again, only a small number of women used 5mg, the dose recommended by the guideline (seven women with a BMI 35-39.9 and five women with a BMI ≥ 40). Most women did not have the dosage recorded.

There were some women who had use of folic acid recorded, but the timing of the folic acid supplementation was not recorded; when these were examined, only 18% of women had no information regarding folic acid use. Of those that did have this recorded, 14% of women with a recorded BMI and 15% of women in the Professional Judgement category had no use of folic acid at all. A further 67% and 69%, respectively, had no record of the dosage used. A total of 15 women were recorded as using 5mg of folic acid supplementation either before or during pregnancy. Of these, three women had either type 1 or type 2 diabetes, and two women had epilepsy. High-dose folic acid is recommended for these conditions, as they are associated with increased risk of neural tube defects.

7.2. Measuring and recording height, weight and body mass index

All pregnant women should have their weight and height measured using appropriate equipment, and their body mass index calculated at the antenatal booking visit. Measurements should be recorded in the handheld notes and electronic patient information system.

D

Information regarding anthropometric measurements recorded during pregnancy was obtained during the observational cohort study. Table 7.2 shows the reported timings of the first reported antenatal weight measurement among women in the retrospective audit cohort.

Seventy-two percent of women within the audit cohort had a weight recorded at the booking appointment. This represents 78% of the women with a weight recorded at any time in pregnancy (women in the Professional Judgement group by definition had no weight measured); this was similar in the two BMI groups. This is different from the entire notification cohort, in which 77% of all women had a booking weight and 85% of those with any weight recorded had it done at the booking visit. An additional 3% of women had their weight recorded before the antenatal booking appointment with a midwife, most likely with the GP. Furthermore, 99% of the women with weight recorded at booking also had the BMI calculated and recorded at the booking appointment.

Table 7.2. Timing of weight measurement in relation to the antenatal booking appointment

	n (%)		
	BMI 35-39.9 N=519	BMI ≥ 40 N=307	BMI ≥ 35 N=826
Weight recorded at booking	402 (77.5)	245 (79.8)	647 (78.3)
Weight recorded within 1 week of booking	13 (2.5)	5 (1.6)	18 (2.2)
Weight recorded >1 week after booking	63 (12.1)	36 (11.7)	99 (12.0)
Other	41 (7.9)	21 (6.9)	62 (7.5)

It is not known whether the recorded weight was based on a measurement performed by the health professional or self-reported by the woman.

7.3. Provision of information for women

All pregnant women with a booking BMI ≥ 30 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how they may be minimised. Women should be given the opportunity to discuss this information.

D

This standard was met for fewer than one-fifth of the women audited. Evidence of information regarding the risks of obesity in pregnancy was provided more often for women with a BMI ≥ 40 , compared to either those in the BMI 35-39.9 range or the Professional Judgement group (24.3%, compared to 13.3% and 14.7%, respectively; $p < 0.001$).

7.4. Risk assessment during pregnancy

Pregnant women with a booking BMI ≥ 40 should have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties with venous access, regional or general anaesthesia can be identified. An anaesthetic management plan for labour and delivery should be discussed and documented in the medical records.

D

Of the women audited with a BMI ≥ 40 , 60.1% were offered an anaesthetic consultation with an anaesthetist; 75.3% of these women had a written anaesthetic management plan made, resulting in the standard being met for 45.1% of women in the relevant BMI group. Of the women who were offered a consultation but did not have a written management plan, 22.7% declined or did not attend; 63.6% of women who were offered a consultation but did not have a plan did not have any reason recorded for not having a plan made.

Women in the lower BMI and Professional Judgement groups were much less likely to be offered an anaesthetic consultation (24.3% and 21.8%, respectively) than in the BMI ≥ 40 group. However, these women were as likely as the women in the higher BMI group to have a written anaesthetic management plan made when offered (69.4% of women with a BMI 35-39.9 and 76.5% of women in the Professional Judgement group).

Women with a booking BMI ≥ 40 should have a documented assessment in the third trimester of pregnancy by an appropriately qualified professional to determine manual handling requirements for childbirth and consider tissue viability issues.

D

This standard was not met for the large majority of women audited with a BMI ≥ 40 or in the Professional Judgement group.

Only 14.4% of women with a BMI ≥ 40 had a documented assessment for manual handling (77% of these were done in the third trimester) and only 10% of women in this BMI category had a tissue viability assessment.

Women in the Professional Judgement group had similar proportions of assessment for manual handling (16.7% of women in the group, 91.7% of these in the third trimester), but were significantly more likely to have an assessment of tissue viability (19.7%; $p = 0.033$) than women with a BMI ≥ 40 .

7.5. Thromboprophylaxis

Women with a booking BMI ≥ 30 should be assessed at their first antenatal visit and throughout pregnancy for the risk of thromboembolism. Antenatal and post delivery thromboprophylaxis should be considered in accordance with the RCOG Clinical Green-top Guideline No. 37.¹³

D

Women within the audit sample were assigned to risk categories (Table 7.3) in accordance with the original version of the RCOG Green-top Guideline No.37 (2004)¹⁴ in order to assess whether thromboprophylaxis was administered appropriately. It is important to note that the recently updated version (2009),¹³ which had not been published at the time the audit was conducted, includes revised risk assessments and dosages.

Table 7.3. Recommendations for antenatal and postnatal thromboprophylaxis treatment according to the RCOG Green-top Guideline No. 37 (2004)^a

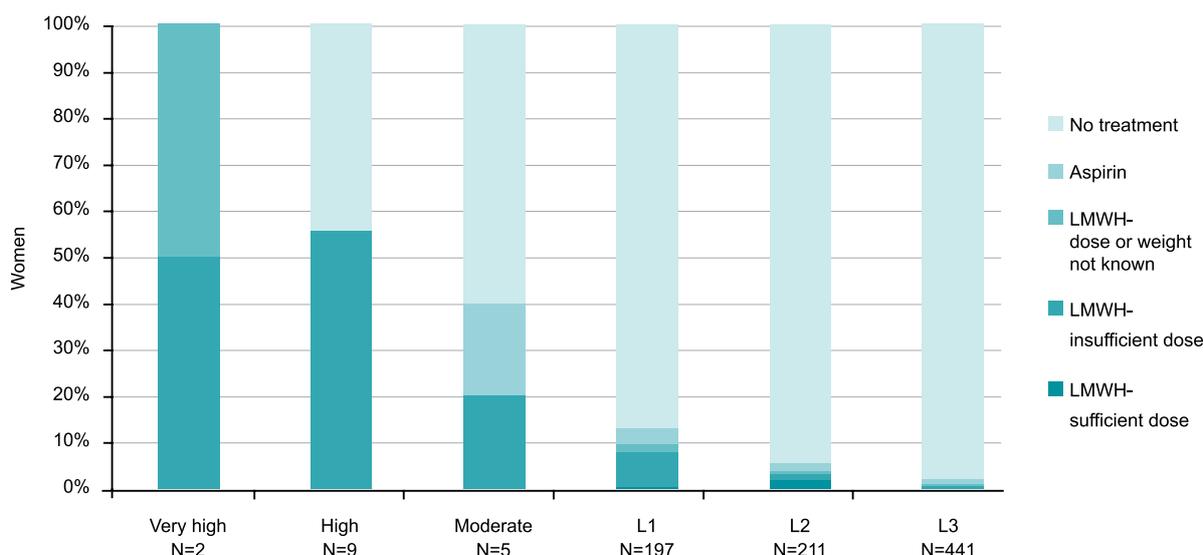
Risk	Previous VTE and/or thrombophilia status	Antenatal Prophylaxis	Postnatal Prophylaxis
Very high	Previous VTE (\pm thrombophilia) on long-term Warfarin	Antenatal high prophylactic or therapeutic dose LMWH	At least 6 weeks of postnatal Warfarin
High	Previous recurrent VTE not on long-term Warfarin	Antenatal prophylactic LMWH	6 weeks of postnatal prophylactic LMWH
	Previous VTE + thrombophilia	Antenatal prophylactic LMWH	6 weeks of postnatal prophylactic LMWH
	Previous VTE + family history of VTE	Antenatal prophylactic LMWH	6 weeks of postnatal prophylactic LMWH
	Asymptomatic thrombophilia (antithrombin deficiency, combined defects, homozygous FVL or prothrombin gene defect)	Antenatal prophylactic LMWH	6 weeks of postnatal prophylactic LMWH
Moderate	Single previous provoked VTE without thrombophilia, family history, or other risk factors	Possible antenatal low-dose aspirin	6 weeks of postnatal prophylactic LMWH
	Asymptomatic thrombophilia (except antithrombin deficiency, combined defects, homozygous FVL or prothrombin gene defect)	Possible antenatal low-dose aspirin	6 weeks of postnatal prophylactic LMWH
Low	No previous VTE or thrombophilia with 3 or more persistent risk factors (obesity + 2 factors)	Consider antenatal prophylactic LMWH	Consider for 3-5 days postnatal prophylactic LMWH
	No previous VTE or thrombophilia with 2 persistent risk factors (obesity + 1 factors)	Nothing	Consider for 3-5 days postnatal prophylactic LMWH
	No previous VTE or thrombophilia with obesity as only risk factor	Nothing	Nothing

^a Adapted from the RCOG Green-top Guideline No. 37 (2004)

7.5.1. Antenatal thromboprophylaxis

Figure 7.2 shows the use of antenatal thromboprophylaxis by risk category, according to national guidance.¹⁴ Two women had a very high risk of venous thromboembolism (VTE); both had thromboembolism risk noted at the booking visit and both were offered and prescribed antenatal thromboprophylaxis of LMWH. One woman, in the BMI 35-39.9 category, commenced LMWH at 15 weeks, while the other woman, in the Professional Judgement category, did not have the gestation at which LMWH was prescribed recorded in the maternity notes.

Figure 7.2. Use of antenatal thromboprophylaxis by VTE risk category

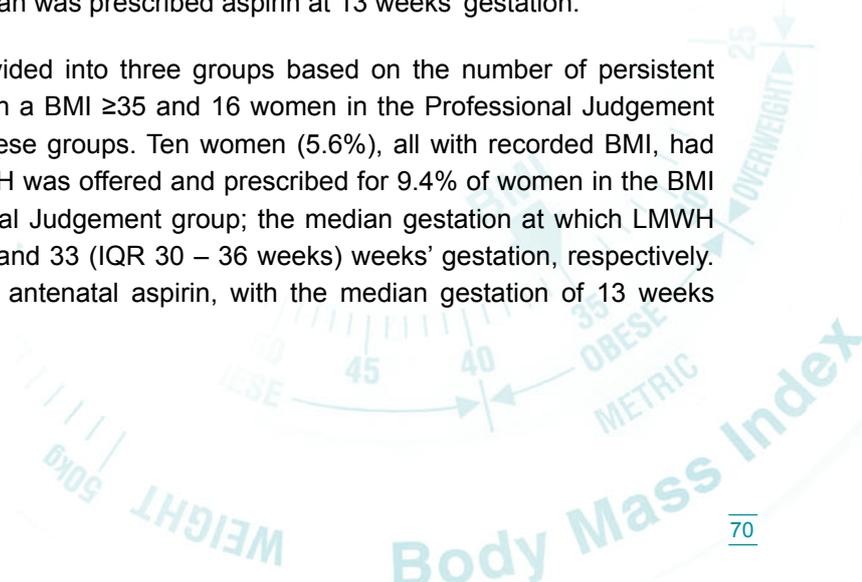


L1, Lower risk group 1 (3 or more persistent risk factors); L2, Lower risk group 2 (2 persistent risk factors); L3, Lower risk group 3 (1 persistent risk factor)

There were nine women with a BMI ≥ 35 identified as having a high risk of VTE. There was documented evidence of thromboembolism risk noted at booking for one third of these women; however, antenatal LMWH was offered and prescribed for only five of the nine women. The median gestation at which antenatal LMWH was commenced was 26 weeks' gestation (IQR 13 – 39 weeks); gestation was unknown for one woman. Aspirin was not prescribed antenatally for any women in this group.

Five women, all with a BMI ≥ 35 , were at moderate risk of VTE. None of these women had documented evidence of thromboembolism risk noted at booking. One woman was offered and prescribed antenatal LMWH, but the gestation at which this occurred was not recorded. This woman was also prescribed aspirin, again at an unknown gestation. A second woman was prescribed aspirin at 13 weeks' gestation.

The 'low at risk' category was further sub-divided into three groups based on the number of persistent risk factors present. A total of 181 women with a BMI ≥ 35 and 16 women in the Professional Judgement group were categorised into the highest of these groups. Ten women (5.6%), all with recorded BMI, had thromboembolism risk noted at booking. LMWH was offered and prescribed for 9.4% of women in the BMI group and 12.5% of women in the Professional Judgement group; the median gestation at which LMWH was prescribed was 33 (IQR 27 – 37 weeks) and 33 (IQR 30 – 36 weeks) weeks' gestation, respectively. An additional seven women were prescribed antenatal aspirin, with the median gestation of 13 weeks (IQR 10 – 16 weeks).



The second 'low at risk' group included 198 women with a BMI ≥ 35 and 13 women in the Professional Judgement group. Thromboembolism risk was noted at booking for 14.1% and 15.4% of women, respectively. LMWH was offered for 4.6% of women in the BMI group (none in the Professional Judgement group) and was prescribed for all but one of these women, with a median gestation at prescription of 30 weeks (IQR 8 – 32 weeks). Aspirin was prescribed for an additional 2.0% of women in the BMI group, at a median gestation of 17 weeks (IQR 13 – 20 weeks). No women in the Professional Judgement group were prescribed aspirin.

There were 395 women with a BMI ≥ 35 and 46 women in the Professional Judgement group assigned to the lowest 'at risk' group. At booking, 10.9% of women with a recorded BMI and 15.2% of women in the Professional Judgement group in this group had thromboembolism risk recorded in the antenatal notes. Antenatal LMWH was offered to 1.3% of women in the BMI group (prescribed to all but one woman) and offered and prescribed to 2.2% of women in the Professional Judgement group. The median gestation for commencing LMWH was 38 weeks (IQR 34 – 39 weeks). An additional 1.0% of women with a BMI ≥ 35 were prescribed aspirin, at a median gestation of 14 weeks (IQR 8 – 29 weeks). No women in the Professional Judgement group were prescribed aspirin. Of all the women in the cohort, only two women were noted to have LMWH contraindicated, and these both had a low risk of VTE. No women were prescribed Warfarin antenatally.

7.5.2. Postnatal thromboprophylaxis

Women at very high, high and moderate risk of VTE should receive LMWH for six weeks after giving birth.¹³
¹⁴ The RCOG guideline published in 2004 recommended that postnatal LMWH should be considered for three to five days for women with a low level of elevated risk of VTE with two or more risk factors.¹⁴ The 2004 guideline did not recommend routine use of postnatal thromboprophylaxis for women with only one risk factor. The updated guideline, published in 2009, however, now recommends one week of postnatal thromboprophylaxis for women with two or more risk factors and for women with BMI ≥ 40 and no other risk factors.¹³

Table 7.4 shows postnatal LMWH use among women with a BMI ≥ 35 . When LMWH use was assessed according to the RCOG Green-top guideline, postnatal thromboprophylaxis was underused, both in terms of it being offered and, in those cases when it was prescribed, the duration of use.

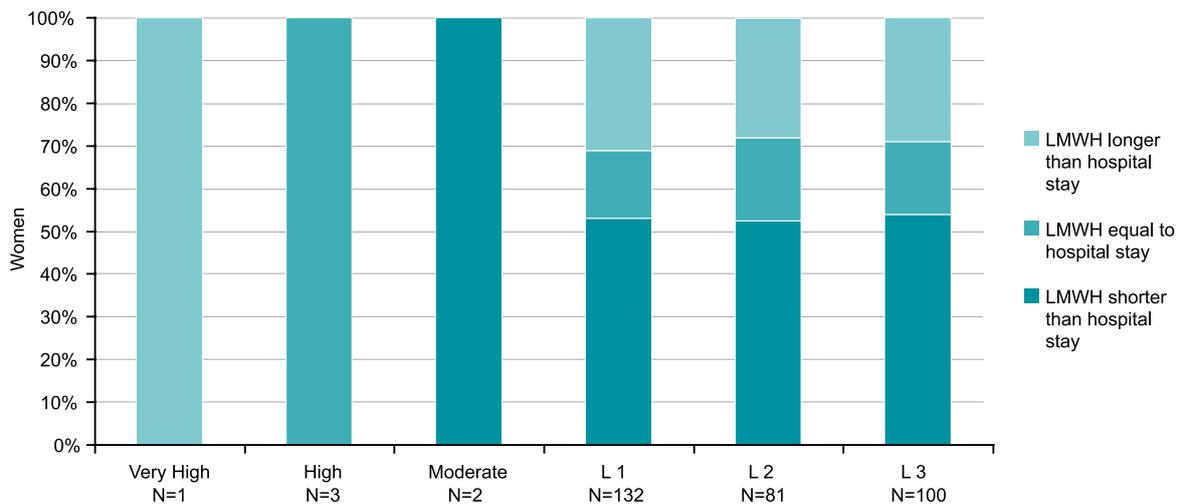
Table 7.4. Postnatal LMWH use among women with a BMI ≥ 35

	n (%)					
	Venous thromboembolism risk categories ^a					
	Very high N=2	High N=9	Moderate N=5	L1 N =197	L2 N =215	L3 N =448
Offered LMWH	2 (100.0)	6 (66.6)	2 (40.0)	163 (82.7)	115 (53.5)	138 (30.8)
Prescribed LMWH	2 (100.0)	6 (66.6)	2 (40.0)	160 (81.2)	108 (50.2)	135 (30.1)
Documented duration of postnatal LMWH ^b	1 (50.0)	3 (50)	0 (0.0)	138 (86.3)	84 (77.8)	103 (76.3)
Adequate duration of LMWH ^b	1 (50.0)	3 (50)	0 (0.0)	72 (52.2)	40 (47.6)	46 (44.7)

^a In accordance with the RCOG Green-top Guideline No 37¹⁴; L1, Lower risk group 1 (3 or more persistent risk factors); L2, Lower risk group 2 (2 persistent risk factors); L3, Lower risk group 3 (1 persistent risk factor); ^b % of women prescribed LMWH

About half of women took LMWH for less time than the length of their hospital stay (53.4%). Most of these women were in the lower risk groups for VTE (see Figure 7.3). The median length of stay in hospital postpartum for all women was two days (IQR 1 – 3 days).

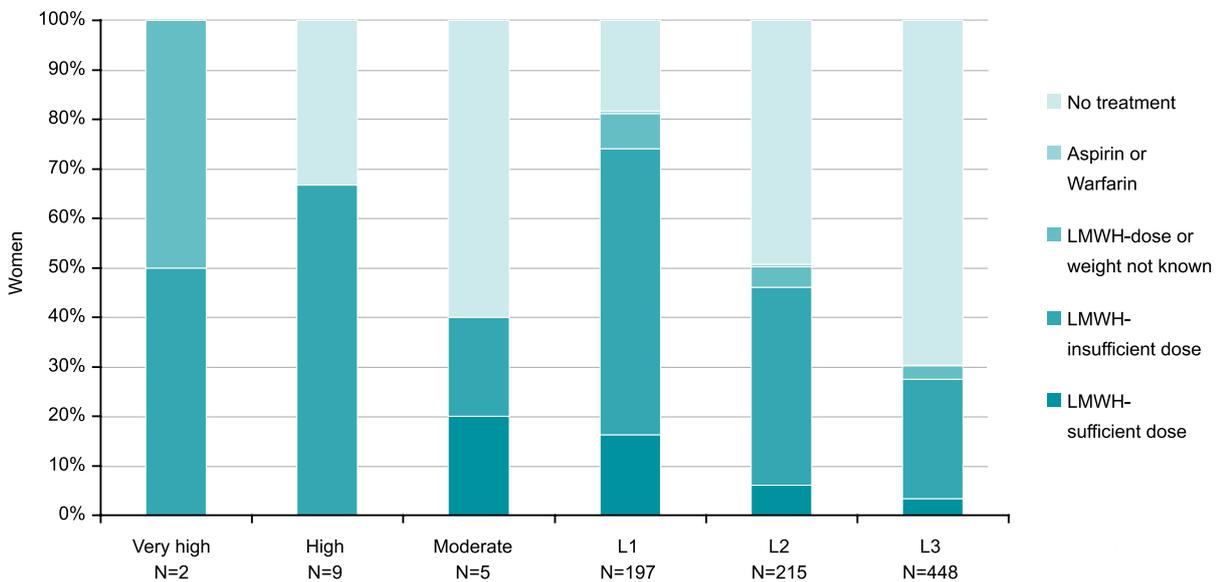
Figure 7.3. Length of hospital stay and duration of prescribed low molecular weight heparin (LMWH) by postnatal VTE risk category



L1, Lower risk group 1 (3 or more persistent risk factors); L2, Lower risk group 2 (2 persistent risk factors); L3, Lower risk group 3 (1 persistent risk factor)

Figure 7.4 illustrates postnatal thromboprophylaxis use and LMWH dosage by VTE risk category and demonstrates that a significant proportion of women are receiving insufficient doses of LMWH.

Figure 7.4. Postnatal thromboprophylaxis and dosage by VTE risk category



L1, Lower risk group 1 (3 or more persistent risk factors); L2, Lower risk group 2 (2 persistent risk factors); L3, Lower risk group 3 (1 persistent risk factor)

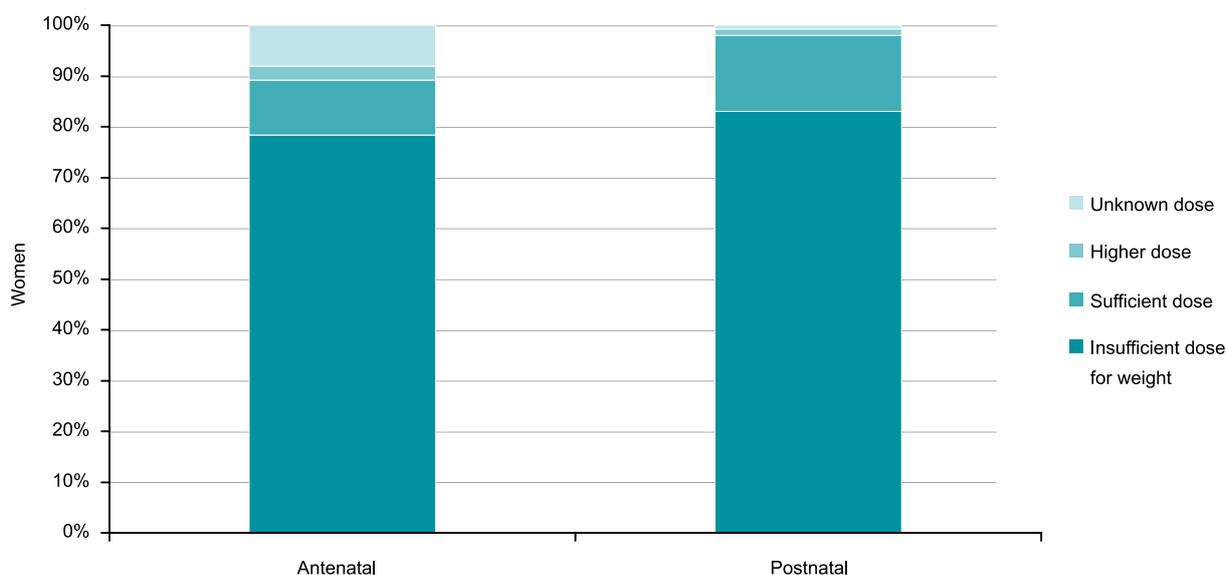
Women with a booking BMI ≥ 30 requiring pharmacological thromboprophylaxis should be prescribed doses appropriate for maternal weight, in accordance with the RCOG Clinical Green-top Guideline No. 37.¹³

D

No woman had documented evidence of a therapeutic dose of LMWH either antenatally or postnatally. Antenatally, 85.3% of women, according to dosages documented in the notes, were prescribed LMWH doses insufficient for their body weight. Postnatally, this number was 83.6%. A dose sufficient for the woman’s body weight was given to 11.8% of women antenatally and 15.1% of women postnatally. A higher prophylactic dose was prescribed for 2.9% of women antenatally and 1.3% of women postnatally.

It was not possible to determine whether the dosages prescribed to women in the Professional Judgement group were appropriate, due to a lack of weight data.

Figure 7.5. Dosage of low molecular weight heparin (LMWH) prescribed to women with a recorded body weight



All women with a BMI ≥ 40 should be offered postnatal thromboprophylaxis regardless of their mode of delivery.

D

This standard was met for 55.4% of women with a BMI ≥ 40 , regardless of mode of delivery. However, women with caesarean deliveries were much more likely to be offered postnatal thromboprophylaxis than women with vaginal deliveries.

Of women who had a vaginal delivery and a BMI ≥ 40 , 30.3% were offered postnatal thromboprophylaxis, and all but one woman were prescribed the drug. One woman was not offered thromboprophylaxis due to it being contraindicated. This is significantly less than the 94.2% of women with a caesarean delivery and BMI of ≥ 40 ($p < 0.001$); all but two of these women were prescribed LMWH, and none had contraindications.

For women with obesity as the only risk factor for VTE, 35.7% were offered postnatal thromboprophylaxis. Again, it was significantly more common for women who had a caesarean delivery to be offered postnatal thromboprophylaxis, at 85.3%, compared to 19.8% of women with vaginal deliveries ($p < 0.001$).

For all women with BMI ≥ 40 who were prescribed postnatal thromboprophylaxis, 19.0% took LMWH for five days or more (11.6% of the total took LMWH for seven days or more); there was no difference based on mode of delivery.

It is unknown whether this standard should have been applied to any of the women in the Professional Judgement group, as their BMIs are unknown. However, 45.5% of women in this group were offered postnatal thromboprophylaxis, including 24.4% of women who had presumed obesity as the only risk factor for VTE. Of the women in the Professional Judgement group, 18.4% of women with vaginal deliveries and 92.9% of women with caesarean deliveries were offered postnatal thromboprophylaxis ($p < 0.001$); for women with no other VTE risk factors, 8.3% with vaginal deliveries and 88.9% with caesarean deliveries were offered postnatal thromboprophylaxis ($p < 0.001$). All women who had the treatment offered had a prescription given, and there were no recorded contraindications.

7.6. Maternal surveillance and screening

An appropriate size of arm cuff should be used for blood pressure measurements taken at the booking visit and all subsequent antenatal consultations. The cuff size used should be documented in the medical records.

C

Blood pressure was recorded antenatally for over 98% of women: 98.7% of women with a recorded BMI had their blood pressure measured and 98.5% of women in the Professional Judgement group had the blood pressure recorded. All women but one with no blood pressure recorded booked at less than 18 weeks' gestation; the remaining woman had no gestation at booking recorded.

Of the women that did have blood pressure recorded antenatally, 92.5% of women with a recorded BMI and 97.0% of the women in the Professional Judgement group did not have the size of blood pressure cuff recorded in the antenatal notes. There was no recorded use of thigh blood pressure cuffs; large blood pressure cuffs were used for 4.4% of women with a BMI 35-39.9 with blood pressure recorded, 11.3% of women with a BMI ≥ 40 , and 3.0% of women in the Professional Judgement category.

Women with a booking BMI ≥ 35 have an increased risk of pre-eclampsia and should have surveillance during pregnancy in accordance with the Pre-eclampsia Community Guideline (PRECOG), 2004.³⁴

B

There were 487 women (60.9%) with a BMI ≥ 35 and one or more additional risk factor(s) for pre-eclampsia. Of these, 93.2% were referred to a consultant obstetrician, but only 17.3% of those referrals had documented evidence of being due, wholly or partially, to identified pre-eclampsia risk. In the Professional Judgement group, 50 (67.6%) women had obesity and one or more additional risk factors for pre-eclampsia. Seventy-nine percent of these women were referred to a consultant obstetrician, but again only 18.4% had documented evidence of that referral being due to pre-eclampsia risk.

For 313 (39.1%) women with a BMI ≥ 35 , there were no additional risks for pre-eclampsia. These women therefore should have been monitored for pre-eclampsia according to the PRECOG guideline. Of these, 43.4% and 41.9% received blood pressure and proteinuria monitoring, respectively, every three weeks from 24 to 32 weeks' gestation. The non-attendance rate was 2.6% for both tests. More women received appropriate monitoring between 32 weeks' gestation and delivery, with 74.5% receiving blood pressure monitoring and 72.4% receiving proteinuria monitoring every two weeks. About 3% did not attend.

There were 24 (32.4%) women in the Professional Judgement group with no risk factors for pre-eclampsia other than obesity. Of these 33.3% received both blood pressure and proteinuria monitoring at the appropriate intervals from 24 to 32 weeks' gestation and 75% were monitored appropriately from 32 weeks' gestation to delivery.

All pregnant women with a booking BMI ≥ 30 should be screened for gestational diabetes, as recommended by the NICE Clinical Guideline No. 63 (Diabetes in Pregnancy, July 2008).³⁵

B

Of all the women with a recorded BMI and no pre-existing diabetes, 72.6% had a test for gestational diabetes mellitus (GDM) offered. An oral glucose tolerance test (OGTT) was performed for 85.2% of women that had been offered the test. The OGTT was administered before 29+0 weeks' gestation for 73.3%; it was done between 24+0 and 28+6 weeks for 60.2% of all women with an OGTT. A total of 16.7% of women had GDM diagnosed after an OGTT performed prior to 24 weeks' gestation. Of those that did not have GDM diagnosed at the first test prior to 24 weeks, 77.1% had a second test performed.

In the Professional Judgement group, 44.6% had a test for gestational diabetes offered, and an OGTT was done for 86.2% of those women. The OGTT was carried out before 29+0 weeks' gestation for 79.2%; it was performed between 24+0 and 28+6 weeks for 70.8% of all women with an OGTT. No women had GDM diagnosed after an OGTT was administered before 24 weeks' gestation. Fifty percent of those that had the first test before 24 weeks went on to have a second test.

7.7. Planning labour and delivery

Women with a booking BMI ≥ 30 should have an informed discussion antenatally about possible intrapartum complications associated with a high BMI, and management strategies considered. This should be documented in the notes.

D

Overall, less than 20% of women had documented evidence of meeting this standard.

In the group of women with a BMI ≥ 40 , 27.7% had documented evidence of information given antenatally about potential intrapartum complications related to obesity. This was significantly more than the 10.2% of women with a BMI 35-39.9 and 9.0% of women in the Professional Judgement group ($p < 0.001$).

A greater number of women had a written obstetric management plan for labour and delivery: 34.2% of women with a BMI 35-39.9, 48.8% of women with a BMI ≥ 40 , and 28.6% of women in the Professional Judgement group. The difference between these three groups was also significant ($p < 0.001$). However, specific discussion of potential intrapartum complications due to obesity associated with these plans was not clearly documented in the notes and, while such discussion may have occurred, we cannot comment of the frequency or extent of such.

Women with a booking BMI ≥ 30 should have an individualised decision for VBAC (vaginal birth after caesarean) following informed discussion and consideration of all relevant clinical factors.

D

This standard was met for just over half of all women who had one previous caesarean delivery.

Among all women with a recorded BMI and one previous caesarean delivery, 54.5% had documented evidence of a discussion relating to risks and benefits of different modes of delivery. There was no significant difference between BMI groups. Only 42.9% of women with one previous caesarean delivery in the Professional Judgement group had documented evidence of a discussion regarding place of delivery. However, this was not significantly different from women with a BMI recorded.

7.8. Care during childbirth

Women with a BMI ≥ 35 should give birth in a consultant-led obstetric unit with appropriate neonatal services, as recommended by the NICE Clinical Guideline No. 55 (Intrapartum Care, Sept 2007).⁵¹

B

Among women with a BMI ≥ 35 , 97.9% gave birth in an obstetric unit; there was no difference between the BMI groups. For women in the Professional Judgement group, 98.7% gave birth in an obstetric unit. In total, ten women in the audit cohort gave birth at home.

For women with a BMI ≥ 35 , 42.9% gave birth in a setting with a Level 3 neonatal unit (intensive care unit), 36.4% gave birth in a facility with a Level 2 unit (high dependency unit), and 18.6% gave birth in a setting with a Level 1 unit (special care unit). There were 17 women (2.1%) that gave birth in a place without neonatal facilities; 11 of those were in the home or at a setting described as "Other".

Among women in the Professional Judgement group, 50.6% gave birth in a facility with a Level 3 neonatal unit, 27.8% had a Level 2 unit, and 20.3% delivered in a setting with a Level 1 unit. One woman delivered in a setting described as "Other", and thus had no neonatal facilities available.

In the absence of other obstetric or medical indications, obesity alone is not an indication for induction of labour and a normal birth should be encouraged.

D

This standard was met for more than 98% of women. Of all women who had an induction of labour, only six (1.8%) had the indicated reason for induction as obesity alone.

The duty anaesthetist covering labour ward should be informed when a woman with a BMI ≥ 40 is admitted to the labour ward if delivery or operative intervention is anticipated. This communication should be documented by the attending midwife in the notes.

D

For women with a BMI ≥ 40 , an anaesthetist of ST6 level or above was informed when a woman was admitted to the labour ward in labour or in need of early delivery in 29.8% of cases. This was similar to the women in the Professional Judgement group, with the anaesthetist informed in 28.2% of cases.

Operating theatre staff should be alerted regarding any woman whose weight exceeds 120kg and who is due to have an operative intervention in theatre.

D

For all women with an intervention in theatre and a weight known to be 120kg or more, there was documented evidence that the theatre staff was alerted about the woman's weight prior to transfer to theatre in only 29.3% of cases. For women in the Professional Judgement group, the theatre staff was alerted in 20.6% of cases.

An obstetrician and an anaesthetist at Specialty Trainee year 6 and above, or with equivalent experience in a non-training post, should be informed and available for the care of women with a BMI ≥ 40 during labour and delivery, including attending any operative vaginal or abdominal delivery and physical review during the routine medical ward round.

D

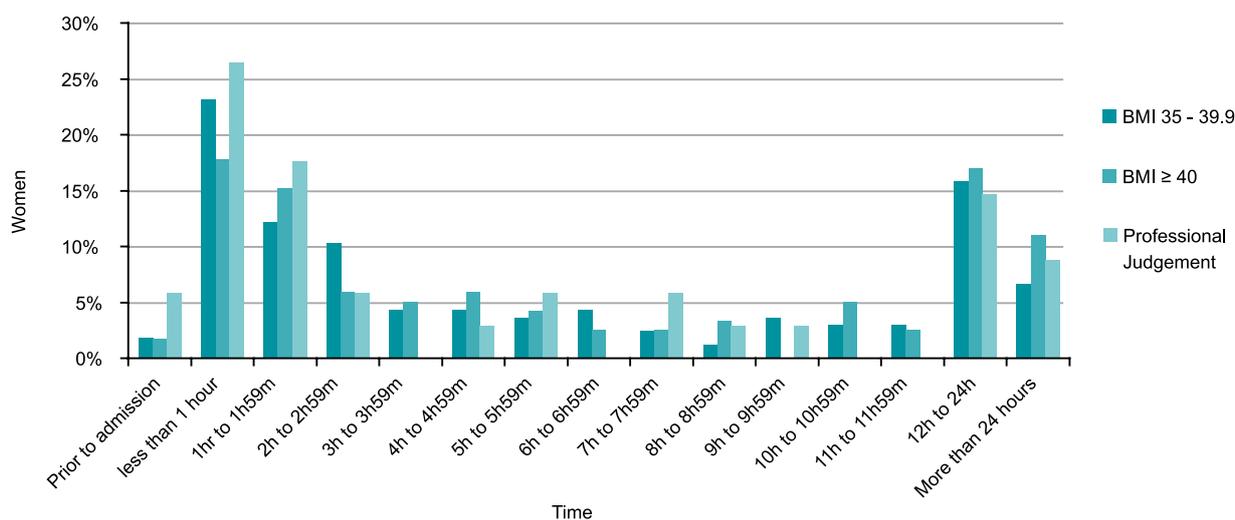
7. Standards of care for women with Class II and Class III maternal obesity

For women with a BMI ≥ 40 , there was documented evidence that an obstetrician of ST6 level or above was informed when the woman was admitted to the labour ward in labour or in need of early delivery in 52.6% of cases. This occurred in 50.0% of Professional Judgement cases. The obstetrician was informed in only 41.8% of the cases where the woman had a BMI of 35-39.9.

An obstetrician, of ST6 level or above, attended instrumental vaginal or caesarean deliveries for 67.3% of relevant women with a BMI ≥ 40 . The anaesthetist, also of ST6 level or above, attended in 61.3% of cases. Among women in the Professional Judgement group, 61.1% had an appropriate obstetrician attend and 50.0% had an anaesthetist of the appropriate level.

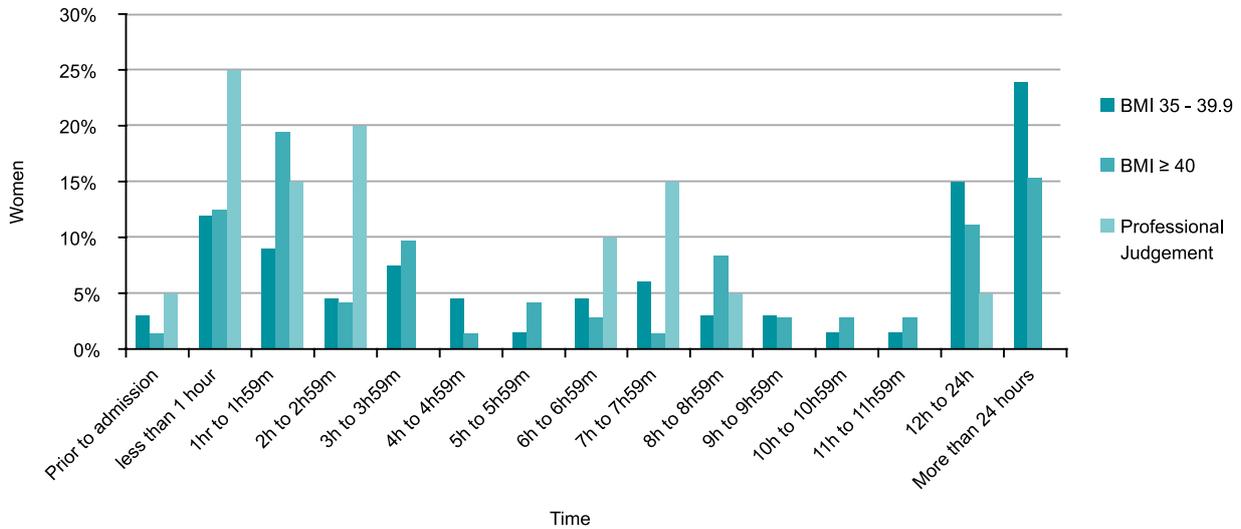
As can be seen in Figure 7.6, the highest percentage of women saw an obstetrician within one hour of being admitted; 23.2% of women with a BMI 35-39.9, 17.8% of women with a BMI ≥ 40 , and 26.5% of women in the Professional Judgement group. The median amount of time elapsed between admission and being seen by an obstetrician was 3 hours 30 minutes (IQR 0h56m – 11h5m) for women with a BMI 35-39.9, 4 hours 45 minutes (IQR 1h14m – 14h34m) for women with a BMI ≥ 40 , and 1 hour 55 minutes (IQR 0h44m – 10h11m) for women in the Professional Judgement group.

Figure 7.6. Time between admission and being reviewed by an obstetrician of ST6 level or above



Of women who were seen by an anaesthetist of the appropriate level, 11.9% of women with a BMI 35-39.9, 12.5% of women with a BMI ≥ 40 , and 25.0% of women in the Professional Judgement group were seen within one hour of admission (see Figure 7.7). The median amount of time elapsed between admission and being seen by an anaesthetist was 7 hours 35 minutes (IQR 2h0m – 23h58m) for women with a BMI 35-39.9, 5 hours 15 minutes (IQR 1h36m – 14h38m) for women with a BMI ≥ 40 , and 2 hours 0 minutes (IQR 0h32m – 6h54m) for women in the Professional Judgement group.

Figure 7.7. Time between admission and being reviewed by an anaesthetist of ST6 level or above

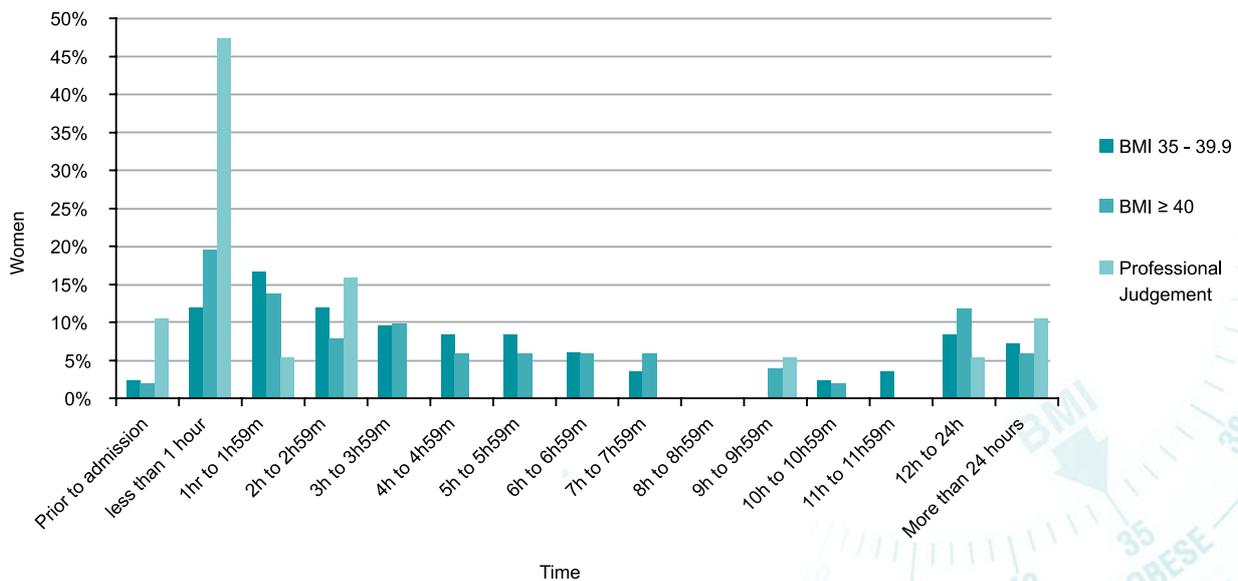


Women with a BMI ≥40 should have venous access established early in labour.

D

For women with spontaneous labour, venous access was established during labour for 40.4% of women with a BMI 35-39.9, 48.3% of women with a BMI ≥40, and 51.2% of women in the Professional Judgement group, and the median number of hours between being admitted in labour and having venous access established was 3 hours 40 minutes (IQR 1h31m – 6h56m), 3 hours 40 minutes (IQR 1h10m – 7h49m) and 0 hours 43 minutes (IQR 0h28m – 2h50m), respectively. Figure 7.8 shows the distribution of when venous access was established for all women with spontaneous onset of labour.

Figure 7.8. Time between admission and establishing venous access among women with spontaneous labour



7. Standards of care for women with Class II and Class III maternal obesity

Among women with induced labour, venous access was not established in approximately 1 in 7 women (see Table 7.5). As with the women with spontaneous labour, about half of those who were induced had venous access established during labour. The remainder, just over one third of women, had venous access established prior to labour.

Table 7.5. Timing of venous access in women with induction of labour

	n (%)			
	BMI 35-39.9 N=180	BMI ≥40 N=109	BMI ≥35 N=289	Professional Judgement N=22
No venous access established	30 (17.8)	15 (14.7)	45 (16.6)	3 (14.3)
Established prior to labour	61 (36.1)	37 (36.3)	98 (36.2)	7 (33.3)
Established during labour	78 (46.2)	50 (49.0)	128 (47.2)	11 (52.4)
Missing	11	7	18	1

All women with a BMI ≥30 should be recommended to have active management of the third stage of labour. This should be documented in the notes.

B

This standard was met for over 95% of women with a vaginal birth. For women with a BMI 35-39.9, 97.8% were recommended active management of the third stage of labour (Table 7.6); all but one of these women had active management of the third stage of labour. For women with a BMI ≥40, 96.8% had active management recommended, and all but two of these women had active management.

For women in the Professional Judgement group, every woman but one had active management of the third stage of labour both recommended and performed.

Table 7.6. Active management of the third stage of labour among women with vaginal births

	n (%)			
	BMI 35-39.9 N=330	BMI ≥40 N=190	BMI ≥35 N=520	Professional Judgement N=51
Recommended	317 (97.8)	180 (96.8)	497 (97.5)	50 (98.0)
Missing	6	4	10	0
Performed	316 (97.8)	178 (95.7)	494 (97.1)	50 (98.0)
Missing	7	4	11	0

Place of delivery may have had some impact on the management of the third stage of labour. Of those who did not have active management of labour recommended (n=14), three women delivered at home, 10 women delivered in an obstetric unit, and one woman delivered in a setting described as "Other". Both women who chose physiological third stage of labour after recommendation of active management by a midwife delivered at home. There were no instances of moderate or severe postpartum haemorrhage in the small number of women who had physiological third stage of labour.

Women with a BMI ≥ 30 having a caesarean section have an increased risk of wound infection, and should receive prophylactic antibiotics at the time of surgery, as recommended by the NICE Clinical Guideline No. 13 (Caesarean Section, April 2004).¹⁰¹

B

This standard was met for over 85% of women with a caesarean delivery. There was no significant difference between the groups in rates of prophylactic antibiotics for caesarean delivery, with 87.2% of women with a BMI 35-39.9, 89.6% of women with a BMI ≥ 40 , and 88.9% of women in the Professional Judgement group receiving antibiotics prophylactically. There was also no significant difference between the rates of prophylactic antibiotic administration for different grades of caesarean section.

7.9. Breastfeeding

Obesity is associated with low breastfeeding initiation and maintenance rates. Women with a booking BMI ≥ 30 should receive appropriate specialist advice and support antenatally and postnatally regarding the benefits, initiation and maintenance of breastfeeding.

B

Antenatally, there was documented evidence of infant feeding options being discussed for 57.9% of women with a recorded BMI and 55.1% of women in the Professional Judgement group. Of these, 84.9% and 86.0%, respectively, had evidence of information and/or advice given antenatally regarding the health advantages of breastfeeding.

Postnatally, 76.8% of women in the BMI group and 82.9% of women in the Professional Judgement group, whose chosen method of feeding was not bottle, had documented evidence that postnatal advice and/or support in relation to breastfeeding was provided.

7.10. Postnatal care and follow-up after pregnancy

Women with a booking BMI ≥ 30 should continue to receive nutritional advice following childbirth from an appropriately trained professional, with a view to weight reduction.

C

This standard was met for only a small minority of women. There was documented evidence that 3.9% of women with a recorded BMI and 2.6% of women in the Professional Judgement group were offered referral to a dietician or nutritionist in the postpartum period. There was no difference between BMI groups.

All women with a booking BMI ≥ 30 who have been diagnosed with gestational diabetes should have a test of glucose tolerance approximately 6 weeks after giving birth.

D

This standard was met for almost two thirds of the women with GDM who were audited. The need for a test of glucose tolerance within two months of giving birth was documented in the notes for 62.8% of women with a BMI 35-39.9 and 60.7% of women with a BMI ≥ 40 . Only two women in the Professional Judgement group had diagnosed GDM, and one of these women had the need for glucose tolerance follow-up documented.

7.11. Discussion

This clinical audit reviewed the maternity notes of 905 women with a pregnancy BMI ≥ 35 . The audit assessed the care that these women received during the antepartum, intrapartum and the postpartum periods against standards of care recommended in the joint CMACE/RCOG Guideline on managing women with obesity in pregnancy.¹²

The audit findings revealed that the use and dosage of folic acid supplementation was poorly documented in the maternity notes. If this documentation is a reflection of actual practice this is of concern. Only 29% of women with a BMI ≥ 35 had supplemented prior to their pregnancy and just 1.4% was known to have supplemented with the recommended 5mg dose. This figure rose to 2.1% during the first trimester. It is important to note that the audit preceded the national recommendation for 5mg of folic acid supplementation for women with obesity, and so compliance with this recommendation was not expected to be high. However, high dose folic acid is important because observational data show an increased risk of neural tube defect (NTD) pregnancies associated with obesity,¹⁹ and high quality evidence from randomised controlled trials show that periconceptional use of folic acid supplementation reduces the risk of the first occurrence, as well as the recurrence, of NTDs.¹⁰² High dose folic acid may be particularly important for women with obesity because evidence shows that among women with obesity, serum folate levels are lower than levels in non-obese women, even after controlling for folate intake.¹⁸

The audit found good compliance (96% of audited cases) with recording height, weight and BMI in the maternity notes; 85% of cases had this information recorded at booking. Since cases were only reported to CMACE if they were known to have a BMI ≥ 35 or considered to have a BMI ≥ 35 , it is possible that compliance may not be as high in the general maternity population, since women who appear to have a raised BMI may be more likely to be weighed and have their weight and BMI documented to determine appropriate care pathways. It is not known whether the documented weight and heights were based on patient-reported values or accurate measurements by healthcare professionals. Appropriate management of women with maternal obesity can only be possible with the consistent identification of those women who are at risk, and identification should be based on accurate weight and BMI assessments because of the under-reporting issues related to self-reported weights.³³

The process of accurate weight measurement and calculation of BMI offers an opportunity to provide information on the risks associated with obesity in pregnancy and how these may be minimised. Fewer than one fifth of the cases audited had documented evidence of providing information related to BMI and pregnancy. While women with a BMI ≥ 40 were more likely to receive this information, gestational weight gain can be considerable for some women. Data presented in the previous chapter showed that, on average, women with a lower early pregnancy BMI gained significantly more than those with a higher BMI, with some gaining up to 30 kilograms between the first and third trimesters. This highlights the importance of providing information not only to those with a raised BMI at the start of pregnancy but also to those at risk of gaining a substantial amount of weight.

Obesity and pregnancy are recognised to be independent risk factors for thromboembolism.^{25 49} However, thromboembolism risk documentation at booking was poor. Thromboembolism risk was documented for only 11% of women recognised to be at risk according to the RCOG UK guideline for thromboprophylaxis during and after pregnancy.¹⁴ Antenatal LMWH was insufficiently prescribed: under half of those considered at high or moderate risk of VTE received it and only 3% of those with a lower level of elevated risk had LMWH prescribed. In the women who received LMWH, the dosage was generally lower than the dose recommended for their body weight in guidelines contemporary with the time of the audit.

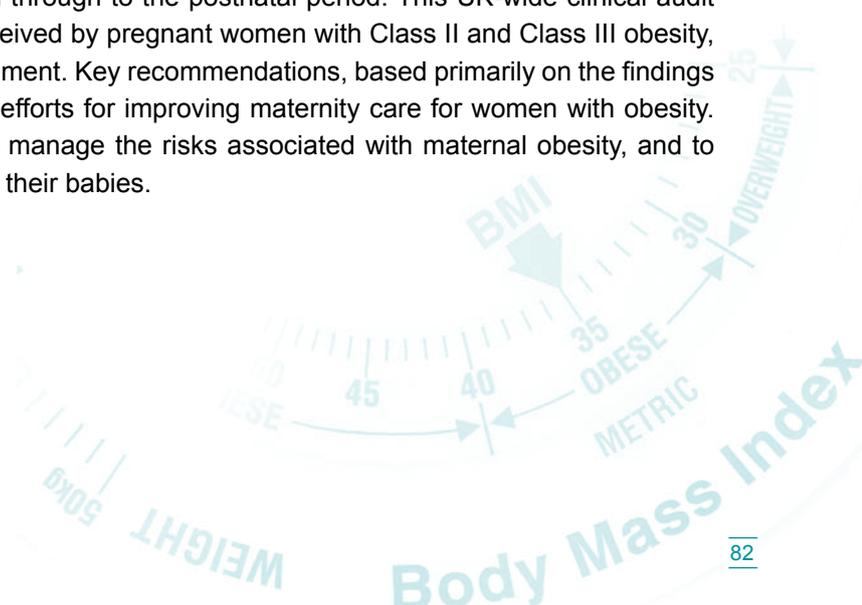
Postnatal LMWH was also underused in terms of it being offered, the dosage, and the duration for which it was prescribed. It is recommended that women with a BMI ≥ 40 should receive postnatal LMWH regardless

of their mode of delivery. While the majority of women with a BMI ≥ 40 who had caesarean sections received LMWH, only 30% of women giving birth vaginally had it prescribed. This is likely to reflect a more formalised thrombosis risk assessment by anaesthetist or obstetrician at the time of section, where consideration of LMWH is usually a standard postoperative instruction. The procedure of risk assessment is perhaps less consistent following vaginal delivery. In addition, caesarean itself is perceived as a significant risk factor for thrombosis while vaginal delivery may not be perceived in the same way, with less likelihood of formalised thrombosis risk assessment compared to caesarean section. A national matched case-control study examining the management and outcomes of antenatal pulmonary embolism (PE) in the UK also reported that LMWH was under-prescribed and prescribed in doses lower than recommended among women who had an antenatal PE.⁴⁹ Clearly in this group at high risk of thrombosis there is a need for consistent practice and tools such as a checklist that would include thromboprophylaxis assessment after delivery regardless of mode of delivery may be helpful, as well as local protocols based on the CMACE/RCOG obesity guideline and the RCOG thromboprophylaxis guideline.^{12 13}

Pregnant women with obesity have a higher risk of anaesthesia-related complications than pregnant women with a healthy BMI, and obesity has been identified as a significant risk factor for anaesthesia-related maternal mortality.^{1 43} Despite these risks, less than half of women with a BMI ≥ 40 had a written anaesthetic management plan, yet over 40% of women with a BMI ≥ 40 required anaesthesia for a caesarean delivery and 9% of these required general anaesthesia. Fifty-five percent of caesarean sections were emergency caesarean deliveries. Anaesthetic challenges may lead to increased decision-to-delivery time in an emergency situation, and these challenges may also increase anaesthetic morbidity. Advanced warning of such challenges may influence the timing of the planned mode of delivery, and allow appropriate staff and facilities to be made available. These findings highlight the need for antenatal anaesthetic reviews, and such anaesthetic consultations should be available to all women with significant obesity, in view of their increased risk of anaesthesia-related complications.

The care received by women in the audit cohort was assessed in relation to national standards of care for women with obesity, and the care received was also examined in relation to outcomes. It was not possible to detect an association between folic acid supplementation and congenital anomalies or between thromboprophylaxis and VTE, despite previous studies showing evidence that these relationships exist. The lack of an association found in this study is most likely because these outcomes are relatively rare and the number of cases small. Case-control studies, which are better suited to addressing these issues than a cohort study such as this, would be required to investigate these associations.

Maternal obesity significantly increases the risk of pregnancy-related complications and can pose a major challenge for health professionals providing maternity care. In March 2010, the joint CMACE/RCOG guideline was published to guide the management of women with obesity in pregnancy.¹² The guideline sets out standards of care covering the prenatal period through to the postnatal period. This UK-wide clinical audit is the first national audit to assess the care received by pregnant women with Class II and Class III obesity, and the findings highlight key areas for improvement. Key recommendations, based primarily on the findings from this study, have been produced to focus efforts for improving maternity care for women with obesity. These recommendations aim to minimise and manage the risks associated with maternal obesity, and to improve the outcomes for both the women and their babies.



8. Conclusions

The prevalence of obesity (BMI ≥ 30) in the general population in England has increased markedly since the early 1990s and currently affects an estimated 25% of adults and 18.5% of women of childbearing age. This study, focusing on women with higher levels of obesity as this is associated with greatest level of risk, demonstrated that around 5% of pregnant woman have a BMI ≥ 35 , and 2% have a BMI of ≥ 40 . Thus large numbers of women are affected by significant obesity.

Obesity carries particular risks in pregnancy for both mother and fetus, including miscarriage, fetal abnormality, gestational diabetes, hypertension, delivery problems and infection. These risks pose particular challenges for maternity services, which had not previously encountered such a widespread problem. Thus there are growing challenges for pregnancy care and maternity services, including the cost of care, to meet the needs of this population. Further, the problems of obesity are not confined to pregnancy. Obesity impacts adversely on a women's health throughout her life such as type 2 diabetes and coronary heart disease. Pregnancy is a time when these women will encounter health professionals, who not only have the opportunity to educate these women on the risks in pregnancy, but also to potentially effect change that will be beneficial lifelong. Thus optimal care in pregnancy may improve pregnancy outcome, and have long lasting benefits on later life for both mother and child. Given the scale of the problem and the level of risk, it is critical to grasp the opportunity to identify optimal management, care provision and interventions in pregnancy to optimise pregnancy outcome. This programme of work provides the information to allow us to shape our maternity services in response to these issues.

As well as describing the actual prevalence of obesity, this programme addressed key issues relating to obesity in pregnancy in an integrated manner, through the development of standards of care for women with obesity in pregnancy, the provision of UK national rates of pregnancy-related outcomes in these women, and an assessment of the current organisation of maternity services. Further, the degree to which clinical standards of care for women with obesity in pregnancy are being met were assessed in a cohort of these women to allow the identification of areas where service provision and care could be improved.

There were many important messages from this work. When service provision was assessed against standards of care there were a number of key findings. Only a small minority of units provided pre-pregnancy care or obesity-specific information to these women - around 33% in Scotland and $<10\%$ in England Wales and Northern Ireland. Such care is critical as the problem of obesity is best addressed before pregnancy as interventions during pregnancy have limited impact and because some of the risks, such as miscarriage and fetal abnormality, occur in the first trimester, often before the woman is even seen at an obstetric unit. Clearly there is a need for better provision of pre-pregnancy care for these women and specific service development is needed in this area. As the care must be delivered pre-pregnancy, this responsibility lies not only with maternity services but in all services who encounter women with an obesity problem such as primary care, family planning, and diabetic services.

During pregnancy risk assessment of these women is vital. A particular issue is in relation to anaesthesia as women with obesity often present anaesthetic difficulty and have a much higher rate of intervention such as caesarean section requiring anaesthesia. Identifying risk in advance by antenatal anaesthetic review can therefore impact on the plan for their delivery of care by predicting and anticipating anaesthetic challenges to ensure that the optimal care is provided. While such anaesthetic review was available, this was taken up in less than half of cases nationally, although this may reflect selection of those at highest risk, the importance of anaesthetic review should still be highlighted for service provision.

In contemporary obstetric practice, guidelines play a prominent role in management and can make significant impact, such as in the management of pre-eclampsia or shoulder dystocia. The challenges of obesity to maternity care, as described in this report, are manifold and interdisciplinary. Appropriate standards of care for the management of women with obesity in pregnancy should be integrated into all antenatal clinics, with

clear policies and guidelines for care available. However, only around half the units surveyed had such a guideline; this is likely to reflect the lack of a national guideline at the time of the survey. With the launch of the CMACE/RCOG guideline arising from this project, this deficiency may be more easily addressed by units throughout the country, facilitating their development of local guidance and protocols.

With regard to equipment, it is concerning that many units lacked equipment such as extra-wide chairs, and beds and theatre tables with appropriate working loads for women with super-morbid obesity. The lack of availability of such equipment poses a risk to women and their carers and it is critical that all units caring for women with high levels of obesity have appropriate equipment to meet the needs of these women. This equipment must be readily available for emergency situations.

The known complications and features associated with obesity were apparent in this study. There was a clear relationship between Index of Multiple Deprivation score and obesity, and there appeared to be a predominance of white Caucasians rather than BME groups, suggesting that the problem is greatest in white Caucasian populations. Obesity was more likely in women aged over 35, consistent with the increased obstetric risk in this age group. Higher rates of co-morbidities such as diabetes, pregnancy-induced hypertension, pre-eclampsia and venous thrombosis were seen, with many of these conditions showing a 'dose response' type relationship with the incidence correlating directly with the degree of obesity. Induction rates and caesarean delivery, with overall rates around 40%, also increased as BMI increased, consistent with higher complication rates, and perhaps an awareness of significant risk factors requiring control of timing of delivery to provide appropriate care. While it is not surprising that these women had higher rates of primary postpartum haemorrhage (PPH), the association between PPH and LMWH use was an unexpected finding. This merits further evaluation in a study designed to specifically address haemostatic risk factors in pregnant women with obesity. This is critical to address as these women also have substantial risk of thrombosis, and obstetricians need reliable data to balance the risk of bleeding and thrombosis. The adverse fetal outcomes ranging from stillbirth to neonatal unit admission are also of concern, but largely reflect the complications associated with obesity in pregnancy. Given the magnitude of the population with obesity, such high intervention rates to address risks and complications, will carry significant resource issues for our maternity services.

In planning maternity care, risk assessment is vital. This study provides compelling evidence of the association between BMI and antenatal, intrapartum, and postpartum complications as well as perinatal outcomes. For example each BMI unit increment was associated with a 6% increased risk of stillbirth and a 2-3% increased risk of induction of labour, caesarean section and primary postpartum haemorrhage. These data emphasise not only the value of BMI at booking, but also the need for preconception care to reduce the level of obesity. As the risk increases with each unit increase in BMI the value of weight reduction, rather than aiming for a normal BMI, which may be unachievable, pre-pregnancy is evident.

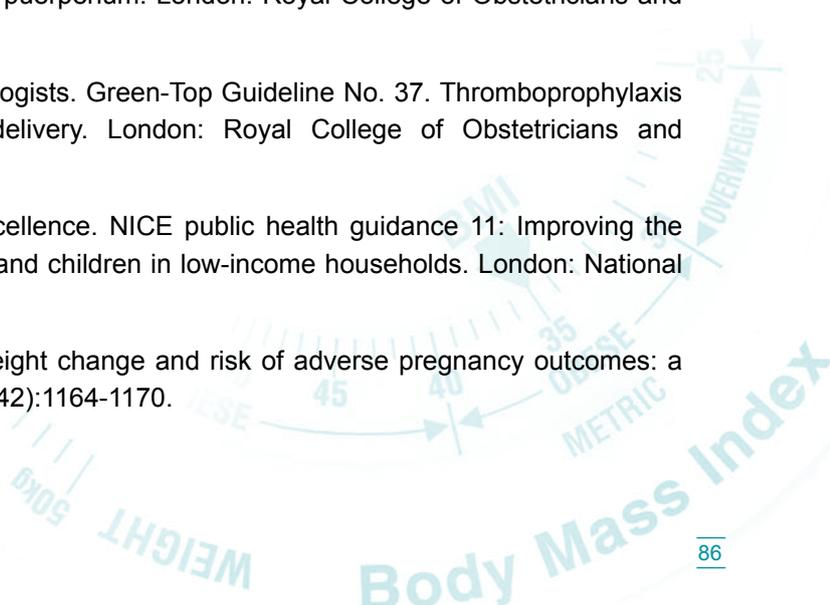
The audit of the care provided to these women highlighted important areas where impact may be readily obtained. Despite the relationship between obesity and fetal abnormality, including neural tube defect, only around one fifth of the cohort were receiving folic acid before pregnancy, and the vast majority did not receive the higher dose that is recommended. Better awareness of patients and practitioners of this issue can readily improve on this. The audit also highlighted the need for better health information being provided to these women. Despite the issues around managing these women with BMI ≥ 40 , only a minority (less than 15%) had any assessment around manual handling. The lack of such assessment can put the mother and her carers at risk, especially around delivery and in emergency situations, if these problems are not anticipated and appropriate provision made. There appeared to be a failure to provide any or adequate antenatal and postnatal thromboprophylaxis in many of these women, despite their increased risk of venous thromboembolism. The new RCOG guideline on thrombosis prevention and the RCOG/CMACE obesity guideline may help address this issue with better local implementation. There was also scope for improvement in assessment for

pre-eclampsia, gestational diabetes and in planning for delivery. For example <50% of women with a BMI ≥ 40 had a written obstetric management plan for labour and delivery, and <30% had documented evidence of information given antenatally about potential intrapartum complications related to obesity. Similarly when admitted for delivery, improvements could also be made in alerting theatre and anaesthetic staff and an obstetrician of appropriate seniority; these issues can be easily addressed by local protocols informed by recent guidelines.¹²

In conclusion this report provides comprehensive and novel data on obesity in pregnancy and the implications for maternity care at a national level. There will be substantial challenges to maternity services in addressing these issues, but the information provided in this report can guide our service development to meet these challenges and provide optimal care for the growing numbers of women with obesity entering pregnancy. The improvement in care that is possible will impact on not only pregnancy outcome, but also future maternal and child health. This report provides key information as we set our priorities for future maternity care.

References

1. Lewis G. (ed), Confidential Enquiry into Maternal and Child Health. Saving Mothers' Lives - Reviewing maternal deaths to make motherhood safer 2003-2005. London: CEMACH, 2007.
2. Office of the Deputy Prime Minister. Index of Multiple Deprivation, 2004, 2004.
3. Heslehurst N, Ells LJ, Simpson H, Batterham A, Wilkinson J, Summerbell CD. Trends in maternal obesity incidence rates, demographic predictors, and health inequalities in 36,821 women over a 15-year period. *BJOG: An International Journal of Obstetrics and Gynaecology* 2007;114(2):187-94.
4. Centre for Maternal and Child Enquiries (CMACE). Perinatal Mortality 2008: United Kingdom. London: CMACE, 2010.
5. The NHS Information Centre. HES Online - Maternity data: Health and Social Care Information Centre, 2010.
6. Royal College of Obstetricians and Gynaecologists. Green-Top Guideline No. 52. Prevention and management of postpartum haemorrhage. London: Royal College of Obstetricians and Gynaecologists, 2009.
7. World Health Organisation. Department of Reproductive Health and Research. WHO guidelines for the management of postpartum haemorrhage and retained placenta. Geneva: World Health Organisation, 2009.
8. Greer IA, Nelson-Piercy C. Low-molecular-weight heparins for thromboprophylaxis and treatment of venous thromboembolism in pregnancy: a systematic review of safety and efficacy. *Blood* 2005;106(2):401-407.
9. Confidential Enquiry into Maternal and Child Health (CEMACH). Perinatal Mortality 2007: United Kingdom. London: CEMACH, 2009.
10. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. *American Journal of Obstetrics & Gynecology* 2007;197(3):223-8.
11. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics and Gynaecology* 2004;103(2):219-24.
12. Centre for Maternal and Child Enquiries & Royal College of Obstetricians and Gynaecologists. CMACE & RCOG Joint Guideline. Management of women with obesity in pregnancy. London: CMACE & RCOG, 2010.
13. Royal College of Obstetricians and Gynaecologists. Green-Top Guideline No. 37. Reducing the risk of thrombosis and embolism during pregnancy and puerperium. London: Royal College of Obstetricians and Gynaecologists, 2009.
14. Royal College of Obstetricians and Gynaecologists. Green-Top Guideline No. 37. Thromboprophylaxis during pregnancy, labour and after vaginal delivery. London: Royal College of Obstetricians and Gynaecologists, 2004.
15. National Institute for Health and Clinical Excellence. NICE public health guidance 11: Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households. London: National Institute for Health and Clinical Excellence, 2008.
16. Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: a population-based study. *The Lancet* 2006;368(9542):1164-1170.



17. Bodnar LM, Catov JM, Roberts JM, Simhan HN. Prepregnancy Obesity Predicts Poor Vitamin D Status in Mothers and Their Neonates. *The Journal of Nutrition* 2007;137(11):2437-2442.
18. Mojtabai R. Body mass index and serum folate in childbearing age women. *European Journal of Epidemiology* 2004;19(11):1029.
19. Rasmussen SA, Chu SY, Kim SY, Schmid CH, Lau J. Maternal obesity and risk of neural tube defects: a metaanalysis. *American Journal of Obstetrics and Gynecology* 2008;198(6):611-619.
20. Scholl TO, Johnson WG. Folic acid: influence on the outcome of pregnancy. *American Journal of Clinical Nutrition* 2000;71(5):1295S-1303.
21. MRC Vitamin Study Research Group. Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. MRC Vitamin Study Research Group. *The Lancet* 1991;338(8760):131-7.
22. Expert Advisory Group. Folic acid and the prevention of neural tube defects: Department of Health; Scottish Office, Home and Health Department; Welsh Office; Department of Health and Social Services, Northern Ireland, 1992.
23. Lashen H, Fear K, Sturdee DW. Obesity is associated with increased risk of first trimester and recurrent miscarriage: matched case-control study. *Human Reproduction* 2004;19(7):1644-6.
24. Jacobsen AF, Skjeldestad FE, Sandset PM. Ante- and postnatal risk factors of venous thrombosis: a hospital-based case control study. *Journal of Thrombosis and Haemostasis* 2008;6(6):905-912.
25. Larsen TB, Sorensen HT, Gislum M, Johnsen SP. Maternal smoking, obesity, and risk of venous thromboembolism during pregnancy and the puerperium: a population-based nested case-control study. *Thrombosis Research* 2007;120(4):505-9.
26. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2001;25(8):1175-82.
27. O'Brien TE, Ray JG, Chan W-S. Maternal body mass index and the risk of pre-eclampsia: a systematic overview. *Epidemiology* 2003;14(3):368-74.
28. Nuthalapaty FS, Rouse DJ, Owen J. The association of maternal weight with cesarean risk, labor duration, and cervical dilation rate during labor induction.[erratum appears in *Obstet Gynecol.* 2004 May;103(5 Pt 1):1019]. *Obstetrics and Gynecology* 2004;103(3):452-6.
29. Kristensen J, Vestergaard M, Wisborg K, Kesmodel U, Secher NJ. Pre-pregnancy weight and the risk of stillbirth and neonatal death. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(4):403-408.
30. Shah A, Sands J, Kenny L. Maternal obesity and the risk of still birth and neonatal death. *Journal of Obstetrics and Gynaecology* 2006;26(Supplement 1):S19.
31. Chu SY, Kim SY, Schmid CH, Dietz PM, Callaghan WM, Lau J, et al. Maternal obesity and risk of cesarean delivery: a meta-analysis. *Obesity Reviews* 2007;8(5):385-94.
32. Amir LH, Donath S. A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *MC Pregnancy and Childbirth* 2007;7:9.
33. Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity Reviews* 2007;8(4):307-326.

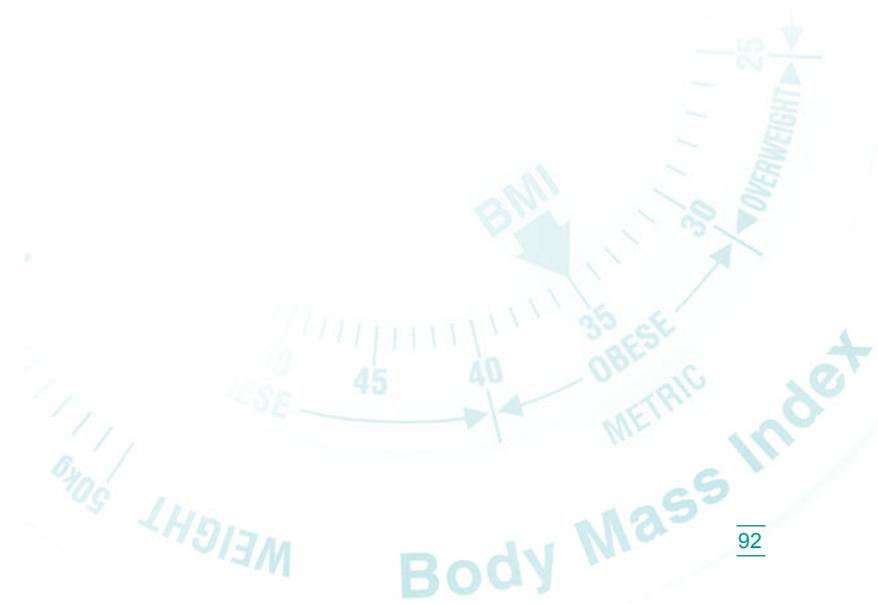
-
34. The Pre-eclampsia Community Guideline Development Group. Pre-eclampsia Community Guideline (PRECOG). Middlesex: Action on Pre-Eclampsia (APEC), 2004.
35. National Institute for Health and Clinical Excellence. Diabetes in pregnancy: Management of diabetes and its complications from pre-conception to the postnatal period. London: National Institute for Health and Clinical Excellence, 2008.
36. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. *BMC Public Health* 2007;7:168.
37. Bianco AT, Smilen SW, Davis Y, Lopez S, Lapinski R, Lockwood CJ. Pregnancy outcome and weight gain recommendations for the morbidly obese woman. *Obstetrics and Gynecology* 1998;91(1):60-64.
38. Callaway LK, Prins JB, Chang AM, McIntyre HD. The prevalence and impact of overweight and obesity in an Australian obstetric population. *Medical Journal of Australia* 2006;184(2):56-9.
39. Duckitt K, Harrington D. Risk factors for pre-eclampsia at antenatal booking: systematic review of controlled studies. *British Medical Journal* 2005;330(7491):549-550.
40. Sattar N, Clark P, Holmes ANN, Lean MEJ, Walker I, Greer IA. Antenatal Waist Circumference and Hypertension Risk. *Obstetrics and Gynecology* 2001;97(2):268-271.
41. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate--a population-based screening study. *American Journal of Obstetrics & Gynecology* 2004;190(4):1091-7.
42. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS, et al. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *New England Journal of Medicine* 2005;352(24):2477-86.
43. Dresner M, Brocklesby J, Bamber J. Audit of the influence of body mass index on the performance of epidural analgesia in labour and the subsequent mode of delivery. *BJOG: An International Journal of Obstetrics and Gynaecology* 2006;113(10):1178-81.
44. Hood DD, Dewan DM. Anesthetic and obstetric outcome in morbidly obese parturients. *Anesthesiology* 1993;79(6):1210-8.
45. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP. Anesthesia-related deaths during obstetric delivery in the United States, 1979-1990. *Anesthesiology* 1997;86(2):277-84.
46. Altermatt F, Muñoz H, Delfino A, Cortínez L. Pre-oxygenation in the obese patient: effects of position on tolerance to apnoea. *British Journal of Anaesthesia* 2005;95:706-9.
47. Dixon B, Dixon J, Carden R, Burn A, Schachter L, Playfair J, et al. Preoxygenation is more effective in the 25 degrees head-up position. *Anesthesiology* 2005;102:1110-5
48. Collins J, Lemmens H, Brodsky J, Brock-Utne J, Levitan R. Laryngoscopy and morbid obesity: a comparison of the "sniff" and "ramped" positions. *Obesity Surgery* 2004;14:1171-5.
49. Knight, M. on behalf of UKOSS. Antenatal pulmonary embolism: risk factors, management and outcomes. *BJOG: An International Journal of Obstetrics and Gynaecology* 2008;115(4):453-461.
50. National Clinical Guideline Centre - Acute and Chronic Conditions. Venous thromboembolism: reducing the risk of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to hospital. London: National Clinical Guideline Centre - Acute and Chronic Conditions at The Royal College of Physicians, 2009.

51. National Institute for Health and Clinical Excellence. Intrapartum Care: Care of healthy women and their babies during childbirth. London: National Institute for Health and Clinical Excellence, 2007.
52. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(6):768-772.
53. Heslehurst N, Moore H, Rankin J, Ells LJ, Wilkinson JR, Summerbell CD. How can maternity services be developed to effectively address maternal obesity? A qualitative study. *Midwifery* 2010; In Press.
54. National Institute for Health and Clinical Excellence. NICE public health guidance 27: Dietary interventions and physical activity interventions for weight management before, during and after pregnancy. London: National Institute for Health and Clinical Excellence, 2010.
55. Heslehurst N, Lang R, Rankin J, Wilkinson JR, Summerbell CD. Obesity in pregnancy: a study of the impact of maternal obesity on NHS maternity services. *BJOG: An International Journal of Obstetrics and Gynaecology* 2007;114(3):334-42.
56. Kiel DW, Dodson EA, Artal R, Boehmer TK, Leet TL. Gestational weight gain and pregnancy outcomes in obese women: how much is enough? *Obstetrics and Gynecology* 2007;110(4):752-8.
57. Cedergren M. Effects of gestational weight gain and body mass index on obstetric outcome in Sweden. *International Journal of Gynaecology & Obstetrics* 2006;93(3):269-74.
58. Claesson IM, Sydsjo G, Brynhildsen J, Cedergren M, Jeppsson A, Nystrom F, et al. Weight gain restriction for obese pregnant women: a case-control intervention study. *BJOG: An International Journal of Obstetrics and Gynaecology* 2008;115(1):44-50.
59. Gray-Donald K, Robinson E, Collier A, David K, Renaud L, Rodrigues S. Intervening to reduce weight gain in pregnancy and gestational diabetes mellitus in Cree communities: an evaluation. *Canadian Medical Association Journal* 2000;163(10):1247-51.
60. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Hilakivi-Clarke L, Weiderpass E, et al. Preventing excessive weight gain during pregnancy - a controlled trial in primary health care. *European Journal of Clinical Nutrition* 2007;61(7):884-891.
61. Olson CM, Strawderman MS, Reed RG. Efficacy of an intervention to prevent excessive gestational weight gain. *American Journal of Obstetrics and Gynecology* 2004;191(2):530.
62. Polley BA, Wing RR, Sims CJ. Randomised controlled trial to prevent excessive weight gain in pregnant women. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2002;26(11):1494-502.
63. Nelson SM, Matthews P, Poston L. Maternal metabolism and obesity: modifiable determinants of pregnancy outcome. *Human Reproduction Update* 2010;16(3):255-275.
64. World Health Organisation. Obesity: Preventing and managing the global epidemic. Geneva: World Health Organisation, 2000.
65. Office for National Statistics. Statistics on Obesity, Physical Activity and Diet: England, January 2008. London, 2008.
66. National Institute for Health and Clinical Excellence. Obesity. Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children. London: National Institute for Health and Clinical Excellence (NICE), 2006.

-
67. Heslehurst N, Rankin J, Wilkinson JR, Summerbell CD. A nationally representative study of maternal obesity in England, UK: trends in incidence and demographic inequalities in 619,323 births, 1989-2007. *International Journal of Obesity* 2010;34(3):420-428.
68. Department of Health. At least five a week: Evidence of the impact of physical activity and its relationship with health. A report from the Chief Medical Officer. London: Department of Health, 2004.
69. Balen AH, Anderson RA. Impact of Obesity on female reproductive health: British Fertility Society, Policy and Practice Guidelines. *Human Fertility* 2007;10(4):195 - 206.
70. Zain MM, Norman RJ. Impact of obesity on female fertility and fertility treatment. *Women's Health* 2008;4:183-194.
71. Heslehurst N, Simpson H, Ells L, Rankin R, Wilkinson J, Lang R, et al. The impact of maternal BMI status on pregnancy outcomes with immediate short-term obstetric resource implications: a meta-analysis. *Obesity Reviews* 2008;9(6):635-683.
72. Saravanakumar K, Rao SG, Cooper GM. The challenges of obesity and obstetric anaesthesia. *Current Opinion in Obstetrics & Gynecology* 2006;18(6):631-5.
73. Boney CM, Verma A, Tucker R, Vohr BR. Metabolic Syndrome in Childhood: Association With Birth Weight, Maternal Obesity, and Gestational Diabetes Mellitus. *Pediatrics* 2005;115(3):e290-296.
74. Raine R, Sanderson C, Hutchings A, Carter S, Larkin K, Black N. An experimental study of determinants of group judgments in clinical guideline development. *Lancet* 2004;364(9432):429-37.
75. Fitzsimons KJ, Modder J. Setting maternity care standards for women with obesity in pregnancy. *Seminars in Fetal and Neonatal Medicine* 2010;15(2):100-107.
76. Murphy MK, Black NA, Lamping DL, McKee CM, Sanderson CFB, Askham J, et al. Consensus development methods, and their use in clinical guideline development *Health Technology Assessment*, 1998;2(3).
77. Royal College of Obstetricians and Gynaecologists. Development of RCOG Green-top Guidelines: Producing a Clinical Practice Guideline. London: Royal College of Obstetricians and Gynaecologists, 2006.
78. Dillman D. *Mail and Internet Surveys: The Tailored Design Method*. Hoboken: John Wiley & Sons., 2006.
79. Child Growth Foundation. British 1990 growth reference for height, weight, BMI and head circumference analysis disk. 2001.
80. British Association of Perinatal Medicine. Standards for hospitals providing neonatal intensive and high dependency care (Second Edition) and Categories of Babies requiring Neonatal Care. London: British Association of Perinatal Medicine, 2001.
81. NHS & Department of Health. Toolkit for high-quality neonatal services. London: Department of Health, 2009.
82. Department of Health. The Health Survey for England, 2006. London: The Stationery Office, 2008.
83. Kanagalingam MG, Forouhi NG, Greer IA, Sattar N. Changes in booking body mass index over a decade: retrospective analysis from a Glasgow Maternity Hospital. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(10):1431-3.
84. Knight M, Kurinczuk JJ, Spark P, Brocklehurst P, on behalf of the UKOSS. Extreme Obesity in Pregnancy in the United Kingdom. *Obstetrics & Gynecology* 2010;115(5):989-997

85. Knight M. The UK Obstetric Surveillance System. *Obstetrics, Gynaecology & Reproductive Medicine* 2008;18(7):199-200.
86. Dr Foster Research. *Weighing up the burden of obesity*. London: Dr Foster Research, 2008.
87. The NHS Information Centre. *The Health Survey for England, 2008. Volume 1: Physical Activity and Fitness*. London: The NHS Information Centre for health and social care, 2009.
88. Balchin I, Whittaker JC, Patel RR, Lamont RF, Steer PJ. Racial variation in the association between gestational age and perinatal mortality: prospective study. *British Medical Journal* 2007;334(7598):833-.
89. National Institute for Health and Clinical Excellence. *Antenatal care: Routine care for the healthy pregnant woman*. London: RCOG, 2008.
90. Healthcare Commission. *Towards better births: A review of maternity services in England*. London: Commission for Healthcare Audit and Inspection, 2008.
91. Zhang WH, Alexander S, Bouvier-Colle MH, Macfarlane A, the M-BG. Incidence of severe pre-eclampsia, postpartum haemorrhage and sepsis as a surrogate marker for severe maternal morbidity in a European population-based study: the MOMS-B survey. *BJOG: An International Journal of Obstetrics & Gynaecology* 2005;112(1):89-96.
92. Zhang J, Bricker L, Wray S, Quenby S. Poor uterine contractility in obese women. *BJOG: An International Journal of Obstetrics & Gynaecology* 2007;114(3):343-348.
93. Higgins CA, Martin W, Anderson L, Blanks AM, Norman JE, McConnachie A, et al. Maternal Obesity and its Relationship With Spontaneous and Oxytocin-Induced Contractility of Human Myometrium In Vitro. *Reproductive Sciences* 2010;17(2):177-185.
94. Child Growth Foundation. *British 1990 Growth Reference for Height, Weight, BMI and Head Circumference analysis disk*, 2001.
95. Hapo Study Cooperative Research Group. Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) Study: associations with maternal body mass index. *BJOG: An International Journal of Obstetrics & Gynaecology* 2010;117(5):575-584.
96. Stothard KJ, Tennant PWG, Bell R, Rankin J. Maternal Overweight and Obesity and the Risk of Congenital Anomalies: A Systematic Review and Meta-analysis. *Journal of the American Medical Association* 2009;301(6):636-650.
97. Shai I, Jiang R, Manson JE, Stampfer MJ, Willett WC, Colditz GA, et al. Ethnicity, Obesity, and Risk of type 2 Diabetes in Women. *Diabetes Care* 2006;29(7):1585-1590.
98. Fitzsimons KJ, Modder J, Greer IA. Obesity in pregnancy: risks and management. *Obstetric Medicine* 2009;2:52-62.
99. Confidential Enquiry into Maternal and Child Health. *Pregnancy in women with type 1 and type 2 diabetes in 2002-2003, England, Wales and Northern Ireland* London: CEMACH, 2005.
100. Vasudevan C, Renfrew M, McGuire W. *Fetal and perinatal consequences of maternal obesity*. Archives of Disease in Childhood - Fetal and Neonatal Edition 2010.
101. National Institute for Health and Clinical Excellence. *Caesarean section*. London: Royal College of Obstetricians and Gynaecologists, 2004.
102. Lumley J, Watson L, Watson M, Bower C. Periconceptional supplementation with folate and/or multivitamins for preventing neural tube defects. *Cochrane Database of Systematic Reviews* 2001(3).

-
103. Glazer NL, Hendrickson AF, Schellenbaum GD, Mueller BA. Weight change and the risk of gestational diabetes in obese women. *Epidemiology* 2004;15(6):733-737.
104. Carmichael SL, Shaw GM, Schaffer DM, Laurent C, Selvin S. Dieting behaviors and risk of neural tube defects. *American Journal of Epidemiology* 2003;158(12):1127-1131.
105. Werler MM, Louik C, Shapiro S, Mitchell AA. Prepregnant weight in relation to risk of neural tube defects. *Journal of the American Medical Association* 1996;275(14):1089-1092.
106. Prendiville WJ, Elbourne D, McDonald S. Active versus expectant management in the third stage of labour.[update of Cochrane Database of Systematic Reviews 2000;(2):CD000007]. *Cochrane Database of Systematic Reviews* 2000(3).
107. Myles TD, Gooch J, Santolaya J. Obesity as an independent risk factor for infectious morbidity in patients who undergo cesarean delivery. *Obstetrics and Gynecology* 2002;100(5 Pt 1):959-64.
108. Mok E, Multon C, Piguél L, Barroso E, Goua V, Christin P, et al. Decreased Full Breastfeeding, Altered Practices, Perceptions, and Infant Weight Change of Prepregnant Obese Women: A Need for Extra Support. *Pediatrics* 2008;121(5):e1319-1324.
109. Leermakers EA, Anglin K, Wing RR. Reducing postpartum weight retention through a correspondence intervention. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 1998;22(11):1103-9.
110. O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. *Journal of Women's Health* 2003;12(10):991-8.
111. Kim C, Newton KM, Knopp RH. Gestational Diabetes and the Incidence of type 2 Diabetes: A systematic review. *Diabetes Care* 2002;25(10):1862-1868.
112. Orozco LJ, Buchleitner AM, Gimenez-Perez G, Roque I Figuls M, Richter B, Mauricio D. Exercise or exercise and diet for preventing type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews* 2008(3):CD003054.
113. Laraia BA, Bodnar LM, Siega-Riz AM. Pregravid body mass index is negatively associated with diet quality during pregnancy. *Public Health Nutrition* 2007;10(9):920-6.

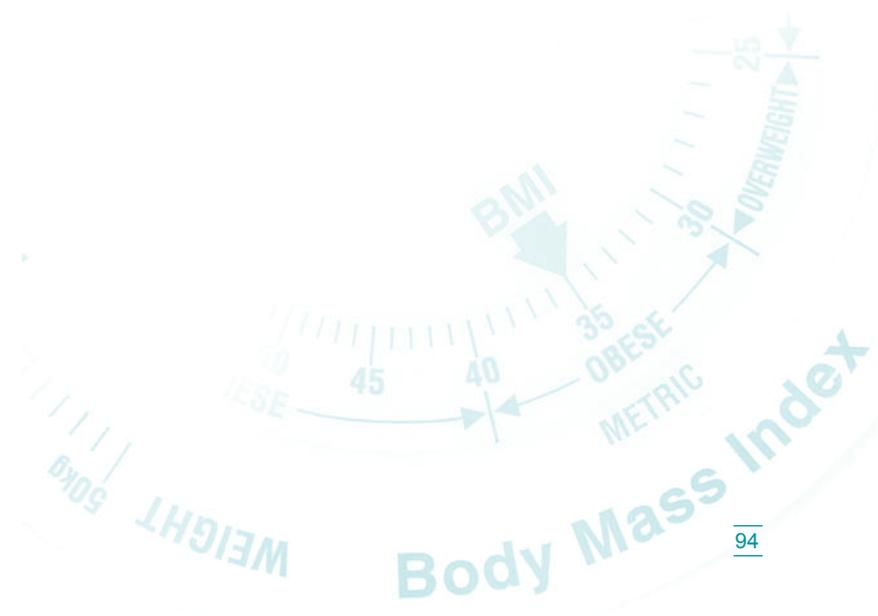


Index of tables

Table 2.1.	Classification of weight status according to BMI ^{64 66}	17
Table 3.1.	Number of standards at each phase of the CMACE consensus process.....	21
Table 3.2.	Maternity records audited as part of the CMACE national maternal obesity audit.....	27
Table 3.3.	Minimum criteria for CMACE recommendations.....	28
Table 4.1.	Survey response from maternity units in the UK, Channel Islands and Isle of Man.....	31
Table 5.1.	Prevalence of maternal obesity by type of maternity unit.....	38
Table 5.2.	Prevalence of maternal obesity by Strategic Health Authority.....	39
Table 6.1.	Number of women meeting the study inclusion criteria.....	43
Table 6.2.	Anthropometric characteristics of women with a pregnancy BMI ≥ 35	43
Table 6.3.	Maternities by deprivation quintiles for England.....	44
Table 6.4.	Maternities by ethnic group.....	44
Table 6.5.	Maternities by age group.....	45
Table 6.6.	Medical conditions among pregnant women by BMI group.....	46
Table 6.7.	Pregnancy-related characteristics by BMI group.....	47
Table 6.8.	Anthropometric characteristics of women with both a first trimester and third trimester weight measurement.....	48
Table 6.9.	Onset of labour by BMI group.....	48
Table 6.10.	Intended and actual place of delivery by BMI group.....	49
Table 6.11.	Mode of delivery by BMI group.....	50
Table 6.12.	Mode of delivery by onset of labour and BMI group.....	51
Table 6.13.	Type of anaesthesia by onset of labour and BMI group among women with caesarean section.....	52
Table 6.14.	Postpartum blood loss by BMI group among women with a singleton pregnancy.....	53
Table 6.15.	Postpartum blood loss by mode of delivery among women with a singleton pregnancy and BMI ≥ 35	54
Table 6.16.	Adjusted odds of primary postpartum haemorrhage by LMWH status among women with a BMI ≥ 35	55
Table 6.17.	Neonatal outcomes of singleton pregnancies by maternal BMI group.....	56
Table 6.18.	Confirmed congenital anomalies in babies born to women with a BMI ≥ 35	57
Table 6.19.	Adjusted odds of women with and without diabetes having a LGA baby, by BMI group.....	59
Table 6.20.	Feeding practices by BMI group among women with a singleton pregnancy.....	59
Table 6.21.	Adjusted odds of co-morbidities, pregnancy-related complications and adverse outcomes for women with a pregnancy BMI 40-49.9 and ≥ 50 in comparison to women with a BMI 35-39.9.....	61
Table 6.22.	Adjusted odds of pregnancy-related complications and adverse outcomes by diabetes status.....	62
Table 7.1.	Dosage of reported folic acid supplementation before and during pregnancy.....	66
Table 7.2.	Timing of weight measurement in relation to the antenatal booking appointment.....	67
Table 7.3.	Recommendations for antenatal and postnatal thromboprophylaxis treatment according to the RCOG Green-top Guideline No. 37 (2004).....	69
Table 7.4.	Postnatal LMWH use among women with a BMI ≥ 35	71
Table 7.5.	Timing of venous access in women with induction of labour.....	79
Table 7.6.	Active management of the third stage of labour among women with vaginal births.....	79

Index of figures

Figure 3.1. Flow chart of process to develop CMACE recommendations.....	29
Figure 4.1. Maximum weight capacity of equipment immediately accessible to maternity units in the UK, Channel Islands and Isle of Man, 2008	35
Figure 5.1. Prevalence of maternal obesity by body mass index category	38
Figure 5.2. Prevalence of maternal obesity by UK nations and crown dependencies	39
Figure 5.3. Regional variation in BMI ≥ 35 during pregnancy	40
Figure 6.1. Mean weight change between the first and third trimester in women with singleton pregnancies, by BMI group.....	47
Figure 6.2. Proportion of babies born large for gestational age by maternal diabetes status and BMI group.....	58
Figure 7.1. Number of cases audited by CMACE	65
Figure 7.2. Use of antenatal thromboprophylaxis by VTE risk category	70
Figure 7.3. Length of hospital stay and duration of prescribed low molecular weight heparin (LMWH) by postnatal VTE risk category	72
Figure 7.4. Postnatal thromboprophylaxis and dosage by VTE risk category.....	72
Figure 7.5. Dosage of low molecular weight heparin (LMWH) prescribed to women with a recorded body weight.....	73
Figure 7.6. Time between admission and being reviewed by an obstetrician of ST6 level or above	77
Figure 7.7. Time between admission and being reviewed by an anaesthetist of ST6 level or above	78
Figure 7.8. Time between admission and establishing venous access among women with spontaneous labour	78



APPENDIX A: Stakeholder organisations consulted during February 2008

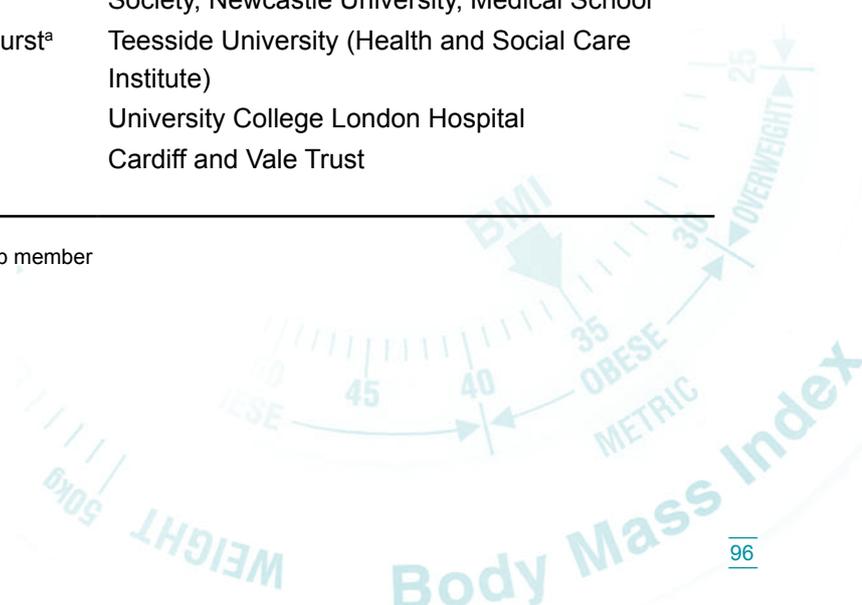
Association for Breastfeeding Mothers
ASO (Association for the Study of Obesity UK) ^a
BAPM (British Association of Perinatal Medicine)
Big Matters
BLISS
BMFMS (British Maternal & Fetal Medicine Society)
British Heart Foundation
British Obesity Surgery Patient Association
Diabetes UK^a
Dietitians in Obesity Management (UK) ^a
EASO (European Association for the Study of Obesity)
Faculty of Public Health
Healthcare Commission
International Association for the Study of Obesity
MEND Central Ltd ^a
MRC Human Nutrition Research ^a
National Back Exchange
National Childbirth Trust ^a
National Collaborating Centre for Women and Children's Health
National Council of Psychotherapists
National Institute for Clinical Excellence
National Obesity Forum
National Perinatal Epidemiology Unit ^a
National Screening Committee
NHS Litigation Authority
North East Maternal Obesity Research Group ^a
OAA (Obstetric Anaesthetists' Association)
Perinatal Institute ^a
Public Health Observatories
Royal College of Anaesthetists
Royal College of General Practitioners ^a
Royal College of Midwives
Royal College of Obstetricians and Gynaecologists ^a
Royal College of Paediatrics and Child Health
Royal College of Pathologists
Royal College of Physicians
SANDS (Stillbirth and Neonatal Death Society)
Society of Endocrinology
South Asian Health Foundation
The Chartered Society of Physiotherapists
The Counterweight Programme
UK Public Health Association
UKOSS (UK Obstetric Surveillance System) ^b
Weight Concern ^a

^a Organisations that participated in the consultation; ^b Participated jointly with the National Perinatal Epidemiology Unit

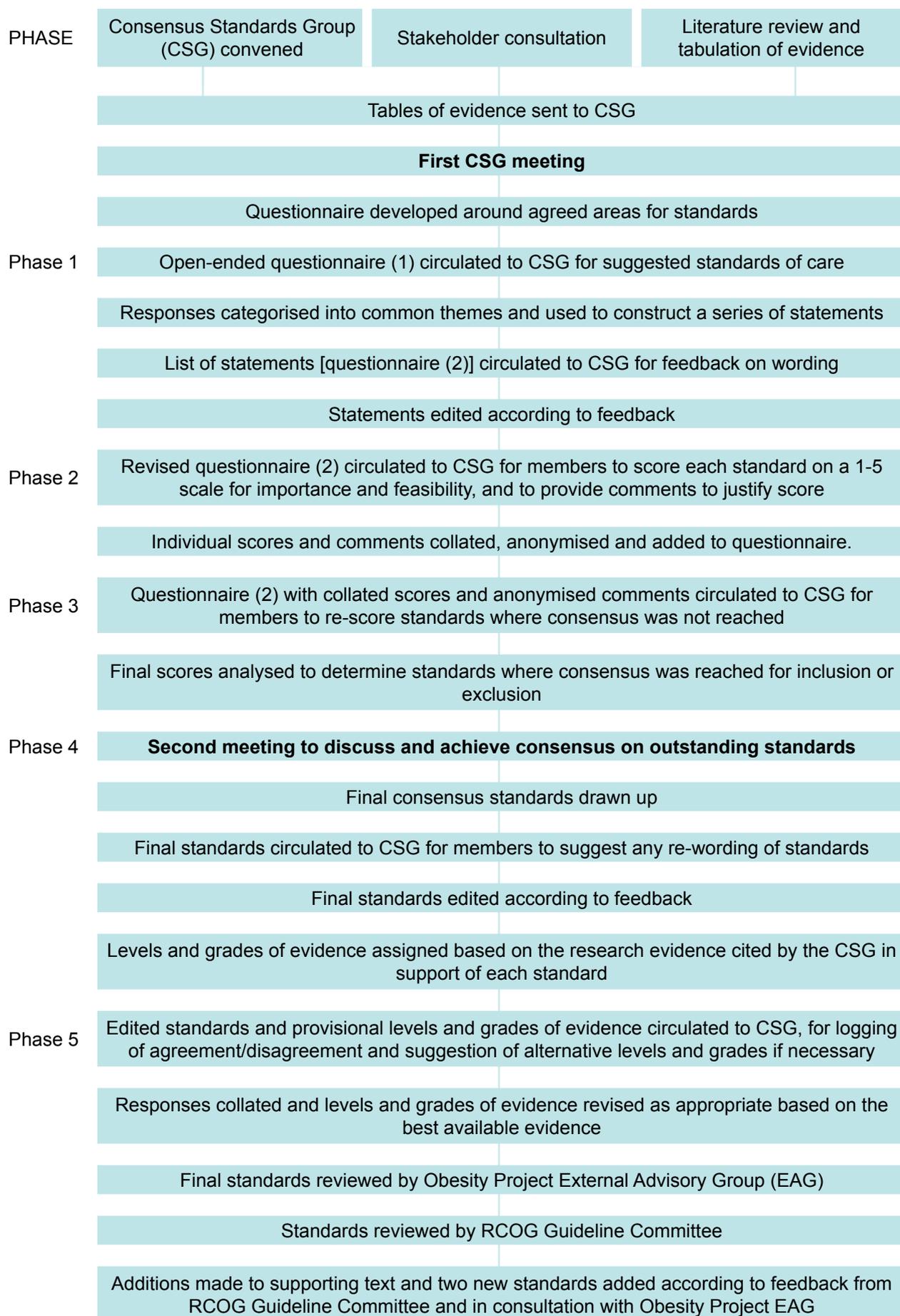
APPENDIX B: Members of the Consensus Standards Group by discipline

Discipline	Name	Organisation
Obstetrics (Chair)	Professor Ian Greer ^a	CEMACH / The Hull York Medical School
Anaesthesia	Dr Martin Dresner ^a	Leeds General Infirmary
Anaesthesia	Dr Anne McCrae	RCoA representative, Department of Anaesthesia, Critical Care and Pain Medicine, Royal Infirmary of Edinburgh
Dietetics	Fiona Taylor	Dietitians in Obesity Management (DOMUK)
Endocrinology	Dr Stephen Robinson ^a	Imperial College School of Medicine at St. Mary's Hospital, London
General Medicine (Obstetrics)	Dr Catherine Nelson-Piercy	RCP representative, St Thomas' Hospital, London
General Practice	Dr David Haslam ^a	National Obesity Forum / Centre for Obesity Research at Luton & Dunstable Hospital
General Practice	Dr Victoria Tzortziou	RCGP representative
Lay Representative	Alex Farrall ^a	Not applicable
Lay Representative	Stacey Grant ^a	Not applicable
Midwifery/Practice & Standards Development Advisor for RCM	Mervi Jokinen	RCM representative
Midwifery	Dr Jane Rogers ^a	Southampton University Hospitals Trust
Manual handling	Mary Muir	National Back Exchange
Neonatology	Dr Helen Budge ^a	Queens Medical Centre – Nottingham
Neonatology/Paediatrics	Dr Laura De Rooy	RCPCH representative, St Georges Hospital
Obstetrics	Professor Andrew Calder	Reproductive and Developmental Sciences, University of Edinburgh
Obstetrics	Dr Andrew Loughney	RCOG representative/ Royal Victoria Infirmary, Newcastle Upon Tyne
Obstetrics	Dr Daghni Rajasingam ^a	Guys and St. Thomas' NHS Trust, London
Obstetrics	Dr T G Teoh	St Mary's Hospital
Perinatal epidemiology	Dr Marian Knight ^a	National Perinatal Epidemiology Unit
Physiotherapy	Maria Jones	Central Manchester and Manchester Children's University Hospitals NHS Trust
Public Health	Dr Ruth Bell	FPH representative, Institute of Health and Society, Newcastle University, Medical School
Public Health	Dr Nicola Heslehurst ^a	Teesside University (Health and Social Care Institute)
Ultrasonography	Raj Dave	University College London Hospital
Welsh representative/ Midwifery	Karen Jewell	Cardiff and Vale Trust

^aConsensus Standards Group and External Advisory Group member



APPENDIX C. Process for developing the standards of care for women with obesity



APPENDIX D: Levels and grades of evidence

Classification of evidence levels

Level	Evidence
1++	High-quality meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias
1-	Meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a high risk of bias
2++	High-quality systematic reviews of case-control or cohort studies or high quality case-control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
2+	Well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal
2-	Case-control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal
3	Non-analytical studies; e.g. case reports, case series
4	Expert opinion / Formal consensus

Grades of evidence

Grade	Evidence
A	At least one meta-analysis, systematic reviews or randomised controlled trial rated as 1++ and directly applicable to the target population; or a systematic review of randomised controlled trials or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++ directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+ directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or extrapolated evidence from studies rated as 2+
GPP	Good practice point Recommended best practice based on the clinical experience of the guideline development group



APPENDIX E: Standards of care for women with obesity in pregnancy

PRE-PREGNANCY CARE

1. Primary care services should ensure that all women of childbearing age have the opportunity to optimise their weight before pregnancy. Advice on weight and lifestyle should be given during family planning consultations, and weight, body mass index and waist circumference should be regularly monitored. [D]
 2. Women of childbearing age with a BMI ≥ 30 should receive information and advice about the risks of obesity during pregnancy and childbirth,⁷¹ and be supported to lose weight before conception.^{103 104} [D]
 3. Women with a BMI ≥ 30 wishing to become pregnant should be advised to take 5mg folic acid supplementation daily, starting at least one month before conception and continuing during the first trimester of pregnancy.^{19 21 105} [B]
 4. Health professionals should take particular care to check that women with a booking BMI ≥ 30 are following advice to take 10 micrograms Vitamin D supplementation daily during pregnancy and while breastfeeding.¹⁵ [C] **
-

PROVISION OF ANTENATAL CARE

5. Management of women with obesity in pregnancy should be integrated into all antenatal clinics, with clear policies and guidelines for care available. [D]
-

MEASURING WEIGHT, HEIGHT AND BMI

6. All pregnant women should have their weight and height measured using appropriate equipment, and their body mass index calculated at the antenatal booking visit. Measurements should be recorded in the handheld notes and electronic patient information system. [D]
-

INFORMATION-GIVING DURING PREGNANCY

7. All pregnant women with a booking BMI ≥ 30 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how they may be minimised.⁷¹ Women should be given the opportunity to discuss this information. [D]
-

RISK ASSESSMENT DURING PREGNANCY

8. Pregnant women with a booking BMI ≥ 40 should have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties with venous access, regional or general anaesthesia can be identified. An anaesthetic management plan for labour and delivery should be discussed and documented in the medical records. [D]
 9. Women with a booking BMI ≥ 40 should have a documented assessment in the third trimester of pregnancy by an appropriately qualified professional to determine manual handling requirements for childbirth and consider tissue viability issues. [D]
-

THROMBOPROPHYLAXIS

10. Women with a booking BMI ≥ 30 should be assessed at their first antenatal visit and throughout pregnancy for the risk of thromboembolism.^{24 25 49} Antenatal and post delivery thromboprophylaxis should be considered in accordance with the RCOG Clinical Green-top Guideline No. 37.¹⁴ [B]
 11. Women with a booking BMI ≥ 30 requiring pharmacological thromboprophylaxis should be prescribed doses appropriate for maternal weight, in accordance with the RCOG Clinical Green-top Guideline No. 37.¹⁴ [D]
 12. Women with a BMI ≥ 30 should be encouraged to mobilise as early as practicable following childbirth to reduce the risk of thromboembolism.²⁴ [B]
 13. All women with a BMI ≥ 40 should be offered postnatal thromboprophylaxis regardless of their mode of delivery. [D]
-

MATERNAL SURVEILLANCE AND SCREENING

14. An appropriate size of arm cuff should be used for blood pressure measurements taken at the booking visit and all subsequent antenatal consultations.³⁴ The cuff size used should be documented in the medical records. [C]
 15. Women with a booking BMI ≥ 30 have an increased risk of pre-eclampsia^{11 26 27 36-41} and should have surveillance during pregnancy in accordance with the Pre-eclampsia Community Guideline (PRECOG), 2004.³⁴ [B]
-

** Additional standard identified by the RCOG Guideline Committee

16. All pregnant women with a booking BMI ≥ 30 should be screened for gestational diabetes,^{26 36-38 42} as recommended by the NICE Clinical Guideline No. 63 (Diabetes in Pregnancy, July 2008).³⁵ [B]

PLANNING LABOUR AND DELIVERY

17. Women with a booking BMI ≥ 30 should have an informed discussion antenatally about possible intrapartum complications associated with a high BMI,²⁸ and management strategies considered. This should be documented in the notes. [D]

18. Women with a booking BMI ≥ 30 should have an individualised decision for VBAC (vaginal birth after caesarean) following informed discussion and consideration of all relevant clinical factors. [D]

CARE DURING CHILDBIRTH

19. Women with a BMI ≥ 35 should give birth in a consultant-led obstetric unit with appropriate neonatal services,^{26 37 38 52} as recommended by the NICE Clinical Guideline No. 55 (Intrapartum Care, Sept 2007).⁵¹ [B]

20. In the absence of other obstetric or medical indications, obesity alone is not an indication for induction of labour and a normal birth should be encouraged. [D]

21. The duty anaesthetist covering labour ward should be informed when a woman with a BMI ≥ 40 is admitted to the labour ward if delivery or operative intervention is anticipated. This communication should be documented by the attending midwife in the notes. [D]

22. Operating theatre staff should be alerted regarding any woman whose weight exceeds 120kg and who is due to have an operative intervention in theatre. [D]

23. An obstetrician and an anaesthetist at Specialty Trainee year 6 and above, or with equivalent experience in a non-training post, should be informed and available for the care of women with a BMI ≥ 40 during labour and delivery, including attending any operative vaginal or abdominal delivery and physical review during the routine medical ward round. [D]

24. Women with a BMI ≥ 40 who are in established labour should receive continuous midwifery care. [D]

25. Women with a BMI ≥ 40 should have venous access established early in labour. [D]

26. All women with a BMI ≥ 30 should be recommended to have active management of the third stage of labour.¹⁰⁶ This should be documented in the notes. [B]

27. Women with a BMI ≥ 30 having a caesarean section have an increased risk of wound infection,^{26 52 107} and should receive prophylactic antibiotics at the time of surgery as recommended by the NICE Clinical Guideline No. 13 (Caesarean Section, April 2004).¹⁰¹ [B]

28. As recommended by the NICE Clinical Guideline No. 13 (Caesarean Section, April 2004), women undergoing caesarean section who have more than 2cm subcutaneous fat, should have suturing of the subcutaneous tissue space in order to reduce the risk of wound infection and wound separation.¹⁰¹ [A] ++

POSTNATAL CARE AND FOLLOW-UP AFTER PREGNANCY

29. Obesity is associated with low breastfeeding initiation and maintenance rates.^{32 108} Women with a booking BMI ≥ 30 should receive appropriate specialist advice and support antenatally and postnatally regarding the benefits, initiation and maintenance of breastfeeding.⁸⁹ [B]

30. Women with a booking BMI ≥ 30 should continue to receive nutritional advice following childbirth from an appropriately trained professional, with a view to weight reduction.^{109 110} [C]

31. All women with a booking BMI ≥ 30 who have been diagnosed with gestational diabetes should have a test of glucose tolerance approximately six weeks after giving birth. [D]

32. Women with a booking BMI ≥ 30 and gestational diabetes who have a normal test of glucose tolerance following childbirth, should have regular follow up with the GP to screen for the development of type 2 diabetes.¹¹¹ [B]

33. All women with a booking BMI ≥ 30 who have been diagnosed with gestational diabetes should have annual screening for cardio-metabolic risk factors, and be offered lifestyle and weight management advice.¹¹² [B]

++ Additional standard identified by the RCOG Guideline Committee

LOCAL GUIDELINES

34. All maternity units should have accessible multidisciplinary guidelines which are communicated to all individuals and organisations providing care to pregnant women with a booking BMI ≥ 30 . These guidelines should include consideration of:
- Referral criteria
 - Facilities and equipment
 - Care in pregnancy
 - Place of birth and care in labour
 - Provision of anaesthetic services
 - Management of obstetric emergencies
 - Postnatal advice [D]
-

FACILITIES AND EQUIPMENT

35. All maternity units should have a documented environmental risk assessment regarding the availability of facilities to care for pregnant women with a booking BMI ≥ 30 . This risk assessment should address the following issues:
- Circulation space
 - Accessibility including doorway widths and thresholds
 - Safe working loads of equipment (up to 250kg) and floors
 - Appropriate theatre gowns
 - Equipment storage
 - Transportation
 - Staffing levels
 - Availability of, and procurement process for, specific equipment:
 - large blood pressure cuffs
 - sit-on weighing scale
 - large chairs without arms
 - large wheelchairs,
 - ultrasound scan couches
 - ward and delivery beds
 - theatre trolleys
 - operating theatre tables
 - lifting and lateral transfer equipment [D]
36. Maternity units should have a central list of all facilities and equipment required to provide safe care to pregnant women with a booking BMI ≥ 30 . The list should include details of safe working loads, product dimensions, where specific equipment is located and how to access it. [D]
-

EDUCATION OF HEALTH PROFESSIONALS

37. All health professionals involved in the care of pregnant women should receive education about maternal nutrition and its impact on maternal, fetal and child health.¹¹³ [D]
38. All health professionals involved in maternity care should receive training in manual handling techniques and the use of specialist bariatric equipment which may be required for pregnant and postnatal women with obesity. [D]
-

AREAS FOR FURTHER RESEARCH

39. Research is needed to determine the optimal weight gain during pregnancy for women in different BMI categories. [D]
40. Evidence-based guidance is required on the optimal caesarean section technique for women with obesity in pregnancy. [D]
-



Confidential Enquiry into Maternal and Child Health

Improving the health of mothers, babies and children

OBESITY AND MATERNITY SERVICES SURVEY

This national survey is being carried out by the Confidential Enquiry into Maternal and Child Health (CEMACH) to assess current maternity service provision for women who are obese. It is intended that the findings from this survey will be used to produce recommendations for the improvement of maternity services for these women.

The survey is confidential to CEMACH; your unit will not be identified in any way in the findings resulting from this survey.

Your participation is greatly appreciated.

Instructions for completing and returning this survey

Please **ensure that one survey is completed for each maternity unit** within your trust. This means that if your trust has both an alongside midwifery unit and a consultant unit, two surveys will need completing.

Completion of this survey is likely to require a multi-professional effort within the unit. We would be grateful if the Head of Midwifery or the Director of Midwifery Services (or equivalent position) could take responsibility for ensuring that the survey is fully completed and returned to CEMACH.

Please complete the questions in the pages that follow and return to the CEMACH regional manager in the pre-addressed envelope by **2nd May 2008**.

If you have any questions about this survey please contact your local CEMACH regional manager, whose details are below.

An individual's body mass index (BMI) is calculated as their weight in kilograms divided by the square of their height in metres (kg/m^2). The World Health Organization (WHO) has used this measure to produce the following BMI categories:

Underweight	<18.5
Normal	18.5 - 24.9
Overweight	25.0 - 29.9
Obesity Class I	30.0 - 34.9
Obesity Class II	35.0 - 39.9
Obesity Class III	≥ 40

THANK YOU FOR YOUR HELP

CEMACH regional manager label: (99.1 x 38.1mm)

RM Name
 Address line 1
 Address line 2
 Address line 3
 Telephone number
 firstname.surname@cemach.org.uk

Your Name: _____

Contact Telephone: _____

If your maternity unit does not routinely provide care for obese women please tick the box and go straight to section 6

Please continue on to the following page

25
 OVERWEIGHT

Body Mass Index

SECTION 1: EQUIPMENT AND FACILITIES

1.1. Please indicate the maximum safe working load of the equipment and facilities that your unit has immediate access to (e.g. in the event of an unexpected admission of a woman with a high BMI). (Tick one maximum safe working load only for each row, and indicate whether the equipment/facility is labelled)

Equipment and facilities	Not available	Maximum safe working load (kg)				Labelled with maximum weight	
		<180	180-249	250-299	≥ 300	Yes	No
a. Extra wide chairs in clinical areas							
b. Extra wide wheelchairs							
c. Toilets							
d. Extra wide commodes							
e. Extra wide examination couches							
f. Hoists							
g. Extra wide ward beds							
h. Extra wide trolleys							
i. Delivery beds							
j. Operating theatre tables							

1.2. Do you use a tool for assessing the risk of pressure damage in obese women (e.g. Waterlow risk assessment scale)?

- Yes
- No

1.3. Does your maternity unit have a central list of all available manual handling equipment for obese women, which includes the weight limits and location of each item?

- Yes
- No

1.4. Is the following equipment located within your maternity unit? (Tick the appropriate answer for each row and location)

Equipment	Early pregnancy unit			Antenatal consulting room			Day assessment unit			Delivery / birthing room			All wards			Theatre		
	Yes	No	N/A	Yes	No	N/A	Yes	No	N/A	Yes	No	N/A	Yes	No	N/A	Yes	No	N/A
a. Step-on scales for weighing up to 300kg																		
b. Sit-on scales for weighing up to 300kg																		
c. Large blood pressure cuff (bladder dimension 12 x 40cm)																		
d. Access doors wide enough to allow specialist equipment for obese women																		

Please continue on to the following page

SECTION 1 CONTINUED: EQUIPMENT AND FACILITIES

OBSTETRIC UNITS ONLY

If you are an *alongside midwifery* or *free-standing midwifery* unit, tick the box and go straight to section 2

1.5. Do you have the following equipment located in your maternity unit? (Tick the appropriate answer for each row)

Equipment	Yes	No
a. Extra long spinal and epidural needle available for regional analgesia in pregnant obese women		
b. A theatre that is always equipped for obese women (i.e. has lateral transfer equipment, appropriate bed)		

SECTION 2: INFORMATION

2.1. Does your maternity unit provide printed information for women focused on obesity and pregnancy?

- Yes
 No

2.2. Please indicate the location and format of your maternity unit's guideline for the care and management of obese women. (Tick the appropriate answers)

Location	Format of guideline	
	Electronically on intranet	Hard Copy
Early pregnancy unit		
Antenatal clinic		
Day assessment unit		
Delivery suite		
Inpatient wards		
We currently have no guideline specifically for the care of obese women who are pregnant <input type="checkbox"/>		

SECTION 3: STAFF AND CARE STRUCTURES

3.1. Do you have a nominated clinical lead for obesity?

- Yes → Go to 3.1.1
 No → Go to 3.2

3.1.1. If yes, what is this person's discipline? (Tick one option only)

- Midwife
 Obstetrician
 Other → Please specify _____

3.2. In your maternity unit, do you have a maternal BMI and/or weight threshold above which additional services (e.g. referral to consultant obstetrician, dietetic advice etc.) for pregnant women are initiated?

- Yes → Please specify _____ BMI and/ or _____ kg
 No

Please continue on to the following page

SECTION 3 CONTINUED: STAFF AND CARE STRUCTURES

3.3. If an obese woman presents for antenatal booking at your maternity unit, is she referred to obstetric consultant led care? (Tick one option only)

- Always
- Sometimes
- Never

3.4. Please complete the table below regarding care received by obese women during pregnancy in your maternity unit. (Tick the appropriate answer for each row)

Care received	Always	Sometimes	Never
a. Obese women are seen by a consultant obstetrician at least once			
b. Obese women have an antenatal anaesthetic review			
c. Obese women are given the opportunity to see a dietician			
d. Obese women have a written plan of care for pregnancy			
e. Obese women have a written plan of care for delivery			
f. Plans of care for labour and delivery are made available to maternity staff			

3.5. Are the following services available for all obese women in your maternity unit? (Tick the appropriate answer for each row)

Services	Yes	No
a. Preconception care and advice specifically for obese women		
b. Specific multidisciplinary antenatal clinic for obese women		
c. Specific dietetic advice		
d. Breastfeeding support (additional to that offered to the general maternity population)		
e. Postnatal physiotherapy		

3.6. Do you have a maternal BMI and/or weight threshold above which women are advised against a home birth?

- Yes → Please specify _____ BMI and/or _____ kg
- No

3.7. Do you have a maternal BMI and/or weight threshold above which women are advised against using a birthing pool?

- Yes → Please specify _____ BMI and/or _____ kg
- No

Please continue on to the following page

SECTION 4: PREPARATION AND TRAINING

4.1. Please indicate how many of the following training sessions have occurred in your maternity unit in the previous 12 months. Please also state the number of staff who attended.

Training sessions	Number of sessions			Number of staff attended
	0	1-3	≥ 4	
a. Manual handling training				
b. Training on using specialist equipment for pregnant obese women				
c. Education/training sessions about obesity and pregnancy for any discipline				

4.2. Has the provision and management of care for obese women during pregnancy been discussed at a senior clinical and/or management meeting held in the previous 12 months? (Tick one option only)

- Yes
 No
 Don't know

4.3. Has your maternity unit conducted an audit on obesity within the previous 12 months (excluding this survey)?

- Yes
 No

SECTION 5: YOUR VIEWS

5.1. In your opinion, what do you feel has happened to the following over the past five years? (Tick the appropriate answer for each row)

Trends	Decreased	Stayed the same	Increased
a. The number of obese women in your maternity unit has...			
b. The levels of morbidity/mortality in obese women and their babies in your maternity unit have...			
c. The number of obese women in the UK's maternity population has...			
d. The levels of morbidity and mortality in obese women in the UK's maternity population have...			

5.2. In your local population, do you feel there are any barriers that prevent obese women from accessing optimal maternity care?

- Yes → Please specify below what you believe these barriers are.
 No → Go to 5.3

Please continue on to the following page

SECTION 5 CONTINUED: YOUR VIEWS

5.3. In your maternity unit, do you feel there should be specific care initiatives for obese women?

- Yes → Please specify below what you believe these initiatives should be.
- No → Go to 5.4

5.4. In your maternity unit, do you feel there are barriers to implementing specific care initiatives for obese women?

- Yes → Please specify below what you believe these barriers are.
- No → Go to section 6

SECTION 6: DELIVERY AND BOOKING INFORMATION

6.1. During 2007, how many deliveries did your maternity unit have? (Include all live births and stillbirths)

_____ Deliveries

6.2. During July 2007, how many women booked for antenatal care in your unit? (Include only women who went on to deliver in your unit)

_____ Women

6.3. Are the following maternal details from the booking visit recorded in the maternity notes and/or entered on an electronic system? (Tick the appropriate answers for each row)

Maternal details	Recorded in maternity notes		Entered on electronic system	
	Yes	No	Yes	No
a. Maternal height				
b. Maternal weight				
c. Maternal body mass index (BMI)				

6.4. At the booking visit in your maternity unit, what is the most common method of obtaining a woman's weight? (Tick one option only)

- Self-reported by woman
- Reported by GP
- Measured by a healthcare professional
- Not usually obtained

Please continue on to the following page

SECTION 6 CONTINUED: DELIVERY AND BOOKING INFORMATION

- 6.5. During July 2007, how many women who booked for antenatal care in your unit had their BMI recorded? (Include only women who went on to deliver in your unit)
- _____ Women If you cannot answer this using electronic records tick the box and go to 7.1
- 6.6. During July 2007, how many of those women who had their BMI recorded had a BMI of 30 to 34.9? (Include only women who went on to deliver in your unit)
- _____ Women If you cannot answer this using electronic records tick the box and go to 7.1
- 6.7. During July 2007, how many of those women who had their BMI recorded had a BMI of 35 or above? (Include only women who went on to deliver in your unit)
- _____ Women If you cannot answer this using electronic records tick the box

SECTION 7: GENERAL INFORMATION

- 7.1. What is the name of your maternity unit? _____
- 7.2. Which of the following describes your maternity unit? (Tick one option only)
- Obstetric unit
- Alongside midwifery unit
- Freestanding midwifery unit
- 7.3. What aspects of maternity care does your unit usually provide for obese women? (Select all that apply)
- Preconception
- Antenatal
- Intrapartum
- Postnatal
- 7.4. What is the name of your trust? _____
- 7.5. What is your position (job title)? _____
- 7.6. Please specify the approximate number of staff working in your maternity unit (full time or part time), including qualified and student midwives, senior and junior obstetricians and anaesthetists, theatre staff, nurses, and healthcare assistants.
- _____ Staff

Please check that ALL questions have been answered before returning this survey to your local CEMACH Regional Manager, whose details are on the front page.

Thank you very much for your cooperation in completing this survey

APPENDIX G: CEMACH Obesity in pregnancy audit notification form



Confidential Enquiry into Maternal and Child Health

Improving the health of mothers, babies and children

OBESITY IN PREGNANCY AUDIT NOTIFICATION FORM

FROM 1ST MARCH 2009

Please report all women giving birth at 24+0 weeks and above, between 1st March 2009 and 30th April 2009, who meet the case definition below

Choose type of case: *(Select one option only)*

- Any woman with a body mass index (BMI) greater than or equal to 35kg/m² at any time during pregnancy.
- Any woman without a known BMI, but weight greater than or equal to 100kg at any time during pregnancy.
- Any woman without a known BMI or weight, but judged by health professionals to be in either of the previous categories.

Instructions for completing and returning this audit notification form

1. Guidance for completing this form can be found on the supplementary information sheet.
2. Some questions are marked with an asterisk (*). Please read the guidance notes before completing these questions.
3. Please complete the form using the information available in the woman's notes. The form should be completed within 7 days of the woman giving birth.
4. Please enter all dates in the format DD/MM/YY.
5. Please enter the notification form identification number on the Labour Ward Log form.
6. Please photocopy the completed forms before returning the original hardcopies to your local CEMACH Regional Office. Forms should be returned on a case-by-case basis.
7. Please retain a copy of each completed form for your records.

Date form completed / /

Number of additional sheets attached

**PLEASE CHECK THAT ALL QUESTIONS HAVE BEEN ANSWERED BEFORE RETURNING THIS
AUDIT NOTIFICATION FORM TO YOUR LOCAL REGIONAL OFFICE**

IDENTIFICATION NUMBER:

OFFICE USE ONLY

Date Received / /

PLEASE ENTER THIS FORM'S IDENTIFICATION NUMBER ON THE LABOUR WARD LOG

SECTION 1: DETAILS OF WOMAN

1.1. Age at this delivery Years Not known

1.2. Ethnicity

White

- British
 Irish
 Other White group

Mixed

- White & Black Caribbean
 White & Asian
 White & Black African
 Any other mixed background

Asian or Asian British

- Indian
 Pakistani
 Bangladeshi
 Other Asian group

Black or Black British

- Caribbean
 African
 Other Black group

Other ethnic groups

- Chinese
 Other ethnic group

Not known

1.3. Deprivation score from postcode*

1.4. Marital status

- Married Cohabiting Single Other Not known

1.5. Previous miscarriages <24 weeks

- 0 ≥1

1.6. Previous births (live and/or stillbirth) ≥24 weeks

- 0 ≥1

1.7. Maternal morbidities* (Select all that apply)

Maternal morbidities	Diagnosed prior to this pregnancy		Diagnosed during or after this pregnancy	
	Yes	No	Yes	No
a. Gestational diabetes			<input type="checkbox"/>	<input type="checkbox"/>
b. Type 1 diabetes	<input type="checkbox"/>	<input type="checkbox"/>		
c. Type 2 diabetes	<input type="checkbox"/>	<input type="checkbox"/>		
d. New thromboembolism (DVT or pulmonary embolism)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Essential hypertension (present before 20 wks)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Pregnancy induced hypertension (developing from 20 wks)			<input type="checkbox"/>	<input type="checkbox"/>
g. Pre-eclampsia (hypertension and proteinuria developing from 20 wks)			<input type="checkbox"/>	<input type="checkbox"/>
h. Severe pre-eclampsia (including HELLP) or eclampsia			<input type="checkbox"/>	<input type="checkbox"/>
i. Cardiovascular condition other than hypertension, please specify _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other maternal morbidity, please specify				
j. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1.8. Assisted conception Yes No Not known

1.9. Date of first booking appointment / /

1.10. Final estimated date of delivery* / /

Use the best estimate based on a 40 week gestation. Use last menstrual period EDD if <5 days different from 1st trimester ultrasound scan EDD. Otherwise, use EDD calculated from 1st trimester ultrasound scan.

1.11. Height Feet Inches **OR** cm Not recorded

25
↑ OVERWEIGHT ↓

WEIGHT 50kg

Body Mass Index

SECTION 3: BABY INFORMATION

If more than one baby please complete and attach additional sheets (1 per baby)

- 3.1. Number of babies
- 3.2. Birth order of this baby (0=singleton, 1=twin 1, etc.)
- 3.3. Date of delivery //
- 3.4. Time of delivery
 00:00-03:59 04:00-07:59 08:00-11:59 12:00-15:59 16:00-19:59 20:00-23:59
- 3.5. Final mode of birth* (Select one option only)
 Spontaneous vaginal (Go to 3.6) Instrumental vaginal (Go to 3.6) Caesarean section (Go to 3.5.1) Vaginal breech (Go to 3.6)
- 3.5.1 If caesarean, indicate classification* (Select one option only)
 Grade 1 (Emergency) Immediate threat to life of woman or fetus Grade 2 (Urgent) Maternal or fetal compromise which is not immediately life threatening Ambiguous
 Grade 3 (Scheduled) Needing early delivery but no maternal or fetal compromise Grade 4 (Elective) At a time to suit woman and staff
- 3.5.2 If caesarean, indicate type of anaesthesia (Select one option only)
 General anaesthesia Regional anaesthesia
- 3.6. Birth weight Grams
- 3.7. Congenital anomaly confirmed Yes No
If yes, please specify anomaly _____
- 3.8. Pregnancy outcome (Select one option only)
 Live birth (Go to 3.9) Stillbirth (Go to 3.8.1) Early neonatal death (if known when completing form) (Go to 3.9) Other (Go to 3.9)
- 3.8.1 If stillbirth, was the baby alive at onset of care in labour? (Select one option only)
 Yes No Never in labour Unattended Not known
If stillbirth, go to Section 4
- 3.9. Neonatal unit admission within 48 hours after birth Yes No
- 3.10. Intended method of feeding (Select one option only)
 Breastfeeding Formula Breastfeeding and formula Not known
- 3.11. Actual method of first feed* (Select one option only) Tick if not applicable
 Breastfeeding Formula Expressed breast milk Not known
- 3.12. Method of feeding at discharge* (Select one option only) Tick if not applicable
 Breastfeeding Formula Breastfeeding and formula Not known

SECTION 4: DETAILS OF PERSON COMPLETING FORM

- 4.1 Name _____ 4.4 Trust name _____
- 4.2 Job title _____ 4.5 Telephone _____
- 4.3 Unit name _____ 4.6 Email _____

NOW PLEASE PHOTOCOPY THIS FORM AND RETAIN A COPY FOR YOUR RECORDS

25
OVERWEIGHT

50kg
WEIGHT

Body Mass Index



Centre for Maternal and Child Enquiries
Improving the health of mothers, babies and children

**OBESITY IN PREGNANCY
 AUDIT PROFORMA**

JULY TO SEPTEMBER 2009

Please complete one form for every woman randomly selected for the audit phase of the Obesity in Pregnancy project.

Instructions for completing this audit proforma

1. Please answer all questions as best you can based on what has been **documented in the available records**. Occasionally, you may need to refer to the electronic patient system. **You should only need to refer to the unit coordinator or maternity staff to determine the level of obstetrician and anaesthetist for Q5.5 and Q5.6, or to request missing investigations or clinical records.**
2. Please do not skip any questions. All questions should have an appropriate response option.
3. Some questions are marked with an asterisk (*). Please read the guidance notes before completing these questions.
4. Please enter all dates and times in the format DD/MM/YY and HH:MM (24hr clock).
5. Please ensure that all forms are entered fully on to the database by 30th September 2009.

Date proforma entered onto the database / /

Region _____ **Unit** _____

Date form completed / / **Unit contact** _____

Sources used to complete form *(Select all that apply)*

- | | | | | |
|--|--|--|--|--|
| <input type="checkbox"/> Hand-held maternity notes | <input type="checkbox"/> GP referral letter | <input type="checkbox"/> Pathology records | <input type="checkbox"/> In-patient drug charts | <input type="checkbox"/> Out-patient drug charts |
| <input type="checkbox"/> Anaesthetic records | <input type="checkbox"/> Discharge summaries | <input type="checkbox"/> Professional correspondence | <input type="checkbox"/> Discussion with staff (Q5.5 & 5.6 only) | <input type="checkbox"/> Other |

If other, please specify _____

SECTION 1: DETAILS OF WOMAN

- | | |
|---|---|
| 1.1. Woman's notification number | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| 1.2. CMACE assigned case type | <input type="checkbox"/> BMI ≥ 35 kg/m ² <input type="checkbox"/> Professional judgement |
| 1.3. Date of delivery | <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> |
| 1.4. Birth weight | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Grams |
| 1.5. Maternal age | <input type="text"/> <input type="text"/> Years NA (Age not recorded) <input type="checkbox"/> |

SECTION 2: PREPREGNANCY AND EARLY PREGNANCY CARE

- 2.1. Booked at another maternity unit Yes No
- 2.1.1 Gestation at transfer of care to this unit Weeks *NA (Booked at this maternity unit)*
- 2.1.2 Antenatal notes available from maternity unit of booking Yes No *NA (Booked at this maternity unit)*
- 2.2. Folic acid used either before or during pregnancy Yes No Not recorded
- 2.3.1 Highest recorded dose (*Select one option*) 400µg 4mg 5mg unknown
NA (No folic acid use)
- 2.3. Folic acid used anytime before pregnancy * Yes No Not recorded
- 2.3.1 Highest recorded dose before pregnancy (*Select one option*) 400µg 4mg 5mg unknown
NA (No folic acid use)
- 2.4. Folic acid used anytime during the 1st trimester * Yes No Not recorded
- 2.4.1 Highest recorded dose during 1st trimester (*Select one option*) 400µg 4mg 5mg unknown
NA (No folic acid use)
- 2.5. Evidence of information given antenatally about risks of obesity in pregnancy Yes No

SECTION 3: MATERNAL SURVILLANCE, SCREENING AND ASSESSMENT

- 3.1. Primary reason for referral to consultant obstetrician (*Select one option only*) *NA (No referral)*
 Obesity alone Obesity + other factors Other factors only Not recorded
- 3.2. Documented evidence that referral to an obstetrician was due partially or wholly to increased risk/risk factors for developing pre-eclampsia Yes No *NA (No referral)*
- 3.3. Risk factors identified during this pregnancy/delivery
- | | | |
|--|------------------------------|-----------------------------|
| Pre-existing renal disease | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Proteinuria at booking (≥1+ protein on dipstick or ≥3g/24hours) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Pre-eclampsia in a previous pregnancy | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Family history of pre-eclampsia | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Parity >4 | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Gross varicose veins | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Paraplegia | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Sickle cell disease | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Inflammatory disorders (e.g. inflammatory bowel disease) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Nephrotic syndrome | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Certain cardiovascular diseases * | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Myeloproliferative disorders (e.g. essential thrombocythaemia, polycythaemia vera) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Surgical procedure in pregnancy or puerperium | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Hyperemesis | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Dehydration | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Ovarian hyperstimulation syndrome | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Severe infection (e.g. pyelonephritis) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Immobility (>4 days bed rest) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Excessive blood loss * | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Long-haul travel (≥4 hours) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Prolonged labour * | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Midcavity instrumental delivery * | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Immobility after delivery * | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

3.4. Obesity listed as a risk factor at booking * Yes No

3.5. Thromboembolism risk noted at booking Yes No

3.6. Previous venous thromboembolism (VTE) history * (Select one option only)
 No previous VTE Single unprovoked VTE Single provoked VTE Recurrent VTE

3.6.1 Family history of VTE Yes No

3.7. Evidence of thrombophilia

Antithrombin deficiency	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Protein C deficiency	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Protein S deficiency	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Homozygous factor V Leiden (FVL)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Heterozygous FVL	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Prothrombin gene defect	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Antiphospholipid syndrome (APS)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Lupus anticoagulant	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Anticardiolipin antibodies	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Other thrombophilia, type not specified	<input type="checkbox"/> Yes	<input type="checkbox"/> No

3.8. Long-term Warfarin use Yes No

3.9. Evidence that prophylactic low molecular weight heparin (LMWH) was offered antenatally * Yes No

3.9.1 If no, was LMWH contraindicated? Yes No NA (LMWH offered)

3.10. Prophylactic LMWH prescribed antenatally Yes No Not recorded

3.10.1 Dose * Dose recorded Yes No NA (LMWH not prescribed)

Enoxaparin (Clexane)	<input type="checkbox"/> <input type="checkbox"/> mg daily	<input type="checkbox"/> <input type="checkbox"/> mg/kg/daily
Dalteparin (Fragmin)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> units daily	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> u/kg/daily
Tinzaparin (Innohep)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> units daily	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> u/kg/daily

3.10.2 Date prescribed / /

Date not recorded NA (LMWH not prescribed)

3.11. Evidence that other pharmacological thromboprophylactic agent was offered antenatally *

Aspirin	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Warfarin	<input type="checkbox"/> Yes	<input type="checkbox"/> No

3.11.1 Date prescribed / /

Not recorded NA (No other agent prescribed)

3.12. Use of graduated compression stockings (TEDs) antenatally * Yes No

3.12.1 If no, why? (Select one option only) NA (TEDs used)

Woman declined Appropriate size not available Other Reason not recorded

If other, please specify _____

3.13. First antenatal blood pressure (BP) measurement mmHg (Systolic) NA (BP not recorded)
 mmHg (Diastolic)

3.13.1 Date and/or gestation of first BP measurement / /
 completed weeks' gestation
 Date/weeks not recorded NA (BP not recorded)

3.13.2 Size of cuff (Select one option only) NA (BP not recorded)
 Regular Large Thigh Not recorded

3.14. Diagnostic test for gestational diabetes mellitus (GDM) offered * Yes No NA (Pre-existing diabetes)

3.14.1 Date and/or gestation of first diagnostic test / /
 completed weeks' gestation
 Date/weeks not recorded NA (No diagnostic test)

3.14.2 Type of test used to diagnose GDM *
Oral glucose tolerance test Yes No NA (No diagnostic test)
Fasting blood glucose Yes No NA (No diagnostic test)
Home blood glucose monitoring Yes No NA (No diagnostic test)
HbA_{1c} Yes No NA (No diagnostic test)
Other Yes No NA (No diagnostic test)
If other, please specify _____

3.14.3 Gestational diabetes diagnosed at first test? Yes No NA (No diagnostic test)

3.14.3.1 If no, date and/or gestation of second diagnostic test / /
 completed weeks' gestation
 Date/weeks not recorded NA (No 2nd diagnostic test)

Blood pressure			Proteinuria		
3.15. Between 24 and 32 weeks, blood pressure (BP) and proteinuria assessed at least once every 3 weeks *	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born 24-27 weeks) <input type="checkbox"/>
3.15.1 If no, was this due to DNAs?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born 24-27 weeks) <input type="checkbox"/>
3.16. Between 32 weeks and delivery, BP and proteinuria assessed at least once every 2 weeks *	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born 32-34 weeks) <input type="checkbox"/>
3.16.1 If no, was this due to DNAs?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born 32-34 weeks) <input type="checkbox"/>

SECTION 4: PLANNING LABOUR AND CHILDBIRTH

4.1. Infant feeding options discussed antenatally Yes No

4.1.1 Evidence of information and/or advice given antenatally regarding the health advantages of breastfeeding Yes No

4.2. Evidence of information given antenatally about potential intrapartum complications related to obesity Yes No

4.3. Written obstetric management plan for labour and delivery *	<input type="checkbox"/> Yes	<input type="checkbox"/> No							
4.4. If one previous caesarean section only, evidence of discussion relating to risks and benefits of different modes of delivery *	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (No previous CS or >1 previous CS) <input type="checkbox"/>						
4.5. Antenatal anaesthetic consultation offered	<input type="checkbox"/> Yes	<input type="checkbox"/> No							
4.6. Written anaesthetic management plan for labour and delivery	<input type="checkbox"/> Yes	<input type="checkbox"/> No							
4.6.1 Date and/or gestation at which plan was made	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> completed weeks' gestation	<input type="checkbox"/> Date/weeks not recorded NA (No plan) <input type="checkbox"/>						
4.6.2 If no plan, why? (Select one option only)	<input type="checkbox"/> Declined or DNA	<input type="checkbox"/> Other	<input type="checkbox"/> Not known NA (Plan in notes) <input type="checkbox"/>						
	If other, please specify _____								
4.7. Assessment to determine manual handling requirements for childbirth	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born before third trimester) <input type="checkbox"/>						
4.7.1 If yes, was this in the third trimester?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (No assessment) <input type="checkbox"/>						
SECTION 5: LABOUR AND CHILDBIRTH									
5.1. Date and time of admission in labour or for induction of labour or caesarean section *	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> : <input type="text"/> <input type="text"/>	NA (Delivered outside of unit) <input type="checkbox"/>						
5.2. Assessment of tissue viability *	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Baby born before third trimester) <input type="checkbox"/>						
5.3. If operative intervention in theatre, evidence that operating theatre staff were alerted about the woman's weight/BMI prior to transfer to theatre *	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (No operative intervention in theatre) <input type="checkbox"/>						
5.4. If induced, was obesity indicated as the only reason?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	NA (Not induced) <input type="checkbox"/>						
5.5. If admitted to labour ward in labour or needing early delivery, evidence that an obstetrician and anaesthetist, at level ST6 or above, were informed about the woman's presence *	<table border="0"> <tr> <td style="text-align: center;">ST6 Obstetrician, or above</td> <td style="border-left: 1px solid black; text-align: center;">ST6 Anaesthetist, or above</td> </tr> <tr> <td><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known</td> <td style="border-left: 1px solid black;"><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known</td> </tr> </table>			ST6 Obstetrician, or above	ST6 Anaesthetist, or above	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known		
ST6 Obstetrician, or above	ST6 Anaesthetist, or above								
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known								
5.5.1 Date and time the woman is first seen by:	<table border="0"> <tr> <td style="text-align: center;">ST6 Obstetrician, or above</td> <td style="border-left: 1px solid black; text-align: center;">ST6 Anaesthetist, or above</td> </tr> <tr> <td><input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/></td> <td style="border-left: 1px solid black;"><input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/></td> </tr> <tr> <td><input type="checkbox"/> Not known</td> <td style="border-left: 1px solid black;"><input type="checkbox"/> Not known</td> </tr> </table>			ST6 Obstetrician, or above	ST6 Anaesthetist, or above	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	<input type="checkbox"/> Not known	<input type="checkbox"/> Not known
ST6 Obstetrician, or above	ST6 Anaesthetist, or above								
<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/>								
<input type="checkbox"/> Not known	<input type="checkbox"/> Not known								
5.6. Obstetrician and anaesthetist, at level ST6 or above, attended instrumental vaginal delivery or caesarean section *	<table border="0"> <tr> <td style="text-align: center;">ST6 Obstetrician, or above</td> <td style="border-left: 1px solid black; text-align: center;">ST6 Anaesthetist, or above</td> </tr> <tr> <td><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known</td> <td style="border-left: 1px solid black;"><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known</td> </tr> </table>			ST6 Obstetrician, or above	ST6 Anaesthetist, or above	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known		
ST6 Obstetrician, or above	ST6 Anaesthetist, or above								
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not known								
	NA (Not an instrumental delivery or caesarean section) <input type="checkbox"/>								

5.7. Venous access established prior to delivery (Select one option only)

- Not established
 Established during labour
 Established prior to labour
 Established prior to delivery but woman never in labour

5.7.1 Date and time that venous access was established

□□/□□/□□ □□:□□

Date/time not recorded NA (Venous access not established)

5.8. Use of graduated compression stockings (TEDs) during labour and delivery *

- Yes No

5.8.1 If no, why? (Select one option only)

NA (TEDs used)

- Woman declined
 Appropriate size not available
 Other
 Reason not recorded

If other, please specify _____

5.9. If vaginal birth, evidence that active management of the third stage of labour was recommended *

- Yes No NA (Not a vaginal birth)

5.10. If vaginal birth, was the third stage of labour actively managed? *

- Yes No NA (Not a vaginal birth)

5.11. If caesarean, were prophylactic antibiotics administered at time of surgery? *

- Yes No NA (Not a caesarean)

SECTION 6: AFTER CHILDBIRTH

6.1. Use of graduated compression stockings (TEDs) after delivery *

- Yes No
 NA (Maternal death during or prior to childbirth)

6.1.1 If no, why? (Select one option only)

NA (TEDs used)

- Woman declined
 Appropriate size not available
 Other
 Reason not recorded

If other, please specify _____

6.2. Evidence that prophylactic LMWH was offered postnatally

- Yes No NA (Maternal death)

6.2.1 If no, was LMWH contraindicated?

- Yes No NA (LMWH offered; maternal death)

6.3. Prophylactic LMWH prescribed postnatally

- Yes No Not recorded
 NA (maternal death)

6.3.1 Dose

Dose known Yes No NA (LMWH not prescribed)

Enoxaparin (Clexane) □□ mg daily □□ mg/kg/daily

Dalteparin (Fragmin) □□□□ units daily □□□□ u/kg/daily

Tinzaparin (Innohep) □□□□ units daily □□□□ u/kg/daily

6.3.2 Date prescribed

□□/□□/□□

Not recorded NA (Not prescribed)

6.3.3 Date commenced

□□/□□/□□

Not recorded NA (Not prescribed)

6.3.4 Date ended

□□/□□/□□

Not recorded NA (Not prescribed)

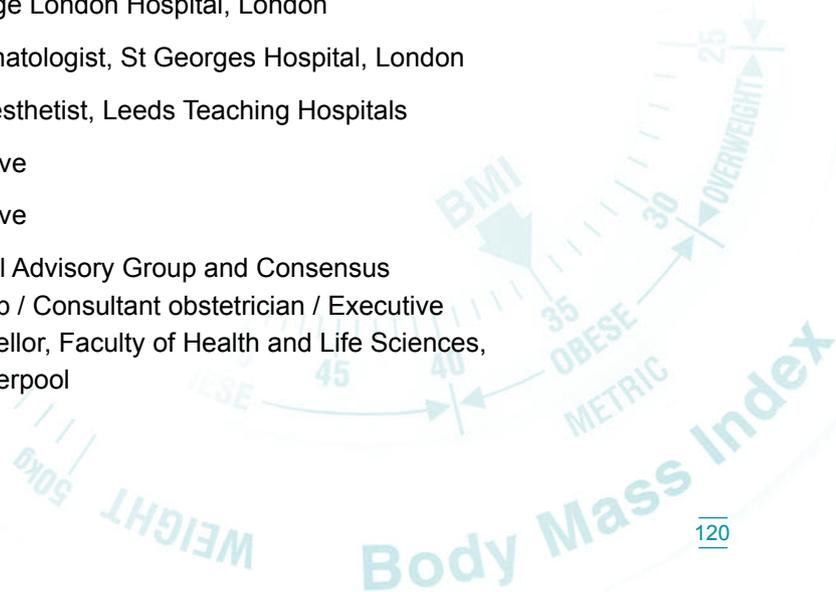
APPENDIX I: Contributors to the CMACE Obesity in Pregnancy project

Obesity External Advisory Group

- Dr Helen Budge** Associate Professor of Neonatology, University of Nottingham
- Dr Martin Dresner** Consultant Anaesthetist, Leeds Teaching Hospitals
- Alex Farrall** Lay representative
- Professor Ian Greer** Chair of External Advisory Group / Consultant obstetrician / Executive Pro-Vice-Chancellor, Faculty of Health and Life Sciences, University of Liverpool
- Dr David Haslam** General Practitioner / Chairman of the National Obesity Forum / Physician in Obesity Medicine at the Centre for Obesity Research at Luton & Dunstable Hospital
- Dr Nicola Heslehurst** Senior Lecturer, Health and Social Care Institute, Teesside University
- Dr Marian Knight** Senior Clinical Research Fellow / Honorary Consultant in Public Health National Perinatal Epidemiology Unit, University of Oxford
- Dr Daghni Rajasingam** Consultant Obstetrician, Guys and St. Thomas' NHS Trust, London
- Dr Stephen Robinson** Consultant Physician and senior lecturer, Imperial College School of Medicine at St. Mary's Hospital, London
- Dr Jane Rogers** Consultant Midwife, Southampton University Hospitals Trust

Obesity Consensus Standards Group

- Dr Ruth Bell** Senior Lecturer / Honorary NHS Consultant in Public Health, Institute of Health & Society, Newcastle University
- Dr Helen Budge*** Reader in Neonatology, University Hospital, Nottingham
- Professor Andrew Calder** Professor Emeritus of Obstetrics and Gynaecology/Assistant Principal of the University of Edinburgh
- Raj Davé** Sonographer, Elizabeth Garrett Anderson Obstetrics Hospital, University College London Hospital, London
- Dr Laura De Rooy** Consultant Neonatologist, St Georges Hospital, London
- Dr Martin Dresner*** Consultant Anaesthetist, Leeds Teaching Hospitals
- Alex Farrall*** Lay representative
- Stacey Grant** Lay representative
- Professor Ian Greer*** Chair of External Advisory Group and Consensus Standards Group / Consultant obstetrician / Executive Pro-Vice-Chancellor, Faculty of Health and Life Sciences, University of Liverpool



Professor David Haslam*	General Practitioner / Chairman of the National Obesity Forum / Physician in Obesity Medicine
Dr Nicola Heslehurst*	Senior Lecturer, Health and Social Care Institute
Karen Jewell	Consultant Midwife, Cardiff and Vale University Local Health Board
Mervi Jokinen	Practice and Standards Development Adviser, Royal College of Midwives
Maria Jones	Senior Specialist Physiotherapist, St Mary's Hospital, Manchester
Dr Marian Knight*	Senior Clinical Research Fellow/Honorary Consultant in Public Health National Perinatal Epidemiology Unit University of Oxford
Mr Andrew Loughney	Consultant Obstetrician, Newcastle Hospitals NHS Foundation Trust
Dr Anne F McCrae	Consultant Anaesthetist, Royal Infirmary of Edinburgh
Mary Muir	Specialist Therapy and Regional Contracts Manager, ArjoHuntleigh UK
Professor Catherine Nelson-Piercy	Consultant Obstetric Physician, Guy's & St Thomas Foundation Trust and Queen Charlotte's & Chelsea Hospital, Imperial College Healthcare Trust / Professor of Obstetric Medicine, King's College, London
Dr Daghni Rajasingam*	Consultant Obstetrician, Guy's and St Thomas' Hospital NHS Foundation Trust, London
Dr Stephen Robinson*	Consultant Endocrinologist, Imperial College at St Mary's, London
Dr Jane Rogers*	Consultant Midwife, Southampton University Hospitals Trust and Southampton University.
Fiona Taylor	Specialist Obesity Dietitian, Middlesbrough, Redcar & Cleveland Community Services & Practice Liaison Lecturer, Leeds Metropolitan University / Chair DOM UK
Mr T G Teoh	Obstetrician & Gynaecologist and Subspecialist in Maternal & Fetal Medicine, Imperial College Healthcare NHS Trust
Dr Victoria Tzortziou Brown	General Practitioner, Tower Hamlets PCT

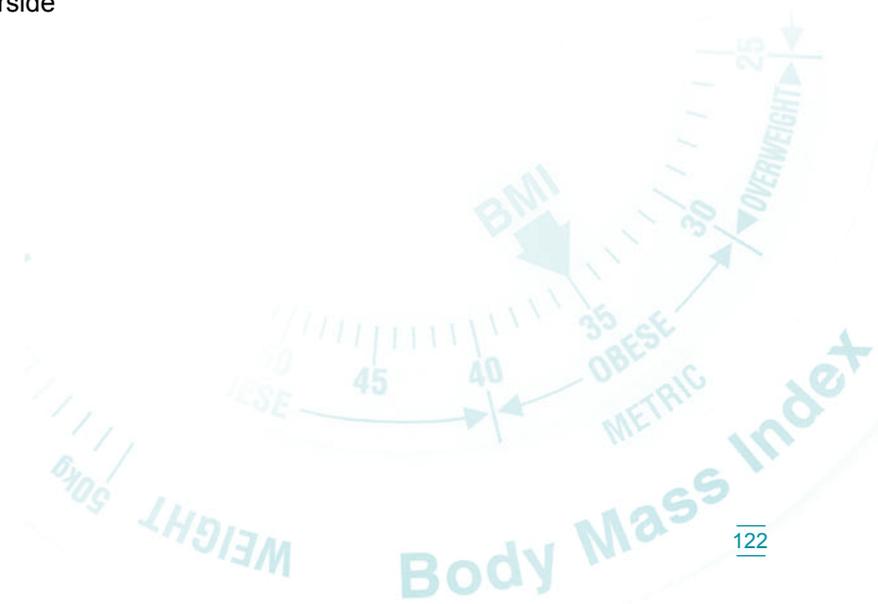
*Consensus Standards Group and External Advisory Group member

CMACE Regional Managers responsible for data collection for the project

Carol Hay	East of England
Julie Maddocks	North West and West Midlands
Marjorie Renwick	North East
Dawn Roberts	Wales
Rachel Thomas	London and South East
Rosie Thompson	South West and Wessex
Sue Wood	East Midland, Yorkshire and Humberside

CMACE Regional Assistants involved in data collection for the project

Shahida Akhtar	Assistant Regional Manager, London and South East
Aqsa Aziz	Administrative Assistant, North West and West Midlands
Lisa Davis	Regional Project Midwife CMACE
Daniel Beever	Administrative Assistant, East Midlands, Yorkshire and Humberside
Jo Coffee	Regional Assistant, South West and Wessex
Helen Doyle	Regional Assistant, East of England
Claire Elsam	Midwife, Kingston Hospital
Jo Fitzsimons	Midwife, Princess Royal Hospital, Haywards Heath
Sanila Gill	Administrative Assistant, London and South East
Clara Haken	Project Midwife Learning and Dissemination
Kerry Keeves	Projects Assistant, London and South East
David Kimani	Administrative Assistant, London and South East
Emily Liddiard	Administrative Assistant, North West and West Midlands
Clare Wade	Assistant Regional Manager, East Midlands, Yorkshire and Humberside



CMACE Board of Trustees

Professor Sir Sabaratnam Arulkumaran	Head of Obstetrics and Gynaecology, St George's Hospital Medical School / President-elect of the International Federation of Gynecology & Obstetrics (FIGO)
Dr Jean Chapple	Consultant in Perinatal Epidemiology / Public Health, Westminster Primary Care Trust
Professor Peter Fleming	Professor of Infant Health and Developmental Physiology, University of Bristol
Sally Jenkinson	Director of Children's Services, The Children's Trust
Lea Sellers	Media trainer, television consultant and writer
Anne Seymour	Lay member
Louise Silverton	Deputy General Secretary, Royal College of Midwives
Professor James Walker	Chair of the CMACE Board of Trustees / Department of Obstetrics and Gynaecology, St James' University Hospital, Leeds / Senior Vice President, RCOG

Personnel from affiliated nations involved in data collection for the project

Department of Health, Social Services and Public Safety(DHSSPS), Northern Ireland

Dr Angela Bell	Director of Maternal and Child Health
Malcolm Buchanan	Administrator
Terry Falconer	Project Manager
Joanne Gluck	Clinical Research Midwife

NHS Quality Improvement Scotland (NHS QIS), Scotland

Kenny Gifford	Reproductive Health Programme Administrator
Leslie Marr	Reproductive Health Programme Co-ordinator



Published December 2010

CMACE, Chiltern Court, 188 Baker Street, London, NW1 5SD

Tel: 020 7486 1191 Fax: 020 7486 6226

Email: info@cmace.org.uk Website: www.cmace.org.uk

Designed and produced by ie Marketing, Bristol. Tel: 0117 923 2235.

Printed by Henry Ling Ltd, at the Dorset Press, Dorchester, DT1 1HD.

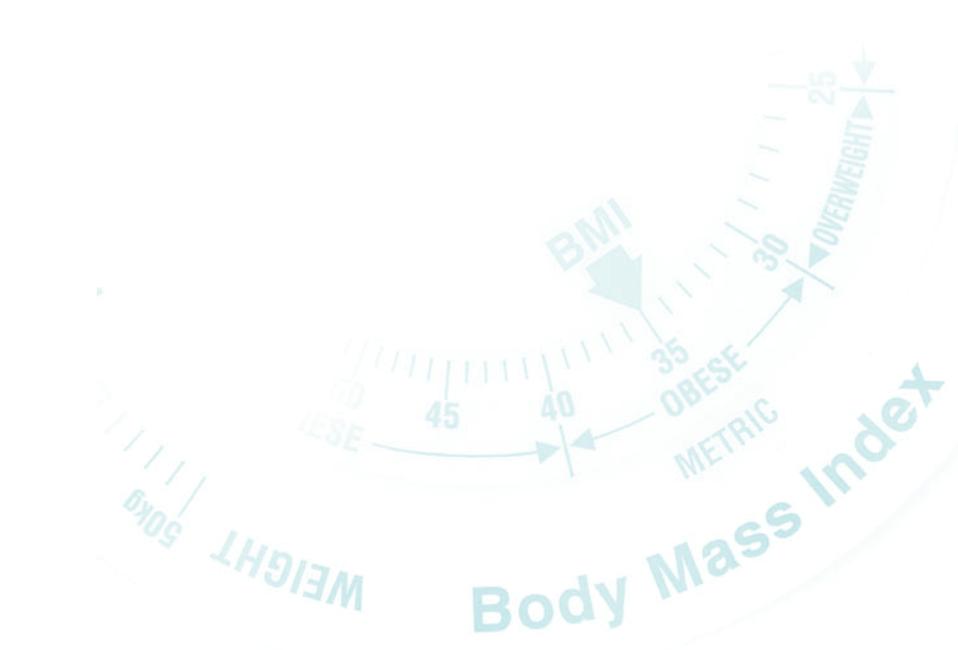


ISBN: 978-0-9558055-4-7

UK Price £15 Ireland and rest of Europe Price 17.50€

To obtain further copies of this report please email info@cmace.org.uk or visit www.cmace.org.uk

NOTES:



NOTES:

changing the future of diabetes

Living with diabetes isn't easy. It takes discipline, control and support from the people around you. At Novo Nordisk, we want to be your partner in living well with diabetes.

We know that we are not simply treating diabetes. We are helping real people live better lives. We understand that diabetes is just a part of who you are – not what defines you. This understanding is behind every decision or action we take, and fuels our passion for changing the perception, treatment and future of diabetes for good.

At Novo Nordisk, we are Changing Diabetes®
www.novonordisk.co.uk
www.changingdiabetes.co.uk





Published December 2010

CMACE, Chiltern Court, 188 Baker Street, London, NW1 5SD

Tel: 020 7486 1191 Fax: 020 7486 6226

Email: info@cmace.org.uk Website: www.cmace.org.uk

Designed and produced by ie Marketing, Bristol. Tel: 0117 923 2235.

Printed by Henry Ling Ltd, at the Dorset Press, Dorchester, DT1 1HD.

ISBN: 978-0-9558055-4-7