Full Title:

A Nationally Representative Study of Maternal Obesity in England, UK: Trends in Incidence and Demographic Inequalities in 619 323 Births, 1989-2007

Authors:

1) Nicola Heslehurst, PhD, Health and Social Care Research Institute, School of Health and Social Care, Teesside University, UK

2) Judith Rankin, PhD, Institute of Health and Society, Newcastle University, UK

3) John R. Wilkinson, MD, North East Public Health Observatory, School of Medicine and Health, Durham University Queen's Campus, UK

4) Carolyn D. Summerbell, PhD, School of Medicine and Health, Durham University Queen's Campus, UK

Corresponding Author: Dr. Nicola Heslehurst, Health and Social Care Research Institute, Parkside West Offices, Teesside University, Middlesbrough, England, UK, TS1 3BA, **Telephone number:** +44 (0) 1642 342758, **Fax number:** +44 (0) 1642 342961, **Email:** n.heslehurst@tees.ac.uk

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Running Head:

Trends in Maternal Obesity in England

Abstract

Background: There is an absence of national statistics for maternal obesity in the UK. This study is the first to describe a nationally representative maternal obesity research dataset in England.

Design: Retrospective epidemiological study of first trimester obesity

Methods: Data from 34 maternity units were analysed, including 619 323 births between 1989 and 2007. Data analysis included trends in first trimester maternal BMI status over time, and geographical distribution of maternal obesity. Population demographics including maternal age, parity, ethnic group, deprivation, and employment were analysed to identify any maternal obesity associated health inequalities. All demographics were tested for multicollinearity. Logistic regression analyses were adjusted for all demographics as confounders.

Results: First trimester maternal obesity is significantly increasing over time, having more than doubled from 7.6% to 15.6% over the 19 years ($p<0.001$), and shows geographic variation in incidence. There are also demographic health inequalities associated with maternal obesity, including increased odds of being obese with increasing age, parity, black ethnic group, and deprivation. There is also an association between morbid obesity and increased levels of unemployment.

Conclusions: The increase in maternal obesity has serious implications for the health of mothers, infants, and service providers, yielding an additional 47 500 women per year requiring high dependency care in England. The demography of women most at risk of first trimester obesity highlight health inequalities associated with maternal obesity which urgently needs to be addressed.

Key Words: Maternal Obesity, Pregnancy, Body Mass Index, Health Inequalities, Epidemiology

Introduction

The Health Survey for England (HSE) reported an increase in obesity among women of childbearing age from 12.0% in 1993 to 18.5% in 2006 (1). The Confidential Enquiry into Maternal and Child Health (CEMACH) also reported that of all mothers who died during 2000-2002 in the UK, 30% were obese (BMI>30kg/m^2) (2). Between 2003-2005, more than half of all mothers who died were overweight or obese (BMI>25kg/m^2), with over 15% being morbidly obese (BMI>40kg/m^2), or super morbidly obese (BMI>50kg/m^2) (3). Despite the HSE and CEMACH data suggesting that obesity in pregnancy is increasing, there is a paucity of national or international statistics on the true incidence.

Three UK studies have demonstrated that the incidence of maternal obesity has increased from 3.2% to 8.9% between 1990 and 1999 in Cardiff (4), from 9.4% to 18.9% between 1990 and 2002/4 in Glasgow (5), and from 9.9% to 16.0% between 1990 and 2004 in Middlesbrough (6). The scale of obesity in the pregnant population on an international level has also been summarised as being between 1.8% and 25.3% according to data from published studies (7). However there are difficulties with direct comparison of the international data due to the variation in the definition of obesity, the differences in time periods of the published studies, and the majority of studies representing regions of the United States and Australia.

This study is the first to compile a national level dataset of maternal BMI, and to identify trends in maternal BMI over time, and demographic inequalities relating to maternal BMI on a national and regional level in England.

Methods

A survey of routine electronic data collection of anthropometric measurements in pregnant women was carried out among all NHS maternity units in England (n=243) in 2006 (89% response). One hundred and thirty five maternity units reported collecting anthropometric data electronically, and 58 of these indicated that they wanted to participate in the study. Forty nine maternity units (32 NHS Trusts) were sampled as they reported collecting all data items required for the study electronically. Eight NHS Trusts were later excluded from the study: three due to incorrect reporting of data collection; two due to inadequate BMI records; one due to R&D approval not being completed in time; one due to staff shortages; and one due to staff changes. Thirty-seven maternity units (24 NHS Trusts) were included in the final sample. The demographics of women of childbearing age in the local authorities of the maternity units recruited into the study were compared with the demographics of women of childbearing age in England using the national census (8) and Index of Multiple Deprivation (9) reference data, and the population was found to be nationally representative.

NHS MREC approval was granted and R&D approval was gained from all NHS Trusts that provided the data for the study. Anonymised retrospective data was provided by the maternity units for all complete years of electronic data collection in their unit, and the data ranged from 1st January 1989 to 31st December 2007. Data were excluded when the booking BMI or gestational age could not be calculated; the BMI was unrealistic (10); and when the gestational age at booking was unrealistic (based on a combination of clinical expertise and the NICE induction of labour clinical guidelines (11)). Previous research identified a lag effect between obesity in

the pregnant population when compared with the general population of women of childbearing age (6). This phenomenon was potentially due to the exclusion of late bookers, which theoretically included a large proportion of the target population of obese women in pregnancy. This study adjusted for naturally incurred weight gain of late bookers (women who booked after their first trimester) using published data on BMI change per gestational week (12), rather than excluding late bookers and potentially excluding a large proportion of the obese population.

Data Analysis: Trends in Obesity Incidence over Time

Women were grouped based on their BMI into the WHO categories of underweight, ideal, overweight, and obese (13). Obesity subgroups were also analysed using the definitions of moderately obese, severely obese, morbidly obese, and super morbidly obese. The CHI squared test for trend (CHI^2_1) was used to investigate significant changes in proportions of BMI groups over time. The data did not require adjustment for age as there was no significant change in population age over time (range in mean age over time 27 years, SD 5, and 29 years, SD 6).

Data Analysis: Geographical Distribution of Maternal Obesity

The data were grouped into geographical region using the Ordinance Survey Government Office Region (GOR) boundaries. There are nine GORs in England ranging in population size from 2.5 million to 8 million (14). These boundaries are used for a range of administrative functions, and apart from one, are co-teminus with Strategic Health Authorities. The current trends in BMI groups for each region were calculated using the data for 2007 to identify any regional variation in maternal obesity incidence (with the exception of the two NHS Trusts that could not provide

2007 data and therefore 2006 data were used). Statistical significance in the distribution of BMI Groups was analysed using CHI^2.

Data Analysis: Demographic Inequalities and Maternal BMI

Logistic regression was carried out to analyse the relationship between BMI and demographic variables. Age and parity were continuous data, and ethnic group and employment were grouped based on the national census (8). Deprivation quintiles utilised postcode and the index of multiple deprivation (9). The rank of deprivation ranges from 1 (most deprived) to 32,482 (least deprived), and quintiles for the study group were defined in equal proportions. CHI^2 was used to test for an independent association between predictor variables and BMI group, and multicollinearity tests were carried out using linear regression diagnostics and Pearson's r correlation tests. No multicollinearity was present between the predictor variables, and therefore all were included in the final regression model.

Results

Data were provided for a total of 738 307 deliveries. Following exclusions (16.1%), 619 323 deliveries remained. Some individual cases fulfilled multiple exclusion criteria. The leading reason for exclusion was insufficient data provided to calculate the BMI (88.9%). The characteristics of the included population are described in Table 1.

The pregnancy population change in BMI over time between the start and end year of study is shown in Figure 1. This illustrates a substantial drop in the ideal BMI range, and a population shift to the right with increasing levels of obesity.

There was a significant trend in the proportion of women in each BMI group over time (Table 2). The increase in the proportion of women who are obese has doubled from 8% to 16% over the 19 years studied ($p<0.001$), whilst there has been a 12% decrease in the ideal BMI group from 66% to 54% ($p<0.001$). Although the CHI^2_1 for underweight was significant with a minimum of 3.9% and a maximum of 6.2% of the population ($p<0.001$), overall it fluctuated around 5%. There was also a significant trend in the incidence of overweight with a gradual increase of 4% ($p<0.001$). A significant trend over time was also found for the obesity subgroups. The majority of the obese population in this study are moderately obese and there has been a 4.3% increase in the proportion of women in this group, from 5.7% to 10% ($p<0.001$). The increase in the remaining subgroups is proportionately lower and decreases as the severity of obesity increases. However, when comparing the rate of increase from 1989 to 2007 the relationship is seen to be increasing at the most rapid rate within the morbidly obese group; moderately obese 1.75, severely obese 2.71, morbidly obese 4.0, super morbidly obese 3.6.

Trends in this study were compared with women of childbearing age using HSE data (Figure 2), which shows a lag effect between the two populations. Trend lines were modelled for the data as a time series (with time points from 1-19 being the equivalent of 1989-2007), and the obese pregnancy population trend line shows a good fit with an exponential model ($R^2=0.9695$), indicating that the increasing rates over time are accelerating rather than increasing in a linear fashion.

The NHS Trusts that provided data included representation of all GORs with the exception of East Midlands, and there was a significant relationship between maternal BMI and GOR (CHI^2 = 826.2, p<0.001, 21 df). The incidence of first trimester obesity for the GOR's was compared with the obesity prevalence in the general population of women using HSE data. Incidence of obesity in the pregnant population was lower than in the general population of women for all regions, with a difference of 7.4% in the overall proportion for England, and ranging from a minimum difference of 5.8% to a maximum of 10.7% for the individual GOR's (Table 3). There are also different regional patterns of obesity in pregnancy when compared to the general population, although the West Midlands and the North East regions are in the top three for both populations. The East Midlands is the third most obese region for women in the general population, and HSE data shows that it has previously been the region with the highest prevalence of obesity in women (15). Based on regional trends in the HSE population data maternal obesity incidence, an estimation of maternal obesity incidence in the East Midlands was calculated to range between 16.3% to 21.2%, with a mean of 18.8%, placing it among the top four obese regions in the pregnancy population. Figure 3 illustrates the GOR's with higher than average, lower than average and equal to average incidence of maternal obesity.

The adjusted results of the logistic regression analysis for demographic predictors of maternal BMI groups are shown in Table 4. There is a significant increase in the odds of being overweight or obese with increasing parity and age. Overall women who were underweight, overweight, or obese were more likely to be employed (than unemployed, housewives or carers, or in education). This relationship did not remain significant when looking at the subgroups of obesity, where there was a significantly

increased odds of women being a housewife or carer if they were morbidly or super morbidly obese, and increased odds of being unemployed in women who were super morbidly obese. There were increased odds of women living in the more deprived quintiles throughout all BMI groups when compared with women of an ideal BMI. There were increased odds for overall obese women to be living in the most deprived quintile compared with the least deprived quintile, and when the subgroups of obesity were explored the relationship with deprivation was seen to increase as the level of obesity increased. The ethnic group Black/Black British was the only ethnic group to have increased odds of overweight and obesity. However, this relationship decreased with increasing levels of obesity, and the relationship was no longer significant in the super morbidly obese group.

Discussion

The results of this first nationally representative study have shown that first trimester obesity is increasing with time, that there are geographical differences in the incidence of maternal obesity, and there are demographic health inequalities. The increasing rates of maternal obesity supports previous research carried out in the UK at individual maternity unit level (4-6), although the actual proportions vary.

The increase in the proportion of women who are obese over time has important implications. Additional numbers of women who are considered to be high risk results in additional care and support required during pregnancy. NICE guidance and CEMACH recommend that women with a BMI>30kg/m^2 should have consultant care rather than midwifery led care (3, 16), which places a massive burden on maternity unit resources. At a national level the change in the proportion of women who are

obese has doubled from 45 064 to 92 501 women (using the average number of births per year for all 243 NHS maternity units in England, 592 960 (17)). Thus approximately 47 500 additional women will require high dependency care in England every year as a result of the change in BMI over time. The small proportional increases in the obesity subgroups also have considerable implications for maternity services. The increase in the proportion of moderately obese women by 4.3% over the 19 years results in an additional 25 500 women per year in England being in this BMI category, the 2.4% increase in the severely obese group results in an additional 14 000 women each year, the 1.2% increase in the morbidly obese group results in an additional 7 000 women each year, and the 0.2% increase in the super morbidly obese group results in an additional 1 000 women each year.

The increase in first trimester obesity has major implications to clinical practice with the increasing demand for high dependency care, and the management of complications that arise. The regional differences in the incidence of maternal obesity identified suggests that there will be inequalities with some maternity units feeling the strain of the increasing demand on service more than others. This is particularly evident for maternity services located in the West Midlands, Yorkshire and the Humber, the North East, and the East Midland regions of England.

The lag effect between the pregnancy and general population of women identified in this study has also been described in previous research (6). Previous research hypothesised that this may be related physiological factors hindering fertility in the obese population, and this may explain the existence of a lag effect identified in this study. There is a relationship between obesity and foetal loss (18), and this study

utilised data on completed pregnancies rather than all pregnancies, due to the need to calculate the gestational age at booking from the gestational age at delivery. Thus, the results of this study may be an underestimation of maternal obesity, especially in light of the latest CEMACH report on perinatal mortality where mothers were obese in 22.9% of all late foetal loss, and 30.4% of stillbirths (18).

The demographic predictors of being obese in pregnancy highlight health inequalities that largely reflect previous research (6), particularly residing in areas of deprivation, which had the strongest relationship with obesity following adjustment for confounding variables. The additional analysis carried out in this study on the obesity subgroups shows a striking positive relationship with deprivation and increasing levels of obesity. Therefore women who have the highest clinical risk (super morbidly obese) are those facing the highest level of inequality. A certain degree of caution must be noted with the super morbidly obese group due to the limited size of this BMI group in comparison with the other BMI groups. However, overall the sample is large and the population characteristics are representative of women of childbearing age in the general population. The relationship with deprivation and inequalities in pregnancy is highlighted in the CEMACH reports, where deprivation is significantly related to maternal death(3). The 2007 report identified that women who live in the most deprived areas are five times more likely to die compared to women living in the least deprived areas (3), and this finding in conjunction with the strong links with increasing levels of obesity and deprivation pose major health inequality issues to women residing in the areas of greatest deprivation in England.

Further inequalities exist with obesity, employment, and ethnic group. Although analysis of overall obesity (BMI>30kg/m^2) shows that women are significantly less likely to be unemployed than employed, this result masks the relationship with increasing levels of obesity. There is a relationship with women being more likely to be unemployed or housewives/carers as the level of obesity increases, and this finding is supported in the HSE data for women in the general population where obesity was found to be related to unemployment in women following adjustment for confounding variables obese women were 33% more likely to be unemployed than non-obese women, and this rose to 55% for severely obese women (19). The impact of unemployment in pregnancy is also highlighted in the 2007 CEMACH report, which shows that a third of all women who died in pregnancy were either single and unemployed, or were unemployed with an unemployed partner (3).

The results for ethnic group show a positive relationship with obesity and women being Black/Black British, which is representative of the relationship with women in the general population, where Black African and Black Caribbean women have the highest prevalence of obesity (20). In addition, the latest CEMACH report also identified that Black African and Black Caribbean women had a higher risk of mortality during pregnancy when compared with white women (3). Interestingly this study identified a significantly reduced relationship with Asian women and being overweight or obese, and this remained for all obesity subgroups. As there is an increased relationship with obesity and Asian women in the general population (20), this finding was unexpected to some extent. This inverse relationship with Asian women and obesity may be due to the association between obesity and age in women, where obesity is most raised in post-menopausal women (15). This may be

more prominent in Asian women in the general population making obesity most prevalent in post-menopausal women, and therefore not being reflective of women of childbearing age and the pregnancy population. There could also be physiological implications relating specifically to obese Asian women resulting in a high proportion of obese Asian women having fertility problems and therefore excluding them from the pregnancy population. There is a relationship with infertility and central adiposity (21), and the HSE shows that women who are Bangladeshi and Pakistani have the highest risk ratio for having a waist-hip ratio over 0.85 (2.29 and 1.77 respectively when compared to the general population) (22).

The relationship with obesity and increasing age and parity is similar to that observed in previous research (6). These results also reflect the associations found in the general population, where increasing age and parity are linked with increasing levels of obesity (15), and pregnancy is a recognised life event in women in the promotion of obesity (23-25).

This is the first study to address maternal obesity on a national level, and the strengths of the study are in its large sample size, and the representativeness of the population when compared to England. The sample size has also allowed for the first opportunity to identify the trends in the obesity subgroups of moderately, severely, morbidly, and super morbidly obese (4-6).

The relationship between obesity, ethnic group, deprivation, and unemployment identified in this study indicate significant health inequalities in the demographics of those women most likely to be obese in pregnancy. In addition, the relationship

between all of these factors, access to maternity services, and risk of maternal death highlights how closely linked the issues surrounding health inequalities are in pregnant women. Further national level research is required to identify the trends in Scotland, Wales, and Northern Ireland in order to gain a UK perspective on maternal BMI. Also, there is limited evidence on the effectiveness of interventions in tackling maternal obesity, and further research is required to identify ways to halt the yearly accelerating rise in maternal obesity incidence in England.

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Figures and Tables

Figure 3 Foot Notes: * Including data from 32 maternity units for 2007 deliveries, and 2 maternity units for 2006 deliveries where 2007 data was not available

**No data provided for East Midlands, the proportion was modelled based on the HSE 2006 data for women and GOR, and the differences in proportions for all other GOR's pregnancy data compared to the HSE data

[1] The map was produced by the North East Public Health Observatory

Table 1 Maternal Characteristics of a Nationally Representative Sample of 619 323 Deliveries between 1989 and 2007 in England

	Total (n= 619,323)		Underweight BMI (kg/m^2) <18.5 (n= 31,021)		Ideal BMI (kg/m^2) 18.5-24.9 (n= 353,327)		Overweight BMI (kg/m^2) 25-29.9 (n= 153,574)		Obese BMI (kg/m^2) >30 (n= 81,401)		Moderately Obese BMI (kg/m^2) 30-34.9 (n= 53,563)		Severely Obese BMI (kg/m^2) 35-39.9 (n= 19,213)		Morbidly Obese BMI (kg/m^2) 40-49.9 (n= 7,969)		Super Morbidly Obese BMI (kg/m^2) >50 (n= 656)	
Maternal Age (mean, SD)	28.7	6	26.3	6.1	28.6	6.0	29.3	5.8	29.3	5.8	29.2	6	29.3	5.7	29.5	5.6	30.2	5.9
Parity (mean, SD)	1.1	1	1.0	1.2	1.0	1.2	1.2	1.3	1.4	1.4	1.3	1	1.4	1.4	1.5	1.4	1.5	1.5
Ethnic Group (n, %)																		
White	447423	83.2	20651	4.6	254883	57.0	110566	24.7	61323	13.7	39627	8.9	14814	3.3	6363	1.4	519	0.1
Asian or Asian British	50738	9.4	4181	8.2	28320	55.8	12967	25.6	5270	10.4	3905	7.7	1043	2.1	300	0.6	22	0.0
Black or Black British	22525	4.2	977	4.3	9639	42.8	7273	32.3	4636	20.6	3121	13.9	1048	4.7	434	1.9	33	0.1
Mixed	5962	1.1	430	7.2	3376	56.6	1400	23.5	756	12.7	491	8.2	178	3.0	74	1.2	13	0.2
Chinese or Other Ethnic Group	11394	2.1	1046	9.2	7144	62.7	2334	20.5	870	7.6	639	5.6	145	1.3	76	0.7	10	0.1
Employment Category* (n, %)																		
Employed	262504	42.4	10035	3.8	149861	57.1	67400	25.7	35208	13.4	23315	8.9	8288	3.2	3356	1.3	249	0.1
Not Employed	44411	7.2	3549	8.0	25034	56.4	9747	21.9	6081	13.7	3887	8.8	1486	3.3	644	1.5	64	0.1
Higher Education	8042	1.3	539	6.7	4654	57.9	1876	23.3	973	12.1	666	8.3	220	2.7	80	1.0	7	0.1
School Age/Education Under 18 yrs	5087	0.8	635	12.5	3563	70.0	665	13.1	224	4.4	160	3.1	50	1.0	13	0.3	1	0.0
Housewife/Carer	92892	15.0	5773	6.2	49790	53.6	23205	25.0	14124	15.2	9017	9.7	3421	3.7	1554	1.7	132	0.1
Deprivation Quintile (n, %)																		
1 Most Deprived	136368	22.9	8204	6.0	71171	52.2	34604	25.4	22389	16.4	14262	10.5	5539	4.1	2371	1.7	217	0.2
2	119606	20.1	6373	5.3	64566	54.0	30821	25.8	17846	14.9	11391	9.5	4379	3.7	1922	1.6	154	0.1
3	110026	18.5	5249	4.8	62419	56.7	27715	25.2	14643	13.3	9813	8.9	3364	3.1	1362	1.2	104	0.1
4	104074	17.5	4578	4.4	62030	59.6	25548	24.5	11918	11.5	8006	7.7	2721	2.6	1098	1.1	93	0.1
5 Least Deprived	125450	21.1	5381	4.3	78077	62.2	29511	23.5	12481	9.9	8613	6.9	2728	2.2	1064	0.8	76	0.1
Gestation Week at Booking (mean, SD)	14.0	6.4	19.3	10.3	14.0	6.1	13.6	5.8	13.1	5.5	13.2	6	13.0	5.5	12.8	5.4	13.0	6.4
Late Booking >13 weeks (n, %)																		
No	355618	57.4	11861	38.2	202467	57.3	90414	58.9	50876	62.5	33138	61.9	12136	63.2	5174	64.9	428	65.2
Yes	263705	42.6	19160	61.8	150860	42.7	63160	41.1	30525	37.5	20425	38.1	7077	36.8	2795	35.1	228	34.8

*Employment data not provided by 3 maternity units

Figure 1 Change in Maternal First Trimester BMI between 1989 and 2007 in a Population of 619 323 Deliveries

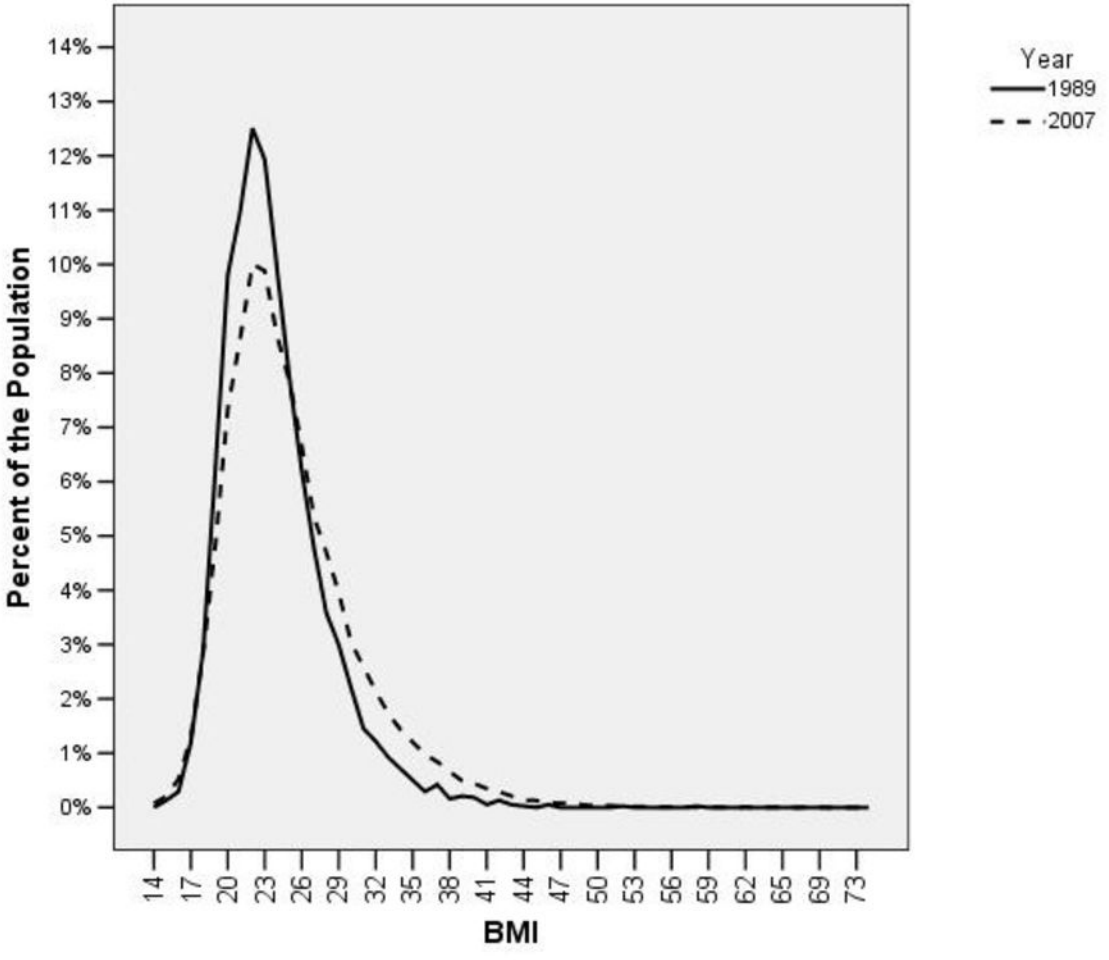
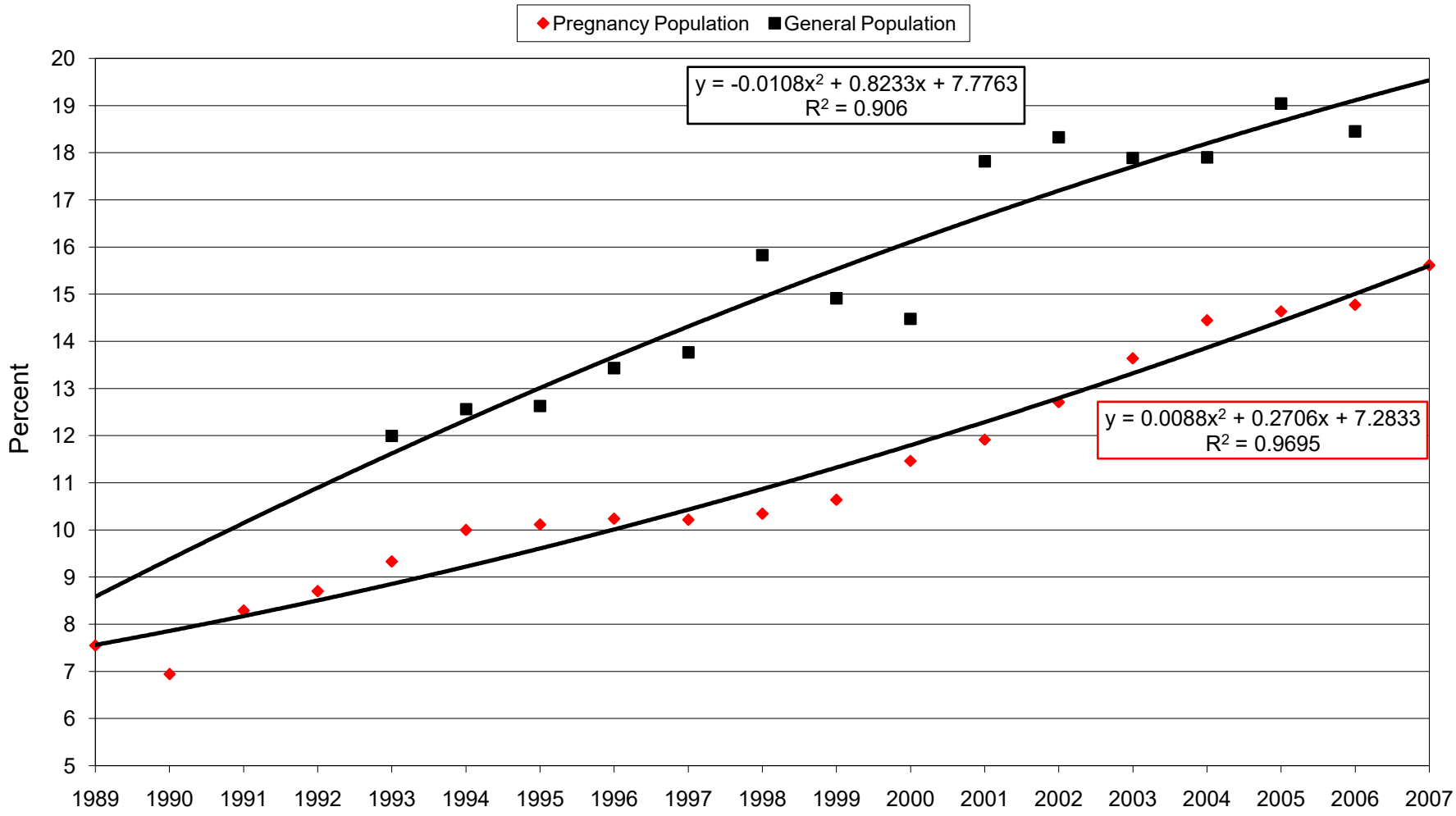


Table 2 Distribution of Maternal First Trimester BMI Group by Year

			Percent							
Year	Maternity Units (n)	Sample (n)	Underweight BMI (kg/m^2) <18.5	Ideal BMI (kg/m^2) 18.5-24.9	Overweight BMI (kg/m^2) 25.0-29.9	Obese BMI (kg/m^2) >30.0	Moderately Obese BMI (kg/m^2) 30.0-34.9	Severely Obese BMI (kg/m^2) 35.0-39.9	Morbidly Obese BMI (kg/m^2) 40.0-49.9	Super Morbidly Obese BMI (kg/m^2) >50.0
1989	1	3773	4.51	65.62	22.32	7.55	5.65	1.43	0.42	0.05
1990	2	6092	4.63	66.15	22.28	6.94	5.11	1.46	0.34	0.03
1991	4	13029	4.27	65.48	21.97	8.29	5.74	1.99	0.51	0.05
1992	4	12687	4.43	63.86	23.01	8.70	6.19	1.79	0.66	0.06
1993	5	15775	4.10	62.70	23.87	9.33	6.61	1.94	0.75	0.03
1994	5	15664	3.88	61.33	24.80	10.00	6.93	2.32	0.74	0.01
1995	6	16160	4.44	61.53	23.90	10.12	6.92	2.33	0.79	0.07
1996	6	16371	4.83	61.87	23.07	10.24	6.98	2.25	0.98	0.04
1997	6	16580	4.89	61.87	23.03	10.22	6.89	2.49	0.79	0.04
1998	6	16359	5.09	61.06	23.52	10.34	7.00	2.34	0.96	0.05
1999	6	16253	5.17	59.88	24.32	10.64	7.27	2.41	0.87	0.09
2000	14	24964	5.76	58.65	24.13	11.46	7.72	2.71	0.97	0.07
2001	15	28356	6.01	57.93	24.14	11.92	7.95	2.76	1.15	0.06
2002	17	35311	6.18	56.55	24.56	12.71	8.42	3.01	1.21	0.07
2003	21	54040	4.74	56.53	25.09	13.64	9.10	3.07	1.38	0.10
2004	24	65601	4.94	55.27	25.34	14.44	9.33	3.47	1.52	0.12
2005	26	77169	4.94	54.83	25.59	14.64	9.48	3.55	1.48	0.13
2006	29	86628	5.09	55.06	25.07	14.77	9.55	3.50	1.58	0.14
2007	32	98511	4.93	53.58	25.88	15.61	10.01	3.81	1.61	0.18
Total	34	619323	5.01	57.05	24.80	13.14	8.65	3.10	1.29	0.11
CHI Squared Test for Trend			33.4	2698.4	252.0	2721.4	118.0	18.6	90.0	39.9
p value (1 d.f)			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Figure 2 Trends in Incidence of Maternal Obesity and the Prevalence of Obesity in Women of Childbearing Age (16–44 years) in England's General Population



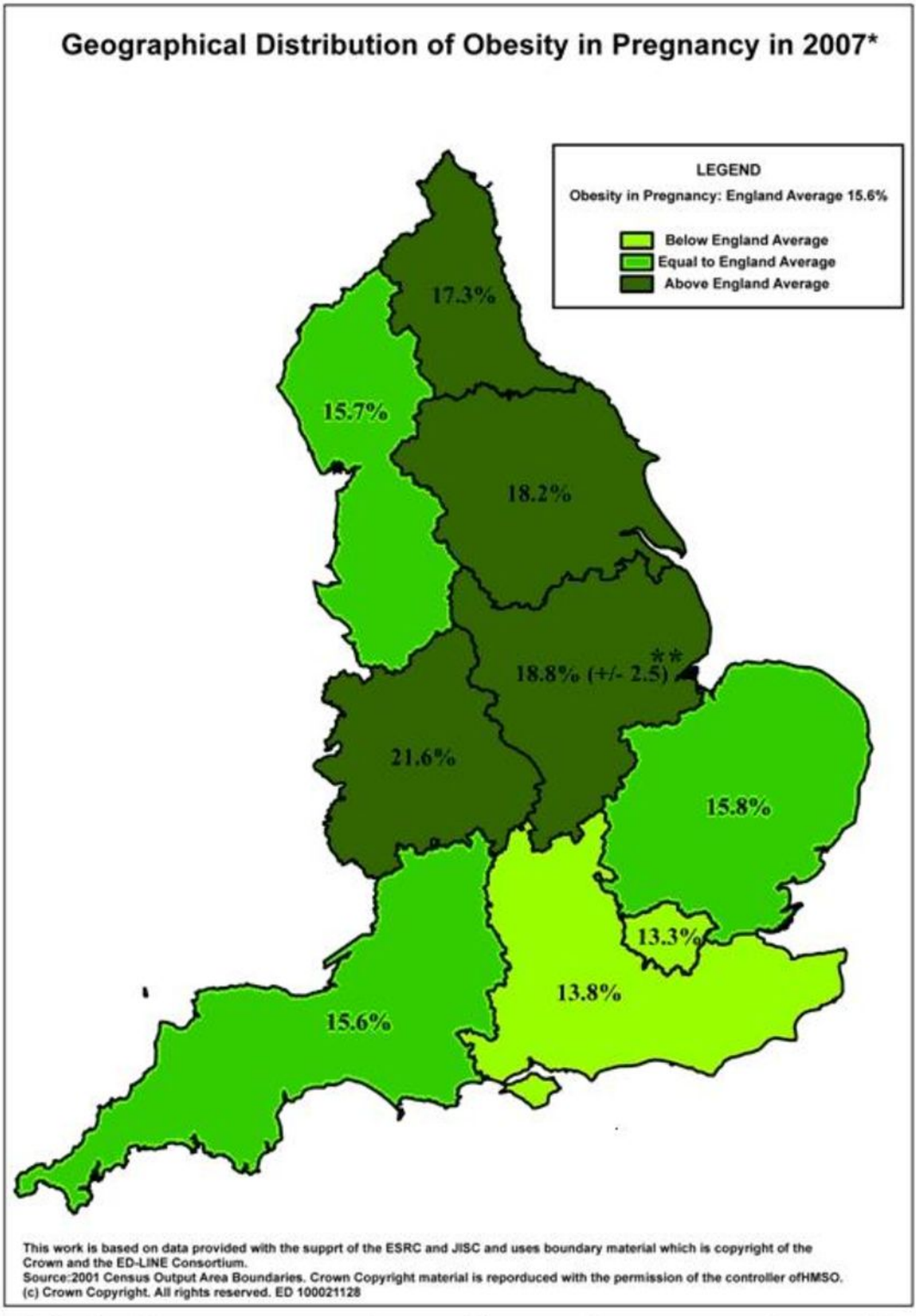
*Genereal Population data Source, Health Survey for England 2006
(http://www.ic.nhs.uk/webfiles/publications/HSE06/ADULT%20TREND%20TABLES%202006.xls)

Table 3 Comparison of the GOR Obesity Rates for the General Population of Women and Maternal First Trimester Obesity Rates for the Study Sample

GOR Code	Region	% Obese women in the general population HSE 2006	% Obese pregnant women 2007*	Difference in proportion (%)
	ENGLAND	23	15.6	7.4
F	West Midlands	29	21.6	7.4
D	Yorkshire & the Humber	24	18.2	5.8
A	North East	28	17.3	10.7
G	East	24	15.8	8.2
B	North West	22	15.7	6.3
K	South West	23	15.6	7.4
J	South East	24	13.8	10.2
H	London	20	13.3	6.7
E	East Midlands	27	no data	no data

*2006 for 2 NHS Trusts

Figure 3 Map of Geographical Distribution of Maternal First Trimester Obesity in England using GOR Boundaries 1



* Including data from 32 maternity units for 2007 deliveries, and 2 maternity units for 2006 deliveries where 2007 data was not available

**No data provided for East Midlands, the proportion was modelled based on the HSE 2006 data for women and GOR, and the differences in proportions for all other GOR's pregnancy data compared to the HSE data

1 The map was produced by the North East Public Health Observatory

Table 4 Adjusted Regression Analyses for Demographic Inequalities

	Underweight (BMI <18.5kg/m^2)			Overweight (BMI 25.0-29.9kg/m^2)			Obese (BMI >30.0kg/m^2)			Moderately Obese (BMI 30.0-34.9kg/m^2)			Severely Obese (BMI 35.0-39.9kg/m^2)			Morbidly Obese (BMI 40.0-49.9kg/m^2)			Super Morbidly Obese (BMI >50.0kg/m^2)		
	OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Parity	0.99	0.97	1.00	1.09	1.09	1.10	1.17	1.16	1.18	1.16	1.15	1.18	1.18	1.16	1.19	1.19	1.16	1.21	1.07	0.99	1.16
Age	1.06	1.06	1.06	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.02	1.02	1.02	1.03	1.03	1.03	1.04	1.07	1.05	1.09
Employment Category																					
Employed	Reference Group																				
Not Employed	0.63	0.60	0.66	0.84	0.82	0.87	0.91	0.88	0.94	0.88	0.85	0.92	0.93	0.87	0.99	1.02	0.93	1.11	1.50	1.12	2.02
Housewife/Carer	0.68	0.65	0.71	0.90	0.88	0.91	0.94	0.92	0.97	0.91	0.88	0.94	0.96	0.92	1.01	1.09	1.02	1.17	1.40	1.10	1.78
Higher Education	0.80	0.72	0.88	0.85	0.80	0.90	0.77	0.71	0.83	0.77	0.71	0.85	0.75	0.65	0.87	0.71	0.56	0.90	0.97	0.45	2.08
School Age/Education Under 18 Years	0.78	0.71	0.86	0.51	0.47	0.56	0.31	0.27	0.36	0.33	0.28	0.39	0.28	0.20	0.38	0.20	0.11	0.36	0.34	0.05	2.43
Deprivation Quintile																					
5 Least Deprived	Reference Group																				
4	1.06	1.00	1.11	1.15	1.12	1.18	1.25	1.21	1.30	1.21	1.16	1.26	1.35	1.26	1.45	1.38	1.24	1.54	1.79	1.18	2.73
3	1.08	1.03	1.14	1.25	1.22	1.28	1.57	1.51	1.62	1.50	1.44	1.56	1.69	1.58	1.81	1.77	1.59	1.97	2.40	1.61	3.59
2	1.07	1.01	1.13	1.39	1.35	1.43	1.97	1.90	2.03	1.76	1.69	1.83	2.36	2.21	2.52	2.63	2.38	2.91	3.59	2.44	5.30
1 Most Deprived	1.11	1.05	1.17	1.45	1.41	1.49	2.20	2.13	2.28	1.96	1.88	2.03	2.71	2.54	2.89	2.97	2.69	3.29	4.69	3.20	6.87
Ethnic Group																					
White	Reference Group																				
Asian or Asian British	0.65	0.62	0.68	1.01	0.98	1.04	0.63	0.60	0.66	0.76	0.72	0.79	0.49	0.45	0.54	0.30	0.26	0.35	0.27	0.15	0.48
Black or Black British	0.86	0.78	0.94	1.71	1.64	1.78	1.78	1.70	1.87	1.95	1.85	2.06	1.60	1.47	1.74	1.51	1.34	1.72	1.45	0.96	2.18
Mixed	0.66	0.59	0.75	0.95	0.88	1.03	0.82	0.74	0.90	0.85	0.76	0.96	0.77	0.64	0.93	0.73	0.55	0.97	1.05	0.47	2.37
Chinese or Other Ethnic Group	0.51	0.47	0.56	0.74	0.69	0.79	0.49	0.45	0.54	0.58	0.52	0.64	0.31	0.25	0.39	0.43	0.32	0.57	0.67	0.32	1.43

OR= odds ratio; 95% Ci= 95% confidence interval