CLINICAL ARTICLE

Racial variation in the number of spontaneous abortions before a first successful pregnancy, and effects on subsequent pregnancies

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ABSTRACT

Objective: To assess the relationship between race and spontaneous abortion, whether the relationship varies by risk factors, and the effect of spontaneous abortions on subsequent pregnancies. Methods: A retrospective study was undertaken using data collected in London, UK, between 1988 and 2000. Logistic regression evaluated histories of spontaneous abortion and associations with small-for-gestational-age and preterm births in black African, black Caribbean, and South Asian women relative to white European women. Interactions with risk factors were assessed. Results: Overall, 196 040 women were included. Compared with white Europeans, the odds of a previous spontaneous abortion were increased in black African (adjusted odds ratio [aOR] 1.20; 95% confidence interval [CI] 1.12–1.29) and black Caribbean women (aOR 1.31; 95% CI 1.21–1.41). The strength of the association with black African race increased with age (P = 0.002), and the association with South Asian race increased with age and body mass index (P < 0.001 for both). Spontaneous abortion was associated with preterm birth in all races, but was strongest in black African women (aOR 1.47; 95% CI 1.29–1.67). Conclusion: The greater incidence of spontaneous abortion in black African and black Caribbean women should prompt further study of risk factors in relation to race. The interaction with age in black African and South Asian women could be important for counseling in relation to timing of pregnancy.

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1. Introduction

Spontaneous abortion is a frequent adverse pregnancy outcome, occurring in approximately 12%–24% of clinically recognized pregnancies [1,2]. However, few studies have assessed racial/ethnic variation in incidence of spontaneous abortion. Two studies found an increased incidence in Afro-Caribbean women, although the increase ranged from 50% [3] to 300% [4]. Additionally, neither study assessed whether the increased incidence was modified by known risk factors, such as maternal age and body mass index (BMI).

Women who have experienced spontaneous abortion have increased rates of adverse outcomes in their next continuing pregnancy, such as preterm birth and small-for-gestational-age neonates [5]. Moreover, black and South Asian women are at an increased risk of preterm birth [6,7] and small-for-gestational-age neonates [6], irrespective of any previous spontaneous abortions. The risk in these women could be a result of genetic differences between ethnic/racial groups, because differences are found even after correction for socioeconomic risk factors [7], although residual lifestyle and cultural factors could remain after such adjustment. Nevertheless, these differences could have implications for other pregnancy outcomes, including spontaneous abortion. However, whether the effect of previous spontaneous abortion on these outcomes varies between ethnic/racial groups does not seem to have been reported previously. Given the greater risk of neonatal death and disability arising from these outcomes, and the increasing rates of preterm birth in most countries with reliable data [8], it is important to identify women at risk of adverse pregnancy outcomes.

Therefore, the aim of the present study was to determine: 1) whether the reported history of spontaneous abortion varied by race among nuliparous women; 2) whether risk factors such as BMI and maternal age had a differential effect between races on incidence of spontaneous abortion; and 3) the effect of spontaneous abortion on subsequent preterm birth and small-for-gestational-age neonates, by racial group. Race refers to genetic ancestry and reflects physical differences that have evolved in geographically isolated groups over millennia, whereas ethnic origin refers to social traits such as culture and diet. The two are not always the same (people can change their culture but not their genetics). In the present study, the descriptor “race” will be used.

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2. Materials and methods

A retrospective study was undertaken using data from the St Mary’s Maternity Information System, which contains information about 585,291 women who attended 15 maternity units in the North West Thames Region of London, UK, for prenatal care and delivery between 1988 and 2000. In 2002, ethical approval was obtained from St Mary’s local research ethics committee for multiple uses of the data. Because data had been routinely collected and anonymized, patient consent was not required.

The North West Thames Region had a population of 3.3 million in 1988 and 3.8 million in 2000, as well as various racial groups, and suburban, rural and metropolitan areas [9,10]. Information was collected on demograhic characteristics, medical history, and outcomes of all women and newborns from the first prenatal visit until 28 days after delivery. Data were entered into the system by trained clerks or midwives with online validation and standardized clinical definitions.

Only nulliparous women were included within the present analysis to exclude any bias that could be caused by including women more than once and to eliminate the effect of parity. Consequently 332,302 pregnancies were excluded. Additionally, inclusion was restricted to women aged 13–45 years at delivery who had a BMI (calculated as weight in kilograms divided by the square of height in meters) of 15–40 and delivered a baby with a birth weight greater than 500 g between 24 and 43 weeks of pregnancy. These criteria lead to the exclusion of 32,523 women. Additionally, 24,426 women were excluded because information about race was missing or because they were of mixed race or from racial groups with fewer than 15,000 women in the dataset. In analyses of subsequent outcomes, women with missing gestational age or birth weight were excluded.

Race was self-reported. White European, black African, black Caribbean, and South Asian racial groups were chosen for the present analysis because most participants in the dataset belonged to one of these groups. The South Asian group included women from India, Pakistan, and Bangladesh.

Previous spontaneous abortions were self-reported (0, 1, 2, or ≥3) and assessed as a continuous variable. The comparison group was no previous spontaneous abortions. Gestational age and birth weight were recorded at delivery. Preterm birth was defined as delivery before 37 completed weeks of gestation. Gestational age was calculated from the first day of the last menstrual period or measurements taken from fetal ultrasonography before 24 weeks of gestation if the last menstrual period was uncertain or cycle length variable [11]. Small-for-gestational-age birth weight, defined as a weight below the 10th centile corrected for sex and gestational age at birth, was calculated using birth weight standards for nulliparous English women [12].

Marital status (married, unmarried with a partner, or unmarried without a partner), cigarette smoking (current or non-smoker), and histories of induced abortion, hypertension, renal disease, cardiac disease, and epilepsy were self-reported. Diabetes status was reported by midwives at delivery and classified as established (pregestational) diabetes, gestational diabetes (diagnosed for the first time in the index pregnancy), or no diabetes. Women recorded as not having diabetes did not report the disorder and were not on a calorie-restrictive diet, oral hypoglycemics, or insulin.

Maternal age was defined as the mother’s age on the day of her child’s birth. BMI was assessed at the first prenatal visit, using either self-reported or measured weight. Socioeconomic deprivation was evaluated using the Carstairs socioeconomic deprivation score [13], which is based on census data on car ownership, unemployment, overcrowding, and social class within postcode sectors of residence containing approximately 16,000 residents. Five categories were constructed (1 = least deprived, 5 = most deprived).

Missing data was assumed to be missing at random and was dealt with using multiple imputation by chained equations [14]. Imputation was used for marital, smoking, and diabetes statuses; Carstairs deprivation score; BMI; and histories of hypertension, renal disease, cardiac disease, and epilepsy. All variables except for BMI had less than 10% of data missing; BMI had 17.8% of data missing. Five imputations were created using a set of appropriate imputation models constructed of all covariates and outcome variables, stratified by race. To reflect the proportion of missing data in BMI, an additional 15 imputations were created to verify that the results were robust to the number of imputations used.

Non-imputed data were summarized by race. Continuous variables were summarized by median and interquartile range, and groups were compared using χ² tests. For imputed data, logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for previous spontaneous abortions within each racial group and for the whole population. The three minority races (black African, black Caribbean, and South Asian) were compared with white Europeans to maintain consistency with most literature on racial disparities. Effect modification was evaluated through inclusion of an interaction term between race and the potential effect modifier. Interactions were assessed using the Wald test.

Next, logistic regression was used to quantify the association between spontaneous abortion and both preterm birth and low birth weight in the next continuing pregnancy, using imputed data. Dose–response relationships were evaluated by including the exposure as a continuous variable in the model and evaluating the Wald test. P values were two-sided, and P < 0.05 was considered statistically significant. A Bonferroni correction was performed when multiple comparisons were made. Statistical analyses were performed using Stata version 12.1 (StataCorp, College Station, TX, USA).

3. Results

A total of 196,040 nulliparous women were included in the present analysis. Black Caribbean women comprised the smallest group (3.0% of the sample), whereas white European women was the largest (80.9%). All characteristics varied by race, including diabetes status, BMI, maternal age, and number of previous spontaneous abortions (P < 0.001 for all) (Table 1). The group with the highest proportion of women who had had a previous spontaneous abortion was black Caribbean (15.7%); the group with the lowest proportion was South Asian women (11.8%).

The unadjusted logistic regression analysis showed that, compared with white European women, the odds of a previous spontaneous abortion were increased in black African women (OR 1.10; 95% CI 1.03–1.18) and black Caribbean women (OR 1.16; 95% CI 1.08–1.25), but reduced among South Asian women (OR 0.83; 95% CI 0.80–0.87). Table 2 shows the factors associated with previous spontaneous abortion for the whole population and each race, after adjustment for potential confounders. Black African and black Caribbean races were independently and positively associated with spontaneous abortion, whereas South Asian women had marginally reduced odds of previous spontaneous abortion.

Maternal age at delivery was a positive independent risk factor for all races (Table 2). Within each racial group, cigarette smoking, established diabetes, or subsequent development of gestational diabetes (indicating a pre-diabetic state before pregnancy) were the factors most strongly associated with previous spontaneous abortions. Thus, these three factors were also most strongly associated with spontaneous abortion within the population as a whole.

When interactions between risk factors and race were included in the multivariate logistic regression model, BMI (P < 0.001) and maternal age at delivery (P < 0.001) were found to be positive effect modifiers for South Asian women; the strength of the association between previous spontaneous abortion and South Asian women increased with increasing BMI and age relative to white European women. Similarly, a positive interaction with age was found for black African women (P = 0.002).
Comparisons by age group showed that, relative to white European women aged 21–25 years, South Asian women aged younger than 20 years or 21–25 years were less likely to have had a previous spontaneous abortion (Table 3). This difference disappeared in older age groups. Odds were also reduced in black African and black Caribbean women aged younger than 20 years. However, odds were increased in all women aged 26 years or older, irrespective of racial group.

Comparisons by BMI showed that the odds of spontaneous abortion relative to white European women with a normal BMI were greatest for South Asian women (Table 3).
Table 2
Independent factors associated with reported previous spontaneous abortion, by maternal racial group and using imputed data (n = 196 040).4,6

| Maternal age at delivery | White European (n = 158587) | Black African (n = 6659) | Black Caribbean (n = 5808) | South Asian (n = 24986) | Total (n = 196040) |
|--------------------------|-------------------------------|--------------------------|-----------------------------|--------------------------|-------------------|
| BMI                      | 1.02 (1.02–1.02)              | 1.03 (1.01–1.05)          | 0.99 (0.98–1.01)             | 1.04 (1.03–1.05)          | 1.02 (1.02–1.03)  |
| Marital statusd           |                               |                          |                             |                          |                   |
| Married                   |                               |                          |                             |                          |                   |
| Unmarried with partner   | 0.93 (0.89–0.97)              | 1.01 (0.83–1.23)          | 1.04 (0.85–1.28)             | 0.88 (0.71–1.11)          | 0.94 (0.91–0.98)  |
| Unmarried without partner| 0.90 (0.86–0.95)              | 0.97 (0.80–1.17)          | 0.88 (0.72–1.07)             | 0.86 (0.62–1.20)          | 0.91 (0.87–0.95)  |
| History of hypertension  | 1.00 (0.90–1.11)              | 0.80 (0.46–1.40)          | 1.09 (0.70–1.68)             | 1.32 (0.85–2.04)          | 1.03 (0.91–1.11)  |
| History of epilepsy      | 1.17 (0.98–1.40)              | 0.96 (0.26–3.52)          | 0.29 (0.04–2.16)             | 0.85 (0.44–1.65)          | 1.12 (0.95–1.33)  |
| History of renal disease  | 1.14 (0.92–1.40)              | 2.02 (0.67–6.08)          | 0.79 (0.22–2.82)             | 0.52 (0.19–1.46)          | 1.10 (0.90–1.34)  |
| History of induced abortion| 0.94 (0.91–0.98)            | 0.82 (0.70–0.96)          | 0.90 (0.76–1.07)             | 1.06 (0.92–1.23)          | 0.94 (0.91–0.98)  |
| History of cardiac disease| 1.21 (1.04–1.40)             | 1.42 (0.59–3.39)          | 1.81 (0.95–3.46)             | 0.99 (0.56–1.74)          | 1.22 (1.06–1.40)  |
| Diabetes statusa         |                               |                          |                             |                          |                   |
| Established diabetes     | 1.31 (1.04–1.65)              | 3.83 (1.07–13.70)         | 2.08 (0.77–5.56)             | 0.99 (0.46–2.13)          | 1.35 (1.10–1.67)  |
| Gestational diabetes     | 1.25 (1.07–1.46)              | 1.19 (0.75–1.90)          | 2.09 (1.27–3.44)             | 1.49 (1.20–1.87)          | 1.38 (1.22–1.56)  |
| Smokingc                 | 1.36 (1.31–1.41)              | 0.96 (0.70–1.34)          | 1.50 (1.26–1.82)             | 1.75 (1.38–2.22)          | 1.37 (1.33–1.42)  |
| Carstairs deprivation scored |                           |                          |                             |                          |                   |
| 2                        | 0.97 (0.93–1.01)              | 1.06 (0.75–1.48)          | 1.14 (0.77–1.68)             | 1.08 (0.90–1.28)          | 0.98 (0.94–1.02)  |
| 3                        | 0.99 (0.95–1.04)              | 0.89 (0.63–1.26)          | 0.92 (0.63–1.35)             | 1.07 (0.92–1.25)          | 1.00 (0.96–1.04)  |
| 4                        | 1.04 (1.00–1.09)              | 1.00 (0.73–1.36)          | 1.00 (0.70–1.42)             | 1.09 (0.93–1.28)          | 1.04 (1.00–1.09)  |
| 5                        | 1.07 (1.01–1.14)              | 0.91 (0.66–1.25)          | 1.15 (0.82–1.62)             | 1.13 (0.97–1.33)          | 1.06 (1.01–1.12)  |
| Year of delivery         | 1.01 (1.01–1.01)              | 0.99 (0.98–1.01)          | 1.01 (0.99–1.03)             | 1.01 (1.00–1.02)          | 1.01 (1.01–1.01)  |
| Racial groupd            |                               |                          |                             |                          |                   |
| Black African            | –                              | –                        | –                            | –                        | 1.20 (1.12–1.29)  |
| Black Caribbean          | –                              | –                        | –                            | –                        | 1.31 (1.21–1.41)  |
| South Asian              | –                              | –                        | –                            | –                        | 0.95 (0.91–1.00)  |

Abbreviation: BMI, body mass index (calculated as the weight in kilograms divided by the square of height in meters).

4. Discussion

Strong, independent relationships between both black African and black Caribbean races and spontaneous abortion relative to white European race have been reported. The factors strongly associated with previous spontaneous abortion were maternal age at delivery, BMI, smoking, and diabetes status. In black African and South Asian women, the size of the association increased with age more rapidly than in white Europeans. The rate of spontaneous abortion also rose with BMI, most strikingly in South Asians. Previous spontaneous abortion was associated with preterm birth, most prominently in black African women, and significant dose–response relationships were

Table 3
Adjusted odds ratios for previous spontaneous abortion according to advancing maternal age and increasing body mass index, by maternal racial group and using non-imputed data (n = 136 208).4,6

| BMI                        | White European (n = 110447) | Black African (n = 3875) | Black Caribbean (n = 3721) | South Asian (n = 18 165) |
|----------------------------|-----------------------------|--------------------------|-----------------------------|--------------------------|
| Underweight                | 1.01 (0.97–1.05)            | 0.89 (0.74–1.08)         | 1.19 (0.98–1.46)            | 0.77 (0.72–0.82)         |
| Normal                     | 1.12 (1.07–1.18)            | 1.12 (1.07–1.18)         | 1.41 (1.35–1.48)            | 0.93 (0.91–0.96)         |
| Overweight/obese           | 1.45 (1.39–1.51)            | 1.45 (1.39–1.51)         | 1.40 (1.34–1.46)            | 1.12 (1.09–1.15)         |
| Age, y                     |                             |                          |                             |                          |
| <20                        | 0.73 (0.71–0.75)            | 0.55 (0.49–0.62)         | 0.69 (0.64–0.75)            | 0.52 (0.49–0.55)         |
| 21–25                      | 1.02 (0.96–1.08)            | 1.21 (1.14–1.29)         | 0.81 (0.78–0.84)            | 1.39 (1.05–1.12)         |
| 26–30                      | 1.12 (1.10–1.14)            | 0.83 (0.52–1.45)         | 1.55 (1.47–1.64)            | 1.62 (1.55–1.69)         |
| ≥35                        | 1.50 (1.47–1.53)            | 2.25 (2.10–2.40)         | 2.09 (1.95–2.25)            | 2.70 (2.53–2.90)         |

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).

4. Discussion

Strong, independent relationships between both black African and black Caribbean races and spontaneous abortion relative to white European race have been reported. The factors strongly associated with previous spontaneous abortion were maternal age at delivery, BMI, smoking, and diabetes status. In black African and South Asian women, the size of the association increased with age more rapidly than in white Europeans. The rate of spontaneous abortion also rose with BMI, most strikingly in South Asians. Previous spontaneous abortion was associated with preterm birth, most prominently in black African women, and significant dose–response relationships were
found in all racial groups. Previous spontaneous abortion was not associated with low birth weight for any racial group.

A few previous studies have also found a greater incidence of spontaneous abortion in black African and Afro-Caribbean women [3,4]. The association between spontaneous abortion and subsequent preterm birth has also been found previously [5], although a stronger association in black African women relative to white Europeans does not seem to have been identified previously. The present findings could reflect differences in healthcare access. Health care is free in the UK, but ethnic minority groups are more likely to access maternity services late in pregnancy and less likely to have a scan at 20 weeks than are their white British counterparts [15].

Health problems which might underlie the present findings include higher rates of uterine fibroids [16] and systemic lupus erythematosus [17] in black women—disorders that are known risk factors for spontaneous abortion and preterm birth [18,19]—and higher rates of polycystic ovarian syndrome in South Asian women. Symptoms of polycystic ovarian syndrome present at a younger age in South Asian women than in white women [20]. The disorder causes reproductive problems—42%–73% of affected women [21] experience spontaneous abortions—and it is associated with a greater BMI—approximately 50% of patients are overweight or obese, with menstrual irregularities occurring more frequently in obese than normal-weight women [22]. Additionally, it has been proposed that surgical management of spontaneous abortion without cervical pretreatment could mediate the association between spontaneous abortion and preterm birth by weakening the cervix, leading to preterm birth in the next continuing pregnancy [23]. Although management of spontaneous abortion is unlikely to vary by race, there are racial disparities in cervical insufficiency. Black women are at two-fold greater risk of cervical insufficiency than white women [24], which could compound any cervical damage arising from the management of spontaneous abortion.

Data on the number of previous spontaneous abortions used in the present study were collected prospectively, avoiding any bias toward a particular hypothesis regarding the pregnancy’s outcome. There is a risk of under-reporting, but this is unlikely to vary by race, and the rates of spontaneous abortion reported are similar to other populations in the UK and other high-income countries [3,5]. The North West Thames dataset has been extensively validated [25,26] and a substantial number of variables collected, allowing for appropriate adjustment and assessment of interaction. Data regarding confounders and effect modifiers were collected after spontaneous abortion, which might have led to residual confounding, although many of variables reflect long-term health outcomes that are unlikely to change (e.g. history of epilepsy and renal disease). Additionally, the interpregnancy interval between an initial spontaneous abortion and subsequent pregnancy is, on average, less than 6 months [27], so any residual confounding will be minimal and is unlikely to vary by race. Finally, because only women in their first pregnancy were included, results are only generalizable to nulliparous women.

In summary, black Caribbean and black African nulliparous women had an increased incidence of spontaneous abortion, and the effect of spontaneous abortions on subsequent preterm birth varied by racial group. In South Asian women, incidence of spontaneous abortion increased with age and BMI, which could relate to higher rates of polycystic ovary syndrome—yet another reason to encourage South Asian women to avoid being overweight.

The influence of age on spontaneous abortion varied by race, which could be important for counseling in relation to the timing of pregnancy, whereas the differential effect of spontaneous abortion on preterm birth by race has implications for clinical practice. Current practice involves identifying women who could be at increased risk of preterm birth, and providing regular assessment with a view to optimizing outcomes for preterm newborns. The present findings contribute to the identification of at-risk women. Overall, the findings should prompt detailed studies of the factors known to affect rates of spontaneous abortion in relation to race.

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Conflict of interest

C.T.O-W. has no conflicts of interest. P.J.S has received funding and honoraria to support speaking at meetings from Ferring Pharmaceuticals, Alliance Medical, Pfizer, Milupa, the Obstetric Anaesthetists’ Association, the North Midlands Urogynaecological Society. Postgraduate Education and Academic Affairs Department National Guard Health Affairs Riyadh Saudi Arabia, BabyLifeline, the International Federation of Gynecology and Obstetrics, Bristol Hospitals Healthcare Trust, the Icelandic Medical Association, the 3rd Military Hospital Chonqing, Asia-Pacific Congress of Fetal/Maternal Medicine, the British Maternal and Fetal Medicine Society, the British Association of Perinatal Medicine, the European Congress of Perinatal Medicine, the Swedish Society of Obstetricians and Gynaecologists, the National Perinatal Society of Jordan, the National Perinatal Society of Turkey, the Royal College of Obstetricians and Gynaecologists, the International Association for Adult Congenital Heart Disease, the World Association of Perinatal Medicine, the Japanese Society for Congenital Heart disease and the Universities of Cape Town, Rome, Zurich, Leuven, Uppsala, Copenhagen, Leeds, Nottingham, and Cambridge; has been treated to dinner while attending a meeting with representatives of Hewlett Packard Ltd. to discuss fetal monitoring; has received fees for medicolegal opinions/consultancy from the Welsh Health Legal Authority, Northwick Park Hospitals NHS Trust, Newham University Hospital, Her Majestys Police, and various solicitors; and receives publication royalties from Elsevier and the Authors Licensing and Collecting Society.

References

[1] Everett C. Incidence and outcome of bleeding before the 20th week of pregnancy: a prospective study from general practice. BMJ 1997;315(7099):32–4.

[2] Wang X, Chen C, Wang L, Chen D, Guan W, French J. Conception, early pregnancy loss, and time to clinical pregnancy: a population-based prospective study. Fertil Steril 2003;79(3):577–84.

[3] Mukherjee S, Velez Edwards DR, Baird DD, Savitz DA, Hartmann KE. Risk of miscarriage among black women and white women in a U.S. prospective cohort study. Am J Epidemiol 2013;177(11):1271–8.

[4] Khalil A, Rezende J, Akolekar R, Syngelaki A, Nicolaides KH. Maternal racial origin, and adverse pregnancy outcome: a cohort study. Ultrasound Obstet Gynecol 2013;41(3):278–85.

[5] Bhattacharya S, Towndend J, Shetty A, Campbell D, Bhattacharya S. Does miscarriage in an initial pregnancy lead to adverse obstetric and perinatal outcomes in the next continuing pregnancy? BJOG 2008;115(13):1623–9.

[6] Bryant AS, Wovcholoh A, Caughey AB, Washington AE. Racial/ethnic disparities in obstetric outcomes and care: prevalence and determinants. Am J Obstet Gynecol 2010;202(4):335–43.

[7] Patel RR, Steer P, Doyle P, Little MP, Elliott P. Does gestation vary by ethnic group? A London-based study of over 122,000 pregnancies with spontaneous onset of labour. Int J Epidemiol 2004;33(1):107–13.

[8] March of Dimes, The Partnership for Maternal, Newborn and Child Health, Save the Children, World Health Organisation. Born Too Soon: The Global Action Report On Preterm Birth. http://www.who.int/reproductivehealth/publications/preterm_birth_report/en/. Published 2012. Accessed February 26, 2015.

[9] Office for National Statistics. Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid-1982 to Mid-1990. http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A33A77-162628. Published 1998. Accessed February 26, 2015.

[10] Office for National Statistics. Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid-1991 to Mid-2000 Local Authority Population Studies. http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A33A77-162632. Published 2000. Accessed February 26, 2015.

[11] Balchin I, Whitaker JC, Steer PJ, Lamont RF. Are reported preterm birth rates reliable? An analysis of interhospital differences in the calculation of the weeks of gestation at delivery and preterm birth rate. BJOG 2004;111(2):160–3.

[12] Tin W, Warrhy UK, Hye EN. Selection biases invalidate current low birthweight weight-for-gestation standards. The Northern Neonatal Network. Br J Obstet Gynaecol 1997;104(2):180–5.

[13] Carstairs V, Norris R. Deprivation and health in Scotland. Aberdeen: Aberdeen University Press; 1991.

[14] Little R, Rubin D. Statistical analysis with missing data. Hoboken, NJ: Wiley-Interscience; 2006.

[15] Raleigh VS, Hussey D, Seccombe I, Hall R. Ethnic and social inequalities in women’s experience of maternity care in England: results of a national survey. J R Soc Med 2010;103(5):188–99.

[16] Jacoby VL, Fujimoto YV, Giudice LC, Kuppermann M, Washington AE. Racial and ethnic disparities in benign gynecologic conditions and associated surgeries. Am J Obstet Gynecol 2010;202(6):514–21.

[17] Pons-Estel GJ, Alarcon GS, Scottfeld L, Reinibl L, Cooper GS. Understanding the epidemiology and progression of systemic lupus erythematosus. Semin Arthritis Rheum 2010;39(4):257–68.

[18] Lee JH, Norwitz ER, Shaw J. Contemporary management of fibroids in pregnancy. Rev Obstet Gynecol 2010;3(1):20–7.

[19] Smyth A, Oliveira GH, Lahr BD, Bailey KR, Norby SM, Garovic V. A systematic review and meta-analysis of pregnancy outcomes in patients with systemic lupus erythematosus and lupus nephritis. Clin J Am Soc Nephrol 2010;5(11):2080–8.

[20] Wijeyaratne CN, Bala AB, Barth JS, Belchete PE. Clinical manifestations and insulin resistance (IR) in polycystic ovarian syndrome (PCOS) among South Asians and Caucasians: is there a difference? Clin Endocrinol (Oxf) 2002;57(3):343–50.

[21] Sirmans SM, Pate KA. Epidemiology, diagnosis, and management of polycystic ovary syndrome. Clin Epidemiol 2013;5(1):1–13.

[22] Gambineri A, Pelusi C, Vicensi V, Pagotto U, Pasquali R. Obesity and the polycystic ovary syndrome. Int J Obes Relat Metab Disord 2002;26(7):883–96.

[23] McCarthy FP, Khoshbin AS, North RA, Rahma MB, Walker J, Baker PN, et al. Pregnancy loss managed by cervical dilatation and curettage increases the risk of spontaneous preterm birth. Hum Reprod 2013;28(12):3197–206.

[24] Anum EA, Brown H, Strauss JS. Health disparities in risk for cervical insufficiency. Hum Reprod 2010;25(11):2894–900.

[25] Maresh M, Dawson AM, Beard RW. Assessment of an on-line computerized perinatal data collection and information system. Br J Obstet Gynaecol 1986;93(12):1309–13.

[26] Cleary R, Beard RW, Coles J, Devlin HB, Hopkins A, Roberts S, et al. The quality of routinely collected maternity data. Br J Obstet Gynaecol 1994;101(12):1042–7.

[27] Love ER, Bhattacharya S, Smith NC, Bhattacharya S. Effect of interpregnancy interval on outcomes of pregnancy after miscarriage: retrospective analysis of hospital episode statistics in Scotland. BMJ 2010;341:c3967.