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DOI:
10.1080/13697137.2019.1606794

Document Version
Peer reviewed version

Citation for published version (Harvard):
Ghoubara, A, Sundar, S & Ewies, AAA 2019, 'Black women with postmenopausal bleeding have lower prevalence of endometrial cancer than other ethnic groups', *Climacteric*, vol. 22, no. 6, pp. 632-636. https://doi.org/10.1080/13697137.2019.1606794

Black women with postmenopausal bleeding have lower prevalence of endometrial cancer than other ethnic groups

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Abstract

Objectives: Modern medical practice strives for a personalized approach to patient care. The evidence regarding prevalence of endometrial cancer in various ethnic groups is scarce and conflicting. This study was conducted to determine this in postmenopausal bleeding (PMB) women.

Methods: Prospectively collected data of 1995 women attending PMB clinic over a 4-year period. Women were grouped according to self-assigned ethnicity into “White”, “Black”, “South Asian” and “Others”, and according to investigation results into *group 1*-benign findings and *group 2*-hyperplasia or cancer.

Results: The adjusted odds ratio (95% CI) for Black ethnicity was 0.35 (0.17-72; p=0.001). This means that Black women had 65% (28%-83%) less odds for developing endometrial hyperplasia and cancer compared to White women, independent from other predictors. Comparing to White ethnicity, women in all ethnic groups were significantly younger at presentation with PMB, had shorter duration since last menopausal bleeding (LMP), and less likely to be diabetic ($p<0.001$).

Conclusion: This study found significantly lower prevalence of endometrial cancer in the Black race in PMB women population; a finding that cannot be readily explained by other known risk factors. Further research is warranted to confirm the results and explore the underlying etiology.

Keywords

Endometrial cancer, endometrial hyperplasia, ethnicity, postmenopausal bleeding, race

Introduction

Non-White ethnic groups comprise around 14.1% of the English and Welsh population, the largest group being South Asians (Indians, Pakistanis and Bangladeshis), followed by Blacks (Black Africans and Black Caribbean) and Chinese [1]. However; data on the incidence of cancers by ethnic group remains scarce, particularly that of endometrial cancer [2]. National Cancer Intelligence Network (NCIN, England, 2002-2006) statistics revealed that the rates of endometrial cancer in women aged ≥ 65 years were statistically significantly lower in Asian and non-significantly higher in black (incidence rate ratio = 1.16) when compared with White women. Results were inconclusive for women <65 years of age. However; these data were criticized because of high volume of missing ethnicity data; 6005/27680 (22%) [2, 3]. On the other hand, many population-based studies revealed lower prevalence of endometrial cancer and higher mortality rates in African Americans [4, 5, 6].

There are few studies in the literature aimed to fit predictions model to predict the development of endometrial hyperplasia and cancer in women with postmenopausal bleeding (PMB) using the demographic and clinical characteristics like age, body mass index (BMI) and endometrial thickness. However, none of these studies used ethnicity as an input parameter, and a systematic review of published prediction models did not discuss the relevance of ethnicity to endometrial cancer [7]. In the era of precision medicine, aiming to offer a personalized approach to patient care, information about the association between ethnicity and endometrial cancer would be helpful to develop targeted strategies for cancer prevention and potentially better identify communities at risk [8, 9]. This is particularly important in women with PMB who represent the highest risk group. Given the scarcity of

information in this area, this study was conducted to determine the association between ethnicity and the rate of developing endometrial hyperplasia and cancer in women with PMB. Since our Cancer Centre serves a district with diverse multi-ethnic population, it was deemed optimal to evaluate such an association.

Materials and methods

The routine demographic and clinical data of the PMB clinic were prospectively collected in a specially designed Microsoft Access database, then extracted anonymously and compiled on an Excel spreadsheet. The database contained the details of 1995 consecutive women reviewed at Sandwell and West Birmingham Hospitals NHS Trust, UK between 1st January 2011 and 31st January 2015. The investigations results were accessed using the hospital electronic "Clinical Data Archive". PMB was defined as an episode of vaginal bleeding occurring ≥ 12 months after cessation of menstruation in women aged ≥45 years. Women were managed according to an evidence-based PMB protocol as described in previous studies [10-12]. The ethnicity data were collected by self-assignment during the consultation as per categories recommended by the Office of National Statistics [13]. For the purposes of the study, ethnicity was categorized into four groups: (1) White; including White British and other Whites, (2) Black; including Black Caribbean and Black Africans, (3) South Asian; including Indians, Bangladeshis and Pakistanis, and (4) Others; including Middle Eastern, Asian others and Mixed [2]. Women were further categorized according to the investigation results into: *group 1* - benign finding, and *group 2* - endometrial hyperplasia or cancer.

The ethnic distribution of the population in the district served by the Trust is 61.9% White, 7.6% Black, 22.5% South Asian, and 8% Others [14]. During the study period, the ethnic distribution of women attending the hospital in all departments was 48.9% White, 11.6%

Black, 22% South Asian, and 17.5% Others. The ethnic distribution of our PMB cohort was 65% White, 13% Black, 14% South Asian, and 8% Others. Data were collected as part of the routine treatment, and the project was considered as "service evaluation"; therefore, ethics approval was not deemed necessary. Service evaluation does not require ethical approval in the UK [15, 16].

Statistical analyses were carried out using Minitab© version 18 statistical package software (Pennsylvania State University, Pennsylvania, USA). Distribution of continuous variables was determined by Anderson-Darling and Kolmogorov-Smirnov tests. When normally distributed, they were presented as mean with standard deviation. When not normally distributed, they were presented as median with interquartile range. Differences between two outcome groups were sought by *t* test or the Mann-Whitney test, while differences in four ethnic groups were sought by analysis of variance (or the Kruskal-Wallis test) as demanded by distribution. Inter-group differences were sought by Tukey's test. Differences in categorical indices were sought by the Chi-squared test (Tables 1 and 2) with adjustment by family-wise error rate for multiple analyses. A Multivariable binomial logistic regression analysis (MVLRA) was used to identify the independent predictors of endometrial hyperplasia and cancer. Univariate factors linked to outcome were selected for the MVLRA. With several indices in the analysis, we selected those factors with a more stringent $p<0.02$ i.e. age, time since LMP, BMI, endometrial thickness and ethnicity. HRT, hypertension and other factors were not part of the model as they were not linked to outcome (Table 3 and 4). Data with a non-normal distribution were log transformed. $p<0.05$ was considered statistically significant.

Results

Clinical and demographic data of the 1995 women are shown in Table 1. Comparing the groups, there was a difference in age (ANOVA p<0.001) and time since last LMP (ANOVA *p*<0.001) with the White women being older and having a longer time since LMP than the three other groups (all *p*<0.05, Tukey's test). The groups were matched for BMI (ANOVA *p*=0.071), but not hypertension with Black women being more likely to be hypertensive (adjusted *p*=0.01) compared to the White women, or the use of HRT with Black and South Asian women being less likely to use HRT than White women (adjusted *p*=0.045 and *p*=0.003, respectively). There was a difference in the incidence of diabetes, with White women being more likely to be diabetic than the three other groups (each adjusted Chi-squared *p*<0.003). There was no difference in the use of tamoxifen (Chi-squared *p*=0.197) or in endometrial thickness (Kruskal-Wallis *p*=0.301). Table 2 shows outcomes and histological subtypes.

One hundred and ninety-seven (10%) of the women had endometrial hyperplasia and cancer. Compared to White ethnicity, Black women had a significantly lower prevalence of endometrial hyperplasia and cancer (Chi-squared *p*<0.01), and of endometrial cancer alone (Chi-squared p<0.02). Analyzing for type of cancer, Black women had a higher rate of non-endometrioid cancer (*n*=6, 67%) compared to White women (*n*=26, 27%)(Chi-squared *p* =0.015). In determining those factors with a potential to predict endometrial hyperplasia and cancer, Table 3 shows analysis of clinical and demographic data according to outcome (i.e. endometrial hyperplasia and cancer, or free of these conditions). It showed that age, ethnicity, time since LMP, BMI and endometrial thickness all predicted outcome with *p*<0.02.

These five univariate predictors were fed into MVLRA (Table 4). Only Black ethnicity and endometrial thickness independently predicted the risk of endometrial hyperplasia and cancer. The adjusted odds ratio (95% CI) for Black ethnicity was 0.35 (0.17-0.72; p=0.001). This means that Black women had 65% (28%-83%) less odds for developing endometrial hyperplasia and cancer compared to White women, independent from other predictors. When compared to "White", "South Asian" and "Other" ethnic groups did not show any statistically significant association between the ethnicity and the outcome.

The statistical analysis was repeated after removing the oldest 125 women (9.7%) until the ages of various ethnic groups are no longer significantly different to each other. Based on this sub analysis of 1866 women, endometrial thickness and Black ethnicity were still independent predictors of endometrial hyperplasia and cancer (both $p \leq 0.001$). When compared to White women, the odds ratio (95% CI) for endometrial hyperplasia and cancer in Black women was 0.35 (0.17-0.72). Thus, the adjusted odd ratios produced from the MVLRA were exactly the same when the ages of the four groups was not significantly different, negating a role of this potential confounder.

Discussion

To our knowledge, this is the first study to quantify the risk of endometrial hyperplasia and cancer according to ethnicity in PMB women population. This study found that Black women had 65% lower risk to develop endometrial hyperplasia and cancer when compared to White women. There was no statistically significant difference between “White”, “South Asian” and “Other” ethnic groups. Grouping endometrial hyperplasia and cancer had not affected the results since Black women showed also significantly lower prevalence of endometrial cancer alone when compared to White women. Similar findings were obtained from population-based studies. Farley *et al* found that the incidence of endometrial cancer in African Americans was 30% lower and the mortality rate 80% higher when compared to Whites [4].

A report of “The Surveillance, Epidemiology, and End Results, SEER” program data, including 1844 African American and 16512 Caucasian women, found the incidence of endometrial cancer in African Americans to be 65% of that in Caucasians, while the rates of aggressive subtypes (serous and clear cell adenocarcinomas and sarcomas) were doubled in African Americans [17]. Another report of SEER analysis by Cote *et al* showed that the age-adjusted incidence rates for all types-endometrial cancer is less in non-Hispanic black (NHB) compared to non-Hispanic white (NHW). (RR=0.81, 95% CI=0.8-0.83, $p<0.0001$), while the incidence of serous endometrial cancer is higher in the NHB (RR=2.19, 95%CI=2.05-2.33, $p<0.0001$). Further, the annual percentage change for the NHB was significantly higher than that of NHW (2.5 *v* 0.6) [18].This was also shown in another cohort study where the incidence in African Americans was 76% of that in Whites, but African American rates of aggressive subtypes was >3 times higher [6]. Nonetheless, the national statistics in England

revealed that the rates of endometrial cancer in women aged ≥ 65 years were non-significantly higher in black when compared with White women [3].

In this study and the other population-based studies [6], adjustment for other confounders did not explain the observed lower risk among Back women. While the differences in risk between ethnic groups could be attributed to the groups themselves, it may also be attributed to a deleterious germline mutation or a widespread environmental exposure [8].

The strength of the present study is that the data were collected prospectively, consecutively, and in a standardized fashion, with no missing ethnicity data. The use of self-assigned ethnicity was one of the major strengths since it is more accurate than other older systems such as name analysis [2]. In addition, this cohort is relatively homogeneous including only women presented with PMB who represent the highest risk group for endometrial cancer. However, the relatively small sample size did not allow for subgroup analysis.

The terms South Asian and Black encompass a number of more specific ethnicities, each with their own unique lifestyle, culture and characteristics. Shirley *et al* found strong evidence of intra-ethnic differences in the South Asian group, with rates among Bangladeshis <50% that of Indians, Pakistanis or Whites. The lower prevalence of obesity, high parity, and higher initiation of breastfeeding among Bangladeshis may contribute to these differences. There was no difference observed between Black Africans and Black Caribbean [2]. Similar to population-based studies [2, 8], one recognized challenge in interpreting our findings is the absence of data on nativity for each patient. Women were classified according to ethnicity rather than specific country of origin; hence it was not feasible to evaluate differences

between women who are foreign-born versus UK-born. Determining these differences may be relevant to disease development. In addition, in this cohort, the tamoxifen usage was higher in White women (4.4%) when compared with Black (1.2%). However; the univariate analysis showed no effect of tamoxifen usage on the outcomes, and the logistic regression model approach, to control for the effect of tamoxifen on the outcome, showed insignificant adjusted odds ratio. This might be attributed to the small sample size of the Black ethnic group.

Another weakness in this study is the lack of information about the type of hormonal replacement therapy (HRT) used. Although Black women were significantly (adjusted p=0.045) less likely to use HRT (6%) when compared to White women (11.5%), it is not known whether they used more of continuous combined HRT, which is recognized to be protective to the endometrium, rather than sequential HRT.

The endometrial hyperplasia and cancer group is indeed small relative to the benign endometrium group and thus very unbalanced, but this is to be expected in every day practice. Therefore, it was preferred not to perform a nested study with only a randomly selected 175 women in the benign endometrium group. However, despite the small sample, we have full confidence in the predictors of endometrial hyperplasia and cancer at p<0.001 and p=0.002. Had these values been closer to 0.05, it would have been concerning.

Conclusion

The results of this study suggest significantly lower prevalence of endometrial cancer in the Black race in PMB women population. This finding cannot be readily explained by known risk factors. As oncology continues to strive for a precise personalized approach to patient care, further research is warranted to confirm the findings and explore the underlying etiology.

Author contributions

AG: Managed the data, wrote the first draft and revised the manuscript.

SS: Contributed to the study design and revised the manuscript.

AAAE: Developed the idea, designed the study and revised the manuscript.

Conflicts of interest

None of the authors has any conflicts of interest for this manuscript

Funding

No fund was obtained for this study but the research fellowship of AG was funded by Aswan University, Egypt and the Egyptian Cultural Bureau in London, UK.

References

1. Office for National Statistics. Ethnicity and National Identity in England and Wales: 2011 [Web page]. London, UK: Office for National Statistics; 2012 [16 April 2018]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/articles/ethnicityandnationalidentityinenglandandwales/2012-12-11
2. Shirley MH, Barnes I, Sayeed S, et al. Incidence of breast and gynaecological cancers by ethnic group in England, 2001-2007: a descriptive study. BMC Cancer. 2014 Dec 18;14:979. doi: 10.1186/1471-2407-14-979. PubMed PMID: 25522857; PubMed Central PMCID: PMCPMC4301395.
3. National Cancer Intelligence Network. Cancer Incidence and Survival by Major Ethnic Group, England, 2002-2006 [Web page]. London, UK: National Cancer Intelligence Network; 2009 [16 April 2018]. Available from: http://www.ncin.org.uk/view?rid=75
4. Farley J, Risinger JI, Rose GS, et al. Racial disparities in blacks with gynecologic cancers. Cancer. 2007 Jul 15;110(2):234-43. doi: 10.1002/cncr.22797. PubMed PMID: 17559136.
5. Centers for Disease Control and Prevention. Uterine Cancer Rates by Race and Ethnicity [Web page]. GA, USA: Centers for Disease Control and Prevention; 2013 [16 April 2018]. Available from: http://www.cdc.gov/cancer/uterine/statistics/race.htm
6. Setiawan VW, Pike MC, Kolonel LN, et al. Racial/ethnic differences in endometrial cancer risk: the multiethnic cohort study. Am J Epidemiol. 2007 Feb 1;165(3):262-70. doi: 10.1093/aje/kwk010. PubMed PMID: 17090617.

7. van Hanegem N, Breijer MC, Opmeer BC, et al. Prediction models in women with postmenopausal bleeding: a systematic review. Womens Health (Lond). 2012 May;8(3):251-62. doi: 10.2217/whe.12.10. PubMed PMID: 22554173.

8. Schlumbrecht M, Baeker Bispo JA, Balise RR, et al. Variation in type II endometrial cancer risk by Hispanic subpopulation: An exploratory analysis. Gynecol Oncol. 2017 Nov;147(2):329-333. doi: 10.1016/j.ygyno.2017.09.002. PubMed PMID: 28888539.

9. Pinheiro PS, Sherman RL, Trapido EJ, et al. Cancer incidence in first generation U.S. Hispanics: Cubans, Mexicans, Puerto Ricans, and new Latinos. Cancer Epidemiol Biomarkers Prev. 2009 Aug;18(8):2162-9. doi: 10.1158/1055-9965.EPI-09-0329. PubMed PMID: 19661072.

10. Ghoubara A, Sundar S, Ewies AAA. Predictors of malignancy in endometrial polyps: study of 421 women with postmenopausal bleeding. Climacteric. 2018 Feb;21(1):82-87. doi: 10.1080/13697137.2017.1410783. PubMed PMID: 29219004.

11. Ghoubara A, Sundar S, Ewies AAA. Endometrial pathology in recurrent postmenopausal bleeding – observational study of 385 women. Climacteric. 2018;21(3). doi: 10.1080/13697137.2018.1461825.

12. Ghoubara A, Emovon E, Sundar S, et al. Thickened endometrium in asymptomatic postmenopausal women – determining an optimum threshold for prediction of atypical hyperplasia and cancer. Journal of Obstetrics and Gynaecology. 2018;38(4). doi: 10.1080/01443615.2018.1458081.

13. Office for National Statistics. What is the recommended ethnic group question for use on a survey in England? [Web page]. London, UK: Office for National Statistics; 2016 [16 April 2018]. Available from: http://webarchive.nationalarchives.gov.uk/20160106185816/http://www.ons.gov.uk/o

ns/guide-method/measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html#8

14. Birmingham City Council. 2011 ethnic group by age ward [Web page]. Birmingham, UK: Birmingham City Council; 2018 [18 June 2018]. Available from: https://www.birmingham.gov.uk/downloads/file/9839/2011_ethnic_group_by_age_ward

15. National Health System (NHS) Health Research Authority (HRA). Governance Arrangements for Research Ethics Committees (GAfREC) [Web page]. London, UK: UK Health Departments; 2017 [16 April 2018]. Available from: http://www.hra.nhs.uk

16. University College of London (UCL) Research Ethics Committe. Exemptions [Web page]. London, UK: University College of London; 2015 [16 April 2018]. Available from: https://ethics.grad.ucl.ac.uk/exemptions.php

17. Long B, Liu FW, Bristow RE. Disparities in uterine cancer epidemiology, treatment, and survival among African Americans in the United States. Gynecol Oncol. 2013 Sep;130(3):652-9. doi: 10.1016/j.ygyno.2013.05.020. PubMed PMID: 23707671; PubMed Central PMCID: PMCPMC4074587.

18. Cote ML, Ruterbusch JJ, Olson SH, et al. The Growing Burden of Endometrial Cancer: A Major Racial Disparity Affecting Black Women. Cancer Epidemiol Biomarkers Prev. 2015 Sep;24(9):1407-15. doi: 10.1158/1055-9965.EPI-15-0316. PubMed PMID: 26290568.

Tables legends

Table 1: Women characteristics grouped by ethnicity (n=1995)

Table 2: Histopathological subtypes of the outcomes (*n*=1995)

Table 3: Univariate predictors of outcome

Table 4: Results of the multivariable logistic regression analysis

Table 1: Women characteristics grouped by ethnicity (*n*=1995)

Variable	White 1288 (65%)	Black 264 (13%)	South Asian 280 (14%)	Other 163 (8%)	Total *n*=1995
Age (years)	62.1 (11.3)	58.5 (10.5)*	59.2 (9.1)*	58.2 (8.7)*	60.9 (10.8)
Duration since LMP (years)	10 (3-20)	6 (2-19)*	8 (3-15)*	6 (3-12)*	8 (3-20)
BMI (kg/m^2)	29.9 (8.9)	31.3 (8.3)	30.3 (7.3)	29.7 (7.8)	30.8 (7.3)
HRT users (*n*, %)	148 (11.5%)	17 (6%)*[a]	13 (5%)*[b]	13 (7%)	191 (9.6%)
Hypertension (*n*, %)	526 (41%)	134 (51%)*[c]	133 (48%)	67 (41%)	860 (43.1%)
Diabetes (*n*, %)	161 (8%)	71 (4%)*[d]	98 (5%)*[d]	39 (2%)*[d]	369 (18.5%)
Tamoxifen users (*n*, %)	57 (4.4%)	5 (1.2%)	8 (3%)	6 (3.7%)	76 (3.8%)
Endometrial thickness (mm)	4.5 (2.7-8)	4.5 (2.5-8)	5 (2.7-10)	5 (2.8-10)	5 (3-9)

BMI=Body Mass Index HRT=Hormone Replacement Therapy LMP=Last menstrual period

Normally distributed continuous variable data (Age and BMI) presented as mean (SD) and analysed by ANOVA, while not normally distributed continuous data (duration since LMP and endometrial thickness) are presented as median (inter-quartile range) and analysed by Kruskal-Wallis.

*$p<0.05$ Tukey's test, duration since LMP log transformed.

Categorical data (HRT use, diabetes, hypertension, diabetes, and Tamoxifen use) are presented as *n* (%), and analysed by Chi-squared test, and adjusted for family-wise error rate versus White women; [a]$p=0.045$, [b]$p=0.003$, [c]$p=0.01$, [d]$p<0.003$.

Table 2: Histopathological subtypes of the outcomes (*n*=1995)

Histopathological Subtype	White 1288 (64.4%)	Black 264 (13.2%)	South Asian 280 (14%)	Other 163 (8.2%)	Total *n*=1995
Group 1 (benign findings)	1150 (89.3%)	253 (95.8%)	251 (89.6%)	144 (88.3%)	1798 (90.1%)
Group 2 (endometrial hyperplasia and cancer)	138 (10.7%)	11 (4.2%)	29 (10.4%)	19 (11.7%)	197 (9.9%)
Endometrial non-atypical hyperplasia	19 (1.5%)	0 (0%)	5 (1.8%)	0 (0%)	24 (1.2%)
Endometrial atypical hyperplasia	24 (1.9%)	2 (0.8%)	5 (1.8%)	4 (2.5%)	35 (1.8%)
Endometrial cancer	95 (7.4%)	9 (3.4%)	19 (6.8%)	15 (9.2%)	138 (6.9%)
Endometrioid	69 (5.4%)	3 (1.1%)	13 (4.6%)	9 (5.5%)	94 (4.7%)
Non-endometrioid	26 (2%)	6 (2.3%)	6 (2.1%)	6 (3.7%)	44 (2.2%)
Serous	18 (1.4%)	6 (2.3%)	3 (1.1%)	3 (1.8%)	30 (1.5%)
Others	8 (0.6%)	0 (0%)	3 (1.1%)	3 (1.8%)	14 (0.7%)

Others=Other types of non-endometrioid endometrial cancer including clear cell carcinoma, squamous cell carcinoma and endometrial sarcoma.

All data are presented as *n*(%).

Table 3: Univariate predictors of outcome

	Group 1: benign findings (*n*=1798, 90%)	**Group 2: endometrial hyperplasia and cancer (*n*=197, 10%)**	***p* value**
Age (years)	60.4 (10.7)	65.4 (10.6)	<0.001*
Ethnicity (*n*, %)			
White	1150 (89.3%)	138 (10.7%)	
Black	253 (95.8%)	11 (4.2%)	0.01*
South Asian	251 (89.6%)	29 (10.4%)	
Other	144 (88.3%)	19 (11.7%)	
Time since LMP (years)	8 (3-20)	14.5 (6-20)	<0.001*
BMI (kg/m^2)	30.6 (7.2)	33.0 (8.1)	<0.001*
HRT use (*n*, %)	180 (10%)	11 (5.6%)	0.045
Hypertension (*n*, %)	754 (42%)	91 (46.2%)	0.251
Diabetes (*n*, %)	327 (18.2%)	42 (21.3%)	0.282
Tamoxifen use (*n*, %)	71 (4%)	5 (2.54%)	0.326
Endometrial thickness (mm)	4.5 (3-8)	13.3 (9-20)	<0.001*

BMI=Body Mass Index HRT=Hormone Replacement Therapy LMP=Last menstrual period

Normally distributed continuous variable data (Age and BMI) presented as mean (SD), while not normally distributed continuous data (duration since LMP and endometrial thickness) are presented as or median (inter-quartile range).

Categorical data (HRT use, diabetes, hypertension, diabetes, and Tamoxifen use) are presented as *n* (%).

*$p<0.05$ compared to group 2; *p* value is produced from *t* test applied for normally distributed continuous data, Mann-Whitney U test applied for not normally distributed continuous data, and Chi-squared test applied for categorical data.

Variables (Age, duration since LMP, ethnicity, BMI, and endometrial thickness) were selected to be fed into the multivariable logistic regression analysis as *p* value was<0.02.

Table 4: Results of the multivariable logistic regression analysis

Predictor	**Adjusted odds ratio**	**95% confidence interval**	***p* value**
Age	1.02	0.99-1.04	0.200
Duration since LMP	1.14	0.87-1.5	0.352
BMI	1.01	0.99-1.04	0.278
Endometrial thickness	8.45	6.16-11.63	<0.001*
Ethnicity			0.016*
White	Reference	Reference	
Black	0.35	0.17-0.72	
South Asians	0.8	0.48-1.34	
Others	1.02	0.55-1.88	

BMI=Body Mass Index LMP=Last menstrual period

Age and BMI are normally distributed, no variable transformation required before the regression analysis.

Duration since LMP and Endometrial thickness were log transformed for analysis as they are not normally distributed.