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Factors associated with receiving surgical treatment for menorrhagia in England and Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.

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Manuscripts

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3 **Factors associated with receiving surgical treatment for menorrhagia in England and**
4 **Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.**
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ABSTRACT

Objective To examine factors associated with receiving surgery for heavy menstrual bleeding (HMB) in England and Wales.

Design National cohort study

Setting NHS hospitals

Participants Women with HMB aged 18-60 who had a new referral to secondary care.

Methods Patient-reported data linked to administrative hospital data. Risk ratios (RR) estimated using multivariable Poisson regression.

Primary outcome measure Surgery within one year of first outpatient clinic visit.

Results 14,545 women were included. At their first clinic visit, mean age was 42 years, mean symptom severity score was 62 (scale ranging from 0 [least] to 100 [most severe]), 73.9% of women reported having symptoms for >1 year, and 30.4% reported no prior treatment in primary care. One year later, 42.6% had received surgery. Of these, 57.8% had endometrial ablation and 37.2% hysterectomy. Women with more severe symptoms were more likely to receive surgery (most versus least severe quintile, 33.1% v. 56.0%; RR:1.6, 95% CI:1.5 to 1.7). Surgery was more likely among those who reported prior primary care treatment compared to those who did not (48.0% v. 31.1%; RR:1.5, 95% CI:1.4 to 1.6). Surgery was less likely among Asian and more likely among black women, compared to white women. Surgery was not associated with socioeconomic deprivation.

Conclusions Receipt of surgery for HMB depends on symptom severity and prior treatment in primary care. Referral pathways should be locally audited to ensure women with HMB receive care that addresses their individual needs and preferences, especially for those who do not receive treatment in primary care.

Funding The National Heavy Menstrual Bleeding (HMB) Audit was funded by the Healthcare Quality Improvement Partnership as part of the National Clinical Audit and Patient Outcomes Programme, contract number HQIP NCA 004.

Keywords Heavy menstrual bleeding, deprivation, ethnicity, health inequalities, hysterectomy, endometrial ablation

Article Summary

Strengths and limitations of this study

- This study is the first to examine initial treatments for Heavy Menstrual Bleeding immediately after referral to secondary care
- The inclusion of patient-reported symptom severity addresses a knowledge gap about the importance of how women feel about their heavy menstrual bleeding on the treatment they receive
- As the data were collected by a national audit in England and Wales the sample is relatively large, allowing comparisons between minority ethnic groups
- Even though the sample size is large, the National HMB Audit recruited approximately 30% of eligible women. However, the characteristics of the women recruited were broadly representative of the UK population in terms of ethnicity and age
- Linking audit data to administrative hospital data also allowed comparisons between socioeconomic groups

INTRODUCTION

Heavy menstrual bleeding (HMB) affects one in four women of reproductive age. It is a condition that impairs the quality of life of many women who are otherwise healthy[1]. Every year in England and Wales, an estimated 50,000 women with HMB are referred to secondary care provided by the National Health Service (NHS)[2], which constitutes approximately 20% of referrals to specialist gynaecology services[3], and approximately 28,000 women undergo surgical treatment[4]. In the majority of women, the cause of their HMB is not known[5].

Medical treatments for HMB include (oral) medication and the hormone-releasing intrauterine device (LNG-IUS). Surgical treatment, including endometrial ablation (EA) and hysterectomy, is an option if medical treatment is ineffective or undesirable[1, 5, 6]. A systematic review of randomised clinical trials suggests that EA, hysterectomy and LNG-IUS all reduce HMB and are more acceptable to most women than oral medication[1]. The review found that surgical treatment is most effective over the short term although the quality of included trials was limited[1]. Hysterectomy will stop HMB but around 3% of women experience potentially serious postoperative complications[7]. EA and LNG-IUS appear to be safe, acceptable and effective treatments for HMB although some women who have EA will require a repeat procedure[1, 8-10].

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3 Since the early 1990s, there has been a steady increase in the use of EA rather than hysterectomy in
4 women who have surgical treatment for HMB[11]. Since 2004, more EA procedures than
5 hysterectomies have been conducted in England[4, 11-13]. Previous studies have found regional
6 variations in rates of surgery for HMB in England large enough to suggest scope for improvements in
7 HMB management[3, 12, 14, 15]. In addition, women from socioeconomically deprived areas report
8 more severe HMB at their first outpatient gynaecology visit[16] and higher rates of hysterectomy for
9 HMB, than women living in the least deprived areas[8], potentially reflecting inequitable access to
10 secondary care and use of surgery for HMB.
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17 In this paper, we investigate the factors that determine whether women who have been referred to
18 secondary care for HMB get surgical treatment. We use patient-reported data from the National
19 HMB Audit linked to administrative hospital databases: Hospital Episode Statistics (HES) and the
20 Patient Episode Database for Wales (PEDW). We explore the impact that symptom severity,
21 treatment received in primary care and patient characteristics including age, ethnicity and
22 socioeconomic deprivation have on the chance that women receive surgical treatment in the first
23 year after their referral to secondary care.
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METHODS

Data

Women aged between 18 and 60 years in England and Wales who had a new referral for HMB to a gynaecology outpatient clinic of an NHS hospital were eligible to participate in the National HMB Audit[2, 4, 13, 17]. The National HMB Audit took place between 2010 and 2014, with an estimated recruitment rate of 32% [2, 17]. National HMB Audit data were linked at the patient-level (by a trusted third party) to HES and PEDW, administrative databases containing records of all admissions to NHS hospitals in England and Wales to provide data on treatments received in secondary care.

Measures

Women were considered to have had a surgical procedure for HMB (the study outcome) if any HES/PEDW procedure field described abdominal or vaginal hysterectomy, EA, myomectomy or UAE, recorded using UK Office for Population Censuses and Surveys classification (OPCS), 4th revision codes[18]. For women who underwent a surgical procedure for HMB, information on underlying conditions was available from HES/PEDW, recorded using International Classification of Diseases, 10th revision (ICD-10) codes[19]. These were grouped as: “endometriosis (with or without uterine fibroids or polyps)”, “uterine fibroids and/or polyps (no endometriosis)” and “no obvious cause”. Women without codes for uterine fibroids, polyps or endometriosis, but with code(s) indicating excessive or irregular menstrual bleeding, were classed as having no obvious cause of their HMB. The codes used to define surgery and underlying conditions are detailed in the supporting information (Appendix S1).

Women who gave informed consent completed a baseline questionnaire (in the gynaecology outpatient clinic of an NHS hospital before their consultation) on age (categorised as 18-34, 35-39, 40-44, 45-49, 50-60), ethnicity (grouped as “white”, “Asian or Asian British”, “black or black British” and “other” (combining “Chinese”, “mixed” and “other”), duration and severity of HMB symptoms, obstetric history (analysed as “nulliparous” or “parous”), prior HMB treatment and co-morbidities. To capture co-morbidities (grouped: 0, 1 and 2 or more) women were asked “Have you been told by a doctor that you have any of the following?” with the response options: heart disease, high blood pressure, lung disease, diabetes, depression, thyroid disorder, kidney disease, and cancer (in the last 5 years). Body mass index (BMI, grouped: <25, 25-30, and ≥30) was derived from self-reported height and weight[20]. The Index of Multiple Deprivation (IMD), an area-level measure of relative socioeconomic deprivation, was extracted from HES/PEDW and analysed as quintiles (1= most deprived areas, 5= least deprived areas) according to the national distribution. Further information is given in the supporting information (Appendix S2).

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4 Women were asked: “How long have you had symptoms of HMB?” (“2 months or less”, “>2 months
5 but <1 year”, “>1 year” or “don’t know”), analysed as “<1 year”, “≥1 year”. Symptom severity scores
6 were derived from the Uterine Fibroid Symptom and Quality of Life (UFS-QoL) questionnaire adapted
7 for the HMB Audit[21]. Scores could range from 0 (least severe, best possible score) to 100 (most
8 severe, worst possible score), analysed in quintiles. Further information is provided in the supporting
9 information (Appendix S3).
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14 15 **Statistical analysis**

16 We present descriptive statistics (means and proportions) of patient and HMB-related characteristics
17 and treatment received in the year after the first outpatient clinic visit for HMB. For descriptive
18 statistics, those who had more than one surgical treatment in the year following their first outpatient
19 clinic visit were categorised by the last likely surgical treatment (according to clinical experience and
20 protocol).
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25 We used multivariable Poisson regression with robust standard errors to estimate risk ratios (RR)
26 that represent the associations between patient and HMB-related characteristics reported by women
27 at their first gynaecology outpatient clinic visit and receiving surgical treatment in the first year
28 following this[22]. We chose to report risk ratios rather than odds ratios because the latter are more
29 difficult to interpret, especially if the proportions being compared are relatively large. In a secondary
30 analysis, we examined associations between these characteristics and whether women received EA
31 or hysterectomy among those having one of these procedures. Women who received both EA and a
32 hysterectomy in the year following their first outpatient visit (n=699) were included in the EA
33 treatment group for this analysis because EA was the first procedure.
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42 Levels of missing data were low (<3%) for the majority of variables but 7% of women were missing
43 ethnicity data and 23% were missing height or weight data required to derive BMI (Table 1). For
44 regression analyses missing values were imputed using multiple imputation by chained equations[23]
45 with statistical coefficients obtained using ten imputed datasets, pooled using Rubin’s rules[24].
46 Analyses were performed in Stata version 15.
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51 **Patient involvement**

52 The national HMB Audit was supported by a clinical reference group which included lay members
53 and patient representatives. The lay members and patient representatives provided input to the
54 design of the study and interpretation of the results, and contributed to the dissemination plan. The
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3 clinical reference group met on a regular basis for the duration of the audit. Women with HMB also
4 participated in a pilot study to assess the logistical issues of the prospective national HMB audit. This
5 informed the design of written materials and key procedures for the audit. Ninety-six women with
6 HMB also participated in interviews to refine and psychometrically evaluate the adapted UFS-QOL
7 instrument.
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10 11 12 **RESULTS**

13 **Description of the cohort**

14
15 15,325 eligible women completed the questionnaire at their first visit to a gynaecology outpatient
16 clinic. 14,545 women (94.9%) could be linked to HES or PEDW for information on surgical treatments
17 and deprivation. Of these women, 11.6% (n=1,578) reported ethnic minority backgrounds (black,
18 n=571; Asian, n=731), with the distribution of ethnicities broadly representative of the UK
19 population[25]. The mean age of women was 42.4 years (standard deviation [SD]: 7.6) and the mean
20 BMI was 27.3 kg/m² (SD: 5.4) (Table 1). The majority of women had given birth (83.1%, n=11,727)
21 and one third reported co-morbidities (33.8%, n=4,925). The mean score for symptom severity at
22 first outpatient clinic visit was 61.8 (SD: 21.3) and this score ranged from 34.3 (SD: 10.8) in the least
23 severe symptoms quintile, to 93.8 (SD: 5.1) in the most severe symptoms quintile. Almost three-
24 quarters of women reported HMB symptoms for more than one year and nearly a third (30.4%)
25 reported that they had not received medical treatment for their HMB in primary care before referral
26 (Table 1).
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Table 1 Characteristics of women at their initial HMB outpatient visit

Denominator (n=14545)	% (n) unless otherwise stated
Age, mean (sd)	42.4 (7.6)
Age group	
18-34	14.8 (2155)
35-39	12.9 (1881)
40-44	26.6 (3870)
45-49	31.3 (4554)
50-60	14.3 (2085)
Ethnicity	
White	88.4 (11987)
Asian or Asian British	4.2 (731)
Black or black British	5.4 (571)
Other	2.0 (276)
Missing	6.7 (980)
Socioeconomic deprivation (IMD)	
Quintile 1 (most deprived)	23.5 (3418)
Quintile 2	21.7 (3159)
Quintile 3	20.2 (2944)
Quintile 4	18.7 (2720)
Quintile 5 (least deprived)	15.8 (2304)
BMI, mean (sd)	27.3 (5.4)
BMI categories	
<25	39.5 (4424)
25-30	31.7 (3569)
≥30	28.8 (3226)
Missing	23.0 (3346)
Parity	
Nulliparous	16.9 (2378)
Parous	83.1 (11727)
Missing	3.0 (440)
Number of comorbidities	
0	66.1 (9620)
1	25.4 (3701)
≥2	8.4 (1224)
Overall health	
Excellent/very good	37.4 (5356)
Good	42.0 (6009)
Fair/poor	20.7 (2958)
Missing	1.5 (222)
Symptom severity at baseline	
Severity score at baseline (overall), mean (sd)	61.8 (21.3)
Severity score at baseline (quintiles), mean (sd)	
Quintile 1 (least severe)	34.3 (10.8)
Quintile 2	56.5 (4.4)
Quintile 3	68.5 (2.6)
Quintile 4	78.9 (3.4)
Quintile 5 (most severe)	93.8 (5.1)
Duration of symptoms	
<1 year	26.1 (3677)
≥1 year	73.9 (10434)
Missing	3.0 (434)
Prior treatment for HMB in primary care	
No	30.4 (4296)
Yes	69.6 (9819)
Missing	3.0 (430)

Treatment received in the year following first outpatient clinic visit

Approximately forty percent of women received surgical treatment for HMB in the year following their first outpatient clinic visit (42.6%, Table 2), with most of those undergoing EA (57.8%) or hysterectomy (37.2%). The small number of women receiving UAE (n=129) or myomectomy (n=179) precluded further analysis of these groups separately.

Receipt of surgical treatment by women's characteristics

Symptom severity at first outpatient clinic visit and medical treatment received for HMB in primary care were associated with surgical treatment received in the year following first outpatient clinic visit. The rate of surgical treatment was higher among those reporting the most severe symptoms than among those reporting the least severe symptoms (RR comparing the most to the least severe symptoms quintile 1.6, 95% CI: 1.5 to 1.7, Table 2). Receipt of surgery was highest among those aged 40-44 and 45-49 years, where half (49.9%) had received surgery, and lowest among women aged 18-34 years (18.4%, Table 2), despite similar mean symptom severity scores for the 18-34 year olds (63.3, SD: 20.8) and the 40-45 and 45-49 year olds (62.7 SD: 21.2 and 61.6, SD: 21.2, data not shown).

The rate of surgery was higher among women who reported prior treatment in primary care than among those who did not (RR 1.5, 95% CI: 1.4 to 1.6, Table 2). Among women who reported that they had received prior treatment in primary care, the proportion that received surgery was highest among those reporting the most severe symptoms in all age groups, and use of surgery increased with age up to age 40-49 years (Figure 1). Among those who reported that they had not received prior treatment in primary care these patterns were broadly similar, although the relationship between symptom severity and surgery was less marked for women age 35-39 years where a similar proportion of women in each of the three most severe symptoms quintiles received surgery (Figure 1). The proportion of women who received surgery was markedly lower among women aged between 18-34 years and who reported the least severe symptoms, than for women aged 45-49 years and who reported the most severe symptoms, among both those who had, and those who had not, received treatment in primary care. Among the women who reported having had prior treatment in primary care, the proportion receiving surgery among 18-34 year olds with symptoms in the least severe quintile was 14% compared with 70% of 45-49 year olds with symptoms in the most severe quintile. Corresponding percentages among those who reported no prior treatment in primary care were 11% and 48% respectively (Figure 1).

Figure 1 (Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile) about here

Other characteristics were associated with the receipt of surgery although the magnitude of the associations was smaller than for symptom severity or prior treatment. Higher rates of surgical treatment were seen in women who had given birth, and those who had a higher BMI (25-30 or ≥ 30). Compared to white women, women reporting an Asian background had lower rates of surgery (RR 0.8, 95% CI: 0.7 to 0.9), whilst women of black ethnic backgrounds had higher rates (RR 1.1, 95% CI: 1.0 to 1.2, Table 2). Socioeconomic deprivation was not associated with surgical treatment.

Table 2 Characteristics associated with receiving surgical treatment in the first year following an initial outpatient visit for HMB

Denominator (n=14545)	Received surgical treatment	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	42.6% (6195)				
Age group					<0.0001
18-34	18.4% (396)	0.37	0.36	0.32, 0.41	
35-39	41.1% (774)	0.82	0.81	0.75, 0.86	
40-44	49.9% (1932)	1.00	0.97	0.92, 1.01	
45-49	49.9% (2273)	1	1	-	
50-60	39.3% (820)	0.79	0.76	0.72, 0.83	
Ethnicity					0.0006
White	42.9% (5146)	1	1	-	
Asian or Asian British	30.8% (176)	0.74	0.79	0.69, 0.91	
Black or black British	49.0% (358)	1.14	1.11	1.02, 1.22	
Other	39.1% (108)	0.91	0.96	0.82, 1.13	
Socioeconomic deprivation (IMD)					0.2600
Quintile 1 (most deprived)	41.7% (1424)	1	1	-	
Quintile 2	41.2% (1300)	0.99	0.97	0.91, 1.03	
Quintile 3	42.9% (1263)	1.03	1.02	0.96, 1.09	
Quintile 4	44.5% (1211)	1.07	1.04	0.98, 1.11	
Quintile 5 (least deprived)	43.3% (997)	1.04	1.03	0.96, 1.10	
BMI categories					0.0016
≤ 25	38.8% (1715)	1	1	-	
25-30	46.1% (1636)	1.19	1.09	1.04, 1.15	
≥ 30	45.9% (1480)	1.18	1.06	1.01, 1.12	
Parity					0.0137
Nulliparous	32.0% (760)	1	1	-	
Parous	44.8% (5252)	1.40	1.09	1.02, 1.16	
Number of comorbidities					0.0825
0	42.1% (4049)	1	1	-	
1	43.7% (1618)	1.04	0.97	0.95, 1.02	
≥ 2	43.1% (528)	1.02	0.92	0.85, 1.00	
Severity score at baseline					<0.0001
Quintile 1 (least severe)	33.1% (1233)	1	1	-	
Quintile 2	39.9% (1437)	1.20	1.14	1.06, 1.21	
Quintile 3	43.3% (1001)	1.31	1.25	1.16, 1.34	
Quintile 4	49.6% (1292)	1.50	1.39	1.31, 1.49	
Quintile 5 (most severe)	56.0% (1118)	1.69	1.56	1.46, 1.67	
Prior treatment for HMB in primary care					<0.0001
No	31.1% (1335)	1	1	-	
Yes	48.0% (4709)	1.54	1.50	1.42, 1.58	

Footnotes: Multivariable model adjusted for age group, ethnicity, IMD, BMI, parity, number of comorbidities, baseline symptom severity and HMB treatment received in primary care. Categories compared using the Wald test, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Type of first surgical treatment received by women's characteristics

Symptom severity was associated with having hysterectomy rather than EA (Table 3). Among women who underwent EA or a hysterectomy, the rate of hysterectomy was higher among those reporting the most severe symptoms compared to those reporting the least severe symptoms (RR comparing most vs. least severe symptoms quintile 1.6, 95% CI: 1.4 to 1.8). Those who were obese (BMI 25-30) had higher rates of hysterectomy than those of a healthy weight (BMI <25) (RR 1.2, 95% CI: 1.1 to 1.3). Black women had higher rates of hysterectomy than white women (RR 1.3, 95% CI: 1.1 to 1.7). Younger women (18-34 years) had lower rates of hysterectomy than those aged 45-49 years (RR 0.6, 95% CI: 0.5 to 0.8).

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Table 3 Characteristics associated with receiving hysterectomy (compared to endometrial ablation) in the first year following an initial outpatient visit for HMB

Denominator (n=5920)					
	Received hysterectomy	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	27.1% (1606)				
Age group					0.0002
18-34	17.4% (62)	0.58	0.64	0.50, 0.84	
35-39	25.5% (181)	0.83	0.77	0.65, 0.91	
40-44	25.7% (478)	0.88	0.85	0.76, 0.95	
45-49	29.9% (652)	1	1	-	
50-60	29.1% (233)	0.97	0.92	0.80, 1.07	
Ethnicity					0.0404
White	26.8% (1350)	1	1	-	
Asian or Asian British	27.7% (44)	1.04	0.93	0.49, 1.20	
Black or black British	34.9% (88)	1.30	1.34	1.09, 1.66	
Other	32.6% (30)	1.20	1.14	0.67, 1.28	
Socioeconomic deprivation (IMD)					0.1437
Quintile 1 (most deprived)	28.2% (378)	1	1	-	
Quintile 2	24.4% (298)	0.86	0.93	0.80, 1.08	
Quintile 3	26.3% (319)	0.93	0.97	0.83, 1.12	
Quintile 4	29.4% (344)	1.04	1.12	0.97, 1.29	
Quintile 5 (least deprived)	27.4% (267)	0.97	1.01	0.87, 1.19	
BMI categories					0.0198
≤25	24.7% (399)	1	1	-	
25-30	29.7% (465)	1.20	1.18	1.05, 1.32	
≥30	28.0% (400)	1.13	1.10	0.97, 1.24	
Parity					0.4965
Nulliparous	25.4% (165)	1	1	-	
Parous	27.4% (1404)	1.09	0.95	0.82, 1.10	
Number of comorbidities					0.2709
0	27.0% (1039)	1	1	-	
1	26.5% (414)	0.98	0.97	0.87, 1.09	
≥2	29.9% (153)	1.11	1.12	0.95, 1.32	
Severity score at baseline (quintiles)					<0.0001
Quintile 1 (least severe)	22.0% (251)	1	1	-	
Quintile 2	26.0% (362)	1.18	1.17	1.00, 1.37	
Quintile 3	28.2% (271)	1.28	1.27	1.08, 1.50	
Quintile 4	26.3% (326)	1.20	1.23	1.05, 1.44	
Quintile 5 (most severe)	33.9% (365)	1.54	1.58	1.35, 1.84	
Prior treatment for HMB in primary care					0.0004
No	30.8% (389)	1	1	-	
Yes	26.2% (1185)	0.86	0.82	0.74, 0.92	

*Multivariable model adjusted for age group, ethnicity, IMD, baseline BMI, parity and number of comorbidities, baseline symptom severity and HMB treatment received in primary care. 699 women received both EA and a hysterectomy in the year following their first outpatient visit. Here they are included in the EA group as this represents the first surgical treatment choice. Categories compared using the Wald test, *p<0.05, **p<0.01, ***p<0.001*

Underlying conditions by surgical procedure received

Women who received a hysterectomy were more likely to have an underlying condition diagnosed than women who receive EA. Of women who received a hysterectomy, 52.1% had a diagnosis of uterine fibroids or polyps (without endometriosis) recorded and 21.3% had endometriosis (with or without uterine fibroids or polyps). In contrast, more than half of women undergoing EA had no obvious cause of their HMB diagnosed (52.9%; Appendix S4).

DISCUSSION

Main findings

Approximately 40% of women referred to secondary care for HMB in England and Wales received a form of surgical treatment in the first year following their initial outpatient clinic visit in secondary care. The rate of surgery was 50% higher among women who reported having received treatment in primary care prior to their first outpatient visit than among those who did not. In addition, more severe symptoms were also associated with higher rates of surgery, and with receiving hysterectomy rather than EA. Women with an Asian ethnic background had lower rates of surgery, whilst women with a black ethnic background had higher rates of surgery, after adjusting for symptom severity than women with a white ethnic background. Socioeconomic deprivation was not associated with the rate of surgery.

Interpretation

We previously reported that socioeconomic deprivation influences access to secondary care for HMB[16] as for other conditions[26]. However, our findings illustrate that once women reach secondary care services, their receipt of surgical treatment depends mainly on their symptom severity, and whether or not they have received treatment in primary care prior to their referral. Nearly one-third of women reported that they had no treatment for their HMB in primary care and the chance that these women had surgery within the first year after their referral was considerably lower than for women who had prior treatment in primary care. National guidelines for the management of HMB in the UK indicate that hormonal or non-hormonal medical therapy can be started in primary care. Our findings suggest that this may reduce the number of potentially inappropriate referrals to specialist services[5]. However, immediate referral can be appropriate for women seeking further diagnostic tests and reassurance, even without medical treatment[6, 27-29]. In addition, some women may be referred immediately because they do not wish to take drug treatment, or it is anticipated that treatment available in primary care may fail to control their symptoms to an acceptable level[5].

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3 We also observed variation in surgery rates by ethnic background, after accounting for symptom
4 severity. Compared to white women, women reporting Asian ethnicity had lower rates of surgery,
5 and women reporting black ethnicity had higher rates of surgery. These differences may reflect
6 inequitable use of surgical care, or may be attributable to variations according to ethnicity in the
7 prevalence of HMB-related conditions (such as fibroids), cultural norms (for example, accepting
8 heavy periods as normal), and patient preferences for treatment, which have been reported
9 previously [30-32].
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15 Since 2004, more EA procedures than hysterectomies have been conducted in England[11, 13].
16 However, little was previously known about the determinants of hysterectomy compared to EA. We
17 show that the choice of procedure is strongly linked to symptom severity and age with a higher
18 proportion of older women and those who had worse symptoms receiving a hysterectomy. All
19 women should have the opportunity to discuss the benefits and risks of both EA and hysterectomy,
20 to help them make informed decisions about their treatment[5].
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26 Despite the existence of national guidelines for the management of HMB in the UK, developed by the
27 National Institute for Health and Care Excellence and the Royal College of Obstetricians and
28 Gynaecologists[5, 30, 33], only a minority of hospitals in England and Wales reported local protocols
29 on the management of women with HMB to the National HMB Audit[34]. Local auditing of referral
30 pathways could help to ensure that referrals to secondary care without prior treatment in primary
31 care reflect patient-centred care.
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37 **Strengths and limitations**

38 A number of studies have reported treatment outcomes for women with HMB[9, 15] but our study is
39 the first national study reporting on initial treatments for HMB immediately after referral to
40 secondary care. It is also the first to examine the impact of sociodemographic factors and symptoms
41 on the chance that women with HMB will receive surgical treatment. We used data collected by a
42 national clinical audit in England and Wales, linked to administrative hospital data, which produced a
43 large sample. We estimated that the National HMB Audit recruited approximately a third of all
44 eligible women, and the characteristics of those recruited were broadly representative of the UK
45 population in terms of ethnicity and age[35, 36]. Information on women's fertility intentions was not
46 available, so we could not explore whether this influenced observed associations between age and
47 ethnicity and receiving surgery.
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Conclusions

Once women reach secondary care services, the chance that they will have surgical treatment within a year is strongly linked to their symptom severity and age and also, albeit less strongly, to their parity, BMI and ethnic background. Having received treatment in primary care before referral also increases the likelihood of surgery after referral. Our finding that a third of women were referred without prior treatment in primary care may raise questions about whether these referrals were appropriate. However, some women may benefit from referral for advice and further assessment, or may seek immediate surgical treatment. We recommend that referral pathways between primary and secondary care should be locally audited to ensure that the care that women with HMB receive addresses their individual needs and preferences.

ACKNOWLEDGEMENTS

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This publication is based on data collected by or on behalf of the Healthcare Quality Improvement Partnership, who have no responsibility or liability for the accuracy, currency, reliability and/or correctness of this publication.

AUTHOR CONTRIBUTIONS

TM and JvdM derived the research question. AK, IGU, DC and LBM supported data collection directly and JS, TM and JvdM advised. RG performed the analyses and wrote the manuscript. All authors contributed to and approved the manuscript.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ETHICAL APPROVAL

The study is exempt from UK National Research Ethics Service (NRES) approval because it involved the analysis of an existing data set of anonymised data for service evaluation. Based on the Health Research Authority's guidance, audits are regulated as standard clinical practice outside of the Research Ethics Service[37]. Approvals for the use of anonymised HES data were obtained as part of the standard HES data access process.

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1
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3 NHS England, the Welsh Government and, with some with some individual projects, other devolved
4 administrations and crown dependencies (www.hqip.org.uk/national-programmes).
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7 **DATA SHARING**

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9 The National HMB Audit was identified as an eligible audit in the Prime Minister's transparency
10 agenda in 2011. The provider-level data from the second and third annual report are now available.
11 For more information, please visit the National HMB Audit data transparency page
12 (<https://goo.gl/pHwFjv>). The full HMB audit data are available on request from the Healthcare
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15 Quality Improvement Partnership.
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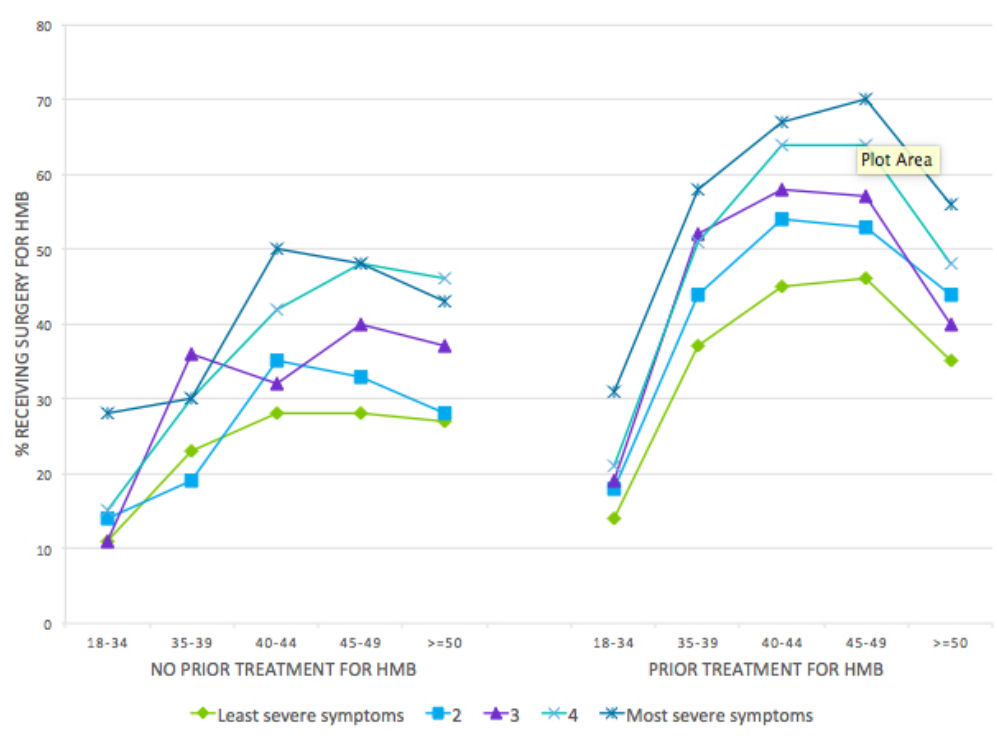
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Figure legend

Figure 1: Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile

For peer review only



Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile

214x153mm (72 x 72 DPI)

Appendix S1**Table S1: Codes used to define surgery for HMB and underlying conditions**

Procedures for HMB	OPCS-4 codes
Hysterectomy (abdominal or vaginal)	Q07, Q08
Endometrial ablation	Q16, Q17
Myomectomy	Q09.2, Y75.2 or Y08.4
Uterine artery embolization	L713 or Y53+Z96.6
Underlying condition(s)	ICD-10 codes
Uterine fibroids/polyps (without endometriosis)	D25, N84.0/N84.1
Endometriosis	
<i>Endometriosis only</i>	<i>N80.0</i>
<i>Endometriosis and uterine fibroids</i>	<i>N80.0 and D25</i>
<i>Endometriosis and polyps</i>	<i>N80.0 and N84.0/N84.1</i>
No obvious cause	N92.0, N92.1, N92.4, N92.5, N92.6, N93.8, N93.9

Appendix S2

The Index of Multiple Deprivation (IMD) is an area-level measure of relative deprivation available in both HES and PEDW. For analysis, we used IMD quintiles (1 = most deprived areas, 5 = least deprived areas). The methods used to calculate IMD scores in each UK country are similar but not directly comparable. We used a combined measure for England and Wales where those in each country-specific quintile were assigned to the same quintile in the combined measure: this preserved women's relative deprivation position within each country. The distribution of sociodemographic characteristics and symptom severity and duration by level of deprivation did not vary significantly by country (data not shown).

Appendix S3

Symptom severity scores were derived from an adapted version of the Uterine Fibroid Symptom and Quality of Life (UFS-QOL) questionnaire[22]. Of five candidate questionnaires evaluated, only the UFS-QOL could be used throughout the care pathway and was psychometrically strong[4]. The UFS-QOL was therefore adapted for HMB and a UK population. We conducted semi-structured interviews with women ($n = 7$) and clinicians ($n = 5$) and a mini focus group ($n = 3$) with local Heavy Menstrual Bleeding Audit coordinators to determine suitable alternative words to describe HMB, and to identify words not clearly understood in UK English. Based on this we changed the wording throughout the questionnaire to refer to 'heavy menstrual bleeding' (i.e. heavy periods) rather than 'fibroids', changed 'checking' to 'ticking'; 'soiling' to 'staining'; 'blue' to 'low'; and 'wiped out' to 'exhausted'. The adapted version performed acceptably in a psychometric evaluation and has been used to report the audit data[2, 4, 13, 17]. The UFS-QOL consists of eight symptom items which are scored to produce a severity subscale which we use in this paper[4].

Appendix S4

Table S4: Underlying conditions by surgical procedure received

Surgical procedure received*	Underlying condition(s) %		
	Uterine fibroids and/or polyps (no endometriosis)	Endometriosis (with or without uterine fibroids/polyps)	No obvious cause
Hysterectomy (n=2234)	52.1	21.3	26.5
Endometrial ablation (n=3506)	44.8	2.3	52.9
Uterine artery embolization (n=128)	96.1	2.3	1.6
Myomectomy (n=177)	95.5	3.4	1.1

Table 4 presents row percentages among those with both diagnosis/diagnoses and procedure recorded.

* Last likely surgical procedure received according to clinical experience and protocol.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Line number(s)
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	25-49
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	56-81
Objectives	3	State specific objectives, including any prespecified hypotheses	78-81
Methods			
Study design	4	Present key elements of study design early in the paper	85-90
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	87-90
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	86-90
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	107-144
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	92-100, 137-139
Bias	9	Describe any efforts to address potential sources of bias	299-305
Study size	10	Explain how the study size was arrived at	172-174
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	108-135, 137-144
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	147-157
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	153-157
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	172-174
		(b) Give reasons for non-participation at each stage	172-174
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	172-181, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1

Outcome data	15*	Report numbers of outcome events or summary measures	189-191, Table 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2
		(b) Report category boundaries when continuous variables were categorized	Table 1, Table 2
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	220-224
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	298-312
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	230-273
Generalisability	21	Discuss the generalisability (external validity) of the study results	302-305
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	159-163

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Factors associated with receiving surgical treatment for menorrhagia in England and Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-024260.R1
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Primary Subject Heading:	Obstetrics and gynaecology
Secondary Subject Heading:	Epidemiology, Health services research, Surgery
Keywords:	GYNAECOLOGY, AUDIT, EPIDEMIOLOGY

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3 **Factors associated with receiving surgical treatment for menorrhagia in England and**
4 **Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.**
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24 Running title: Determinants of surgery for heavy menstrual bleeding

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ABSTRACT

Objective To examine factors associated with receiving surgery for heavy menstrual bleeding (HMB) in England and Wales.

Design National cohort study

Setting NHS hospitals

Participants Women with HMB aged 18-60 who had a new referral to secondary care.

Methods Patient-reported data linked to administrative hospital data. Risk ratios (RR) estimated using multivariable Poisson regression.

Primary outcome measure Surgery within one year of first outpatient clinic visit.

Results 14,545 women were included. At their first clinic visit, mean age was 42 years, mean symptom severity score was 62 (scale ranging from 0 [least] to 100 [most severe]), 73.9% of women reported having symptoms for >1 year, and 30.4% reported no prior treatment in primary care. One year later, 42.6% had received surgery. Of these, 57.8% had endometrial ablation and 37.2% hysterectomy. Women with more severe symptoms were more likely to receive surgery (most versus least severe quintile, 33.1% v. 56.0%; RR:1.6, 95% CI:1.5 to 1.7). Surgery was more likely among those who reported prior primary care treatment compared to those who did not (48.0% v. 31.1%; RR:1.5, 95% CI:1.4 to 1.6). Surgery was less likely among Asian and more likely among black women, compared to white women. Surgery was not associated with socioeconomic deprivation.

Conclusions Receipt of surgery for HMB depends on symptom severity and prior treatment in primary care. Referral pathways should be locally audited to ensure women with HMB receive care that addresses their individual needs and preferences, especially for those who do not receive treatment in primary care.

Funding The National Heavy Menstrual Bleeding (HMB) Audit was funded by the Healthcare Quality Improvement Partnership as part of the National Clinical Audit and Patient Outcomes Programme, contract number HQIP NCA 004.

Keywords Heavy menstrual bleeding, deprivation, ethnicity, health inequalities, hysterectomy, endometrial ablation

Article Summary

Strengths and limitations of this study

- This study is the first to examine initial treatments for Heavy Menstrual Bleeding immediately after referral to secondary care
- The inclusion of patient-reported symptom severity addresses a knowledge gap about the importance of how women feel about their heavy menstrual bleeding on the treatment they receive
- As the data were collected by a national audit in England and Wales the sample is relatively large, allowing comparisons between minority ethnic groups
- Even though the sample size is large, the National HMB Audit recruited approximately 30% of eligible women. Whilst the recruitment rate was not as high as desired, the characteristics of those recruited were broadly representative of the UK population in terms of ethnicity and age
- Using audit data linked to administrative hospital data also allowed comparisons between socioeconomic groups

INTRODUCTION

Heavy menstrual bleeding (HMB) affects one in four women of reproductive age. It is a condition that impairs the quality of life of many women who are otherwise healthy[1]. Every year in England and Wales, an estimated 50,000 women with HMB are referred to secondary care provided by the National Health Service (NHS)[2], which constitutes approximately 20% of referrals to specialist gynaecology services[3], and approximately 28,000 women undergo surgical treatment[4]. In the majority of women, the cause of their HMB is not known[5].

Medical treatments for HMB include (oral) medication and the hormone-releasing intrauterine device (LNG-IUS). Surgical treatment, including endometrial ablation (EA) and hysterectomy, is an option if medical treatment is ineffective or undesirable[1, 5, 6]. A systematic review of randomised clinical trials suggests that EA, hysterectomy and LNG-IUS all reduce HMB and are more acceptable to most women than oral medication[1]. The review found that surgical treatment is most effective over the short term although the quality of included trials was limited[1]. Hysterectomy will stop HMB but around 3% of women experience potentially serious postoperative complications[7]. EA and LNG-IUS appear to be safe, acceptable and effective treatments for HMB although some women who have EA will require a repeat procedure[1, 8-10].

Since the early 1990s, there has been a steady increase in the use of EA rather than hysterectomy in women who have surgical treatment for HMB[11]. Since 2004, more EA procedures than hysterectomies have been conducted in England[4, 11-13]. Previous studies have found regional variations in rates of surgery for HMB in England large enough to suggest scope for improvements in HMB management[3, 12, 14, 15]. In addition, women from socioeconomically deprived areas report more severe HMB at their first outpatient gynaecology visit[16] and higher rates of hysterectomy for HMB, than women living in the least deprived areas[8], potentially reflecting inequitable access to secondary care and use of surgery for HMB.

In this paper, we investigate the factors that determine whether women who have been referred to secondary care for HMB get surgical treatment. We use patient-reported data from the National HMB Audit linked to administrative hospital databases: Hospital Episode Statistics (HES) and the Patient Episode Database for Wales (PEDW). We explore the impact that symptom severity, treatment received in primary care and patient characteristics including age, ethnicity and socioeconomic deprivation have on the chance that women receive surgical treatment in the first year after their referral to secondary care.

METHODS

Data

Women aged between 18 and 60 years in England and Wales who had a new referral for HMB to a gynaecology outpatient clinic of an NHS hospital were eligible to participate in the National HMB Audit[2, 4, 13, 17]. The National HMB Audit took place between 2010 and 2014, with an estimated recruitment rate of 32% [2, 17]. National HMB Audit data were linked at the patient-level (by a trusted third party) to HES and PEDW, administrative databases containing records of all admissions to NHS hospitals in England and Wales to provide data on treatments received in secondary care.

Measures

Women were considered to have had a surgical procedure for HMB (the study outcome) if any HES/PEDW procedure field described abdominal or vaginal hysterectomy, EA, myomectomy or uterine artery embolisation (UAE), recorded using UK Office for Population Censuses and Surveys classification (OPCS), 4th revision codes[18]. For women who underwent a surgical procedure for HMB, information on underlying conditions was available from HES/PEDW, recorded using International Classification of Diseases, 10th revision (ICD-10) codes[19]. These were grouped as: “endometriosis (with or without uterine fibroids or polyps)”, “uterine fibroids and/or polyps (no endometriosis)” and “no obvious cause”. Women without codes for uterine fibroids, polyps or endometriosis, but with code(s) indicating excessive or irregular menstrual bleeding, were classed as having no obvious cause of their HMB. The codes used to define surgery and underlying conditions are detailed in the supporting information (Appendix S1).

Women who gave informed consent completed a baseline questionnaire (in the gynaecology outpatient clinic of an NHS hospital before their consultation) on age (categorised as 18-34, 35-39, 40-44, 45-49, 50-60), ethnicity (grouped as “white”, “Asian or Asian British”, “black or black British” and “other” (combining “Chinese”, “mixed” and “other”), duration and severity of HMB symptoms, obstetric history (analysed as “nulliparous” or “parous”), prior HMB treatment and co-morbidities. To capture co-morbidities (grouped: 0, 1 and 2 or more) women were asked “Have you been told by a doctor that you have any of the following?” with the response options: heart disease, high blood pressure, lung disease, diabetes, depression, thyroid disorder, kidney disease, and cancer (in the last 5 years). Body mass index (BMI, grouped: <25, 25-30, and ≥30) was derived from self-reported height and weight[20]. The Index of Multiple Deprivation (IMD), an area-level measure of relative socioeconomic deprivation, was extracted from HES/PEDW and analysed as quintiles (1= most deprived areas, 5= least deprived areas) according to the national distribution. Further information is given in the supporting information (Appendix S2).

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4 Women were asked: “How long have you had symptoms of HMB?” (“2 months or less”, “>2 months
5 but <1 year”, “>1 year” or “don’t know”), analysed as “<1 year”, “≥1 year”. Symptom severity scores
6 were derived from the Uterine Fibroid Symptom and Quality of Life (UFS-QoL) questionnaire adapted
7 for the HMB Audit[21]. Scores could range from 0 (least severe, best possible score) to 100 (most
8 severe, worst possible score), analysed in quintiles. Further information is provided in the supporting
9 information (Appendix S3).

15 **Statistical analysis**

16 We present descriptive statistics (means and proportions) of patient and HMB-related characteristics
17 and treatment received in the year after the first outpatient clinic visit for HMB. For descriptive
18 statistics, those who had more than one surgical treatment in the year following their first outpatient
19 clinic visit were categorised by the last likely surgical treatment (according to clinical experience and
20 protocol).

21 We used multivariable Poisson regression with robust standard errors to estimate risk ratios (RR)
22 that represent the associations between patient and HMB-related characteristics reported by women
23 at their first gynaecology outpatient clinic visit and receiving surgical treatment in the first year
24 following this[22]. We chose to report risk ratios rather than odds ratios because the latter are more
25 difficult to interpret, especially if the proportions being compared are relatively large. In a secondary
26 analysis, we examined associations between these characteristics and whether women received EA
27 or hysterectomy among those having one of these procedures. Women who received both EA and a
28 hysterectomy in the year following their first outpatient visit (n=699) were included in the EA
29 treatment group for this analysis because EA was the first procedure. We tested for interaction
30 between both ethnicity and BMI and HMB-related condition.

31 Levels of missing data were low (<3%) for the majority of variables but 7% of women were missing
32 ethnicity data and 23% were missing height or weight data required to derive BMI (Table 1). For
33 regression analyses missing values were imputed using multiple imputation by chained equations[23]
34 with statistical coefficients obtained using ten imputed datasets, pooled using Rubin’s rules[24].
35 Analyses were performed in Stata version 15.

53 **Patient involvement**

54 The national HMB Audit was supported by a clinical reference group which included lay members
55 and patient representatives. The lay members and patient representatives provided input to the
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3 design of the study and interpretation of the results, and contributed to the dissemination plan. The
4 clinical reference group met on a regular basis for the duration of the audit. Women with HMB also
5 participated in a pilot study to assess the logistical issues of the prospective national HMB audit. This
6 informed the design of written materials and key procedures for the audit. Ninety-six women with
7 HMB also participated in interviews to refine and psychometrically evaluate the adapted UFS-QOL
8 instrument.
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14 RESULTS

15 Description of the cohort

16 15,325 eligible women completed the questionnaire at their first visit to a gynaecology outpatient
17 clinic. 14,545 women (94.9%) could be linked to HES or PEDW for information on surgical treatments
18 and deprivation. Of these women, 11.6% (n=1,578) reported ethnic minority backgrounds (black,
19 n=571; Asian, n=731), with the distribution of ethnicities broadly representative of the UK
20 population[25]. The mean age of women was 42.4 years (standard deviation [SD]: 7.6) and the mean
21 BMI was 27.3 kg/m² (SD: 5.4) (Table 1). The majority of women had given birth (83.1%, n=11,727)
22 and one third reported co-morbidities (33.8%, n=4,925). The mean score for symptom severity at
23 first outpatient clinic visit was 61.8 (SD: 21.3) and this score ranged from 34.3 (SD: 10.8) in the least
24 severe symptoms quintile, to 93.8 (SD: 5.1) in the most severe symptoms quintile. Almost three-
25 quarters of women reported HMB symptoms for more than one year and nearly a third (30.4%)
26 reported that they had not received medical treatment for their HMB in primary care before referral
27 (Table 1).
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38 Treatment received in the year following first outpatient clinic visit

39 Approximately forty percent of women received surgical treatment for HMB in the year following
40 their first outpatient clinic visit (42.6%, Table 2), with most of those undergoing EA (57.8%) or
41 hysterectomy (37.2%). The small number of women receiving UAE (n=129) or myomectomy (n=179)
42 precluded further analysis of these groups separately.
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Table 1 Characteristics of women at their initial HMB outpatient visit

Denominator (n=14545)	% (n) unless otherwise stated
Age (years), mean (sd)	42.4 (7.6)
Age group (years)	
18-34	14.8 (2155)
35-39	12.9 (1881)
40-44	26.6 (3870)
45-49	31.3 (4554)
50-60	14.3 (2085)
Ethnicity	
White	88.4 (11987)
Asian or Asian British	4.2 (731)
Black or black British	5.4 (571)
Other	2.0 (276)
Missing	6.7 (980)
Socioeconomic deprivation (IMD*)	
Quintile 1 (most deprived)	23.5 (3418)
Quintile 2	21.7 (3159)
Quintile 3	20.2 (2944)
Quintile 4	18.7 (2720)
Quintile 5 (least deprived)	15.8 (2304)
BMI, mean (sd)	27.3 (5.4)
BMI categories	
<25	39.5 (4424)
25-30	31.7 (3569)
≥30	28.8 (3226)
Missing	23.0 (3346)
Parity	
Nulliparous	16.9 (2378)
Parous	83.1 (11727)
Missing	3.0 (440)
Number of comorbidities	
0	66.1 (9620)
1	25.4 (3701)
≥2	8.4 (1224)
Overall health	
Excellent/very good	37.4 (5356)
Good	42.0 (6009)
Fair/poor	20.7 (2958)
Missing	1.5 (222)
Symptom severity at baseline	
Severity score at baseline (overall), mean (sd)	61.8 (21.3)
Severity score at baseline (quintiles), mean (sd)	
Quintile 1 (least severe)	34.3 (10.8)
Quintile 2	56.5 (4.4)
Quintile 3	68.5 (2.6)
Quintile 4	78.9 (3.4)
Quintile 5 (most severe)	93.8 (5.1)
Duration of symptoms	
<1 year	26.1 (3677)
≥1 year	73.9 (10434)
Missing	3.0 (434)
Prior treatment for HMB in primary care	
No	30.4 (4296)
Yes	69.6 (9819)
Missing	3.0 (430)

*IMD=Index of Multiple Deprivation, an area-level measure of relative socioeconomic deprivation.

Receipt of surgical treatment by women's characteristics

Symptom severity at first outpatient clinic visit and medical treatment received for HMB in primary care were associated with surgical treatment received in the year following first outpatient clinic visit. The rate of surgical treatment was higher among those reporting the most severe symptoms than among those reporting the least severe symptoms (RR comparing the most to the least severe symptoms quintile 1.5, 95% CI: 1.4 to 1.6, Table 2). Receipt of surgery was highest among those aged 40-44 and 45-49 years, where half (49.9%) had received surgery, and lowest among women aged 18-34 years (18.4%, Table 2), despite similar mean symptom severity scores for the 18-34 year olds (63.3, SD: 20.8) and the 40-45 and 45-49 year olds (62.7 SD: 21.2 and 61.6, SD: 21.2, data not shown).

The rate of surgery was higher among women who reported prior treatment in primary care than among those who did not (RR 1.4, 95% CI: 1.4 to 1.5, Table 2), and among those who reported a longer duration of symptoms at their initial outpatient visit for HMB (RR 1.3, 95% CI: 1.2 to 1.4). Among women who reported that they had received prior treatment in primary care, the proportion that received surgery was highest among those reporting the most severe symptoms in all age groups, and use of surgery increased with age up to age 40-49 years (Figure 1). Among those who reported that they had not received prior treatment in primary care these patterns were broadly similar, although the relationship between symptom severity and surgery was less marked for women age 35-39 years where a similar proportion of women in each of the three most severe symptoms quintiles received surgery (Figure 1). The proportion of women who received surgery was markedly lower among women aged between 18-34 years and who reported the least severe symptoms, than for women aged 45-49 years and who reported the most severe symptoms, among both those who had, and those who had not, received treatment in primary care. Among the women who reported having had prior treatment in primary care, the proportion receiving surgery among 18-34 year olds with symptoms in the least severe quintile was 14% compared with 70% of 45-49 year olds with symptoms in the most severe quintile. Corresponding percentages among those who reported no prior treatment in primary care were 11% and 48% respectively (Figure 1). Adjusting for patient characteristics had only a small impact on the magnitude of the associations observed between both symptom severity and prior treatment in primary care and the rate of surgery.

Figure 1 (Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile) about here

Other characteristics were associated with the receipt of surgery although the magnitude of the associations was smaller than for symptom severity or prior treatment. Higher rates of surgical treatment were seen in women who had given birth, and those who had a higher BMI (25-30 or ≥ 30).

Compared to white women, women reporting an Asian background had lower rates of surgery (RR 0.8, 95% CI: 0.7 to 0.9), whilst women of black ethnic backgrounds had higher rates (RR 1.1, 95% CI: 1.0 to 1.2, Table 2). Socioeconomic deprivation was not associated with surgical treatment.

Table 2 Characteristics associated with receiving surgical treatment in the first year following an initial outpatient visit for HMB

Denominator (n=14545)	Received surgical treatment	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	42.6% (6195)				
Age group (years)					<0.0001***
18-34	18.4% (396)	0.37	0.37	0.33, 0.41	
35-39	41.1% (774)	0.82	0.81	0.75, 0.86	
40-44	49.9% (1932)	1.00	0.96	0.92, 1.01	
45-49	49.9% (2273)	1	1	-	
50-60	39.3% (820)	0.79	0.78	0.73, 0.83	
Ethnicity					0.0036**
White	42.9% (5146)	1	1	-	
Asian or Asian British	30.8% (176)	0.74	0.82	0.71, 0.93	
Black or black British	49.0% (358)	1.14	1.10	1.00, 1.21	
Other	39.1% (108)	0.91	0.98	0.84, 1.14	
Socioeconomic deprivation (IMD[^])					0.2776
Quintile 1 (most deprived)	41.7% (1424)	1	1	-	
Quintile 2	41.2% (1300)	0.99	0.97	0.91, 1.03	
Quintile 3	42.9% (1263)	1.03	1.02	0.96, 1.09	
Quintile 4	44.5% (1211)	1.07	1.03	0.97, 1.10	
Quintile 5 (least deprived)	43.3% (997)	1.04	1.02	0.95, 1.09	
BMI categories					0.0026**
≤25	38.8% (1715)	1	1	-	
25-30	46.1% (1636)	1.19	1.09	1.04, 1.14	
≥30	45.9% (1480)	1.18	1.06	1.00, 1.11	
Parity					0.0076*
Nulliparous	32.0% (760)	1	1	-	
Parous	44.8% (5252)	1.40	1.09	1.02, 1.17	
Number of comorbidities					0.0712
0	42.1% (4049)	1	1	-	
1	43.7% (1618)	1.04	0.97	0.92, 1.02	
≥2	43.1% (528)	1.02	0.92	0.85, 1.00	
Severity score at baseline					<0.0001***
Quintile 1 (least severe)	33.1% (1233)	1	1	-	
Quintile 2	39.9% (1437)	1.20	1.13	1.06, 1.21	
Quintile 3	43.3% (1001)	1.31	1.24	1.16, 1.33	
Quintile 4	49.6% (1292)	1.50	1.39	1.29, 1.47	
Quintile 5 (most severe)	56.0% (1118)	1.69	1.53	1.43, 1.64	
Duration of symptoms at baseline					<0.0001***
<1 year	32.3% (1186)	1	1	-	
≥1 year	46.6% (4867)	1.45	1.28	1.21, 1.36	
Prior treatment for HMB in primary care					<0.0001***
No	31.1% (1335)	1	1	-	
Yes	48.0% (4709)	1.54	1.44	1.36, 1.52	

Footnotes: [^]IMD=Index of Multiple Deprivation, an area-level measure of relative socioeconomic deprivation. Multivariable model adjusted for age group, ethnicity, IMD, BMI, parity, number of comorbidities, baseline symptom severity and HMB treatment received in primary care. Categories compared using the Wald test, *p<0.05, **p<0.01, ***p<0.001

Type of first surgical treatment received by women's characteristics

Symptom severity was associated with having hysterectomy rather than EA (Table 3). Among women who underwent EA or a hysterectomy, the rate of hysterectomy was higher among those reporting the most severe symptoms compared to those reporting the least severe symptoms (RR comparing most vs. least severe symptoms quintile 1.6, 95% CI: 1.3 to 1.8). Women who reported a longer duration of symptoms at their initial outpatient visit for HMB were more likely to have undergone a hysterectomy than EA (RR 1.2, 95% CI: 1.1 to 1.4). Those who were obese (BMI 25-30) had higher rates of hysterectomy than those of a healthy weight (BMI <25) (RR 1.2, 95% CI: 1.1 to 1.3). Adjusting for patient characteristics had only a small impact on the magnitude of the associations observed between both symptom severity, prior treatment in primary care and underlying condition and the likelihood of receiving hysterectomy.

Women with an underlying condition diagnosed were more likely to have received a hysterectomy than women with no obvious cause of their HMB diagnosed. Women were twice as likely to have had a hysterectomy (RR 2.1, 95% CI: 1.9 to 2.4) if they had a diagnosis of uterine fibroids or polyps (without endometriosis) recorded, and four times more likely if they had endometriosis (with or without uterine fibroids or polyps) (RR 3.9, 95% CI: 3.4 to 4.5, Table 3). Of women who received a hysterectomy, 52.1% had a diagnosis of uterine fibroids or polyps (without endometriosis) recorded and 21.3% had endometriosis (with or without uterine fibroids or polyps). In contrast, more than half of women undergoing EA had no obvious cause of their HMB diagnosed (52.9%; Appendix S4). There was no significant interaction between either ethnicity or BMI and underlying condition although the power to detect a significant interaction in the complex relationship between ethnicity and HMB-related conditions would be small.

Table 3 Characteristics associated with receiving hysterectomy (compared to endometrial ablation) in the first year following an initial outpatient visit for HMB

Denominator (n=5920)	Received hysterectomy	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	27.1% (1606)				
Age group (years)					0.0713
18-34	17.4% (62)	0.58	0.79	0.61, 1.03	
35-39	25.5% (181)	0.83	0.84	0.71, 0.99	
40-44	25.7% (478)	0.88	0.91	0.82, 1.01	
45-49	29.9% (652)	1	1	-	
50-60	29.1% (233)	0.97	0.88	0.77, 1.01	
Ethnicity					0.1184
White	26.8% (1350)	1	1	-	
Asian or Asian British	27.7% (44)	1.04	0.75	0.91, 1.00	
Black or black British	34.9% (88)	1.30	1.13	1.09, 1.39	
Other	32.6% (30)	1.20	0.88	0.62, 1.26	
Socioeconomic deprivation (IMD^Δ)					0.3004
Quintile 1 (most deprived)	28.2% (378)	1	1	-	
Quintile 2	24.4% (298)	0.86	0.93	0.80, 1.08	
Quintile 3	26.3% (319)	0.93	0.97	0.84, 1.11	
Quintile 4	29.4% (344)	1.04	1.01	0.94, 1.24	
Quintile 5 (least deprived)	27.4% (267)	0.97	1.03	0.89, 1.19	
BMI categories					0.0450*
≤25	24.7% (399)	1	1	-	
25-30	29.7% (465)	1.20	1.15	1.03, 1.29	
≥30	28.0% (400)	1.13	1.08	0.96, 1.21	
Parity					0.2340
Nulliparous	25.4% (165)	1	1	-	
Parous	27.4% (1404)	1.09	0.95	0.82, 1.10	
Number of comorbidities					0.3223
0	27.0% (1039)	1	1	-	
1	26.5% (414)	0.98	0.97	0.86, 1.08	
≥2	29.9% (153)	1.11	1.12	0.95, 1.32	
Severity score at baseline (quintiles)					<0.0001***
Quintile 1 (least severe)	22.0% (251)	1	1	-	
Quintile 2	26.0% (362)	1.18	1.17	1.00, 1.37	
Quintile 3	28.2% (271)	1.28	1.26	1.07, 1.49	
Quintile 4	26.3% (326)	1.20	1.23	1.05, 1.43	
Quintile 5 (most severe)	33.9% (365)	1.54	1.57	1.34, 1.83	
Duration of symptoms at baseline					0.0078**
<1 year	24.2% (273)	1	1	-	
≥1 year	28.0% (1304)	1.16	1.20	1.05, 1.36	
Prior treatment for HMB in primary care					0.0005***
No	30.8% (389)	1	1	-	
Yes	26.2% (1185)	0.86	0.80	0.71, 0.89	
HMB-related condition					<0.0001***
No obvious cause	14.7% (360)	1	1	-	
Uterine fibroids and/or polyps (no endometriosis)	30.6% (847)	1.99	2.11	1.86, 2.41	
Endometriosis (with or without uterine fibroids/polyps)	59.5 (332)	3.79	3.91	3.41, 4.48	

^ΔIMD=Index of Multiple Deprivation, an area-level measure of relative socio-economic deprivation. Multivariable model adjusted for age group, ethnicity, IMD, baseline BMI, parity and number of comorbidities, baseline symptom severity and HMB treatment received in primary care. 699 women received both EA and a hysterectomy in the year following their first outpatient visit. Here they are included in the EA group as this represents the first surgical treatment choice. Categories compared using the Wald test, *p<0.05, **p<0.01, ***p<0.001

DISCUSSION

Main findings

Approximately 40% of women referred to secondary care for HMB in England and Wales received a form of surgical treatment in the first year following their initial outpatient clinic visit in secondary care. The rate of surgery was 50% higher among women who reported having received treatment in primary care prior to their first outpatient visit than among those who did not. In addition, more severe symptoms were also associated with higher rates of surgery, and with receiving hysterectomy rather than EA. Women with an Asian ethnic background had lower rates of surgery, whilst women with a black ethnic background had higher rates of surgery, after adjusting for symptom severity than women with a white ethnic background. Socioeconomic deprivation was not associated with the rate of surgery.

Interpretation

We previously reported that socioeconomic deprivation influences access to secondary care for HMB[16] as for other conditions[26]. However, our findings illustrate that once women reach secondary care services, their receipt of surgical treatment depends mainly on their symptom severity, and whether or not they have received treatment in primary care prior to their referral. Nearly one-third of women reported that they had no treatment for their HMB in primary care and the chance that these women had surgery within the first year after their referral was considerably lower than for women who had prior treatment in primary care. National guidelines for the management of HMB in the UK indicate that hormonal or non-hormonal medical therapy can be started in primary care. Our findings suggest that this may reduce the number of potentially inappropriate referrals to specialist services[5]. However, immediate referral can be appropriate for women seeking further diagnostic tests and reassurance, even without medical treatment[6, 27-29]. In addition, some women may be referred immediately because they do not wish to take drug treatment, or it is anticipated that treatment available in primary care may fail to control their symptoms to an acceptable level[5].

We also observed variation in surgery rates by ethnic background, after accounting for symptom severity. Compared to white women, women reporting Asian ethnicity had lower rates of surgery, and women reporting black ethnicity had higher rates of surgery. These differences may reflect inequitable use of surgical care, or may be attributable to variations according to ethnicity in the prevalence of HMB-related conditions (such as fibroids), cultural norms (for example, accepting heavy periods as normal), and patient preferences for treatment, which have been reported

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3 previously [30-32]. We observed higher surgery rates among overweight and obese women, which
4 may also be attributable to the prevalence of HMB-related conditions such as fibroids[33, 34].
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7 Since 2004, more EA procedures than hysterectomies have been conducted in England[11, 13].
8 However, little was previously known about the determinants of hysterectomy compared to EA. We
9 show that the choice of procedure is strongly linked to symptom severity and HMB-related
10 conditions, with a higher proportion of those who had worse symptoms, and those who had an
11 underlying condition (uterine fibroids, polyps or endometriosis) diagnosed receiving a hysterectomy.
12 All women should have the opportunity to discuss the benefits and risks of both EA and
13 hysterectomy, to help them make informed decisions about their treatment[5].
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20 Despite the existence of national guidelines for the management of HMB in the UK, developed by the
21 National Institute for Health and Care Excellence and the Royal College of Obstetricians and
22 Gynaecologists[5, 30, 35], only a minority of hospitals in England and Wales reported local protocols
23 on the management of women with HMB to the National HMB Audit[36]. Local auditing of referral
24 pathways could help to ensure that referrals to secondary care without prior treatment in primary
25 care reflect patient-centred care.
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31 **Strengths and limitations**

32 A number of studies have reported treatment outcomes for women with HMB[9, 15] but our study is
33 the first national study reporting on initial treatments for HMB immediately after referral to
34 secondary care. It is also the first to examine the impact of sociodemographic factors and symptoms
35 on the chance that women with HMB will receive surgical treatment. We used data collected by a
36 national clinical audit in England and Wales, linked to administrative hospital data, which produced a
37 large sample. We estimated that the National HMB Audit recruited approximately a third of all
38 eligible women. Whilst the recruitment rate was not as high as desired, the characteristics of those
39 recruited were broadly representative of the UK population in terms of ethnicity and age[37, 38] and
40 the sample size was large. Information on women's fertility intentions was not available, so we could
41 not explore whether this influenced observed associations between age and ethnicity and receiving
42 surgery.
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51 **Conclusions**

52 Once women reach secondary care services, the chance that they will have surgical treatment within
53 a year is strongly linked to their symptom severity and age and also, albeit less strongly, to their
54 parity, BMI and ethnic background. Having received treatment in primary care before referral also
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3 increases the likelihood of surgery after referral. Our finding that a third of women were referred
4 without prior treatment in primary care may raise questions about whether these referrals were
5 appropriate. However, some women may benefit from referral for advice and further assessment, or
6 may seek immediate surgical treatment. We recommend that referral pathways between primary
7 and secondary care should be locally audited to ensure that the care that women with HMB receive
8 addresses their individual needs and preferences.
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For peer review only

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AUTHOR CONTRIBUTIONS

TM and JvdM derived the research question. AK, IGU, DC and LBM supported data collection directly and JS, TM and JvdM advised. RG performed the analyses and wrote the manuscript. All authors contributed to and approved the manuscript.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ETHICAL APPROVAL

The study is exempt from UK National Research Ethics Service (NRES) approval because it involved the analysis of an existing data set of anonymised data for service evaluation. Based on the Health Research Authority's guidance, audits are regulated as standard clinical practice outside of the Research Ethics Service. Approvals for the use of anonymised HES data were obtained as part of the standard HES data access process.

FUNDING

The National Audit of Heavy Menstrual Bleeding (HMB) Audit was commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP), contract number HQIP NCA 004. HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing, and National Voices. Its aim is to promote quality improvement in patient outcomes, and in particular, to increase the impact that clinical audit, outcome review programmes and registries have on healthcare quality in England and Wales. HQIP holds the contract to commission, manage and develop the National Clinical Audit and Patient Outcomes Programme (NCAPOP), comprising around 40 projects covering care provided to people with a wide range of medical, surgical and mental health conditions. The programme is funded by

1
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3 NHS England, the Welsh Government and, with some with some individual projects, other devolved
4 administrations and crown dependencies (www.hqip.org.uk/national-programmes).
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7 **DATA SHARING**

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9 The National HMB Audit was identified as an eligible audit in the Prime Minister's transparency
10 agenda in 2011. The provider-level data from the second and third annual report are now available.
11 For more information, please visit the National HMB Audit data transparency page
12 (<https://goo.gl/pHwFjv>). The full HMB audit data are available on request from the Healthcare
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15 Quality Improvement Partnership.
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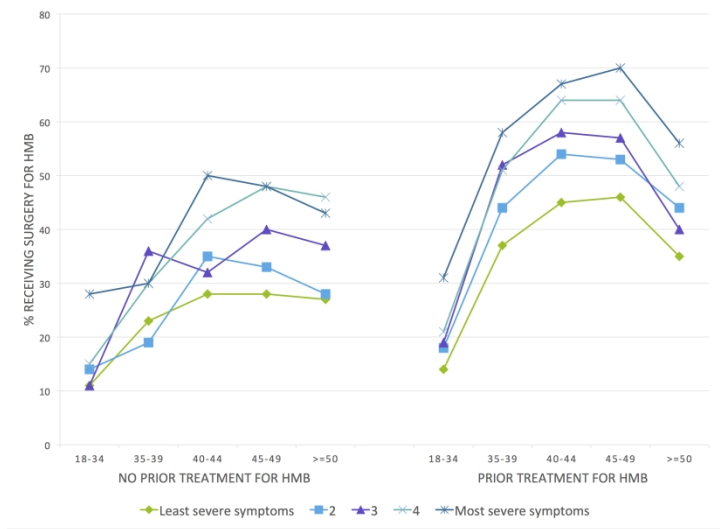
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Figure legend

Figure 1: Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile

For peer review only

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Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile

297x209mm (300 x 300 DPI)

Appendix S1**Table S1: Codes used to define surgery for HMB and underlying conditions**

Procedures for HMB	OPCS-4 codes
Hysterectomy (abdominal or vaginal)	Q07, Q08
Endometrial ablation	Q16, Q17
Myomectomy	Q09.2, Y75.2 or Y08.4
Uterine artery embolization	L713 or Y53+Z96.6
Underlying condition(s)	ICD-10 codes
Uterine fibroids/polyps (without endometriosis)	D25, N84.0/N84.1
Endometriosis	
<i>Endometriosis only</i>	<i>N80.0</i>
<i>Endometriosis and uterine fibroids</i>	<i>N80.0 and D25</i>
<i>Endometriosis and polyps</i>	<i>N80.0 and N84.0/N84.1</i>
No obvious cause	N92.0, N92.1, N92.4, N92.5, N92.6, N93.8, N93.9

Appendix S2

The Index of Multiple Deprivation (IMD) is an area-level measure of relative deprivation available in both HES and PEDW. For analysis, we used IMD quintiles (1 = most deprived areas, 5 = least deprived areas). The methods used to calculate IMD scores in each UK country are similar but not directly comparable. We used a combined measure for England and Wales where those in each country-specific quintile were assigned to the same quintile in the combined measure: this preserved women's relative deprivation position within each country. The distribution of sociodemographic characteristics and symptom severity and duration by level of deprivation did not vary significantly by country (data not shown).

Appendix S3

Symptom severity scores were derived from an adapted version of the Uterine Fibroid Symptom and Quality of Life (UFS-QOL) questionnaire[22]. Of five candidate questionnaires evaluated, only the UFS-QOL could be used throughout the care pathway and was psychometrically strong[4]. The UFS-QOL was therefore adapted for HMB and a UK population. We conducted semi-structured interviews with women ($n = 7$) and clinicians ($n = 5$) and a mini focus group ($n = 3$) with local Heavy Menstrual Bleeding Audit coordinators to determine suitable alternative words to describe HMB, and to identify words not clearly understood in UK English. Based on this we changed the wording throughout the questionnaire to refer to 'heavy menstrual bleeding' (i.e. heavy periods) rather than 'fibroids', changed 'checking' to 'ticking'; 'soiling' to 'staining'; 'blue' to 'low'; and 'wiped out' to 'exhausted'. The adapted version performed acceptably in a psychometric evaluation and has been used to report the audit data[2, 4, 13, 17]. The UFS-QOL consists of eight symptom items which are scored to produce a severity subscale which we use in this paper[4].

Appendix S4

Table S4: Underlying conditions by surgical procedure received

Surgical procedure received*	Underlying condition(s) %		
	Uterine fibroids and/or polyps (no endometriosis)	Endometriosis (with or without uterine fibroids/polyps)	No obvious cause
Hysterectomy (n=2234)	52.1	21.3	26.5
Endometrial ablation (n=3506)	44.8	2.3	52.9
Uterine artery embolization (n=128)	96.1	2.3	1.6
Myomectomy (n=177)	95.5	3.4	1.1

Table 4 presents row percentages among those with both diagnosis/diagnoses and procedure recorded.

* Last likely surgical procedure received according to clinical experience and protocol.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Line number(s)
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	25-49
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	56-81
Objectives	3	State specific objectives, including any prespecified hypotheses	78-81
Methods			
Study design	4	Present key elements of study design early in the paper	85-90
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	87-90
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	86-90
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	107-144
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	92-100, 137-139
Bias	9	Describe any efforts to address potential sources of bias	299-305
Study size	10	Explain how the study size was arrived at	172-174
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	108-135, 137-144
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	147-157
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	153-157
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	172-174
		(b) Give reasons for non-participation at each stage	172-174
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	172-181, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1

Outcome data	15*	Report numbers of outcome events or summary measures	189-191, Table 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2
		(b) Report category boundaries when continuous variables were categorized	Table 1, Table 2
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	220-224
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	298-312
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	230-273
Generalisability	21	Discuss the generalisability (external validity) of the study results	302-305
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	159-163

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Factors associated with receiving surgical treatment for menorrhagia in England and Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.

Journal:	<i>BMJ Open</i>
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Primary Subject Heading:	Obstetrics and gynaecology
Secondary Subject Heading:	Epidemiology, Health services research, Surgery
Keywords:	GYNAECOLOGY, AUDIT, EPIDEMIOLOGY

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Manuscripts

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3 **Factors associated with receiving surgical treatment for menorrhagia in England and**
4 **Wales: findings from a cohort study of the National Heavy Menstrual Bleeding Audit.**
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8 Geary, RS^{1,2}, Gurol-Urganci I^{1,2}, Kiran A^{1,2}, Cromwell DA^{1,2}, Bansi-Matharu L³, Shakespeare J⁴,
9 Mahmood T², van der Meulen J^{1,2}
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26 Running title: Determinants of surgery for heavy menstrual bleeding

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ABSTRACT

Objective To examine factors associated with receiving surgery for heavy menstrual bleeding (HMB) in England and Wales.

Design National cohort study

Setting NHS hospitals

Participants Women with HMB aged 18-60 who had a new referral to secondary care.

Methods Patient-reported data linked to administrative hospital data. Risk ratios (RR) estimated using multivariable Poisson regression.

Primary outcome measure Surgery within one year of first outpatient clinic visit.

Results 14,545 women were included. At their first clinic visit, mean age was 42 years, mean symptom severity score was 62 (scale ranging from 0 [least] to 100 [most severe]), 73.9% of women reported having symptoms for >1 year, and 30.4% reported no prior treatment in primary care. One year later, 42.6% had received surgery. Of these, 57.8% had endometrial ablation and 37.2% hysterectomy. Women with more severe symptoms were more likely to receive surgery (most versus least severe quintile, 33.1% v. 56.0%; RR:1.6, 95% CI:1.5 to 1.7). Surgery was more likely among those who reported prior primary care treatment compared to those who did not (48.0% v. 31.1%; RR:1.5, 95% CI:1.4 to 1.6). Surgery was less likely among Asian and more likely among black women, compared to white women. Surgery was not associated with socioeconomic deprivation.

Conclusions Receipt of surgery for HMB depends on symptom severity and prior treatment in primary care. Referral pathways should be locally audited to ensure women with HMB receive care that addresses their individual needs and preferences, especially for those who do not receive treatment in primary care.

Funding The National Heavy Menstrual Bleeding (HMB) Audit was funded by the Healthcare Quality Improvement Partnership as part of the National Clinical Audit and Patient Outcomes Programme, contract number HQIP NCA 004.

Keywords Heavy menstrual bleeding, deprivation, ethnicity, health inequalities, hysterectomy, endometrial ablation

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3 Article Summary
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5 Strengths and limitations of this study
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- 7 • This study uses national audit data from England and Wales to examine initial treatments
8 for heavy menstrual bleeding immediately after referral to secondary care
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- 10 • The sample is relatively large allowing comparisons between minority ethnic groups
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- 12 • Linking audit data with administrative hospital data also allowed comparisons between
13 socioeconomic groups
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- 15 • The recruitment rate of 30% was not as high as desired, but the characteristics of those
16 recruited were broadly representative of the UK population in terms of ethnicity and age
17
- 18 • The collection of patient-reported symptom severity addresses a knowledge gap about
19 how women feel about their heavy menstrual bleeding and the treatment they receive
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INTRODUCTION

Heavy menstrual bleeding (HMB) affects one in four women of reproductive age. It is a condition that impairs the quality of life of many women who are otherwise healthy[1]. Every year in England and Wales, an estimated 50,000 women with HMB are referred to secondary care provided by the National Health Service (NHS)[2], which constitutes approximately 20% of referrals to specialist gynaecology services[3], and approximately 28,000 women undergo surgical treatment[4]. In the majority of women, the cause of their HMB is not known[5].

Medical treatments for HMB include (oral) medication and the hormone-releasing intrauterine device (LNG-IUS). Surgical treatment, including endometrial ablation (EA) and hysterectomy, is an option if medical treatment is ineffective or undesirable[1, 5, 6]. A systematic review of randomised clinical trials suggests that EA, hysterectomy and LNG-IUS all reduce HMB and are more acceptable to most women than oral medication[1]. The review found that surgical treatment is most effective over the short term although the quality of included trials was limited[1]. Hysterectomy will stop HMB but around 3% of women experience potentially serious postoperative complications[7]. EA and LNG-IUS appear to be safe, acceptable and effective treatments for HMB although some women who have EA will require a repeat procedure[1, 8-10].

Since the early 1990s, there has been a steady increase in the use of EA rather than hysterectomy in women who have surgical treatment for HMB[11]. Since 2004, more EA procedures than hysterectomies have been conducted in England[4, 11-13]. Previous studies have found regional variations in rates of surgery for HMB in England large enough to suggest scope for improvements in HMB management[3, 12, 14, 15]. In addition, women from socioeconomically deprived areas report more severe HMB at their first outpatient gynaecology visit[16] and higher rates of hysterectomy for HMB, than women living in the least deprived areas[8], potentially reflecting inequitable access to secondary care and use of surgery for HMB.

In this paper, we investigate the factors that determine whether women who have been referred to secondary care for HMB get surgical treatment. We use patient-reported data from the National HMB Audit linked to administrative hospital databases: Hospital Episode Statistics (HES) and the Patient Episode Database for Wales (PEDW). We explore the impact that symptom severity, treatment received in primary care and patient characteristics including age, ethnicity and socioeconomic deprivation have on the chance that women receive surgical treatment in the first year after their referral to secondary care.

METHODS

Data

Women aged between 18 and 60 years in England and Wales who had a new referral for HMB to a gynaecology outpatient clinic of an NHS hospital were eligible to participate in the National HMB Audit[2, 4, 13, 17]. The National HMB Audit took place between 2010 and 2014, with an estimated recruitment rate of 32% [2, 17]. National HMB Audit data were linked at the patient-level (by a trusted third party) to HES and PEDW, administrative databases containing records of all admissions to NHS hospitals in England and Wales to provide data on treatments received in secondary care.

Measures

Women were considered to have had a surgical procedure for HMB (the study outcome) if any HES/PEDW procedure field described abdominal or vaginal hysterectomy, EA, myomectomy or uterine artery embolisation (UAE), recorded using UK Office for Population Censuses and Surveys classification (OPCS), 4th revision codes[18]. For women who underwent a surgical procedure for HMB, information on underlying conditions was available from HES/PEDW, recorded using International Classification of Diseases, 10th revision (ICD-10) codes[19]. These were grouped as: “endometriosis (with or without uterine fibroids or polyps)”, “uterine fibroids and/or polyps (no endometriosis)” and “no obvious cause”. Women without codes for uterine fibroids, polyps or endometriosis, but with code(s) indicating excessive or irregular menstrual bleeding, were classed as having no obvious cause of their HMB. The codes used to define surgery and underlying conditions are detailed in the supporting information (Appendix S1).

Women who gave informed consent completed a baseline questionnaire (in the gynaecology outpatient clinic of an NHS hospital before their consultation) on age (categorised as 18-34, 35-39, 40-44, 45-49, 50-60), ethnicity (grouped as “white”, “Asian or Asian British”, “black or black British” and “other” (combining “Chinese”, “mixed” and “other”)), duration and severity of HMB symptoms, obstetric history (analysed as “nulliparous” or “parous”), prior HMB treatment and co-morbidities. To capture co-morbidities (grouped: 0, 1 and 2 or more) women were asked “Have you been told by a doctor that you have any of the following?” with the response options: heart disease, high blood pressure, lung disease, diabetes, depression, thyroid disorder, kidney disease, and cancer (in the last 5 years). Body mass index (BMI, grouped: <25, 25-30, and ≥30) was derived from self-reported height and weight[20]. The Index of Multiple Deprivation (IMD), an area-level measure of relative socioeconomic deprivation, was extracted from HES/PEDW and analysed as quintiles (1= most deprived areas, 5= least deprived areas) according to the national distribution. Further information is given in the supporting information (Appendix S2).

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5 Women were asked: "How long have you had symptoms of HMB?" ("2 months or less", ">2 months
6 but <1 year", ">1 year" or "don't know"), analysed as "<1 year", "≥1 year". Symptom severity scores
7 were derived from the Uterine Fibroid Symptom and Quality of Life (UFS-QoL) questionnaire adapted
8 for the HMB Audit[21]. Scores could range from 0 (least severe, best possible score) to 100 (most
9 severe, worst possible score), analysed in quintiles. Further information is provided in the supporting
10 information (Appendix S3).
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15 16 **Statistical analysis**

17 We present descriptive statistics (means and proportions) of patient and HMB-related characteristics
18 and treatment received in the year after the first outpatient clinic visit for HMB. For descriptive
19 statistics, those who had more than one surgical treatment in the year following their first outpatient
20 clinic visit were categorised by the last likely surgical treatment (according to clinical experience and
21 protocol).
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28 We used multivariable Poisson regression with robust standard errors to estimate risk ratios (RR)
29 that represent the associations between patient and HMB-related characteristics reported by women
30 at their first gynaecology outpatient clinic visit and receiving surgical treatment in the first year
31 following this[22]. We chose to report risk ratios rather than odds ratios because the latter are more
32 difficult to interpret, especially if the proportions being compared are relatively large. In a secondary
33 analysis, we examined associations between these characteristics and whether women received EA
34 or hysterectomy among those having one of these procedures. Women who received both EA and a
35 hysterectomy in the year following their first outpatient visit (n=699) were included in the EA
36 treatment group for this analysis because EA was the first procedure. We tested for interaction
37 between both ethnicity and BMI and HMB-related condition.
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46 Levels of missing data were low (<3%) for the majority of variables but 7% of women were missing
47 ethnicity data and 23% were missing height or weight data required to derive BMI (Table 1). For
48 regression analyses missing values were imputed using multiple imputation by chained equations[23]
49 with statistical coefficients obtained using ten imputed datasets, pooled using Rubin's rules[24].
50 Analyses were performed in Stata version 15.
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56 **Patient involvement**

57 The national HMB Audit was supported by a clinical reference group which included lay members
58 and patient representatives. The lay members and patient representatives provided input to the
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3 design of the study and interpretation of the results, and contributed to the dissemination plan. The
4 clinical reference group met on a regular basis for the duration of the audit. Women with HMB also
5 participated in a pilot study to assess the logistical issues of the prospective national HMB audit. This
6 informed the design of written materials and key procedures for the audit. Ninety-six women with
7 HMB also participated in interviews to refine and psychometrically evaluate the adapted UFS-QOL
8 instrument.
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15 RESULTS

16 Description of the cohort

17 15,325 eligible women completed the questionnaire at their first visit to a gynaecology outpatient
18 clinic. 14,545 women (94.9%) could be linked to HES or PEDW for information on surgical treatments
19 and deprivation. Of these women, 11.6% (n=1,578) reported ethnic minority backgrounds (black,
20 n=571; Asian, n=731), with the distribution of ethnicities broadly representative of the UK
21 population[25]. The mean age of women was 42.4 years (standard deviation [SD]: 7.6) and the mean
22 BMI was 27.3 kg/m² (SD: 5.4) (Table 1). The majority of women had given birth (83.1%, n=11,727)
23 and one third reported co-morbidities (33.8%, n=4,925). The mean score for symptom severity at
24 first outpatient clinic visit was 61.8 (SD: 21.3) and this score ranged from 34.3 (SD: 10.8) in the least
25 severe symptoms quintile, to 93.8 (SD: 5.1) in the most severe symptoms quintile. Almost three-
26 quarters of women reported HMB symptoms for more than one year and nearly a third (30.4%)
27 reported that they had not received medical treatment for their HMB in primary care before referral
28 (Table 1).
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40 Treatment received in the year following first outpatient clinic visit

41 Approximately forty percent of women received surgical treatment for HMB in the year following
42 their first outpatient clinic visit (42.6%, Table 2), with most of those undergoing EA (57.8%) or
43 hysterectomy (37.2%). The small number of women receiving UAE (n=129) or myomectomy (n=179)
44 precluded further analysis of these groups separately.
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Table 1 Characteristics of women at their initial HMB outpatient visit

Denominator (n=14545)	% (n) unless otherwise stated
Age (years), mean (sd)	42.4 (7.6)
Age group (years)	
18-34	14.8 (2155)
35-39	12.9 (1881)
40-44	26.6 (3870)
45-49	31.3 (4554)
50-60	14.3 (2085)
Ethnicity	
White	88.4 (11987)
Asian or Asian British	4.2 (731)
Black or black British	5.4 (571)
Other	2.0 (276)
Missing	6.7 (980)
Socioeconomic deprivation (IMD*)	
Quintile 1 (most deprived)	23.5 (3418)
Quintile 2	21.7 (3159)
Quintile 3	20.2 (2944)
Quintile 4	18.7 (2720)
Quintile 5 (least deprived)	15.8 (2304)
BMI, mean (sd)	27.3 (5.4)
BMI categories	
<25	39.5 (4424)
25-30	31.7 (3569)
≥30	28.8 (3226)
Missing	23.0 (3346)
Parity	
Nulliparous	16.9 (2378)
Parous	83.1 (11727)
Missing	3.0 (440)
Number of comorbidities	
0	66.1 (9620)
1	25.4 (3701)
≥2	8.4 (1224)
Overall health	
Excellent/very good	37.4 (5356)
Good	42.0 (6009)
Fair/poor	20.7 (2958)
Missing	1.5 (222)
Symptom severity at baseline	
Severity score at baseline (overall), mean (sd)	61.8 (21.3)
Severity score at baseline (quintiles), mean (sd)	
Quintile 1 (least severe)	34.3 (10.8)
Quintile 2	56.5 (4.4)
Quintile 3	68.5 (2.6)
Quintile 4	78.9 (3.4)
Quintile 5 (most severe)	93.8 (5.1)
Duration of symptoms	
<1 year	26.1 (3677)
≥1 year	73.9 (10434)
Missing	3.0 (434)
Prior treatment for HMB in primary care	
No	30.4 (4296)
Yes	69.6 (9819)
Missing	3.0 (430)

*IMD=Index of Multiple Deprivation, an area-level measure of relative socioeconomic deprivation.

Receipt of surgical treatment by women's characteristics

Symptom severity at first outpatient clinic visit and medical treatment received for HMB in primary care were associated with surgical treatment received in the year following first outpatient clinic visit. The rate of surgical treatment was higher among those reporting the most severe symptoms than among those reporting the least severe symptoms (RR comparing the most to the least severe symptoms quintile 1.5, 95% CI: 1.4 to 1.6, Table 2). Receipt of surgery was highest among those aged 40-44 and 45-49 years, where half (49.9%) had received surgery, and lowest among women aged 18-34 years (18.4%, Table 2), despite similar mean symptom severity scores for the 18-34 year olds (63.3, SD: 20.8) and the 40-45 and 45-49 year olds (62.7 SD: 21.2 and 61.6, SD: 21.2, data not shown).

The rate of surgery was higher among women who reported prior treatment in primary care than among those who did not (RR 1.4, 95% CI: 1.4 to 1.5, Table 2), and among those who reported a longer duration of symptoms at their initial outpatient visit for HMB (RR 1.3, 95% CI: 1.2 to 1.4). Among women who reported that they had received prior treatment in primary care, the proportion that received surgery was highest among those reporting the most severe symptoms in all age groups, and use of surgery increased with age up to age 40-49 years (Figure 1). Among those who reported that they had not received prior treatment in primary care these patterns were broadly similar, although the relationship between symptom severity and surgery was less marked for women age 35-39 years where a similar proportion of women in each of the three most severe symptoms quintiles received surgery (Figure 1). The proportion of women who received surgery was markedly lower among women aged between 18-34 years and who reported the least severe symptoms, than for women aged 45-49 years and who reported the most severe symptoms, among both those who had, and those who had not, received treatment in primary care. Among the women who reported having had prior treatment in primary care, the proportion receiving surgery among 18-34 year olds with symptoms in the least severe quintile was 14% compared with 70% of 45-49 year olds with symptoms in the most severe quintile. Corresponding percentages among those who reported no prior treatment in primary care were 11% and 48% respectively (Figure 1). Adjusting for patient characteristics had only a small impact on the magnitude of the associations observed between both symptom severity and prior treatment in primary care and the rate of surgery.

Figure 1 (Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile) about here

Other characteristics were associated with the receipt of surgery although the magnitude of the associations was smaller than for symptom severity or prior treatment. Higher rates of surgical treatment were seen in women who had given birth, and those who had a higher BMI (25-30 or ≥ 30).

Compared to white women, women reporting an Asian background had lower rates of surgery (RR 0.8, 95% CI: 0.7 to 0.9), whilst women of black ethnic backgrounds had higher rates (RR 1.1, 95% CI: 1.0 to 1.2, Table 2). Socioeconomic deprivation was not associated with surgical treatment.

Table 2 Characteristics associated with receiving surgical treatment in the first year following an initial outpatient visit for HMB

Denominator (n=14545)	Received surgical treatment	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	42.6% (6195)				
Age group (years)					<0.0001***
18-34	18.4% (396)	0.37	0.37	0.33, 0.41	
35-39	41.1% (774)	0.82	0.81	0.75, 0.86	
40-44	49.9% (1932)	1.00	0.96	0.92, 1.01	
45-49	49.9% (2273)	1	1	-	
50-60	39.3% (820)	0.79	0.78	0.73, 0.83	
Ethnicity					0.0036**
White	42.9% (5146)	1	1	-	
Asian or Asian British	30.8% (176)	0.74	0.82	0.71, 0.93	
Black or black British	49.0% (358)	1.14	1.10	1.00, 1.21	
Other	39.1% (108)	0.91	0.98	0.84, 1.14	
Socioeconomic deprivation (IMD[^])					0.2776
Quintile 1 (most deprived)	41.7% (1424)	1	1	-	
Quintile 2	41.2% (1300)	0.99	0.97	0.91, 1.03	
Quintile 3	42.9% (1263)	1.03	1.02	0.96, 1.09	
Quintile 4	44.5% (1211)	1.07	1.03	0.97, 1.10	
Quintile 5 (least deprived)	43.3% (997)	1.04	1.02	0.95, 1.09	
BMI categories					0.0026**
≤25	38.8% (1715)	1	1	-	
25-30	46.1% (1636)	1.19	1.09	1.04, 1.14	
≥30	45.9% (1480)	1.18	1.06	1.00, 1.11	
Parity					0.0076*
Nulliparous	32.0% (760)	1	1	-	
Parous	44.8% (5252)	1.40	1.09	1.02, 1.17	
Number of comorbidities					0.0712
0	42.1% (4049)	1	1	-	
1	43.7% (1618)	1.04	0.97	0.92, 1.02	
≥2	43.1% (528)	1.02	0.92	0.85, 1.00	
Severity score at baseline					<0.0001***
Quintile 1 (least severe)	33.1% (1233)	1	1	-	
Quintile 2	39.9% (1437)	1.20	1.13	1.06, 1.21	
Quintile 3	43.3% (1001)	1.31	1.24	1.16, 1.33	
Quintile 4	49.6% (1292)	1.50	1.39	1.29, 1.47	
Quintile 5 (most severe)	56.0% (1118)	1.69	1.53	1.43, 1.64	
Duration of symptoms at baseline					<0.0001***
<1 year	32.3% (1186)	1	1	-	
≥1 year	46.6% (4867)	1.45	1.28	1.21, 1.36	
Prior treatment for HMB in primary care					<0.0001***
No	31.1% (1335)	1	1	-	
Yes	48.0% (4709)	1.54	1.44	1.36, 1.52	

Footnotes: [^]IMD=Index of Multiple Deprivation, an area-level measure of relative socioeconomic deprivation. Multivariable model adjusted for age group, ethnicity, IMD, BMI, parity, number of comorbidities, baseline symptom severity and HMB treatment received in primary care. Categories compared using the Wald test, *p<0.05, **p<0.01, ***p<0.001

Type of first surgical treatment received by women's characteristics

Symptom severity was associated with having hysterectomy rather than EA (Table 3). Among women who underwent EA or a hysterectomy, the rate of hysterectomy was higher among those reporting the most severe symptoms compared to those reporting the least severe symptoms (RR comparing most vs. least severe symptoms quintile 1.6, 95% CI: 1.3 to 1.8). Women who reported a longer duration of symptoms at their initial outpatient visit for HMB were more likely to have undergone a hysterectomy than EA (RR 1.2, 95% CI: 1.1 to 1.4). Those who were obese (BMI 25-30) had higher rates of hysterectomy than those of a healthy weight (BMI <25) (RR 1.2, 95% CI: 1.1 to 1.3). Adjusting for patient characteristics had only a small impact on the magnitude of the associations observed between both symptom severity, prior treatment in primary care and underlying condition and the likelihood of receiving hysterectomy.

Women with an underlying condition diagnosed were more likely to have received a hysterectomy than women with no obvious cause of their HMB diagnosed. Women were twice as likely to have had a hysterectomy (RR 2.1, 95% CI: 1.9 to 2.4) if they had a diagnosis of uterine fibroids or polyps (without endometriosis) recorded, and four times more likely if they had endometriosis (with or without uterine fibroids or polyps) (RR 3.9, 95% CI: 3.4 to 4.5, Table 3). Of women who received a hysterectomy, 52.1% had a diagnosis of uterine fibroids or polyps (without endometriosis) recorded and 21.3% had endometriosis (with or without uterine fibroids or polyps). In contrast, more than half of women undergoing EA had no obvious cause of their HMB diagnosed (52.9%; Appendix S4). There was no significant interaction between either ethnicity or BMI and underlying condition, although the power to detect a significant interaction in the complex relationship between ethnicity and HMB-related conditions would be small.

Table 3 Characteristics associated with receiving hysterectomy (compared to endometrial ablation) in the first year following an initial outpatient visit for HMB

Denominator (n=5920)	Received hysterectomy	Unadjusted Risk ratio	Adjusted Risk ratio	95% Confidence Interval	p-value
Total	27.1% (1606)				
Age group (years)					0.0713
18-34	17.4% (62)	0.58	0.79	0.61, 1.03	
35-39	25.5% (181)	0.83	0.84	0.71, 0.99	
40-44	25.7% (478)	0.88	0.91	0.82, 1.01	
45-49	29.9% (652)	1	1	-	
50-60	29.1% (233)	0.97	0.88	0.77, 1.01	
Ethnicity					0.1184
White	26.8% (1350)	1	1	-	
Asian or Asian British	27.7% (44)	1.04	0.75	0.91, 1.00	
Black or black British	34.9% (88)	1.30	1.13	1.09, 1.39	
Other	32.6% (30)	1.20	0.88	0.62, 1.26	
Socioeconomic deprivation (IMD^A)					0.3004
Quintile 1 (most deprived)	28.2% (378)	1	1	-	
Quintile 2	24.4% (298)	0.86	0.93	0.80, 1.08	
Quintile 3	26.3% (319)	0.93	0.97	0.84, 1.11	
Quintile 4	29.4% (344)	1.04	1.01	0.94, 1.24	
Quintile 5 (least deprived)	27.4% (267)	0.97	1.03	0.89, 1.19	
BMI categories					0.0450*
≤25	24.7% (399)	1	1	-	
25-30	29.7% (465)	1.20	1.15	1.03, 1.29	
≥30	28.0% (400)	1.13	1.08	0.96, 1.21	
Parity					0.2340
Nulliparous	25.4% (165)	1	1	-	
Parous	27.4% (1404)	1.09	0.95	0.82, 1.10	
Number of comorbidities					0.3223
0	27.0% (1039)	1	1	-	
1	26.5% (414)	0.98	0.97	0.86, 1.08	
≥2	29.9% (153)	1.11	1.12	0.95, 1.32	
Severity score at baseline (quintiles)					<0.0001***
Quintile 1 (least severe)	22.0% (251)	1	1	-	
Quintile 2	26.0% (362)	1.18	1.17	1.00, 1.37	
Quintile 3	28.2% (271)	1.28	1.26	1.07, 1.49	
Quintile 4	26.3% (326)	1.20	1.23	1.05, 1.43	
Quintile 5 (most severe)	33.9% (365)	1.54	1.57	1.34, 1.83	
Duration of symptoms at baseline					0.0078**
<1 year	24.2% (273)	1	1	-	
≥1 year	28.0% (1304)	1.16	1.20	1.05, 1.36	
Prior treatment for HMB in primary care					0.0005***
No	30.8% (389)	1	1	-	
Yes	26.2% (1185)	0.86	0.80	0.71, 0.89	
HMB-related condition					
No obvious cause	14.7% (360)	1	1	-	
Uterine fibroids and/or polyps (no endometriosis)	30.6% (847)	1.99	2.11	1.86, 2.41	<0.0001***
Endometriosis (with or without uterine fibroids/polyps)	59.5 (332)	3.79	3.91	3.41, 4.48	

^AIMD=Index of Multiple Deprivation, an area-level measure of relative socio-economic deprivation. Multivariable model adjusted for age group, ethnicity, IMD, baseline BMI, parity and number of comorbidities, baseline symptom severity and HMB treatment received in primary care. 699 women received both EA and a hysterectomy in the year following their first outpatient visit. Here they are included in the EA group as this represents the first surgical treatment choice. Categories compared using the Wald test, *p<0.05, **p<0.01, ***p<0.001

DISCUSSION

Main findings

Approximately 40% of women referred to secondary care for HMB in England and Wales received a form of surgical treatment in the first year following their initial outpatient clinic visit in secondary care. The rate of surgery was 50% higher among women who reported having received treatment in primary care prior to their first outpatient visit than among those who did not. In addition, more severe symptoms were also associated with higher rates of surgery, and with receiving hysterectomy rather than EA. Women with an Asian ethnic background had lower rates of surgery, whilst women with a black ethnic background had higher rates of surgery, after adjusting for symptom severity than women with a white ethnic background. Socioeconomic deprivation was not associated with the rate of surgery.

Interpretation

We previously reported that socioeconomic deprivation influences access to secondary care for HMB[16] as for other conditions[26]. However, our findings illustrate that once women reach secondary care services, their receipt of surgical treatment depends mainly on their symptom severity, and whether or not they have received treatment in primary care prior to their referral. Nearly one-third of women reported that they had no treatment for their HMB in primary care and the chance that these women had surgery within the first year after their referral was considerably lower than for women who had prior treatment in primary care. National guidelines for the management of HMB in the UK indicate that hormonal or non-hormonal medical therapy can be started in primary care. Our findings suggest that this may reduce the number of potentially inappropriate referrals to specialist services[5]. However, immediate referral can be appropriate for women seeking further diagnostic tests and reassurance, even without medical treatment[6, 27-29]. In addition, some women may be referred immediately because they do not wish to take drug treatment, or it is anticipated that treatment available in primary care may fail to control their symptoms to an acceptable level[5].

We also observed variation in surgery rates by ethnic background, after accounting for symptom severity. Compared to white women, women reporting Asian ethnicity had lower rates of surgery, and women reporting black ethnicity had higher rates of surgery. These differences may reflect inequitable use of surgical care, or may be attributable to variations according to ethnicity in the prevalence of HMB-related conditions (such as fibroids), cultural norms (for example, accepting heavy periods as normal), and patient preferences for treatment, which have been reported

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3 previously [30-32]. We observed higher surgery rates among overweight and obese women, which
4 may also be attributable to the prevalence of HMB-related conditions such as fibroids[33, 34].
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8 Since 2004, more EA procedures than hysterectomies have been conducted in England[11, 13].
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10 However, little was previously known about the determinants of hysterectomy compared to EA. We
11 show that the choice of procedure is strongly linked to symptom severity and HMB-related
12 conditions, with a higher proportion of those who had worse symptoms, and those who had an
13 underlying condition (uterine fibroids, polyps or endometriosis) diagnosed receiving a hysterectomy.
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15 All women should have the opportunity to discuss the benefits and risks of both EA and
16 hysterectomy, to help them make informed decisions about their treatment[5].
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21 Despite the existence of national guidelines for the management of HMB in the UK, developed by the
22 National Institute for Health and Care Excellence and the Royal College of Obstetricians and
23 Gynaecologists[5, 30, 35], only a minority of hospitals in England and Wales reported local protocols
24 on the management of women with HMB to the National HMB Audit[36]. Local auditing of referral
25 pathways could help to ensure that referrals to secondary care without prior treatment in primary
26 care reflect patient-centred care.
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32 33 **Strengths and limitations**

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35 A number of studies have reported treatment outcomes for women with HMB[9, 15] but our study is
36 the first national study reporting on initial treatments for HMB immediately after referral to
37 secondary care. It is also the first to examine the impact of sociodemographic factors and symptoms
38 on the chance that women with HMB will receive surgical treatment. We used data collected by a
39 national clinical audit in England and Wales, linked to administrative hospital data, which produced a
40 large sample. We estimated that the National HMB Audit recruited approximately a third of all
41 eligible women. Whilst the recruitment rate was not as high as desired, the characteristics of those
42 recruited were broadly representative of the UK population in terms of ethnicity and age[37, 38] and
43 the sample size was large. Information on women's fertility intentions was not available, so we could
44 not explore whether this influenced observed associations between age and ethnicity and receiving
45 surgery.
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55 **Conclusions**

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57 Once women reach secondary care services, the chance that they will have surgical treatment within
58 a year is strongly linked to their symptom severity and age and also, albeit less strongly, to their
59 parity, BMI and ethnic background. Having received treatment in primary care before referral also
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3 increases the likelihood of surgery after referral. Our finding that a third of women were referred
4 without prior treatment in primary care may raise questions about whether these referrals were
5 appropriate. However, some women may benefit from referral for advice and further assessment, or
6 may seek immediate surgical treatment. We recommend that referral pathways between primary
7 and secondary care should be locally audited to ensure that the care that women with HMB receive
8 addresses their individual needs and preferences.
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AUTHOR CONTRIBUTIONS

TM and JvdM derived the research question. AK, IGU, DC and LBM supported data collection directly and JS, TM and JvdM advised. RG performed the analyses and wrote the manuscript. All authors contributed to and approved the manuscript.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ETHICAL APPROVAL

The study is exempt from UK National Research Ethics Service (NRES) approval because it involved the analysis of an existing data set of anonymised data for service evaluation. Based on the Health Research Authority's guidance, audits are regulated as standard clinical practice outside of the Research Ethics Service. Approvals for the use of anonymised HES data were obtained as part of the standard HES data access process.

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3 NHS England, the Welsh Government and, with some with some individual projects, other devolved
4 administrations and crown dependencies (www.hqip.org.uk/national-programmes).
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8 **DATA SHARING**

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10 The National HMB Audit was identified as an eligible audit in the Prime Minister's transparency
11 agenda in 2011. The provider-level data from the second and third annual report are now available.
12 For more information, please visit the National HMB Audit data transparency page
13 (<https://goo.gl/pHwFjv>). The full HMB audit data are available on request from the Healthcare
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Quality Improvement Partnership.

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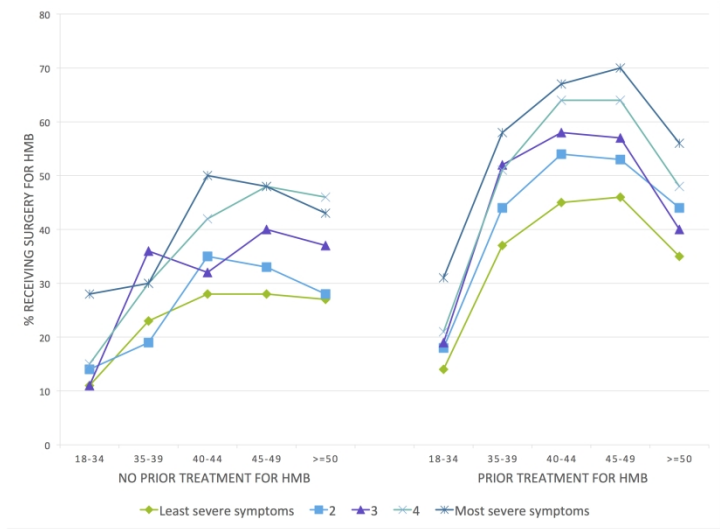
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3 **Figure legend**
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5 Figure 1: Receipt of surgery for HMB based on prior treatment, age group and symptom
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Receipt of surgery for HMB based on prior treatment, age group and symptom severity quintile
297x209mm (300 x 300 DPI)

Appendix S1**Table S1: Codes used to define surgery for HMB and underlying conditions**

Procedures for HMB	OPCS-4 codes
Hysterectomy (abdominal or vaginal)	Q07, Q08
Endometrial ablation	Q16, Q17
Myomectomy	Q09.2, Y75.2 or Y08.4
Uterine artery embolization	L713 or Y53+Z96.6
Underlying condition(s)	ICD-10 codes
Uterine fibroids/polyps (without endometriosis)	D25, N84.0/N84.1
Endometriosis	
<i>Endometriosis only</i>	<i>N80.0</i>
<i>Endometriosis and uterine fibroids</i>	<i>N80.0 and D25</i>
<i>Endometriosis and polyps</i>	<i>N80.0 and N84.0/N84.1</i>
No obvious cause	N92.0, N92.1, N92.4, N92.5, N92.6, N93.8, N93.9

Appendix S2

The Index of Multiple Deprivation (IMD) is an area-level measure of relative deprivation available in both HES and PEDW. For analysis, we used IMD quintiles (1 = most deprived areas, 5 = least deprived areas). The methods used to calculate IMD scores in each UK country are similar but not directly comparable. We used a combined measure for England and Wales where those in each country-specific quintile were assigned to the same quintile in the combined measure: this preserved women's relative deprivation position within each country. The distribution of sociodemographic characteristics and symptom severity and duration by level of deprivation did not vary significantly by country (data not shown).

Appendix S3

Symptom severity scores were derived from an adapted version of the Uterine Fibroid Symptom and Quality of Life (UFS-QOL) questionnaire[22]. Of five candidate questionnaires evaluated, only the UFS-QOL could be used throughout the care pathway and was psychometrically strong[4]. The UFS-QOL was therefore adapted for HMB and a UK population. We conducted semi-structured interviews with women ($n = 7$) and clinicians ($n = 5$) and a mini focus group ($n = 3$) with local Heavy Menstrual Bleeding Audit coordinators to determine suitable alternative words to describe HMB, and to identify words not clearly understood in UK English. Based on this we changed the wording throughout the questionnaire to refer to 'heavy menstrual bleeding' (i.e. heavy periods) rather than 'fibroids', changed 'checking' to 'ticking'; 'soiling' to 'staining'; 'blue' to 'low'; and 'wiped out' to 'exhausted'. The adapted version performed acceptably in a psychometric evaluation and has been used to report the audit data[2, 4, 13, 17]. The UFS-QOL consists of eight symptom items which are scored to produce a severity subscale which we use in this paper[4].

Appendix S4

Table S1: Underlying conditions by surgical procedure received

Surgical procedure received*	Underlying condition(s) %		
	Uterine fibroids and/or polyps (no endometriosis)	Endometriosis (with or without uterine fibroids/polyps)	No obvious cause
Hysterectomy (n=2234)	52.1	21.3	26.5
Endometrial ablation (n=3506)	44.8	2.3	52.9
Uterine artery embolization (n=128)	96.1	2.3	1.6
Myomectomy (n=177)	95.5	3.4	1.1

Table 4 presents row percentages among those with both diagnosis/diagnoses and procedure recorded.

* Last likely surgical procedure received according to clinical experience and protocol.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Line number(s)
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	25-49
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	56-81
Objectives	3	State specific objectives, including any prespecified hypotheses	78-81
Methods			
Study design	4	Present key elements of study design early in the paper	85-90
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	87-90
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	86-90
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	107-144
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	92-100, 137-139
Bias	9	Describe any efforts to address potential sources of bias	299-305
Study size	10	Explain how the study size was arrived at	172-174
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	108-135, 137-144
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	147-157
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	153-157
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	172-174
		(b) Give reasons for non-participation at each stage	172-174
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	172-181, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1

Outcome data	15*	Report numbers of outcome events or summary measures	189-191, Table 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2
		(b) Report category boundaries when continuous variables were categorized	Table 1, Table 2
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	220-224
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	298-312
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	230-273
Generalisability	21	Discuss the generalisability (external validity) of the study results	302-305
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	159-163

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.