Socioeconomic factors may influence the surgical technique for benign hysterectomy

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ABSTRACT

INTRODUCTION: Owing to significantly improved outcomes, vaginal hysterectomy is the recommended standard approach when feasible in preference to abdominal hysterectomy. It is, however, not clear whether the use of vaginal hysterectomy varies with the women's socioeconomic background.

MATERIAL AND METHODS: All 22,150 women registered in the Danish Hysterectomy Database in the 2004-2008-period were included in this cohort study and linked to central registers providing information on education, income and employment. Analyses were carried out using multiple logistic regression models.

RESULTS: Among the 16,645 patients with information on all variables, 34% had a vaginal hysterectomy, while 60% had an abdominal and 6% a laparoscopic procedure. Women with a short education were more likely to undergo vaginal hysterectomy (30%) than women with a higher education (28%) (odds ratio (OR): 1.23; 95% confidence interval (CI): 1.10-1.38), but this association seemed to be fully explained by differences in surgery indication (OR: 0.99; CI: 0.87-1.13). Women out of work less often had a vaginal hysterectomy than women in work when adjusting for surgery indication (OR: 0.79; CI: 0.70-0.88).

CONCLUSION: Small socioeconomic differences in surgical approach in hysterectomy were observed and were seemingly explained by clinical surgery indications, with the exception of women out of work for whom vaginal hysterectomy is used less often.

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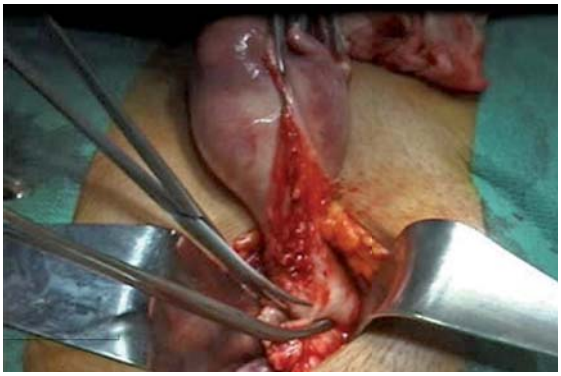
Hysterectomy can either be performed abdominally, vaginally or laparoscopically. The Danish National Guideline on Hysterectomy [1] and the latest Cochrane review on hysterectomy [2] recommend vaginal hysterectomy over abdominal hysterectomy as the standard approach for smaller uteri, i.e. weight below 300 grammes, or when feasible owing to significantly improved outcomes and a shorter hospital stay and recovery period. Hysterectomy is associated with a low socioeconomic position [3-6]. It is, however, not clear whether the use of vaginal hysterectomy varies in relation to women's socioeconomic background.



Abdominal hysterectomy.

The surgical procedure for hysterectomy is usually decided by the clinician in consultation with the patient after a gynaecological examination preceding surgery. Factors like the indication for surgery, the patient's body mass index (BMI), co-morbidity status as well as the patient's preferences should ideally guide the surgical choice. However, two studies from the United States have shown that the patient's median household income is an independent determinant in the use of laparoscopic hysterectomy compared with abdominal hysterectomy [7, 8].

In the present study, we examined the association between the socioeconomic position (SEP) of the patient and the use of the recommended vaginal approach in hysterectomy on benign indication. Furthermore, we assessed the role of the following putative mediating variables on this association: lifestyle, co-morbidity status, hormone use and indication for surgery. Since many of the co-morbid conditions and lifestyle factors such as a high BMI favouring abdominal hysterectomy are associated with social status, we hypothesized that the proportion of women who undergo vaginal hysterectomy would be greater in women with a higher SEP, and that lifestyle and indication for surgery would mediate some of the association.

MATERIAL AND METHODS

All women reported to the Danish Hysterectomy Database (DHD) between 1 January 2004 and 31 December 2008 were included in the study. The DHD is a nation-

ORIGINAL ARTICLE

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TABLE 1

Descriptive characteristics of 22,185 women according to hysterectomy approach in Denmark.

	n (N = 22,185)	Route of hysterectomy, n (%) abdominal (N = 13,212 (60))	vaginal (N= 7,616 (34))	laparoscopic (N = 1,345 (6))	Missing
Age, years					0
< 35	761	381 (50)	260 (34)	120 (15)	
35-44	7,290	4,405 (61)	2,211 (30)	674 (9)	
45-54	9,122	6,448 (71)	2,220 (24)	454 (5)	
55-64	2,694	1,300 (48)	1,347 (50)	47 (2)	
65-74	1,563	485 (31)	1,035 (66)	43 (3)	
> 75	743	193 (26)	543 (73)	7 (1)	
Partner status					70
Single	5,679	3,356 (59)	1,961 (35)	362 (6)	
Ethnicity					32
Danish	21,203	12,531 (59)	7,375 (35)	1,297 (6)	
Western	351	221 (63)	107 (30)	23 (7)	
Non-western	587	433 (74)	129 (22)	25 (4)	
Tobacco					2,997
Non-smoker	13,234	7,790 (59)	4,737 (36)	707 (5)	
Light smoker (1-14 g)	2,475	1,468 (59)	823 (33)	184 (7)	
Heavy smoker (≥ 15 g)	3,467	2,130 (61)	1,068 (31)	269 (8)	
Alcohol consumed, units/week					3,537
0	11,155	6,571 (59)	3,887 (35)	697 (6)	
1-7	5,742	3,314 (58)	2,088 (36)	340 (6)	
8-14	1,358	914 (67)	370 (27)	74 (6)	
> 14	381	258 (68)	103 (27)	20 (5)	
BMI, kg/m²					1,784
< 18.5	353	196 (56)	121 (34)	36 (10)	
18.5-24.9	9,948	5,896 (59)	3,389 (34)	663 (7)	
25-29.9	6,489	3,755 (58)	2,396 (37)	338 (5)	
30-34.9	2,614	1,638 (63)	844 (32)	132 (5)	
≥ 35	985	627 (64)	307 (31)	51 (5)	
Uterus weight, g					2,978
< 300	13,492	6,103 (45)	6,314 (47)	1,075 (8)	
300-500	2,459	2,062 (84)	317 (13)	80 (3)	
> 500	3,244	3,110 (96)	119 (4)	15 (0.5)	
ASA classification					1,453
I	15,654	9,513 (61)	5,080 (32)	1,061 (7)	
II	4,722	2,629 (56)	1,924 (41)	169 (3)	
III	329	184 (56)	138 (42)	7 (2)	
IV	15	9 (60)	5 (33)	1 (7)	
Co-morbidity[a]					0
Diabetes (IDDM/NIDDM)	675	368 (54)	276 (41)	31 (5)	
Cardiovascular	5,658	3,033 (54)	2,359 (42)	260 (4)	
Depression/schizophrenia	2,918	1,761 (60)	953 (33)	204 (7)	
Chronic obstructive pulmonary	1,808	1,077 (60)	602 (33)	129 (7)	
Alcoholism	339	235 (69)	86 (25)	18 (5)	
Connective tissue disease	407	218 (54)	156 (38)	33 (8)	
Pain	4,186	2,342 (56)	1,540 (37)	304 (7)	
Hormone use	3,731	1,820 (49)	1,645 (44)	266 (7)	
Indication for surgery					1,424
Abnormal uterine bleeding	6,950	4,045 (58)	2,381 (34)	524 (8)	
Fibroids	5,281	4,655 (88)	513 (10)	113 (2)	
Genital prolapse	3,032	124 (4)	2,891 (95)	17 (1)	
Pain	2,072	1,233 (60)	525 (25)	314 (15)	
Other[b]	3,411	2,294 (67)	847 (25)	270 (8)	
Highest education					494
Short	3,424	2,107 (62)	1,043 (30)	274 (8)	
Medium	12,631	7,124 (56)	4,819 (38)	688 (6)	
Higher	5,624	3,681 (65)	1,580 (28)	363 (7)	

TABLE 1, CONTINUED

	n (N = 22,185)	Route of hysterectomy, n (%) abdominal (N = 13,212 (60))	vaginal (N= 7,616 (34))	laparoscopic (N = 1,345 (6))	Missing
Employment status					35
In work	15,688	9,932 (63)	4,723 (30)	1,033 (7)	
Out of work	3,955	2,511 (63)	1,189 (30)	255 (6)	
Pensioner	2,495	748 (30)	1,696 (68)	51 (2)	
Gross income, tertiles					0
First – lowest	7,406	4,416 (60)	2,591 (35)	399 (5)	
Second – middle	7,386	4,320 (58)	2,624 (36)	442 (6)	
Third – highest	7,381	4,476 (61)	2,401 (32)	504 (7)	

ASA = American Society of Anesthesiologist; BMI = body mass index; IDDM = insulin-dependent diabetes mellitus; NIDDM = noninsulin-dependent diabetes mellitus. a) Multiple categories may apply. b) Including benign tumour on the ovaries, pre-malign conditions and endometriosis.

wide clinical database linked to the Danish National Patient Registry (NPR), which includes more than 95% of patients in Denmark who undergo elective hysterectomy on a benign indication [9]. The database has been described in detail elsewhere [9]. The study was approved by the Danish Data Protection Agency.

Variables

Drawing a diagram of potential causal pathways [10] between three selected measurements of SEP and surgical procedure for hysterectomy, possible confounders and mediating factors were identified (**Figure 1**). SEP was measured by: Highest attained education (*low, medium* and *higher*), Employment status (*in work, out of work* (including unemployed (n = 2,248), patients on disability pension (n = 1,666) and patients under education (n = 42)), and *pensioners*), and gross household income divided in tertiles *(low, middle, high).* Hysterectomy approach was divided into three categories (abdominal (ABD), vaginal (VAG) or laparoscopic (LAP) approach). In Denmark, the LAP approach is less frequently used and only at a few hospital departments. Since the study focused on use of VAG hysterectomy, we combined ABD- and LAP-assisted hysterectomies into one category in the main analyses presented.

On the basis of the diagram in Figure 1, the following variables were considered confounding or mediating variables for the association: Age; year of hysterectomy; three lifestyle factors: alcohol intake, smoking status and BMI; and co-morbidity status (cardiovascular diseases, chronic obstructive pulmonary disease, diabetes and depression or schizophrenia); weight of the uterus; indication for surgery; and hormone use.

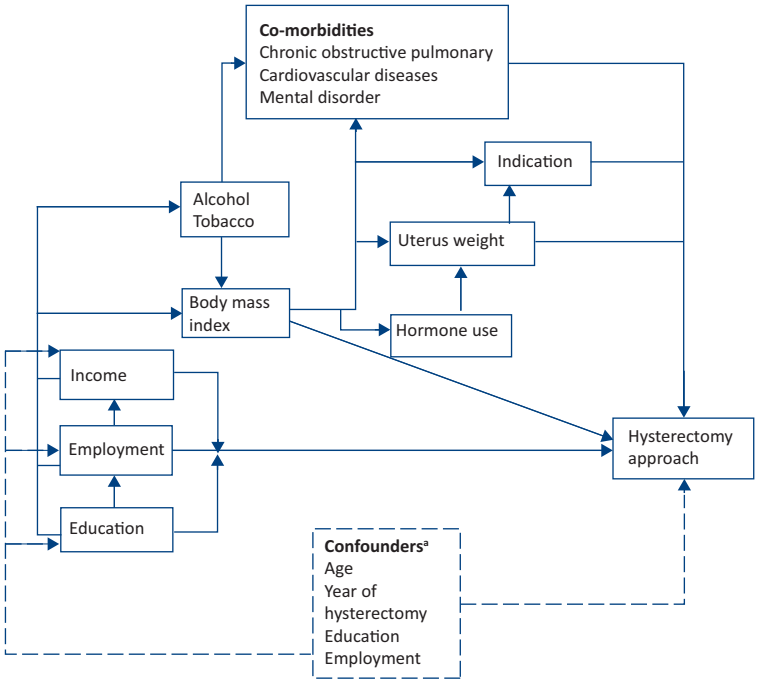
Information about SEP variables was retrieved through register linkage to the Population-Based Integrated Database for Labour Market Research (IDA) [11], and information on hormone use and co-morbidity status was obtained from the Register of Medicinal Product Statistics and the NPR. Data on the rest of the variables were obtained from the DHD.

Statistical methods

The effect of education, employment and income on the probability of undergoing VAG hysterectomy was analyzed using multivariable logistic regression models taking clustering of patients within hospital departments into account. We calculated odds ratio (OR) estimates

FIGURE 1

Causal relations between socioeconomic position indicators, outcome, confounders and mediators.



a) Education is considered a confounder for the association between employment and hysterectomy approach. Education and employment are considered confounders for the association between income and hysterectomy approach.

TABLE 2

Descriptive characteristics of hysterectomy patients according to level of education.

	Highest education, n (%)			
	short (N = 3,424 (16))	medium (N = 12,638 (58))	higher (N = 5,628 (26))	Missing
Age, years				0
< 35	324 (10)	344 (3)	81 (1)	
35-44	1,930 (56)	3,475 (27)	1,774 (31)	
45-54	1,164 (34)	4,918 (39)	2,846 (51)	
55-64	6 (0)	2,020 (16)	618 (11)	
65-74	0 (0)	1,274 (10)	257 (5)	
> 75	0 (0)	607 (5)	52 (1)	
Partner status			31	
Single	1,050 (31)	3,073 (24)	1,360 (24)	
Ethnicity				0
Danish	3,261 (95)	12,247 (97)	5,388 (96)	
Western	17 (1)	165 (1)	129 (2)	
Non-western	146 (4)	226 (2)	111 (2)	
Tobacco				2,933
Non-smoker	1,475 (49)	7,549 (70)	3,904 (80)	
Light smoker (1-14 g)	501 (16)	1,444 (13)	482 (10)	
Heavy smoker (≥ 15 g)	1,052 (35)	1 835 (17)	515 (10)	
Alcohol consumed, units/week				3,467
0	1,975 (68)	6,319 (60)	2,544 (53)	
1-7	749 (26)	3,315 (31)	1,606 (33)	
8-14	137 (4)	693 (7)	508 (11)	
> 14	48 (2)	187 (2)	142 (3)	
BMI (kg/m²)				1,739
< 18.5	90 (3)	184 (2)	70 (1)	
18.5-24.9	1,400 (44)	5,346 (46)	3,017 (58)	
25-29.9	978 (31)	3,883 (33)	1,489 (29)	
30-34.9	499 (15)	1,572 (14)	468 (9)	
≥ 35	217 (7)	576 (5)	162 (3)	
Uterus weight, g				2,912
< 300	2,364 (77)	7,979 (74)	2,860 (58)	
300-500	302 (10)	1,303 (12)	804 (17)	
> 500	383 (13)	1,547 (14)	1,236 (25)	
ASA classification				1,420
I	2,505 (77)	8,531 (73)	4,326 (82)	
II	695 (22)	2,993 (25)	901 (17)	
III	39 (1)	221 (2)	45 (1)	
IV	2 (0)	7 (0)	5 (0)	
Co-morbidity[a]				0
Diabetes (IDDM/NIDDM)	109 (3)	438 (3)	105 (2)	
Cardiovascular	606 (18)	3,835 (30)	1,072 (19)	
Depression/schizophrenia	596 (17)	1,618 (13)	625 (11)	
Chronic obstructive pulmonary	363 (11)	987 (8)	407 (7)	
Alcoholism	117 (3)	172 (1)	38 (1)	
Connective tissue disease	63 (2)	261 (2)	72 (1)	
Pain	831 (24)	2,472 (20)	765 (14)	
Hormone use	535 (16)	2,324 (18)	779 (14)	
Indication for surgery				1,394
Abnormal uterine bleeding	1,575 (49)	3,607 (31)	1,625 (31)	
Fibroids	612 (19)	2,727 (23)	1,833 (34)	
Genital prolapse	106 (3)	2,261 (19)	567 (11)	
Pain	521 (16)	1,088 (9)	432 (8)	
Other[b]	430 (13)	2,083 (18)	829 (16)	

ASA = American Society of Anesthesiologist; BMI = body mass index; IDDM = insulin-dependent diabetes mellitus; NIDDM = noninsulin-dependent diabetes mellitus. a) Multiple categories may apply. b) Including: benign tumour on the ovaries, pre-malign conditions and endometriosis.

together with 95% confidence intervals (CI) using the GENMOD procedure with the generalized estimating equations (GEE) option in SAS 9.1.3, which relaxes the independence assumption for patients operated at the same hospital.

A number of multivariable models were constructed. The first models included each SEP variable alone, adjusting for confounding by age, year of operation and hospital as a random effect. For employment status, we included education as an additional confounder variable, and for income both education and employment were included as confounders in the analyses. In the additional models, the effect of the putative mediating factors on the association was examined by including each factor in a stepwise manner according to the causal diagram (Figure 1). All previously included factors were kept in the model when adding the next potential mediator. Mutual interactions between education, employment and income were tested, and further interactions between the SEP factors and indication for surgery were investigated and found to be insignificant and consequently not reported.

Trial registration: not relevant.

RESULTS

A total of 22,185 women were recorded in the DHD in the 2004-2008 period. Among the 22,185 patients, 5,540 had missing information on one or more variables (**Table 1**). Among the 16,645 patients with information on all variables, 34% had a VAG hysterectomy, 60% an ABD and 6% a LAP procedure.

Women with a higher education seemed less likely to have a VAG hysterectomy (28%) than women with a short- (30%) or medium-length (38%) education (Table 1). The same pattern was observed for income, where the women with low (35%) and middle (36%) incomes were more likely to have a VAG hysterectomy than women with a high income (32%) (Table 1). No differences in the use of VAG hysterectomy were observed (30%) for women in work or out of work (Table 1). Women who were older, from Danish or Western countries, had a lower alcohol intake, smoked less and had less co-morbidity, except for cardiovascular diseases, seemed to have a higher change of VAG hysterectomy (Table 1). The same was observed for women with a smaller uterus and genital prolapse as the main indication for surgery (Table 1).

Women with a short education had hysterectomy at a younger age, a smaller uterus, and the most common indication for surgery was dysfunctional uterine bleeding. Inversely, women with a higher education more often had surgery due to genital fibroids (**Table 2**).

The confounder-adjusted analyses for the association between education and hysterectomy approach

showed that women with a short- and medium-length education were more likely to obtain a VAG hysterectomy than women with a higher education (**Table 3**, Model 1). The patients' lifestyle, co-morbidity status and the use of hormones did not seem to mediate this association, while uterus weight and indication for surgery attenuated the association which became insignificant. The latter was confirmed in a sub-analysis that only included women who had hysterectomy for abnormal uterine bleeding; this analysis showed no association between low SEP and use of VAG hysterectomy (OR: 1.01; IC: 0.86-1.19). Compared with women in work, those out of work had a decreased likelihood of VAG hysterectomy when adjusting for confounders, while pensioners were found to have an increased likelihood of VAG hysterectomy (Table 3, Model 1). Lifestyle factors, co-morbidity status and hormone use had no effect on the association between employment status and hysterectomy approach, whereas uterus weight and indication for surgery seemed to attenuate the relation for pensioners rendering the estimates insignificant (Table 3, Models 5 and 6). When all covariates were included in the model, the estimates for women out of work decreased further, which indicated that they were even less likely to have a VAG hysterectomy than women in work (OR: 0.80; IC: 0.71-0.89). No association was found between income and hysterectomy approach (Table 3, Model 1-6).

Previous studies have focused on SEP differences in access to LAP hysterectomy. We consequently repeated the analysis to examine the association between SEP and use of LAP-assisted hysterectomy compared with ABD and VAG hysterectomies combined. These analyses were based on fewer cases (n = 1,345); although no association was found for any of the SEP variables, the wide confidence limits implied estimates of low precision due to lack of power. In addition, we examined the association between SEP and ABD hysterectomy versus VAG hysterectomy when excluding LAP hysterectomy from the analysis. However, no change in the results was found.

DISCUSSION

In this nationwide study of 22,185 women undergoing hysterectomy in Denmark, we found that less educated women were more likely to undergo a VAG procedure than women with a high educational level. This relation, which was contrary to our initial hypothesis, seemed to be fully explained by differences in the indication for surgery. However, our study also showed that women out of work less often had a VAG hysterectomy than women in jobs when adjusting for differences in surgery indication.

To our knowledge, only two other studies which both originate from the United States have investigated the association between SEP and the surgical approach used for hysterectomy [3, 4]. However, both of these studies focused on the influence of SEP on the use of LAP hysterectomy. The studies found that irrespective of race or ethnicity, lower income was associated with a lower risk of undergoing laparoscopy. In Denmark, where no economic hindrances in access to hysterectomy exist due to fully tax-financed healthcare, we found no influence of income on the hysterectomy approach. We compared VAG hysterectomy with ABD and LAP hysterectomy combined since the VAG approach is the recommended surgical procedure for hysterectomy [2]. In addition, LAP hysterectomy was infrequently performed at only a few hospitals in Denmark [9], and

TABLE 3

Multivariable odds ratio (95% confidence intervals) of vaginal hysterectomy according to education, employment status and income in 16,645 Danish patients.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Education						
Short	1.23 (1.10-1.38)	1.24 (1.10-1.39)	1.24 (1.10-1.40)	1.24 (1.10-1.39)	1.01 (0.89-1.15)	0.99 (0.87-1.13)
Medium	1.26 (1.16-1.37)	1.26 (1.16-1.38)	1.26 (1.16-1.38)	1.25 (1.15-1.37)	1.10 (1.00-1.20)	1.06 (0.96-1.16)
Higher	Reference	Reference	Reference	Reference	Reference	Reference
Employment status						
In work	1.49 (1.21-1.83)	1.50 (1.22-1.85)	1.50 (1.21-1.84)	1.49 (1.21-1.83)	1.27 (1.05-1.54)	0.97 (0.76-1.24)
Out of work	0.85 (0.77-0.93)	0.85 (0.78-0.94)	0.86 (0.78-0.94)	0.86 (0.78-0.94)	0.83 (0.75-0.91)	0.80 (0.71-0.89)
Pensioner	Reference	Reference	Reference	Reference	Reference	Reference
Income						
Low	0.97 (0.90-1.05)	0.95 (0.86-1.05)	0.95 (0.86-1.05)	0.95 (0.86-1.06)	0.98 (0.87-1.12)	0.98 (0.87-1.11)
Middle	1.00 (0.98-1.07)	0.98 (0.90-1.07)	0.98 (0.90-1.07)	0.98 (0.90-1.07)	0.97 (0.87-1.08)	0.97 (0.89-1.07)
High	Reference	Reference	Reference	Reference	Reference	Reference

Model 1: Adjusted for confounders: age, year of operation, education, employment, income. Model 2: Adjusted for confounders and lifestyle factors. Model 3: Adjusted for confounders, lifestyle and co-morbidities. Model 4: Adjusted for confounders, lifestyle, co-morbidities and hormone use. Model 5: Adjusted for confounders, lifestyle, co-morbidities, hormone use and uterus weight. Model 6: Adjusted for confounders, lifestyle, co-morbidities, hormone use, uterus weight and indication for surgery.

the analyses of this outcome may not have had enough power to detect any associations.

We hypothesized that due to differences in patients' lifestyles and co-morbidity statuses, a higher SEP would be associated with the use of VAG hysterectomy. However, the estimates of the association between SEP and hysterectomy approach were only influenced by the weight of the uterus and by surgery indication. These findings indicate that the clinical surgery indication was the most important factor when deciding on the hysterectomy approach; and the different distribution of indications for hysterectomy between SEP groups therefore explains the socioeconomic difference in surgical approach. Earlier studies have also found that women with a lower SEP more often have a hysterectomy for bleeding disorders, while women with a higher SEP more often have genital fibroids as surgery indication [12, 13]. The association between surgical indication and SEP could be explained by different use and knowledge of alternative non-surgical treatments such as hormone therapy and various minimally invasive methods for larger leiomyomas among the SEP groups [12]. Other studies have suggested that difficulties in the understanding of healthcare information among women with lower SEP leads to less frequent inquires about treatment and surgical decision-making [8, 14]. With a failed result following various treatments prior to hysterectomy, only the large fibroids would be left for surgery in women with a high SEP. For these clinical characteristics, the ABD approach would be considered the most favourable choice which could explain the association found. However, the study showed that regardless of surgery indication, having a job was associated with use of vaginal hysterectomy. This suggests that non-clinical factors may influence the choice of surgical procedure. Surprisingly, a similar pattern of associations was not observed for the effect of education or income level on the use of VAG hysterectomy. This may indicate that employment captures a more marginalized and less resourceful SEP group with the category *out of work* than *short education* or *low income* does.

Our study accounted for 95% of all patients registered in the NPR with a hysterectomy on benign indication. Data on patient charateristics and surgical procedure were generated from the DHD which enjoys high validity and completeness of most data [9]. Data on SEP were collected prospectively from databases for administrative purpose, which reduces the risk of missing information and limits recall bias, which is often seen when using SEP based on self-reported data. We used three different meassurements for SEP which is also an advantage since education, employment status and income are not necessarily related to the same underlying causal process [15, 16].

A limitation of our study is the relatively high proportion of missing data. We chose to conduct complete-subject analysis, which reduced the dataset with 25% of the population. A repetition of the analyses with all cases included in the model and missing information coded as "unknown" did not change the estimates considerably from those seen on the data for complete cases. Lifestyle factors seemed to have very limited effects on the association between SEP and hysterectomy approach. Further, we do not believe that the missing data on uterus weight and indication for surgery were associated with the hysterectomy approach in any systematic way, and, consequently, we do not expect that this would violate the estimated ORs.

CONCLUSION

Our study only revealed small socioeconomic differences in hysterectomy approach which seemed to be explained by clinical surgery indications; however, the results did indicate that the VAG approach is less likely to be used in women who are out of work than in the working population.

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