Nationwide rates of conversion from laparoscopic or vaginal hysterectomy to open abdominal hysterectomy in Germany

Andreas Stang, Ray M. Merrill, Oliver Kuss

Nationwide Rates of Conversion from Laparoscopic or Vaginal Hysterectomy to Open Abdominal Hysterectomy in Germany

Andreas Stang, MD[1], Ray M. Merrill, PhD,[2] Oliver Kuss, PhD,[3]

1. Institut für Klinische Epidemiologie, Medizinische Fakultät, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany
2. Department of Health Science, College of Life Sciences, Brigham Young University, Provo, UT 84602, U.S.A.
3. Institut für Medizinische Epidemiologie, Biometrie und Informatik, Universitätsklinikum Halle und Medizinische Fakultät, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany

Address for correspondence:

Andreas Stang, Institut für Klinische Epidemiologie, Medizinische Fakultät, Martin-Luther-Universität Halle-Wittenberg, Magdeburger Str. 8, 06097 Halle, Phone +49-345-557-3567, Fax +49-345-557-3565, e-mail: andreas.stang@medizin.uni-halle.de

Disclosure of funding

No funding.

Acknowledgements

We are very grateful for the many helpful comments by Katrina Spilsbury, CHIRI, Centre for Population Health Research, Curtin University of Technology, Perth, Western Australia, on an earlier draft of this manuscript. We thank Mareike Kunze, Institut für Medizinische Epidemiologie, Biometrie und Informatik, Universitätsklinikum Halle und Medizinische Fakultät, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale)University of Halle, for the preparation of the figures.

Counts

Abstract:	247
Main text (excl. references):	2,985
References:	37
Tables	4
Tables (on request)	2
Figures	1

Abstract

Introduction: The aim of this study was to provide population-based German-wide hysterectomy rates based on the national hospitalization file and to estimate the rate of conversion from laparoscopical or vaginal hysterectomy to open abdominal hysterectomy.

Material and Methods: Nationwide population-based DRG (diagnosis related diseases) data of the years 2005 and 2006 were used to calculate hysterectomy rates by indication group and type of surgical approach.

Results: Overall 305,015 hysterectomies were performed during the study period (4.5 out of 1,000 women aged 20 years or more). The hysterectomy rate for benign diseases of the genital tract among women aged 20 years or more (3.6 out of 1,000 women) is higher than in Sweden but lower than in the US or Australia. Only 6% and 5% of all hysterectomies were performed by laparoscopically assisted vaginal hysterectomy and laparoscopic hysterectomy, respectively. 26% of hysterectomies for benign diseases among women aged 50 years or more included bilateral oophorectomy. 10% of laparoscopical hysterectomies and 1% of vaginal hysterectomies necessitated a conversion to an abdominal hysterectomy. For both types of hysterectomies, the conversion rates were highest for primary malignant genital tract cancer and other cancers compared to the other indication groups. Whereas the conversion rate for laparoscopical hysterectomies increased by age, this rate did not change by age for vaginal hysterectomies.

Conclusions: Conversion from laparoscopically or vaginal hysterectomy to open abdominal hysterectomy is associated with the indication and type of hysterectomy started with and is considerably higher for laparoscopic than vaginal hysterectomies.

Keywords: Epidemiology; Germany; hospital data; hysterectomy; incidence; population-based.

Introduction

Hysterectomy is the most frequently performed major surgical procedure in gynecology across many places in the world (1). Several studies have shown marked variations of hysterectomy rates across and within industrialized countries (2-7) and over time (2;7-9). It has been shown that selected factors influence hysterectomy rates beyond the incidence of genital tract diseases such as availability of obstetricians and gynecologists, the number of hospital beds per capita, the type of health-care insurance available, the gender of the gynecologists, the social class of the patient (10;11), available information about the different treatment modalities among patients (12), and cultural norms related to fertility-sparing, less definitive procedures. The increasing prevalence of obesity has also contributed to an increased rate of abnormal uterine bleeding, which, in turn, may contribute to greater use of hysterectomy (13;14).

Hysterectomy surveillance provides an indication of female reproductive health and how women are being treated for problems of the reproductive system. Population-based nationwide hysterectomy rates in Germany (population of 42 million women) have not been estimated until the current study. Hysterectomies are not performed in ambulatory surgery centers in Germany. In 2004, Germany introduced the DRG (diagnosis related groups) system for reimbursement of inpatient hospital services. All individual hospitalizations with individual diagnostic and therapeutic codes contribute to the nationwide DRG statistics that provide a useful data source for epidemiologic purposes as recent studies with these data have shown (15-17).

The purpose of this study is to quantify nationwide hysterectomy rates by indication groups and by type of surgical approach. Furthermore, we studied factors that might be associated with the rate of conversion from hysterectomies that were started as vaginal or laparoscopic hysterectomies to open abdominal hysterectomies. German hysterectomy rates will be compared with recent studies of other countries.

Material and Methods

Based on an amendment of the hospital financing system in Germany in 1999, the DRG reimbursement system became compulsory for hospitals in 2004. Hospitals annually transfer their individual hospitalization data to the Institute for the Hospital Renumeration System (InEK).

After a plausibility control, the InEK forwards anonymized data to the Federal Bureau of Statistics. Since 2005, the Federal Bureau of Statistics provides individual hospitalization data for scientific uses. Hospitalizations are anonymized, which means that patients that are hospitalized more than once during the study period cannot be re-identified. We were able to use the hospitalization years 2005 and 2006 including overall 17.4 million hospitalizations among women.

For each hospitalization, one primary diagnosis and up to 89 secondary diagnoses coded by ICD-10 can be documented. The diagnosis that led to the hospitalization assessed at the end of the hospitalization (i.e., when pathology and radiology reports were available) is defined as the primary one. In 2005, diagnoses were coded according to the ICD-10-GM (German Modification) version 2005 (18). In 2006, the ICD-10-GM version 2006 was used (19). Up to 100 medical procedures can be coded according to a national classification of operations and procedures (OPS). In 2005 and 2006, the OPS versions of the years 2005 and 2006 respectively were used (20;21). For each hospital stay, the number of in-hospital days was recorded. The few differences between the ICD-10-GM and OPS versions of the years 2005 and 2006 were not relevant for our study question.

We identified hysterectomies by use of the OPS codes 5-682: subtotal hysterectomy, 5-683: total hysterectomy, or 5-685: radical hysterectomy. For the years 2005 and 2006, 307,230 hysterectomies were performed among overall 42 million women in Germany. We excluded 2,215 (0.7%) hysterectomies from all analyses because the place of residence was outside of Germany (N=1,645, 0.5%), unknown (N=249, 0.1%), or the woman was homeless (N=321, 0.1%). This left 305,015 hysterectomies that were considered in the study. We applied a hierarchical algorithm to derive the leading causes (indications) of hysterectomy based on a similar algorithm that was used in previous studies (3;22). The primary and all secondary diagnoses were used to assign hysterectomies to one of six indication groups in the following hierarchical fashion. Firstly, any record of a primary malignant neoplasm of the cervix uteri (C53), uterus (C54-C55), ovary (C56), other & unspecified female genital organs (C57), or placenta (C58) were grouped as “primary malignant tumors of the genital organ.” Secondly, any hysterectomy with a record of ICD-10 code of N85.1 in the absence of a primary malignant tumor of the genital was classified as “endometrial adenomatous hyperplasia.” Thirdly, any hysterectomy with codes in-situ neoplasm of the cervix uteri (D06), other and unspecified part of the uterus (D07.0), and other and unspecified female genital organs (D07.3) were grouped as “in-situ neoplasms of the genital organs.” Fourthly, a hysterectomy associated with ICD-10 code D39 was classified as “neoplasms of uncertain or unknown behaviour of genital organs” and lastly, hysterectomies associated with records indicating a “primary malignant cancer not of the genital tract” were grouped; these typically reflecting debulked cancers of the urinary or intestinal tract. Remaining hysterectomies were classified into the sixth group, “benign disease of the genital tract.” Although hospitalizations for hysterectomy associated with benign diseases of the genital tract usually contained

more than one diagnosis of a benign disease of the genital tract, we used the primary diagnosis for subclassification of these hysterectomies. In a sensitivity analysis, we analyzed the occurrence of a pre-specified list of 24 frequent benign indications of hysterectomies at any ICD-10 code position in the data set, that is, either as primary or any secondary diagnosis (table A1 on request).

Overall, 99% of all hysterectomies had a single hysterectomy-related procedural code (OPS code). The remaining 1% (2,981 hysterectomies) was coded with at least two hysterectomy-related OPS codes and was checked individually. Most often, a clinically plausible single OPS code could be re-assigned to these hysterectomies. Hysterectomies were classified by surgical approach using OPS codes as abdominal, vaginal, laparoscopic, laparoscopic assisted vaginal (LAVH), vaginal hysterectomy with conversion to open abdominal hysterectomy, laparoscopic hysterectomy with conversion to open abdominal hysterectomy, extent of hysterectomy (subtotal versus total hysterectomy), and by additional bilateral oophorectomy (table A2 on request). According to the German DRG system, the surgical approaches (laparoscopic, LAVH, vaginal, open abdominal, conversions,…) produce the same reimbursement if the diagnoses (primary and secondary diagnoses) are identical. For example, hysterectomy for leiomyoma of the uterus - given no comorbidity- produces a single DRG code N21.Z regardless of surgical approach. This DRG code is the basis for reimbursement.

Statistical Methods

Crude and age-specific hysterectomy rates were calculated with the midyear populations of the years 2005 and 2006 as the denominator. In a sensitivity analysis,

we corrected the denominator in the rate calculation for women who have already had a hysterectomy. In other words, the denominator was adjusted by removing the estimated prevalence of women who have already had a hysterectomy. The age-specific prevalence of hysterectomy in the general population was estimated from a recent regional survey in Bremen among women aged 45-74 years (23). As age-specific prevalence of hysterectomy revealed a S-shaped pattern in Bremen, Germany, as well as in a survey in Utah, USA (24), we estimated age-specific probabilities of hysterectomy prevalence and extrapolated hysterectomy probabilities (outside the observed age range) from a logistic regression model. Based on this model, we found an upper limit of hysterectomy prevalence in the population of 40.7% among women aged 85 years and more. This value minimized the Pearson goodness-of-fit statistic from an iterative search across a range (40%-60%) of upper limits of the hysterectomy prevalence among women aged 85 years or more. Thereafter, we corrected the person-years at risk of the population and recalculated hysterectomy rates in Germany for all age groups. We estimated age-specific risks of conversion from laparoscopic or vaginal hysterectomy to open hysterectomy by linear risk models with disjoint indicator variables for the indication groups and age as a further covariate (25). As the term “conversion risk” may be confused with adverse effects following conversion, we instead use the term “conversion rate” throughout the manuscript although the term “rate” is usually reserved for measures that include time in the denominator (26). Statistical analyses were performed using SAS 9.2 (27).

Results

Overall, 3.6 per 1,000 women (any age) per year in Germany underwent hysterectomy. The corrected rate of hysterectomy that accounts for the hysterectomy prevalence was 4.3 per 1,000 women per year, reflecting a 19% increase. Hereafter, uncorrected rates for hysterectomy prevalence are reported. The highest hysterectomy rates were among women aged 40-49 years (9.9 per 1,000 women). Mean and median age at hysterectomy were 52 years (standard deviation 13 years) and 48 years (10% percentile 39 years, 90% percentile 72 years) respectively; and mean and median lengths of stay in the hospital were 9.8 days (standard deviation: 5.9 days) and 9 days (10% percentile: 5 days, 90% percentile: 15 days) respectively.

Twelve percent of all hysterectomies were associated with a primary malignant tumor of the genital organs and of these, primary malignant tumors of the uterus were the most frequent diagnosis (57%). Overall, 81% of all hysterectomies were associated with benign diseases of the genital tract. The ten most frequent primary diagnoses associated with hysterectomy for benign diseases of the genital tract accounted for 96% of all hysterectomies of this group. Leiomyoma of the uterus, genital prolapse, and excessive, frequent and irregular menstruation were the three most common primary diagnoses associated with hysterectomy accounting for 86% of all hysterectomies associated with benign diseases of the genital tract (Table 1).

As hysterectomies associated with benign diseases of the genital tract including benign cancers are often associated with more than one diagnosis, the relative frequencies of benign diseases of the genital tract are considerably higher if secondary diagnoses are also accounted for. For example, we observed overall

132,514 hysterectomies associated with leiomyoma of the uterus as the primary diagnosis. However, an additional 25,316 hysterectomies with a secondary diagnosis of leiomyoma of the uterus were observed. Similarly, 57,260 hysterectomies were associated with genital prolapse as the primary diagnosis and an additional 11,430 hysterectomies had a secondary diagnosis of genital prolapse. The primary diagnosis “excessive, frequent & irregular menstruation (ICD-10: N92)” occurred only among 23,537 hysterectomies associated with benign diseases of the genital tract. However, an additional 53,816 hysterectomies were associated with a secondary diagnosis of N92. Only 0.16% of all hysterectomies associated with benign diseases of the genital tract had primary diagnoses that did not match any diagnosis of our pre-specified list of 24 frequent benign indications of hysterectomy.

Age-specific hysterectomy rates peaked at different ages depending on indication. For example, highest hysterectomy rates for the treatment of genital tract cancers occurred among women aged 60-69 years whereas hysterectomy rates for the treatment of in-situ cancer and benign diseases of the genital tract were highest among women aged 40-49 years (Table 2).

The majority of hysterectomies were performed by the vaginal route (48.1%) followed by abdominal open procedure (40.0%). Six percent of all hysterectomies were performed by LAVH and five percent were performed laparoscopically. Hysterectomies associated with genital tract cancer or other cancers as primary diagnoses were most frequently performed as abdominal open hysterectomies (90.8% and 93.9% respectively). The majority of hysterectomies for benign diseases of the genital tract were performed vaginally (55.2%), followed by abdominal open

procedures (31.7%), LAVHs (6.1%), and laparoscopic hysterectomies (5.8%). 4.8% of all hysterectomies due to benign diseases of the genital tract were subtotal hysterectomies. The proportion of subtotal hysterectomies in this group was highest for hysterectomies undertaken as laparoscopic hysterectomy (64.1%). The proportion of subtotal hysterectomies among women with benign diseases of the genital tract decreased from 6% (20-49 years) to 1% (60 years and more). Overall, 23.2% of all hysterectomies included bilateral oophorectomy. This proportion varied by indication group: primary malignant tumors of the genital organs: 86.9%, endometrial adenomatous hyperplasia: 40.3%, in-situ neoplasia of genital organs: 14.3%, neoplasms of uncertain or unknown behaviour of genital organs: 55.2%, primary malignant cancers other than genital tract cancers: 72.1%, and benign diseases of the genital tract: 12.4%. Just over a quarter (25.6%) of hysterectomies for benign diseases among women aged 50 years or more (most likely either peri- or postmenopausal women) included bilateral oophorectomy. This proportion was 3.9% among women aged < 50 years.

Out of 16,674 laparoscopic hysterectomies, 10.1% necessitated a conversion to an abdominal open hysterectomy. In contrast, out of 146,244 vaginal hysterectomies, only 1.1% necessitated a conversion to an abdominal hysterectomy. For both types of hysterectomies, the rates of conversion were highest for indications including primary malignant genital tract cancer, other cancers as primary diagnosis, and neoplasia of uncertain behavior. Conversion rates were lowest for in-situ genital cancers (laparoscopical and vaginal hysterectomies) and benign diseases of the genital tract (vaginal hysterectomies) (Table 3). Whereas the conversion rate of

laparoscopical hysterectomies monotoneously increased by age, this rate was about constant for vaginal hysterectomies (Figure 1).

The international comparison of population-wide hysterectomy rates among women aged 20 years or more related to benign diseases of the genital tract of the recent years shows that Sweden has the lowest hysterectomy rate and that the United States and Australia have the highest rates. Germany has a rate between these extremes (Table 4).

Discussion

The German-wide hysterectomy rate was 3.6 per 1,000 women per year. Correcting the population used in the rate calculation for hysterectomy prevalence resulted in a 19% increase, a similar increase to that found in another study conducted in Australia (7). As found in studies conducted in the United States (2;3), the highest hysterectomy rates were among women aged 40-49 years (9.9 per 1,000) with benign diseases of the genital tract as the most frequent indication group. As seen in other studies, uterine leiomyoma, genital prolapse, and excessive, frequent and irregular menstruation were the most frequent primary diagnoses for hysterectomy accounting for 86% of all hysterectomies in this indication group (2;3;8;9;13;22;28).

The vaginal route of hysterectomy is considered as a first choice of all benign indications as the post-operative rates of morbidity and complications are lower than abdominal open hysterectomies according to the Society of Obstetricians and Gynaecologists of Canada (SOGC) clinical guidelines (1). We observed that 55% of all hysterectomies for benign indications were vaginal hysterectomies. In contrast, only 29% of hysterectomies for benign indications were vaginal hysterectomies in Sweden from 2001 through 2003 (9). However, since 1993 the percentage of vaginal hysterectomies for benign indications steadily increased in Sweden and most recent unpublished percentages may be higher than those from 2001 through 2003. In the U.S., about 25% of hysterectomies for benign indications were vaginal hysterectomies (29).

To the best of our knowledge, these are the first population-based, unbiased nationwide rate estimates of the conversion from laparoscopic or vaginal

hysterectomy to open abdominal hysterectomy in Germany. For both types of hysterectomies, the rates of conversion were highest for indications including primary malignant genital tract cancer, other cancers as primary diagnosis, and neoplasia of uncertain behavior. The crude rates of conversion from laparoscopic and vaginal hysterectomy to open abdominal hysterectomy among benign indications were 10.5% and 1.1%. In contrast to studies that report conversion rates in highly selected patient series usually treated at a few centers, we provide nationwide, population-based conversion rates which complicates the comparison of our results with those reports.

Published conversion rates vary considerably and may depend on several factors including patient-related factors like uterine size, pelvic and bowel adhesions, and body mass index, physician-related factors like the surgeons' experience, iatrogenic injuries (for example bleeding, perforation, uterovaginal fistula), and extent of surgery (adnexectomy, pelvic/aortic lymph node dissection) (30-34). The age-associated risk patterns of conversion differed by type of hysterectomy. For example, women aged 50 years who underwent hysterectomy for benign diseases of the genital tract had an estimated conversion risk of 11% and 1.1% for laparoscopic and vaginal hysterectomy respectively. In contrast, women aged 80 years who underwent hysterectomy for benign diseases of the genital tract had an estimated conversion risk of 22% and 0.5% for laparoscopic and vaginal hysterectomy respectively. Given the many factors that influence the decision to convert to open abdominal hysterectomy we cannot provide an explanation of the different age-associated risk patterns as clinical details beyond ICD-10 codes and procedure codes are missing in the DRG data set.

The ACOG (American Congress of Obstetricians and Gynecologists) has suggested that concomitant bilateral oophorectomy should be considered during a hysterectomy for benign uterine diseases in peri- and postmenopausal women (35). In Germany, 4% and 26% of all hysterectomies for benign diseases of the genital tract included bilateral oophorectomy among women aged < 50 years and ≥ 50 years (most likely peri- and postmenopausal women) respectively. From 2000 through 2004, Whiteman et al. in the US observed that 37% of hysterectomies among women with benign diseases of the genital tract aged 15-44 years were accompanied by bilateral oophorectomy (2). This proportion was only 3% in Germany.

A few limitations to the study need mention. First, although we used a hierarchical algorithm similar to those that have been repeatedly used in other studies to group indications of hysterectomies (22) (2) (36) (37), this approach does not reflect the entire complexity of diagnoses for women undergoing hysterectomies (38). Second, a more detailed stratification of hysterectomy rates for benign diseases of the uterus by single indications like uterine leiomyoma, prolaps etc. could not be reliably done based on DRG data and would necessitate a medical chart review that was impossible due to data protection laws in Germany. For the same reasons, we could not run detailed analysis of the causes of conversion (disease-related factors and clinician-related factors). Third, due to data confidentiality laws, German DRG data are completely anonymized and therefore validation studies of a random sample of these data is impossible.

In conclusion, this descriptive study provides unbiased nationwide hysterectomy rates for Germany and a benchmark for further studies. We provided a prevalence-adjusted hysterectomy rate. In addition, the rate of conversion of laparoscopical hysterectomies was considerably higher than the rate of vaginal hysterectomies. Age (laparoscopical hysterectomies only) and indication group (laparoscopical and vaginal hysterectomies) were associated with the rate of conversion to open abdominal hysterectomy.

Reference List

1. Lefebvre G, Allaire C, Jeffrey J, Vilos G, Arneja J, Birch C, et al. SOGC clinical guidelines. Hysterectomy. J Obstet Gynaecol Can 2002 Jan;24(1):37-61.

2. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, et al. Inpatient hysterectomy surveillance in the United States, 2000-2004. Am J Obstet Gynecol 2008 Jan;198(1):34-7.

3. Merrill RM. Hysterectomy surveillance in the United States, 1997 through 2005. Med Sci Monit 2008 Jan;14(1):CR24-CR31.

4. Roos NP. Hysterectomy: variations in rates across small areas and across physicians' practices. Am J Public Health 1984 Apr;74(4):327-35.

5. McPherson K, Wennberg JE, Hovind OB, Clifford P. Small-area variations in the use of common surgical procedures: an international comparison of New England, England, and Norway. N Engl J Med 1982 Nov 18;307(21):1310-4.

6. Keskimaki I, Aro S, Teperi J. Regional variation in surgical procedure rates in Finland. Scand J Soc Med 1994 Jun;22(2):132-8.

7. Spilsbury K, Semmens JB, Hammond I, Bolck A. Persistent high rates of hysterectomy in Western Australia: a population-based study of 83 000 procedures over 23 years. BJOG 2006 Jul;113(7):804-9.

8. Vuorma S, Teperi J, Hurskainen R, Keskimaki I, Kujansuu E. Hysterectomy trends in Finland in 1987-1995--a register based analysis. Acta Obstet Gynecol Scand 1998 Aug;77(7):770-6.

9. Lundholm C, Forsgren C, Johansson AL, Cnattingius S, Altman D. Hysterectomy on benign indications in Sweden 1987-2003: a nationwide trend analysis. Acta Obstet Gynecol Scand 2009;88(1):52-8.

10. Domenighetti G, Luraschi P, Marazzi A. Hysterectomy and sex of the gynecologist. N Engl J Med 1985 Dec 5;313(23):1482.

11. Domenighetti G, Casabianca A. Rate of hysterectomy is lower among female doctors and lawyers' wives. BMJ 1997 May 10;314(7091):1417.

12. Domenighetti G, Luraschi P, Casabianca A, Gutzwiller F, Spinelli A, Pedrinis E, et al. Effect of information campaign by the mass media on hysterectomy rates. Lancet 1988 Dec 24;2(8626-8627):1470-3.

13. Gimbel H, Settnes A, Tabor A. Hysterectomy on benign indication in Denmark 1988-1998. A register based trend analysis. Acta Obstet Gynecol Scand 2001 Mar;80(3):267-72.

14. Settnes A, Jorgensen T, Lange AP. Hysterectomy in Danish women: weight-related factors, psychologic factors, and life-style variables. Obstet Gynecol 1996 Jul;88(1):99-105.

15. Stang A, Stausberg J. Inpatient management of patients with skin cancer in Germany: an analysis of the nationwide DRG-statistic 2005-2006. Br J Dermatol 2009 Nov;161 Suppl 3:99-106.

16. Stang A, Katalinic A, Dieckmann KP, Pritzkuleit R, Stabenow R. A novel approach to estimate the German-wide incidence of testicular cancer. Cancer Epidemiol 2010 Jan 28;34:13-9.

17. Stang A, Weichenthal M. Micrographic surgery of skin cancer in German hospitals 2005-2006. J Eur Acad Dermatol Venereol 2010 Jul 15.

18. ICD-10-GM 2005 Systematisches Verzeichnis: Internationale statistische Klassifikation der Krankheiten und verwandter Gesundheitsprobleme, 10. Revision - German Modification. Köln: Deutscher Ärzteverlag; 2004.

19. ICD-10-GM 2006 Systematisches Verzeichnis: Internationale statistische Klassifikation der Krankheiten und verwandter Gesundheitsprobleme. Köln: Deutscher Ärzteverlag; 2006.

20. OPS 2005 Systematisches Verzeichnis. Köln: Deutscher Ärzteverlag; 2005.

21. OPS 2006 Systematisches Verzeichnis. Köln: Deutscher Ärzteverlag; 2006.

22. Keshavarz H, Hillis SD, Kieke BA. Hysterectomy surveillance - United States, 1994-1999. MMWR 2002;51(SS05):1-8.

23. Senator für Arbeit FGJuS. Frauengesundheitsbericht Bremen 2001. Bremen: Media Meter; 2001.

24. Merrill RM, Lyon JL, Wiggins C. Comparison of two methods based on cross-sectional data for correcting corpus uterine cancer incidence and probabilities. BMC Cancer 2001;1:13.

25. Greenland S. Introduction to Regression Models. In: Rothman KJ, Greenland S, Lash TL, eds. Modern Epidemiology. 3 ed. Philadelphia: Wolters Kluwer, Lippincott Williams & Wilkins; 2008. p. 381-417.

26. Elandt-Johnson RC. Definition of rates: some remarks on their use and misuse. Am J Epidemiol 1975 Oct;102(4):267-71.

27. SAS for windows [computer program]. Cary, NC: SAS Institute; 2002.

28. Jacobson GF, Shaber RE, Armstrong MA, Hung YY. Hysterectomy rates for benign indications. Obstet Gynecol 2006 Jun;107(6):1278-83.

29. Julian TM. Vaginal hysterectomy: an apparent exception to evidence-based decision making. Obstet Gynecol 2008 Apr;111(4):812-3.

30. Leonard F, Chopin N, Borghese B, Fotso A, Foulot H, Coste J, et al. Total laparoscopic hysterectomy: preoperative risk factors for conversion to laparotomy. J Minim Invasive Gynecol 2005 Jul;12(4):312-7.

31. Ng CC, Chern BS, Siow AY. Retrospective study of the success rates and complications associated with total laparoscopic hysterectomy. J Obstet Gynaecol Res 2007 Aug;33(4):512-8.

32. Tohic AL, Dhainaut C, Yazbeck C, Hallais C, Levin I, Madelenat P. Hysterectomy for benign uterine pathology among women without previous vaginal delivery. Obstet Gynecol 2008 Apr;111(4):829-37.

33. Eisenkop SM. Total laparoscopic hysterectomy with pelvic/aortic lymph node dissection for endometrial cancer--a consecutive series without case selection and comparison to laparotomy. Gynecol Oncol 2010 May;117(2):216-23.

34. Tunitsky E, Citil A, Ayaz R, Esin S, Knee A, Harmanli O. Does surgical volume influence short-term outcomes of laparoscopic hysterectomy? Am J Obstet Gynecol 2010 Jul;203(1):24-6.

35. Camanni M, Mistrangelo E, Febo G, Ferrero B, Deltetto F. Prophylactic bilateral oophorectomy during vaginal hysterectomy for benign pathology. Arch Gynecol Obstet 2009 Jul;280(1):87-90.

36. National Center for Health Statistics, Pokras R, Hufnagel V. Hysterectomies in the United States, 1965-84. Washington: U.S. Government Printing Office; 1987.

37. Lepine LA, Hillis SD, Marchbanks PA, Koonin LM, Morrow B, Kieke BA, et al. Hysterectomy surveillance - United States. 1980-1993. MMWR 1997;46 (SS-4):1-15.

38. Brett KM, Marsh JV, Madans JH. Epidemiology of hysterectomy in the United States: demographic and reproductive factors in a nationally representative sample. J Womens Health 1997 Jun;6(3):309-16.

Table 1 **Hysterectomy Indication Groups derived from a Hierarchical Algorithm and Diagnoses associated with 305.015 Hysterectomies in Germany from 2005 to 2006**

Indication Groups and ICD-10 Codes	N	%	Bilateral Ooph. %
Primary or secondary diagnosis: Primary malignant cancer of the female genital organs[1]	**37,037**	**12.1**	**86.9**
Cervix uteri (C53)	6,862		
Uterus (C54-C55)	20,982		
Ovary (C56)	9,838		
Other & unspecified female genital organs (C57)	709		
Placenta (C58)	13		
Primary or secondary diagnosis: Endometrial adenomatous hyperplasia (N85.1)	**5,063**	**1.7**	**40.3**
Primary or secondary diagnosis: In-situ neoplasm of the genital organs[1]	**6,337**	**2.1**	**14.3**
Cervix uteri (D06)	6,145		
Other & unspecified part of the uterus (D07.0)	125		
Other & unspecified female genital organs (D07.3)	84		
Primary or secondary diagnosis: Neoplasm of uncertain or unknown behaviour of female genital organs (D39)	**5,646**	**1.9**	**55.2**
Primary diagnosis: Primary malignant cancer other than C53-C58 as the primary diagnosis	**2,712**	**0.9**	**72.1**
Colorectal cancer (C18-C21)	1,256		
Malignant neoplasm of retroperitoneum & peritoneum (C48)	117		
Malignant neoplasm of breast (C50)	161		
Malignant neoplasm of bladder (C67)	393		
Secondary malignant neoplasm of ovary (C79.6)	230		
Other primary cancers	555		

(Table 1 continued)

Indication Groups and ICD-10 Codes	N	%	Bilateral Ooph. %
Benign diseases of the genital tract[2]	**248,220**	**81.4**	**12.4**
Leiomyoma of the uterus (D25)	132,514		
Genital prolaps (N81)	57,260		
Excessive, frequent & irregular menstruation (N92)	23,537		
Endometriosis (N80)	10,041		
Benign neoplasm of ovary (D27)	3,957		
Other noninflammatory disorders of uterus, except cervix (N85) excluding endometrial adenomatous hyperplasia (N85.1)	3,449		
Dysplasia of cervix uteri (N87)	2,628		
Pain and other conditions associated with genital organs and menstrual cycle (N94)	2,151		
Other disorders of urinary system (N39)[3]	2,038		
Menopausal and other perimenopausal disorders (N95)	1,550		
Other diagnoses	9,095		

Legend Table 1

1.) the sum of diagnosis-specific indications does not necessarily add up to the group total as more than one diagnosis of the group may have been the reason for hysterectomy

2.) Ten most frequent primary diagnosis associated with hysterectomy sorted in descending order (these 10 diagnoses include 96% of all hysterectomies associated with benign diseases)

3.) 1,937 out of 2,038 N39 codes (95%) were N39.3 (stress incontinence)

Table 2 Age-specific and Overall Hysterectomy Rates (per 100,000) in Germany of the Years 2005-2006

Federal State	Female Population[1]	Hysterectomy Rate Overall		Indication-specific Age-specific Hysterectomy Rates											
				Primary Malignant Genital Tract Cancer		Endometrial Adenomatous Hyperplasia		In-situ Cancer Genital Tract		Neoplasia of uncertain behaviour		Other Cancer as Primary Diagnosis		Benign Diseases Genital Tract	
		Rate	(SE)	Rate	(SE)	Rate	(SE)	Rate	(SE)	Rate	(SE)	Rate	(SE)	Rate	(SE)
0-19	8,030,309	0.3	0.0	0.1	0.0	0.0		0.0		0.0		0.0		0.2	0.0
20-29	4,785,355	16.8	0.4	2.6	0.2	0.1	0.0	1.6	0.1	0.2	0.0	0.1	0.0	12.2	0.4
30-39	5,720,938	299.5	1.6	17.7	0.4	1.6	0.1	15.8	0.4	3.3	0.2	0.6	0.1	260.6	1.5
40-49	6,626,618	991.7	2.7	38.3	0.5	8.6	0.3	19.9	0.4	13.3	0.3	2.5	0.1	909.0	2.6
50-59	5,245,345	550.5	2.3	66.7	0.8	16.0	0.4	8.0	0.3	11.9	0.3	4.7	0.2	443.2	2.1
60-69	5,182,572	389.5	1.9	100.6	1.0	11.5	0.3	5.1	0.2	9.7	0.3	7.4	0.3	255.2	1.6
70+	6,506,897	304.5	1.5	94.1	0.9	6.6	0.2	2.8	0.1	9.5	0.3	8.0	0.2	183.5	1.2
Overall crude rate	42,098,034	362.4	0.7	44.0	0.2	6.0	0.1	7.5	0.1	6.7	0.1	3.2	0.1	294.9	0.6

Legend Table 2: SE: standard error of the rate.

Table 3

Crude and Age-adjusted Rates (%) (Conversion per 100 operations) and 95% Confidence Intervals of Conversion from Laparoscopical or Vaginal Hysterectomy to Open Abdominal Hysterectomy by Age in Germany of the Years 2005-2006

	Hysterectomies (N)	Mean Age (SD)	Conversions (N)	Crude Conversion Rate	Age-adj. Conversion Rate
Start with laparoscopic hysterectomy					
Primary malignant genital tract cancer	333	62 (14)	85	25.5 (20.8-30.2)	20.0 (15.3-24.6)
Endometrial adenomatous hyperplasia	145	56 (12)	30	20.7 (14.1-27.3)	16.2 (9.6-22.8)
In-situ cancer genital tract	113	47 (10)	8	7.1 (2.4-11.8)	5.2 (1.2-9.3)
Neoplasia of uncertain behaviour	292	51 (12)	78	26.7 (21.6-31.8)	24.4 (19.3-29.5)
Other cancer as primary diagnosis	22	59 (14)	8	36.4 (16.3-56.5)	31.5 (11.5-51.6)
Benign diseases genital tract	15,769	46 (7)	15,769	10.5 (10.0-11.0)	9.8 (9.3-10.2)
Start with vaginal hysterectomy					
Primary malignant genital tract cancer	2,125	59 (17)	75	3.5 (2.7-4.3)	3.8 (3.0-4.6)
Endometrial adenomatous hyperplasia	2,442	56 (11)	44	1.8 (1.3-2.3)	1.9 (1.4-2.5)
In-situ cancer genital tract	4,307	45 (11)	38	0.9 (0.6-1.2)	1.0 (0.7-1.3)
Neoplasia of uncertain behaviour	674	55 (14)	14	2.1 (1.0-3.2)	2.2 (1.1-3.3)
Other cancer as primary diagnosis	102	67 (15)	5	4.9 (0.7-9.1)	5.1 (0.9-9.3)
Benign diseases genital tract	136,594	52 (13)	1,440	1.1 (1.0-1.1)	1.0 (1.0-1.1)

Legend Table 3

Estimated rates are based on linear risk models (25). Conversion from laparoscopic to open abdominal hysterectomy: 1,707 out of 16,674 hysterectomies (10.1%); conversion from vaginal to open abdominal hysterectomy: 1,616 out of 146,244 hysterectomies (1.1%);

Table 4 A Comparison of Hysterectomy Rates per 1,000 Women Across Countries

Publication	Population	Calendar Period	Correction of Population[1]	Age (Years)	Indication for Hysterectomy			
					Any	Cancer	Precancerous lesions	Benign diseases
Merrill 2008 (3)[2)]	United States	2001-2005	no	18+	5.5	0.4	0.2	4.9
Spilsbury et al. 2006 (7)[3)]	Western Australia	2003	no	20+	n.a.	n.a.	n.a.	5.4
Lundholm et al., 2009 (9)	Sweden	2001-2003	no	18+	n.a.	n.a.	n.a.	2.1
This study[4)]								
	Germany	2005-2006	no	20+	4.5	0.5	0.2	3.6
	Germany	2005-2006	yes	20+	5.4	0.7	0.2	4.4

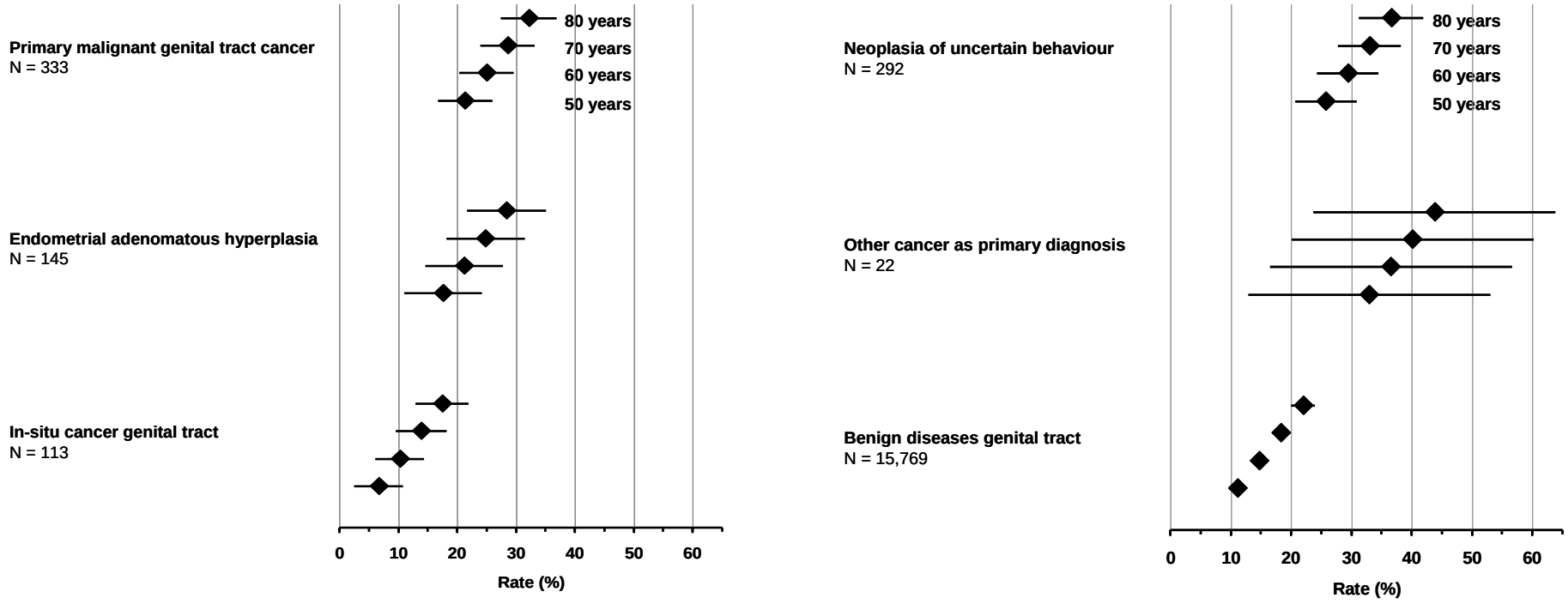
Legend Table 4

1) correction of population at risk for the prevalence of hysterectomy; 2) Cancer of the female genital organs (ICD-9: 179-184); precancerous lesions included endometrial cystic hyperplasia (ICD-9: 621.3) and carcinoma in situ of the genital organs (ICD-9: 233); 3) Spilsbury et al. (7) additionally reported the age-standardized (weights of the Australian population of 2001) additionally adjusted for the underlying prevalence of hysterectomy: 4.8 per 1,000 women; 4) This study: precancerous lesions included endometrial adenomatous hyperplasia (ICD-10: N85.1) and in-situ carcinoma of the genital organs (ICD-10: D06, D07.0, D07.3); n.a.: not applicable or not reported;

Figure 1

Estimated Age-specific Rates (%) and 95% Confidence Intervals of Conversion from Laparoscopical or Vaginal Hysterectomy to Open Abdominal Hysterectomy by Age in Germany of the Years 2005-2006

Conversion from Laparoscopic to Open Abdominal Hysterectomy



Conversion from Vaginal to Open Abdominal Hysterectomy