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Original article

Hysterectomy-corrected incidence rates of cervical and uterine cancers in Massachusetts, 1995 to 2010

Andreas Stang MD [a,b,*], Helen Hawk PhD [c], Richard Knowlton MS [c], Susan T. Gershman PhD [c], Oliver Kuss PhD [d,e]

[a] Institute of Clinical Epidemiology, Medical Faculty, Martin-Luther-University of Halle-Wittenberg, Halle, Germany
[b] Department of Epidemiology, Boston University, School of Public Health, Boston, MA
[c] Massachusetts Department of Public Health, Massachusetts Cancer Registry, Bureau of Health Information, Statistics, Research and Evaluation, Boston, MA
[d] Center for Health and Society, Medical Faculty, Heinrich Heine University, Düsseldorf, Germany
[e] Institute for Biometrics and Epidemiology, German Diabetes Center, Leibniz Institute for Diabetes Research at Heinrich Heine University, Düsseldorf, Germany

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ABSTRACT

Purpose: The aim was to provide ethnicity-specific incidence trends of cervical and uterine cancers uncorrected and corrected for the prevalence of hysterectomy in Massachusetts.
Methods: We used incidence data of invasive cervical (*International Classification of Diseases for Oncology, Third Edition*: C53) and uterine cancer (*International Classification of Diseases for Oncology, Third Edition*: C54-C55) diagnosed from 1995 to 2010 from the Massachusetts Cancer Registry. Data from the Behavioral Risk Factor Surveillance Survey for Massachusetts were used to model the ethnicity-specific prevalence of hysterectomy. We standardized rates by the US 2000 population standard for the periods 1995 to 1998, 1999 to 2002, 2003 to 2006, and 2007 to 2010.
Results: Depending on the period, corrected cervical cancer rates increased by 1.2 to 2.8, 5.6 to 8.3, and 3.2 to 8.2 per 100,000 person-years, and uterine cancer rates increased by 14.3 to 16.7, 14.8 to 29.3, and 6.7 to 15.4 per 100,000 person-years among white non-Hispanic women, black non-Hispanic women, and Hispanic women, respectively. Corrected estimated annual percentage changes increased for uterine cancer among black non-Hispanic women aged 60 years and older. Ethnic disparities between white non-Hispanic women and the other groups became smaller for uterine cancer and larger for cervical cancer after correction.
Discussion: Corrections of cervical and uterine cancer rates for hysterectomy prevalence are important as ethnic disparities, age patterns and time trends of cervical and uterine cancer incidence rates change.

Introduction

Incidence rates of cervical and uterine cancers are usually estimated without the elimination of hysterectomized women from the population at risk, thus resulting in an underestimate of the incidence of these malignant tumors in the population [1]. However, hysterectomy is the most frequently performed major gynecologic surgical procedure across many areas in the world [2–5]. Most often, hysterectomies are undertaken for benign diseases of the genital tract including leiomyoma, endometriosis, and genital prolapse [3,5,6]. For example, about 80% to 85% of hysterectomies in the United States (2001–2005), Germany (2005–2006), and Sweden (1987–2003), respectively, were related to benign diseases of the genital tract [3,5,6]. Hysterectomy rates in the United States in 2004 to 2005 showed a strong age peak at 40 to 44 years and a small second peak at 65 to 69 years [5].

In a study involving women from the National Cancer Institute's Surveillance, Epidemiology, and End Results (NCI/SEER) program who were diagnosed between age 30 and 74 years from 1992 to 2000, Sherman et al. [7] found that failure to correct for hysterectomy prevalence may lead to underestimates of endometrial carcinoma risk, especially among blacks. These researchers, however, neither studied the effect of prevalence correction on cervical cancer rates nor incidence time trends of cervical and uterine cancers corrected for hysterectomy prevalence [7].

Adjustment of population denominators for hysterectomy status results in a decrease in the population at risk and therefore an increase in cancer rates. As black women may have more frequently undergone hysterectomy in the past than white women, lack of

* Corresponding author. Institute of Clinical Epidemiology, Medical Faculty, Martin-Luther-University of Halle-Wittenberg, Magdeburger Str. 8, 06097 Halle (Saale), Germany. Tel.: +49 345 557 3567; fax: +49 345 557 3565.
E-mail address: andreas.stang@uk-halle.de (A. Stang).

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adjustment of population denominators for hysterectomy status could have led to underestimating the differences in the incidence rates of cervical and uterine cancers between these groups [7–9].

Detailed analyses of the Surveillance, Epidemiology and End Results (SEER) program registries of the years 1975 through 2009 revealed that rates of cervical cancer declined for white and black women for all ages. In the early years, cervical cancer incidences were higher among black than white women for all ages. However, the black-to-white disparity of cervical cancer decreased from nearly twofold rate ratios during 1975 to 1979 to unity during 2005 to 2009 among women aged younger than 50 years. In contrast, rates remained elevated for black women aged 50 years or older. A more detailed SEER-based ethnicity-specific analysis of cervical cancer incidences of the years 2005 through 2009 showed that white non-Hispanic, black non-Hispanic, and Asian/Pacific Islander women aged younger than 50 years had approximately identical rates, whereas Hispanic and American Indian/Alaska Native women had clearly higher rates. Among women aged 50 years or older, cervical cancer incidences of Hispanic, black non-Hispanic, American Indian/Alaska Native, and Asian/Pacific Islander women were higher than those among white non-Hispanic women [9]. In a recent state-level uterine corpus cancer incidence study, Siegel et al. [10] found for the majority of US states that hysterectomy correction diminished or reversed the black/white deficit and accentuated the Hispanic/white deficit. They concluded that the lack of hysterectomy correction distorts geographic and racial/ethnic patterns.

The aim of this study was to provide ethnicity-specific incidence rate trends of cervical and uterine cancers uncorrected and corrected for the prevalence of hysterectomy in Massachusetts for the diagnostic years 1995 through 2010.

Material and methods

In 2010, Massachusetts had a population of 6.56 million people (3.18 million men and 3.38 million women). Among women 20 years and older, 80.8% were white non-Hispanic, 5.9% black non-Hispanic, 7.8% Hispanic, and 5.5% other ethnicities including Asian and American Indian, respectively. We excluded ethnicities other than white non-Hispanic, black non-Hispanic, and Hispanic. The Massachusetts Cancer Registry (MCR) collects reports of newly diagnosed cases of cancer from health care facilities and practitioners throughout Massachusetts. Additionally, the MCR has mutual reporting agreements with 24 states to obtain data on Massachusetts residents diagnosed out of state. In addition, the MCR identifies previously unreported cancer cases through review of death certificate data to further improve case completeness (for details www.mass.gov/dph/mcr).

The number of incident invasive cervical (*International Classification of Diseases for Oncology, Third Edition* (ICD-O-3): C53) and uterine primary malignant tumors (ICD-O-3: C54-C55) of the years 1995 through 2010 within age groups 20 to 29, 30 to 39, … , 70 to 79, and 80 years and more were provided by MCR. The corresponding deaths (ICD-10: C53, C54-C55) and midyear populations by ethnicity were provided by the Bureau of Statistics of Health Information, Statistics, Research and Evaluation at the Massachusetts Department of Public Health.

To estimate the age- and ethnicity-specific prevalence of hysterectomy, we used data from the Behavioral Risk Factor Surveillance Survey (BRFSS) for Massachusetts. During the reported years 1995 through 2010, the Massachusetts conducted surveys for landline phone users only. The landline surveys are random-digit-dial telephone surveys of noninstitutionalized Massachusetts adults residing in households with telephones. The sampling of the survey population involves a list-assisted stratified random-digit-dial sampling frame, which assures that Massachusetts households with telephone numbers assigned after publication of the current directories, as well households with deliberately unlisted numbers, are included in the sample in appropriate proportions. To be eligible to participate in the landline telephone survey, a household must be occupied by at least one adult aged 18 years and older. Institutions, group quarters, and temporary residences inhabited for less than one month per year were ineligible for the landline survey. In addition, the Massachusetts sample has six geographical strata to increase the number of respondents who belong to racial and/or ethnic minority group. The BRFSS data are weighted to take into account differences in probabilities of selection because of the telephone number, the number of telephones in a household, and the number of adults in a household. Adjustments are also made to account for nonresponse noncoverage of households without landline telephones and differential participation by sex, age, and race/ethnicity. The response rate and sample size varies over the years. Weighting procedure adjusts for the differences in the response rate and sample size. In 2010, the response proportion was 49% and the female sample size comprised 10,182 respondents (52% of all sample). Overall percentage by ethnicity in 2010 were 82.6% for white non-Hispanic, 5.1% for black non-Hispanic, 8.2% for Hispanics, and 4.1% for Asians. The core Centers for Disease Control and Prevention question about hysterectomy was asked consistently over the years. All nonpregnant women were asked: “have you had a hysterectomy? A hysterectomy is an operation to remove the uterus (womb).” Answer categories included yes, no, don’t know/not sure, or refused. Annual age-specific (10-year age groups 20–29, 30–39, …., 80+ years) of the years 1995 through 2002, 2004, 2006, 2008, and 2010 and ethnicity-specific (white, non-Hispanic, black, non-Hispanic, and Hispanic) prevalence of hysterectomy was provided (http://www.mass.gov/eohhs/gov/departments/dph/programs/health-stats/health-survey/brfss/).

Statistical methods

Previous studies on age-specific patterns of hysterectomy prevalence revealed S-shaped patterns in several countries or states including Utah [11] and Germany [12,13]. These patterns were also seen for all ethnic groups in Massachusetts. To account for the random variation of hysterectomy prevalence within years and age groups, we estimated age-specific annual hysterectomy prevalence by use of weighted logistic regression models for each ethnicity separately. We used the age-specific weight of the population size for each ethnicity and each year. We estimated plateaus of the upper limit of the hysterectomy prevalence together with the regular model parameters by using the OPTC option in SAS PROC PROBIT. We studied two model classes to predict hysterectomy prevalence: one model class that included age, year, and their interaction as linear terms; another model class that additionally included a quadratic term for age and year. To compare the model fit between these model classes, we used the Akaike criterion with lower Akaike criterion values indicating better fit. We also graphically compared predicted versus observed prevalences by ethnicity, age, and year. All subsequent analyses used the predicted hysterectomy prevalences. The SAS code and figures that compare observed with predicted hysterectomy prevalence are available on request.

Midyear populations by age (5-year groups), gender, calendar year, and ethnicity were provided by the Bureau of Statistics of Health Information, Statistics, Research and Evaluation at the Massachusetts Department of Public Health. For the estimation of uncorrected rates, we used these figures as denominators of the rates. After estimation of the hysterectomy prevalence P (by 10-year age group, calendar year and ethnicity), we multiplied (1−P) with the corresponding midyear population within each stratum and therefore reduced the midyear population at risk, that is the person-years at risk. We report uncorrected and corrected