RESEARCH ARTICLE

Health Disparities between Black Hispanic and Black Non-Hispanic Cervical Cancer Cases in the USA

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Abstract

Background: Globally, cervical cancer is a major public health concern. Cervical cancer is the second most common cancer among women, resulting in approximately 500,000 cases per year. The purpose of this study is to compare disease characteristics between Black Hispanic (BH) and Black non-Hispanic (BNH) women in the US. Materials and Methods: We used stratified random sampling to select cervical cancer patient records from the SEER database (1973-2009). We used Chi-square and independent samples t-test to examine differences in proportions and means. Results: The sample included 2,000 cervical cancer cases of Black non-Hispanic and 91 Black Hispanic women. There were statistically significant differences between black Hispanic and black non-Hispanics in mean age at diagnosis (p<0.001), mean survival time (p<0.001), marital status (p<0.001), primary site of cancer (p<0.001); lymph node involvement (p<0.001); grading and differentiation (p<0.0001); and tumor behavior (p<0.001). Black women were more likely to develop cervical cancer and to have the highest mortality rates from the disease. Conclusions: Findings from this study show clear racial and ethnic disparities in cervical cancer incidence and prognosis that should be addressed.

Keywords: Cervical cancer data - ethnicity - Black Hispanic - Black non-Hispanic - statistical analysis

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Introduction

Globally, cervical cancer is responsible for an estimated 500,000 cases and 227,000 deaths annually (WHO, 2013a). Developing nations face issues of poorly developed and financially unsupported cervical cancer screenings programs (Farmer et al., 2010). Therefore, most cases of cervical cancer occur in low and middle income countries and the majority of cases are diagnosed in the later stages of the disease (Farmer et al., 2010; Scarinci et al., 2010). Developed nations also face high cervical cancer incidence and prevalence. In the years between 2006 and 2010, US women faced a cervical cancer incidence of 7.9 per 100,000 (SEER, 2013). Most forms of cervical cancer are caused by the human papillomavirus (HPV), which has over a 100 subtypes (Saslow et al., 2012). Most of the subtypes are benign and without treatment will typically disappear within two years. Thirteen of the 100 subtypes have been described as malignant, the most virulent of which are HPV 16 and 18 (WHO, 2013a). HPV 16 and 18 are responsible for 70% of all cervical cancers and precancerous cervical changes (WHO, 2013a). Symptoms of cervical cancer include vaginal bleeding and discomfort after sexual intercourse, pelvic and back pain, and weight and appetite loss (WHO, 2013a).

Transmitted by skin-to-skin contact and sexual intercourse, HPV is the most common viral infection affecting the reproductive tract (WHO, 2013a). It causes cervical dysplasia, which may develop into premalignant lesions. The type of HPV also affects the grade of cervical cancer (Hariri et al., 2014). MRI scans are used to detect the grade of cervical cancer, which helps practitioners to determine the best course of treatment (Sala et al., 2010). Cervical intraepithelial neoplasia 1, 2, and 3 (CIN1, CIN2, and CIN3) are grades of premalignant lesions which can develop into cervical cancer without treatment (WHO, 2013b). CIN3 is the focus of most cervical cancer screenings in the United States, however, some physicians may provide treatment at the CIN2 stage (Schiffman et al., 2011).

Cervical cancer screenings are important because they result in early detection and early treatment of disease, however, there are differences among screening patterns of different ethnicities (Smith et al., 2011; Simard et al., 2012; Haile et al., 2012). Because of these disparities, it is imperative to assess the differences in cervical cancer survival across ethnicities. Furthermore, ethnicities differ in stage of cancer, which is an important factor in

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predicting patients' prognosis (Maltoni et al., 2012).

Preventing cervical cancer requires reducing the development of pre-cancers by increasing screening and reducing exposure to HPV. These precancerous changes and invasive cervical cancer are readily detected by routine Papanicolaou tests (Pap test) (Pierce-Campbell et al., 2012). It is recommended that cervical cancer screening begin at age 21 despite level of sexual activity or age at sexual initiation (Saslow et al., 2012). Current cervical cancer screening recommendations, state that women who are between the ages of 21 and 29 complete a screening with cytology every 3 years. In addition, for women between ages 30 to 65 it is recommended that they receive cytology alone every 3 years or screening with cytology and HPV testing every 5 years (Moyer, 2012; Saslow et al., 2012). Because of the 15 to 20 year time span between exposure and cervical cancer development, current screening recommendations do not require annual exams (Saslow et al., 2012; WHO, 2013a). Instead, women are urged to screen every three years (CDC, 2013). Currently, there are two prophylactic vaccines Cervarix and Guardasil, which have been approved by the US Food and Drug Administration (FDA). These two vaccines protect against HPV 16 and 18 and are recommended for females between the ages 11 and 16 (DeSantis et al., 2013; Pierce-Campbell et al., 2012; Saslow et al., 2012; Schiffman et al., 2011; WHO, 2013a). Overall, vaccination rates have increased since 2006; however, the rates remain dismally low. For example, less than 50% of US adolescent girls receive one dose of the vaccine and approximately one third have received all 3 doses (Pierce-Campbell et al., 2012; Saslow et al., 2012).

To determine the severity of cancer and the best therapy, physicians use biopsies, colposcopy, computerized tomography (CT) scans, and magnetic resonance imaging (MRI). Developments in the ability of screening tests to detect will results in an increase in detection of CIN2 and CIN3(Schiffman et al., 2011). Treatment of cervical cancer may include removal of all CIN3 cervical cells including a surrounding layer of healthy cells (Schiffman et al., 2011). Localized cancer treatment includes the removal of all cancerous tissue by conization and sometimes a hysterectomy. If the cancer is no longer localized, a radical hysterectomy is used which includes removal of the uterus, cervix, and parts of the vagina (NCI, 2013). This is sometimes followed by a combination of chemotherapy and radiation.

Previous studies have identified that screening and cancer characteristics vary among ethnicities. For example, white non-Hispanic women have a lower incidence of cervical cancer compared to Hispanic women. In addition, there are varying cervical cancer screening rates and incidence across the Hispanic race (Seigel et al., 2012). According to the American Cancer Society, a higher proportion of Puerto Rican women (83.0%) in 2011 was screened for cervical cancer, in comparison to white non-Hispanic women (79.1%), and Mexican women (71.6%) (ACS, 2012). Hispanics can be categorized as black Hispanic or white Hispanic (Khan et al., 2014a). Khan et al. (2014a) developed statistical probability model and posterior inference for the parameters given the survival times of the white Hispanic female cancer patients.

Determinants of cervical cancer include race, ethnicity, socioeconomic status, and geographic location. There has been a consistent failure in reaching the most disadvantaged and at risk populations (Glick et al., 2012; Saslow et al., 2012; Simard et al., 2012). An increase in cervical cancer screening between the years 1993 and 2007 has resulted in a decline in cervical cancer related mortality. This decrease however, did not occur among those with low education levels. Among Hispanics, cervical cancer disparities increased among black non-Hispanics (5x) and white non-Hispanic (4x) (Niccolai et al., 2013). Furthermore, there are cervical cancer incidence differences between racial groups. For example, in 2012, Hispanics had 10.9 cases per 100,000 , blacks 9.6 cases per 100,000 , whites 7.9 cases per 100,000, American Indians and Alaska Natives 7.3 cases per 100,000, and Asians and Alaska Natives 6.6 cases per 100,000 (Pierce-Campbell et al., 2012; SEER, 2013). Between the years 2006 and 2010, blacks experienced the highest mortality rates at 4.2 deaths per 100,000, followed by Alaska Natives and American Indians with 3.5 deaths per 100,000, Hispanics with 2.9 deaths per 100,000, whites with 2.2 deaths per 100,000, and Asians with 1.9 deaths per 100,000. Interestingly, blacks experienced similar cervical cancer rates as Vietnamese and Koreans (Siegel et al., 2012; Wang et al., 2010). In addition, blacks reported the highest rates of late stage cervical cancer diagnosis (Simard et al., 2012).

The high rates of cervical cancer nationally and internationally along with low vaccine uptake makes it important to continue to reduce cervical cancer rates. Cervical cancer is a highly preventable disease and research is needed to provide the best tools to determine patient prognosis and the effective therapies. This study examines racial disparities in cervical cancer rates by using national cancer registry data. We examine the differences in demographic and disease characteristics between BNH and BH.

Materials and Methods

The study used data from the Surveillance Epidemiology and End Results (SEER) database (1973-2009). SEER is a comprehensive database, which began in 1973 collecting data for seven states. Currently, SEER collects and publishes cancer incidence and survival information from cancer registries covering 28% of the US population throughout the United States (SEER, 2013.).

We matched ICD-O-3 site diagnosis codes (C530= Endocervix; C531= Exocervix; C538= Overlap lesion cervix uteri; and C539= Cervix uteri), and SEER database site recode (#27010) for cervical and uterine cancers (resulting in 165,069 cervical cancer cases between years 1973 and 2009) as a part of the data extraction process. We then sorted them by race and ethnicity resulting in 127,428 cases among whites and 20,471 cases among blacks. Of the black group, 20,324 [99.6%] were BNH, and remaining 91 [0.4%] were BH. From here, a simple random sampling was used to select 2,000 cases of black non-Hispanic females and 91 cases of black Hispanic females for a total study sample of 2091 women diagnosed

with cervical cancer. For more information of selection of patients by making use of random sampling, readers are referred to Khan et al. 2014b, 2014c, 2014d, and 2014e. In addition, we used subject's demographic information (age at diagnosis and marital status) as well as cervical cancer information (tumor primary site, grading, behavior, and lymph node involvement) from the SEER dataset for statistical analysis.

Data analysis was performed using IBM SPSS software (IBM SPSS for Windows version 20, 2011). Comparisons of BNH and BH were conducted using either an independent sample t-test or a Pearson's chi-squared test of independence (Table 1 & 2). Alpha level ($\alpha = 0.05$) was used to determine statistical significance. Furthermore, we examined the histological characteristics (Table 3), and 5-year relative survival rates (Table 4) for cervical cancer.

Results

When comparing demographic characteristics across the two groups (Table 1), there were significant differences between the mean age at diagnosis (in years), mean survival days (in months), and marital status ($p<0.001$). The mean age of diagnosis for black non-Hispanic women represented a 0.25 decrease from black Hispanic women. Though mean age of diagnosis did not differ greatly between these two groups, it was still statistically significant at alpha 0.05.

Survival days (in months) were also observed. Overall there is a significant difference in mean survival days ($p <0.001$ at alpha 0.05) between groups. There is a 4.54-month difference between the two groups, where black non-Hispanics are more likely to live longer than black Hispanics, suggesting that ethnicity could play a role in the latency of cervical cancer.

The last demographic characteristic that was observed was marital status. Being single was the most common relationship status reported for both black non-Hispanics and black Hispanics. Both groups followed a similar trend for five of the six options that were presented. The status for "unknown" was the third most frequent option that was selected among black Hispanics accounting for 21.9% (20) of those who were interviewed.

Table 2 deals with the primary site of cervical cancer between the two groups, black non-Hispanic, and black Hispanic, which was the cervix/uteri (92.6% & 83.5%, respectively). The end cervix was the second most prevalent site among black non-Hispanics and black Hispanics (4.5% and 8.8%, respectively). The exocervix accounted for 4.4% (4) of black Hispanics, which differed from the 0.08% (15) of black non-Hispanics. The overlap lesion cervix uteri, was the least prevalent among all the groups.

Of the cases that reported lymph node involvement, almost all had no involvement, accounting for no more than 14% for each group. From those reported, about half was unknown, or was not stated, 4.7% (94) black non-Hispanics and 8.8% (8) black Hispanics.

In comparing grading and differentiation, for those cases that were graded, most were either grade II or III. About 13.2% (12) black Hispanics reported Grade II, and 8.8% (8) reported Grade III. Whereas, 7.0% (140) of black non-Hispanics reported grade II, and 9.4% (188) reported grade III. Less than 1% of individuals that participated reported grade IV. Cell type was not determined, not stated or not applicable for 81.2% (1625) of black non-Hispanic

Table 1. Demographic Characteristics for black non-Hispanic and black Hispanic

Characteristics	black non-Hispanic (n=2000)	black Hispanic (n=91)	p-value
Age at Diagnosis			
Mean	40.04*	40.29	<0.001†
Median	35	37	
Std. Deviation	16.5	15.523	
Survival Days (years)			
Mean	16.54*	12.00*	<0.001†
Median	16.83	13.25	
Std. Deviation	10.75	7.84	
Marital Status			
Single	669 (33.5%)	31 (34.1%)	<0.001‡
Married	580 (29.0%)	24 (26.4%)	
Separated	123 (6.2%)	4 (4.4%)	
Divorced	223 (11.2%)	9 (9.9%)	
Widowed	212 (10.6%)	3 (3.3%)	
Unknown	193 (9.7%)	20 (21.9%)	

*Level of significant, $\alpha = 0.05$; †Independent sample t-test; ‡Chi-square test

Table 2. Cervical Cancer Characteristics for black non-Hispanic and black Hispanic

Characteristics	black non-Hispanic (n=2000)	black Hispanic (n=91)	p-value
Primary Site			
Endocervix (C530)	89 (4.5%)	8 (8.8%)	<0.001‡
Exocervix (C531)	15 (0.8%)	4 (4.4%)	
Overlap lesion cervix uteri (C538)	45 (2.3%)	3 (3.3%)	
Cervix uteri (C539)	1851 (92.6%)	76 (83.5%)	
Lymph node Involvement (1988-2003)			
No lymph node involvement	638 (31.9%)	54 (59.3%)	<0.001‡
Regional lymph node(s)	26 (1.3%)	5 (5.5%)	
Aortic (para-, peri-, lateral)	6 (0.3%)	0 (0.0%)	
Other	6 (0.3%)	1 (1.1%)	
Unknown; not stated	94 (4.7%)	8 (8.8%)	
Grading and Differentiation			
Grade I	29 (1.5%)	2 (2.2%)	<0.001‡
Grade II	140 (7.0%)	12 (13.2%)	
Grade III	188 (9.4%)	8 (8.8%)	
Grade IV	18 (0.9%)	1 (1.1%)	
Cell type not determined, not stated or not applicable			
1625 (81.2%)	68 (74.7%)		
Behavior			
In situ	1346 (67.3%)	53 (58.2%)	<0.001‡
Malignant	654 (32.7%)	38 (41.8%)	

‡Chi-square test

Table 3. Histological Characteristics for Cervical Cancer black Non-Hispanic and black Hispanic

Broad groupings	black non-Hispanic	black Hispanic	Total	P-value
Unspecified neoplasms	5	0	17 (0.3%)	<0.001‡
Epithelial neoplasms, NOS	696	19	1811 (29.7%)	
Squamous cell neoplasms	1202	70	3923 (64.4%)	
Basal cell neoplasms	1	0	1 (0.1%)	
Adenomas and adenocarcinomas	66	2	256 (4.2%)	
Cystic, mucinous and serous neoplasms	4	0	14 (0.2%)	
Ductal and lobular neoplasms	1	0	1 (0.1%)	
Complex epithelial neoplasms	20	0	52 (0.9%)	
Soft tissue tumors and sarcomas, NOS	1	0	1 (0.1%)	
Myomatous neoplasms	0	0	5 (0.1%)	
Complex mixed and stromal neoplasms	4	0	10 (0.2%)	

‡Chi-square test

Table 4. Five Year Relative Survival for Cervical Cancer

Year	All Races			White			Blacks		
	All Ages	Ages<50	Ages 50+	All Ages	Ages<50	Ages 50+	All Ages	Ages<50	Ages 50+
2010	68.10%	77.90%	56.10%	69.50%	79.70%	56.20%	58.20%	64.20%	52.40%

and 74.7% (68) black Hispanic.

Histological and behavior characteristics of cervical cancer suggests that majority of the cases had carcinoma in-situ (67.3% and 58.2%, respectively) and were malignant (32.7% and 41.8% respectively).

Table 3 presents the breakdown of histological characteristics of cervical cancer by broad groupings. In most cases, across the two ethnic groups, cervical cancer was of a squamous cell origin (64.4%). It appears that the black non-Hispanic sample was the only one to be affected by basal cell neoplasms, ductal & lobular neoplasms, and soft tissue tumors & sarcomas, NOS. Basal cell neoplasms, cystic mucinous and serous neoplasms, ductal and lobular neoplasms, complex epithelial neoplasms, soft tissue tumors and sarcomas (NOS), myomatous neoplasms, and complex mixed stromal neoplasms accounted for no more than 1%, where each group had no more than 5 patients in each. More than 50% of black non-Hispanic patients were diagnosed with squamous cell neoplasms.

Table 4 shows the overall 5-year survival rate for cervical cancer (2010) as well as race and age categories. The 5-year survival is significantly different when broken down by race: black (58.2%) vs. white women (69.5%) (Howlader et al., 2014). White patients who are diagnosed are 8.5% more likely to survive than Black patients.

Discussion

Findings have demonstrated that there are clear racial and ethnic differences in cancer diagnosis and survival. Of the two ethnic groups studied, black Hispanic women are by far the most affected by the disease. When investigating age of diagnosis and survival time, black women were diagnosed at a more advanced age and would succumb to the disease sooner when compared to their white counterparts. These findings are consistent with previous studies suggesting that even though the overall incidence and mortality rates of cervical cancer have declined, the rates among minorities continue to be disproportionally high (Downs et al., 2008; CDC, 2011).

As the mean age at diagnosis ranged from age 38 to 40, it is important for women at or over the age 21, to begin and continue screenings as recommended. Because cervical cancer takes, approximately 15 to 20 years to develop women should begin screening at the recommended age to identify and treat pre-cancers and prevent progression to cervical cancer. These study findings give credence to the importance of early detection and treatment in reducing cervical cancer. Although all women will benefit from early and consistent cervical cancer screenings, increased efforts need to be made to lengthen the survival time for black Hispanics. In addition, there may be several social and behavioral determinants that affect the survival time of this group.

The study also finds that across the two ethnic groups investigated that the histologic origin of the cervical cancer was overwhelmingly attributed to the squamous cell neoplasms subtype (64.4%). This was followed by epithelial neoplasms (29.7%) and adenomas/adenocarcinoma subtypes (4.2%). These findings are consistent with a similar study that investigated the histologic subtypes of cervical cancer in reference to race and disease stage (Wang et al., 2004).

Furthermore, it appears that black non-Hispanics may have an increased chance of developing rare forms of cervical cancer such as basal cell neoplasms, ductal, lobular neoplasms, NOS, soft tissue tumors, and sarcomas. This implies that racial and ethnic differences may also affect type of cancer developed within certain ethnicities.

Despite the obvious strengths of this study, such as the use of a nationally recognized cancer database, SEER, which has collected and published critical cancer statistics for over thirty years from cancer registries throughout the United States, with reliable information on incidence, mortality and other included variables some limitations should be noted. A shortcoming of the study was the lack of black Hispanic females registered in the SEER database, therefore limiting our inclusion of this ethnic/racial subgroup to just 91 women. To summarize, the findings of this study stressed the fact that the health disparity in cervical cancer is still very much prevalent. Although there has been a concerted effort to implement policies aiming to close the gap on health outcomes in regards to cervical cancer, they have thus far failed to accomplish this goal specifically when comparing Blacks to the White majority. Health care and public health efforts need to target the most disadvantaged communities and improve health equity in regards to cervical cancer. This may include improving the treatment options for these groups and improving screening efforts to ensure earlier disease detection.

Study results suggest that there is a difference between the two ethnic groups; black Hispanic and black non-Hispanic. Demographic, cervical cancer and histologic characteristics are all statically significant from one another. These findings were limited by the unequal sample size, which black Hispanics consisted of 91 patients. Additional barriers were the limitation of previous medical history and preventative measures that were taken by each ethnic group.

References

American Cancer Society (ACS) (2012). Cancer facts & figures for Hispanics/Latinos 2012-2014. Atlanta: American Cancer Society.

Center for Disease Control (CDC) (2013). Cervical Cancer screening. Retrieved from http://www.cdc.gov/cancer/cervical/basic_info/screening.htm#screen

CDC (2011). CDC's Division of Cancer Prevention and Control. Retrieved March 2014, from Cancer Prevention and Control:

http://www.cdc.gov/cancer/dcpc/about/
DeSantis C, Naishadham D, Jemal A (2013). Cancer Statistics for African Americans, 2013. *CA: Cancer J Clin*, **63**, 151-66.
Downs L, Smith J, Scarinci I, Flowers L, Parham G (2008). The disparity of cervical cancer in diverse populations. *Gynecologic Oncology*, **109**, 22-30.
Farmer P, Frenk J, Knaul FM, et al (2010). Expansion of cancer care and control in countries of low and middle income: a call to action. *Lancet*, **376**, 1186-93.
Glick SB, Clarke AR, Blanchard A, Whitaker AK (2012). Cervical cancer screening, diagnosis and treatment interventions for racial and ethnic minorities: a systematic review. *J Gen Int Med*, **27**, 1016-32.
Haile RW, John EM, Levine AJ, et al (2012). A review of cancer in US Hispanic populations. Ca Prev Res, 5(2), 150-63.
Hariri S, Dunne E, Saraiya M, Unger E, Markowitz L (2014). Manual for the surveillance of vaccine-preventable diseases: Human papillomavirus (HPV). Retrieved January 2014, from http://www.cdc.gov/vaccines/pubs/surv-manual/chpt05-hpv.html
Howlader N, Noon A, Krapcho M (2014). CSR 1975-2011. Retrieved April 2014, from Surveillance, Epidemiology, and End Results Program: http://seer.cancer.gov/csr/1975_2011/
IBM SPSS (2011). IBM Corp. Released. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.
Khan H, Saxena A, Shrestha A (2014a). Posterior inference for white hispanic breast cancer survival data. *J Biometrics & Biostatistics*, **5**, 183.
Khan HMR, Saxena A, Gabbidon K, Stewart TS, Bhatt C (2014b). Survival analysis for White non-Hispanic female breast cancer patients. *Asian Pac J Cancer Prev*, **15**, 4049-54
Khan HMR, Saxena A, Gabbidon K, Rana S, Ahmed NU (2014c). Model-based survival estimates of female breast cancer data. *Asian Pac J Cancer Prev*, **15**, 2893-900.
Khan HMR, Saxena A, Rana S, Ahmed NU (2014d). Bayesian modeling for male breast cancer data. *Asian Pac J Cancer Prev*, **15**, 663-9.
Khan HMR, Saxena A, Shrestha A (2014e). Statistical applications forWhite Hispanic breast cancer survival data. *Asian Pac J Cancer Prev*
Maltoni M, Scarpi E, Pittureri C, et al (2012). Prospective comparison of prognostic scores in palliative care cancer populations. *The oncologist*, **17**, 446-54.
Moyer VA (2012). Screening for cervical cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Int Med*, **156**, 880-91.
NCI. (2013). Cervical Cancer Treatment (Physician Data Query). Retrieved from http://www.cancer.gov/cancertopics/pdq/treatment/cervical/Patient/page4
Niccolai LM, Julian PJ, Bilinski A, et al (2013). Geographic poverty and racial/ethnic disparities in cervical cancer precursor rates in Connecticut, 2008-2009. *Am J Pub Health*, **103**, 156-63.
Pierce-Campbell CM, Menezes LJ, Paskett ED, Giuliano AR (2012). Prevention of invasive cervical cancer in the United States: past, present, and future. Ca Epidemiology, *Biomarkers & Prevention*, **21**, 1402-8.
Sala E, Rockall A, Rangarajan D, Kubik-Huch RA (2010). The role of dynamic contrast-enhanced and diffusion weighted magnetic resonance imaging in the female pelvis. *Eur J Radio*, **76**, 367-85.
Saslow D, Solomon D, Lawson HW, et al (2012). American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology Screening Guidelines for the Prevention and Early Detection of Cervical Cancer. *CA: Cancer J Clin*, **62**, 147-72.
Scarinci IC, Garcia FR, Kobetz E, et al (2010). Cervical cancer prevention: new tools and old barriers. *Cancer*, **116**, 2531-42.
Schiffman M, Wentzensen N, Wacholder S, et al (2011). Human papillomavirus testing in the prevention of cervical cancer. *J Natl Cancer Inst*, **103**, 368-83.
Siegel R, Naishadham D, Jemal A (2012). Cancer Statistics for Hispanics / Latinos , 2012. *CA: Cancer J Clin*, **62**, 283-98.
Simard EP, Fedewa S, Ma J, Siegel R, Jemal A (2012). Widening socioeconomic disparities in cervical cancer mortality among women in 26 states, 1993-2007. *Cancer*, **118**, 5110-6.
Smith RA, Cokkinides V, Brooks D, et al (2011). Cancer screening in the United States, 2011. *CA: Cancer J Clin*, **61**, 8-30.
Surveillance Epidemiology and End Results (SEER). (2013). Seer stat fact sheet cervix uteri.
Wang S, Sherman M, Lacey Jr A (2004). Cervical adenocarcinoma and squamous cell carcinoma incidence trends among white women and black women in the United States for 1976-2000. *Cancer*, **100**, 1035-44.
Wang SS, Carreon JD, Gomez SL, Devesa SS (2010). Cervical cancer incidence among 6 asian ethnic groups in the United States, 1996 through 2004. *Cancer*, **116**, 949-56.
WHO (2013a). WHO fact sheet: Human papillomavirus (HPV) and cervical cancer. Retrieved from http://www.who.int/mediacentre/factsheets/fs380/en/, December 2013
WHO (2013b). WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. Retrieved from http://www.who.int/reproductivehealth/publications/cancers/screening_and_treatment_of_precancerous_lesions/en/, December 2013