



Examining the effect of minority status and neighborhood characteristics on cervical cancer survival outcomes

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ABSTRACT

Objective. Understanding the factors that contribute to mortality and survival is central to health outcome research. The purpose of this study was to investigate the following: (1) differences in survival status by ethnicity and neighborhood median income level; and (2) individual- and neighborhood-level factors influencing cervical cancer survival.

Methods. This study was based on data from 1811 cervical cancer cases obtained through the California Cancer Surveillance Program. The dependent variable was days of survival from date of cancer diagnosis. Zip code-based neighborhood-level variables were obtained from Census 2000 data.

Results. Ethnicity was significantly associated with survival ($\chi^2 = 20.58$; $p < 0.001$), with African-Americans showing the shortest survival. The 5-year survival rates of European-, African-, Latino-, and Asian-American patients for all stages combined were 85%, 75%, 85%, and 84%, respectively. Differences in survival between high- and low-income regions were not observed. However, when ethnicity was considered, Asian-Americans who lived in high-income regions showed longer survival than their low-income community counterparts ($\chi^2 = 4.531$; $p < 0.05$). The multilevel model demonstrated ethnicity, age at diagnosis, and cancer stage stratified by surgery to be significantly associated with cervical cancer survival at the individual level. At the neighborhood level, residing in neighborhoods with a high proportion of African-Americans increased the risk of death by 1%.

Conclusions. The neighborhood context may be an influential contributor to survival for Asian- and African-Americans specifically. These findings necessitate closer examination of the unique contribution of ethnicity and neighborhood on cancer survival to disentangle the role of ethnic group membership, socio-ecological contexts and stress, and medical factors on disease outcomes.

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Introduction

Despite a recent decrease in cervical cancer incidence and mortality, cervical cancer remains the second most common cancer in women worldwide [1]. In the U.S., an estimated 12,200 cases of invasive cervical cancer and an estimated 4210 deaths from this disease are expected in 2010 [2]. The overall survival of cervical cancer patients has increased, a phenomenon largely attributed to the widespread use of screening [3]. Nevertheless, poorer survival has disproportionately affected ethnic minority patients diagnosed with cervical cancer, highlighting ethnic health disparities [4]. However, studies examining this issue have primarily compared African-Americans with European-Americans and excluded other ethnic groups. With the increasing ethnic diversity of the American population, studies including the full diversity of the U.S. population

will further increase our understanding of the extent of disparities in disease outcomes.

Previous studies have investigated potential reasons for the ethnic disparities in cervical cancer outcomes. To date, cancer stage is considered to be the lead prognostic factor influencing survival [5]. Indeed, the stage at diagnosis may be the summation of a complex interaction among multiple factors [6]. For instance, low-income and minority women are known to be diagnosed at later stages and have higher mortality rates than high-income women [7,8] because they experience greater health care-access barriers due to insurance, health care system and language/cultural factors [9]. Furthermore, a study reported that African-Americans are treated less frequently and aggressively and are less likely to receive state-of-the-art therapy than European-Americans [10].

Ethnic minority cancer patients are disproportionately represented among low socio-economic status (SES) groups [6,8,11]; thus, SES may be a primary factor determining the observed ethnic differences in cervical cancer outcomes [12]. Individuals with a high SES tend to live in more affluent, medically resourced neighborhoods, with accessible and state-of-the-art resources and education for cancer screening,

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treatment, and follow-up care. Few studies have investigated the unique role of location of residence to explain disease outcomes [7]. Two studies have demonstrated that women residing in low SES communities have significantly shorter survival times than those living in high SES communities [7]. Furthermore, zip code-level ethnic-specific data, such as the proportion of African- or Latino-Americans, may be a pertinent factor to consider in examining disparities in health outcomes. Reports have documented that health care facilities (i.e., diagnostic equipment and health care specialties) in African-American neighborhoods are inferior to those in European-American communities [13].

Relatively few studies have examined the interactions between ethnicity and SES variables on cancer outcomes, even though the unfavorable effect of SES is magnified for ethnic minority groups [14]. The current study investigates the impact of multi-contextual factors on cervical cancer survival in Los Angeles (LA), California. LA County is population dense, with over 10 million people living in demographically varied residential areas that represent a wide range of ethnic proportions and wealth distribution. Our aims were the following: (1) to examine the differences in survival status by ethnicity and neighborhood median income level (a proxy of measure of SES) among cervical cancer patients; and (2) to investigate individual- and neighborhood-level factors influencing cervical cancer survival. Based on the literature and previous studies, the following hypotheses were formulated:

1. Ethnic minorities (African-, Latino-, and Asian-Americans) residing in regions with low income levels will have shorter survival times than those with high income levels.
2. Cancer stage, ethnicity, income, and the proportion of ethnic minorities within a zip code will influence cervical cancer survival, after controlling for covariates.

Methods

Study design and participants

This study was based on data from 1811 multiethnic cervical cancer cases obtained from the LA County Cancer Registry, according to our inclusion criteria (i.e., cancer stage, recurrence, survival status). Specifically, the study focused cervical cancer patients who were diagnosed between 1997 and 2003 to examine their long-term survival. Patients were included if they were 18 years or older, diagnosed with stages I–III, and had not been diagnosed with another type of cancer. Women with stage IV were excluded in this study because their disease progression is very different.

The cancer registry provided demographic and clinical information for the eligible cases. The clinical information included tumor diagnosis, staging, treatment modalities, and patient follow-up. Data were obtained from the medical record or death certificate for each case. This study was approved with exempt status by the City of Hope Institutional Review Board.

Instruments

The dependent variable was days of survival from the date of cancer diagnosis. The survival status as of May 1, 2009 was used. Overall survival was defined as the time elapsed from the date of cervical cancer diagnosis to the date of death (from any causes) or the date of last contact for patients alive at the end of the study. Individuals without a recorded date of death in the database were assumed to be alive and were censored as of May 1, 2009.

Independent variables included demographic (age and ethnicity) and clinical variables (age at diagnosis, cancer stage, surgery, lymph node surgery, chemotherapy, and radiation). The study included cases identifying themselves as European-, African-, Latino-, and Asian-

American, which are considered to be the four major U.S. ethnic groups. Cancer stage was categorized as I, II, or III. Treatment modalities, including surgery, lymph node surgery, chemotherapy, and radiation, were categorized as “Yes” or “No”. This study also created variables combining surgery with cancer stage (i.e., cancer stage stratified by surgery/lymph node surgery), because cancer stage can influence a surgical procedure. Additionally, a correlation analysis was conducted to show the relationship between surgery and lymph node surgery; the correlation coefficient was 0.38, indicating that the individuals with lymph node surgery were separate from the therapeutic surgery variable; therefore both variables were considered in the analyses.

Additionally, this study included five neighborhood-level variables based on zip code. First, median household income and the number of ethnic minority households within each zip code were drawn from 2000 U.S. Census data. Next, the proportion of low-income households (<\$15,000) and the proportions of African-, Latino-, and Asian-American households were calculated by zip code. Two estimates of median household income were used. The first was the median household income for all households within a zip code regardless of ethnicity, which was used in the multilevel survival analysis to form a cluster. The second was the ethnicity-adjusted median household income, which was used to investigate ethnic differences in survival by neighborhood median income. The ethnicity-adjusted median household income was determined by the median household income information according to the specific ethnic group (i.e., European-, African-, Latino-, and Asian-Americans) within a zip code. This second calculation provided a more accurate income estimate than the first by comparing each ethnic group's median income within a neighborhood to that of the median income of the neighborhood as a whole.

Data analysis

The data were analyzed using SPSS 18.0 and M-plus. All *P*-values reported represent two-tailed tests. Descriptive and correlation analyses were conducted to describe the variables and to test their relationships. ANOVA and Chi-square statistics were also used to examine demographic and clinical differences by ethnicity.

Univariate Cox proportional hazards regression (CPHR) models were employed to investigate demographic and clinical variables that had significant associations with survival. Variables were included in the multivariate and multilevel models according to a selection stay criterion of 0.2 [15]. Next, overall survival curves were drawn by the univariate and multivariate CPHR models to investigate differences in survival curves by ethnicity before and after adjusting for covariates. The Kaplan–Meier method was used to further investigate the relationship between ethnicity and neighborhood contexts, and differences between survival curves were assessed using the log-rank test. In this method, the ethnicity-adjusted median household income for each ethnic group was stratified into low- and high-income categories. Low- and high-income groups were chosen by the lowest (25th percentile) and highest (75th percentile) quartile scores, respectively, and each score was adjusted by ethnicity.

Finally, we employed multilevel survival analysis that allowed for the simultaneous estimation of the effects of individual- and neighborhood-level factors while accounting for the non-independence of observations due to the cluster sampling by zip code [16]. Individual-level factors, including demographic and clinical variables, were entered into the model. Additionally, median household income, the proportion of low-income households, and the proportion of African-, Latino-, and Asian-American households were included at the neighborhood level. For these analyses, *p*-values were adjusted for multiple group comparisons. The importance of a prognostic factor was assessed via the hazard ratio (HR) and its 95% confidence interval.

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