Original Research

The impact of screening on cancer incidence and mortality in Missouri, USA, 2004–2013

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ABSTRACT

Objectives: Population-based evidence regarding impact of cancer screenings and cancer rates in Missouri is lacking. This study examined whether screenings of breast cancer, cervical cancer, and colorectal cancer impact early-stage cancer incidence and mortality in Missouri.

Study design: This is an ecological study based on county-specific estimates of selected cancer screening prevalence and early-stage cancer incidence and cancer mortality.

Methods: County-specific prevalence of clinical breast examination, mammography, Pap test, sigmoidoscopy or colonoscopy, and fecal occult blood test (FOBT) were generated from Missouri County-Level Study (2003, 2007, and 2011). County-specific crude incidence and mortality were calculated (2004–2013). Pearson's correlation and Poisson regression were used to test association between cancer rate and screening prevalence. Covariates included county-level mean age, percentage of whites, percentage with low income, percentage with less than high school education high school, percentage with no insurance, and percentage having difficulties accessing care.

Results: In the adjusted model, 'ever had Pap test' was significantly associated with an increase of 8% in early-stage cervical cancer incidence. Having clinical breast examination or Pap test in the past was also associated with decreases in mortality by 3% and 4%, respectively, although the association was not significant for Pap test. In addition, having mammography was statistically significantly associated with early-stage breast cancer incidence, and having FOBT or sigmoidoscopy or colonoscopy was associated with decreased colorectal cancer mortality; however, magnitude for these associations was only around 1%.

Conclusions: This study provides ecological evidence of the effectiveness of screening services in predicting early stage cancer incidence and in reducing mortality across Missouri counties. Further incentive to promote these screenings in Missouri is needed.

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Introduction

In the state of Missouri in the USA, colorectal cancer and female breast cancer are two of the leading causes of cancer-related deaths.[1] Missouri's cervical cancer mortality rates are in the top quartile of rates in the USA, despite an overall downward trend in mortality.[2] Key in reducing mortality for these cancers is to identify them at early, more treatable stage by means of screening. Clinical breast examination remains an important physical diagnostic tool, especially to those who present with breast complaints, and for patients who choose to have clinical breast examination screening.[3] Mammography has long been regarded as one of the best strategies for preventing death from breast cancer.[4] Yet, a debate on the value of mammography as a screening tool has intensified in recent years, with new estimates showing little evidence for its association with mortality reduction.[5] As for colorectal cancer, emerging evidence shows the benefits of colorectal cancer screenings in cancer outcomes.[6,7] A number of clinical trials have demonstrated the efficacy of fecal occult blood test (FOBT), sigmoidoscopy, or colonoscopy in colorectal cancer mortality reduction.[7] In terms of cervical cancer screening, case–control studies indicate Pap test's significant protective effect in reducing cervical cancer mortality.[8]

In 1992, Missouri began providing free breast cancer and cervical cancer screenings to women meeting certain age, income, and insurance guidelines, as part of the National Breast and Cervical Cancer Early Detection Program (also known as Shown Me Healthy Women in MO).[9] Beginning in 1999, Missouri became one of the first states to pass laws protecting insurance coverage for the full range of colorectal cancer–screening examinations.[10] With these efforts in improving cancer screenings statewide, it is promising that occurrences and death tolls of these diseases have been declining. However, population-based evidence regarding impact of the aforementioned screenings and cancer rates in Missouri is lacking. The present study aimed to examine relationships of the prevalence of screenings with early-stage incidence and mortality for breast, cervical, and colorectal cancers in Missouri's 114 counties and the City of St. Louis. Increased detection of cancer at an earlier stage and reductions in cancer deaths are hallmarks of successful public health cancer screening programs and ideal outcomes to evaluate impact of screening on cancer.[11]

Methods

Design

This is an ecological study based on county-specific estimates of selected cancer screening prevalence and early-stage cancer incidence and cancer mortality.

Data

Data from Missouri County-level Studies (CLSs) in 2003, 2007, and 2011 (total N = 116,890) were used to generate prevalence estimates of cancer screenings for each county. Each CLS follows U.S. Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) methodology and used a nearly identical survey instrument.[11] Data were weighted to be representative of the Missouri adult (≥18 years), noninstitutionalized population of the area covered.[12] Cancer screenings were clinical breast examination, mammography, Pap test, sigmoidoscopy or colonoscopy, and FOBT for each county. Prevalence on both 'ever had screening' (e.g. 'Have you ever had clinical breast examination?') and 'up-to-date screening' (e.g. 'Have you had clinical breast examination within two years?') were examined. All prevalences were estimated using age ranges based on cancer screening age recommendations.[6,13,14] Specifically, female breast cancer screening age was set as age 40 years and above; cervical cancer screening as 21–65 years; and colorectal cancer screening as 50–75 years.

Data from the Missouri Cancer Registry (MCR) were obtained to generate early-stage (i.e. *in situ* and localized) incidence for breast cancer and colorectal cancer and localized incidence for cervical cancer incidence from 2004 to 2013 for each county. In 2004, MCR and other US central cancer registries switched to a new cancer-staging system, Collaborative Stage, from which other staging systems, including Surveillance, Epidemiology and End Results (SEER) Summery Stage, the system previously used by MCR, could be derived. Diagnosis year 2004 was selected as the starting point to keep the staging coding consistent. 2013 was the latest year for which complete cancer incidence data were available at the start of the study. Data from Missouri Department of Health and Senior Services death records were obtained to estimate county-specific cancer deaths from 2004 to 2013. Crude early incidence and death rates were estimated per 100,000 person years. These rates were estimated according to cancer screening age recommendations.

Analysis

Pearson's correlation (*r*) was first used to assess the correlations between cancer screenings and cancer rates. Poisson regression was then performed to further evaluate the relationships by regressing the cancer counts on the screening prevalence with and without adjusting for other factors. Covariates accounted in the adjusted models include county-level mean age, percentage with low income, percentage with less than high school education, percentage without insurance coverage, and percentage attempted to access care but had difficulties getting it for each county. The multivariate models allow us to illustrate the effects of cancer screening on cancer outcomes independent from potential sociodemographic confounding factors. Cancer early incidence and mortality were generated from SEER*Stat (8.3.2). Correlation and regression analyses were done by SAS, version 9.4.

Results

Table 1 presents prevalence of cancer screenings in Missouri overall and by CLS survey year. In Missouri, 93% of women aged 40 years and older had clinical breast examination in the