

consideration of prevention options; decision-making processes and networks, and psychosocial well-being. Transcribed data are analyzed with NVivo 10, using grounded theory methods. Results: Prevention decision making by women who have had close contact with the cancer diagnosis and treatment of a loved one (most often a mother or grandmother, but sometimes a sister, cousin, or close friend) is importantly influenced by these experiences. The process of deciding whether and when to undertake prophylactic mastectomy or oophorectomy, chemoprevention, enhanced surveillance, and/or genetic testing is substantially different in women who have and have not had close personal experience with the cancer of a loved one. Women who have experienced the deaths of one or more loved ones express strong motivation and willingness to undertake definitive interventions; most often this means prophylactic surgery, but this can also include chemoprevention. These women often feel that they are likely to be diagnosed with breast cancer eventually, and seek decisive methods to avoid what they perceive as a life-threatening diagnosis. Women whose loved ones have survived and thrived after a cancer diagnosis are more oriented toward careful surveillance through screening tests and physician checks. These women usually see breast cancer as a challenge they may have to deal with in the future, and they are motivated to set the stage for treatment success by establishing ongoing relationships with highly competent healthcare providers, and by being diagnosed as early as possible. Conclusions: Cancer care has strong effects beyond the cancer patient herself, affecting the decision-making processes and the prevention-related decisions of loved ones as well. Future prevention research for women at elevated risk should consider how their prior experiences with the cancer of friends or family members structure women's expectations of cancer risk, prevention, and outcomes.

Published online March 4, 2016

doi: 10.1158/1055-9965.EPI-16-0091

©2016 American Association for Cancer Research.

### Active Tobacco Smoke and Environmental Tobacco Smoke Exposure During Potential Biological Windows of Susceptibility in Relation to Breast Cancer

White AJ, D'Aloisio AA, Nichols HB, DeRoo LA, Sandler DP

Purpose: Our objective was to prospectively examine active smoking and environmental tobacco smoke (ETS) in relation to breast cancer risk, with a focus on exposures during potential windows of susceptibility. Methods: Sister Study cohort participants ( $n = 50,884$ ) were enrolled between 2003 and 2009 and were followed for a breast cancer diagnosis. Women ages 35–74 in the United States and Puerto Rico were eligible if they had a sister who had been diagnosed with breast cancer. Study participants completed extensive telephone and paper questionnaires including information on established breast cancer risk factors as well as active smoking history and exposure to ETS while in utero and during childhood and adult years. Cox regression analysis was used to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (95% CIs) for invasive

breast cancer incidence associated with active smoking and ETS exposure. Results: During follow-up (mean = 6.4 years), 1,843 invasive breast cancers were diagnosed in the study population. Exposure to ETS in adulthood was not associated with increased breast cancer risk. However, nonsmoking women who were exposed to ETS throughout their childhood (18 years) had an 18% higher risk of breast cancer (95% CI, 1.02–1.38) relative to those without any childhood ETS. In utero ETS exposure also was associated with a modest increase in breast cancer incidence (HR = 1.16, 95% CI, 1.01–1.32) among nonsmokers as was paternal smoking prior to the participant's mother's pregnancy (HR = 1.12, 95% CI, 0.98–1.29). Additionally, active smoking prior to first pregnancy for 10 or more pack-years (HR = 1.31, 95% CI, 1.02–1.67) was associated with an elevated risk of breast cancer. Conclusions: In this large, prospective study, we report evidence that both active smoking and ETS exposure during potential windows of susceptibility, including in utero exposure, childhood and prior to first pregnancy, are associated with higher risk of breast cancer.

Published online March 4, 2016

doi: 10.1158/1055-9965.EPI-16-0091

©2016 American Association for Cancer Research.

### Neighborhood Socioeconomic Deprivation and Geographic Heterogeneity of Tobacco Environment in Missouri

Lian M, Sefko J, Struthers J, Schootman M

Purpose: To examine neighborhood characteristics associated with geographic distribution of tobacco sale outlets in Missouri. Methods: We obtained the addresses of tobacco outlets in Missouri from the Missouri Department of Mental Health. We geocoded these addresses and computed the outlet density by 5-digit ZIP codes. Using the data from the 2008–2012 American Community Survey, we developed a ZIP Code Tabulation Area (ZCTA)-level socioeconomic deprivation (SED) index. We analyzed the relationships of tobacco outlet density with neighborhood SED index and five separate socioeconomic indicators (%population with less than high school, %population unemployed, %households below the poverty, % population under the poverty, and %African Americans). Results: There were more than 5,000 tobacco retailers within Missouri in January, 2014. The number of tobacco retailers ranged from 0 to 56 (median = 2) per ZIP code, while tobacco outlet density ranged from 0 to 29 per 1,000 persons age 18+ (median: 1.18). Tobacco outlet density was significantly correlated with neighborhood SED ( $\rho = 0.21$ ,  $P < 0.001$ ). The consistency of quartiles of both variables was also statistically significant (weighted Kappa = 0.11,  $P < 0.001$ ). Logistic regression analysis indicated that neighborhood SED was associated with more than 3 times higher odds of denser tobacco outlets (>median density) (the most vs. least deprived quartile: odd ratio = 3.24, 95% confidence interval = 2.26–4.65). Similar results were also found for each of the five individual socioeconomic indicators. Conclusion: Geographic distribution of tobacco retailing outlets was strongly associated with neighborhood SED environment. Neighborhoods with greater SED

condition were also more likely to have a higher density of tobacco retailing outlets in Missouri. Our finding implies that higher accessibility to tobacco retailing outlets might play an important role in geographic SED disparity in smoking. Future studies should examine the degree to which neighborhood SED effect on smoking behaviors is mediated by higher accessibility to tobacco retailing outlets. This insight can help policy-makers develop appropriate geographic priority to effectively allocate tobacco control programs to reduce cigarette smoking in Missouri.

Published online March 4, 2016

doi: 10.1158/1055-9965.EPI-16-0092

©2016 American Association for Cancer Research.

### The Association Between Post-Diagnosis Health Behaviors and Quality of Life in Survivors of Ductal Carcinoma In Situ

Hart V, Berkman A, Ba Y, Fujii M, Veal CT, Hampton JM, Gangnon RE, Newcomb PA, Trentham-Dietz A, Sprague BL

**Background:** Survivors of ductal carcinoma in situ (DCIS), an early stage breast cancer, tend to decrease physical activity, gain weight, and maintain alcohol use following treatment. However, the impact of these health behaviors on long-term quality of life (QoL) in DCIS survivors has not been investigated. **Methods:** We examined the association of post-diagnosis body mass index (BMI), physical activity and smoking with QoL among 1,448 DCIS survivors aged 20–74, who were diagnosed during 1995–2006 and enrolled in the population-based Wisconsin In Situ Cohort. Health behaviors and QoL were self-reported during biennial post-diagnosis interviews. Physical and mental QoL were measured using the validated SF-36 questionnaire (higher scores reflect more positive QoL). Generalized linear regression was used to establish QoL mean scores in cross-sectional analyses, with multivariable adjustment for age, comorbidity status, education, and income. **Results:** Women reported 3,444 QoL observations over an average 7.9 years of follow-up. Physical health summary scale measures of QoL were significantly higher among women with healthy BMI (46.5 for healthy weight versus 40.5 for obese,  $P = 0.02$ ) and those who were physically active (45.9 for active women versus 42.6 for inactive,  $P = 0.03$ ). Mental health summary scale scores were significantly higher among non-smokers (51.2 for non-smokers versus 47.1 for current smokers,  $P < 0.01$ ). These associations were consistent over increasing time since treatment up to 15 years. **Conclusion:** Our preliminary analysis suggests that maintaining healthy behaviors following DCIS treatment is associated with improved long-term QoL. Longitudinal analysis using cross-lagged regression is underway to evaluate the temporal association between health behavior and QoL. Understanding factors that impact QoL in DCIS survivors may inform interventions aimed at preventing negative health behaviors and optimizing long term quality of life following a DCIS diagnosis.

Published online March 4, 2016

doi: 10.1158/1055-9965.EPI-16-0093

©2016 American Association for Cancer Research.

### Cigarette Tax Revenues and Consumption under Current and Minimum-Price Regimes

Doogan NJ, Berman ML, Wewers ME

Because nine out of ten lung cancer deaths are attributable to smoking, significant reductions in smoking are likely to reduce lung cancer death as well. It is well known that cigarette demand and consumption are negatively related to price, and that cigarette smokers use price minimization strategies to maintain their tobacco use patterns at a reasonably low cost when prices go up. Two consumer strategies that have received significant attention are legal tax avoidance and illegal tax evasion. These strategies are most common when there is a price differential in an area such as an adjacent state that imposes a relatively lower excise tax on cigarettes. Their effect is a reduction in the intended public health effect of excise taxes that is expected to occur via a drop in consumption, and a reduction in state tax revenues, which may be used to fund tobacco control efforts. An increasingly discussed solution is a minimum price law. If the price is set high enough, among-state price disparities of cigarettes and other tobacco products can be eliminated along with a prominent consumer price reduction strategy. **Purpose:** In this study, cigarette consumption data are used to inform a novel model of consumption that incorporates the effect of adjacent state price differentials. The model is then used to (1) estimate lost (or gained) revenues by state, as well as (2) expected changes in consumption in a scenario involving a minimum price law for cigarettes that sets a nationwide price of \$10 per pack (approximately the average price in New York state in 2014), which would eliminate an among-state price differential, and therefore much of the incentive to avoid or evade taxes. This scenario also raises the price of cigarettes substantially in almost all states. **Methods:** We use yearly state-level cigarette consumption and price data from the Tax Burden on Tobacco from the years 2004–2014. The developed model is a log-linear regression model that uses latent variables (i.e., random effects) to capture basic price effects and adjacent-state price differential effects in a mixed effects model framework. The latent variables offer a simple means of allowing both price effects to vary by state. We analyze the fitted model in two ways. First, we compare model-based consumption predictions under a regime of existing state price and border-state price differentials with predictions from a regime in which the differential is removed. This comparison results in estimates of state-specific consumption lost (or gained) due to border state price differentials; the estimates of lost consumption are multiplied by state-level excise tax and interpreted as lost (or gained) state revenues. A second analysis compares the current regime to one in which cigarette packs are set at \$10 each nationwide to determine the expected consumption reduction. **Results:** Overall, the effect of price on demand is negative, statistically significant, and well within range of the price elasticity estimates available in the literature. The effect of border-state price differential is also negative and statistically significant suggesting that a state's consumption is negatively related to the difference between its cigarette price and the average price of its neighboring states. Both effects are heterogeneous across states. In the first analysis of the fitted model, calculation of lost (or gained) revenue relative to what