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Estimation of Breast Cancer Incident Cases and Medical Care Costs Attributable to Alcohol Consumption Among Insured Women Aged <45 Years in the U.S

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Abstract

Introduction—This study estimated the percentage of breast cancer cases, total number of incident cases, and total annual medical care costs attributable to alcohol consumption among insured younger women (aged 18–44 years) by type of insurance and stage at diagnosis.

Methods—The study used the 2012–2013 National Survey on Drug Use and Health, cancer incidence data from two national registry programs, and published relative risk measures to estimate the: (1) alcohol-attributable fraction of breast cancer cases among younger women by insurance type; (2) total number of breast cancer incident cases attributable to alcohol consumption by stage at diagnosis and insurance type among younger women; and (3) total annual medical care costs of treating breast cancer incident cases attributable to alcohol consumption among younger women. Analyses were conducted in 2016; costs were expressed in 2014 U.S. dollars.

Results—Among younger women enrolled in Medicaid, private insurance, and both groups, 8.7% (95% CI=7.4%, 10.0%), 13.8% (95% CI=13.3%, 14.4%), and 12.3% (95% CI=11.4%, 13.1%) of all breast cancer cases, respectively, were attributable to alcohol consumption. Localized stage was the largest proportion of estimated attributable incident cases. The estimated total number of breast cancer incident alcohol-attributable cases was 1,636 (95% CI=1,570, 1,703) and accounted for estimated total annual medical care costs of $148.4 million (95% CI=$140.6 million, $156.1 million).

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SUPPLEMENTAL MATERIAL

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Conclusions—Alcohol-attributable breast cancer has estimated medical care costs of nearly $150 million per year. The current findings could be used to support evidence-based interventions to reduce alcohol consumption in younger women.

INTRODUCTION

In the U.S., more than 22,000 new cases of breast cancer are diagnosed among women aged <45 years ("younger women") annually.[1] Breast Cancer Education and Awareness Requires Learning Young Act of 2009, or EARLY Act (H.R. 1740, S. 994), and the Centers for Disease Control and Prevention (CDC)'s project has specifically focused on these younger women.[2,3] Breast cancer in younger women is often characterized by aggressive tumor subtypes that are less likely to be amenable to treatment at the time of diagnosis and have poorer survival outcomes than older women.[4–6] The disease affects younger women at a period in which most have family and social responsibilities and others may be completing their education and establishing economic independence. As a result, breast cancer in younger women is associated with substantial adverse health outcomes and economic burden.[7]

Alcohol consumption is a well-established, modifiable risk factor for breast cancer among all women, with an estimated 5%–9% increase in risk per drink per day.[8–12] In addition, cohort studies have found supporting evidence linking alcohol intake to different subtypes of breast cancer, particularly estrogen receptor–positive/progesterone receptor–positive tumors compared to other subtypes.[13–15] Furthermore, recent publications have provided more evidence that consumption of alcoholic beverages is causally associated with breast cancer, even at low to moderate levels of consumption.[8–10,16,17]

According to a national survey conducted in 2015, one in eight women aged 18–44 years engaged in binge drinking, which is defined by CDC as consuming four or more drinks per occasion in the last 30 days.[18,19] In 2013, about 54% of women aged 18–44 years reported any alcohol use and the prevalence of excessive or binge drinking among these women was 18.2%.[20] The prevalence of alcohol consumption among the current birth cohort of younger women may not decrease as they grow older.[19] Therefore, alcohol use and binge drinking among younger women is a public health problem. Several epidemiologic studies have found that risk for breast cancer increases with increasing alcohol intake.[8,21] Because many young women drink, and some drink heavily, young adulthood is a vulnerable period for increasing the risk for developing breast cancer attributable to alcohol during their lifespan.[17,20] Estimating the alcohol-attributable breast cancer incident cases in younger women by stage at diagnosis and by insurance status (Medicaid, private, and both groups together) can help quantify the burden of alcohol-attributable breast cancer in this vulnerable age group. In addition, no study has reported the medical care costs of treating younger women with alcohol-attributed breast cancer cases.

In the past, studies have examined the incidence and costs of breast cancer treatment in Medicaid and privately insured populations, but not by risk factor and stage at diagnosis.[22–26] However, two recent studies have reported the costs of breast cancer treatment in younger women who are Medicaid beneficiaries or are privately insured by stage at

diagnosis, but did not account for risk factors such as alcohol (J Trogdon, University of North Carolina at Chapel Hill, unpublished observations, 2017).[27]

Given these gaps in the literature, the purpose of this study is to estimate the:

1. percentage of breast cancer cases attributable to alcohol consumption among younger women compared with older women;
2. total number of breast cancer incident cases attributed to alcohol; and
3. total annual medical care costs of treating these breast cancer incident cases attributable to alcohol consumption among younger women stratified by stage at diagnosis and insurance type, which includes private insurance, Medicaid, and both groups together.

Providing estimates for younger and older women by insurance type and by stage at diagnosis may help determine strategies that can be effectively used to reduce breast cancer incident cases attributable to alcohol use.

METHODS

Data from several sources were used to address the study objectives in three steps. In Step 1, the authors estimated the alcohol-attributable fraction (AAF; %) of breast cancer cases for women aged 18–44 years compared with those aged 45–64 years using an approach detailed in Ezzati et al.[28] Additional technical details used in calculating AAFs for breast cancer cases are provided in Appendix A (available online). Specifically, the authors started by estimating the prevalence and distribution of alcohol consumption in women. They used data from the 2012–2013 National Survey on Drug Use and Health (NSDUH) to measure alcohol consumption by demographic and health insurance subgroups.[29] The NSDUH protocol reviews the definition of a drink (e.g., can or bottle of beer, glass of wine or wine cooler), and then asks respondents to provide information about the quantity and frequency of consumed drinks. Using this information, it is assumed that each drink consists of 14 grams of ethanol,[30] and the authors constructed a measure of alcohol consumption in average grams of ethanol consumed per day. NSDUH provides a sample of 105,417 people sampled from the civilian, non-institutionalized population aged ≥12 years from all the 50 states plus the District of Columbia. NSDUH collects data through face-to-face interviews with a representative sample of the population at the respondent's place of residence.

More detailed information on the NSDUH survey design and content is available elsewhere.[29] The AAF was calculated using data on the prevalence and distribution of alcohol consumption from NSDUH, coupled with an estimate of the relative risk (RR) of breast cancer associated with the volume of consumed alcohol. The estimated RR of breast cancer was calculated using a meta-analytic dose–response model,[31] and data from the studies reviewed by Bagnardi and colleagues.[32] As the majority of studies did not provide estimates separately for younger versus older women, the authors used an RR estimate of breast cancer for women of all ages and applied it to younger women.

The AAFs were calculated separately for women with Medicaid and for those with private insurance. In calculating AAFs, the authors did not distinguish between excessive drinkers and moderate drinkers. This is because studies have reported that even at low levels of alcohol consumption there is a risk of developing breast cancer.[33,34] Rather, they modeled the probability distribution over all levels of alcohol consumption. This incorporates into the analysis the notion that there may be a small risk of breast cancer associated with even a small amount of drinking.

In Step 2, the total number of breast cancer incident cases attributable to alcohol consumption was calculated by multiplying the estimated AAF of breast cancer cases obtained from Step 1 by the average number of incident breast cancer cases in the U.S. from 2012 to 2013. Average number of incident cases was used to provide a robust estimate from NSDUH. The breast cancer incident cases were obtained from the U.S. Cancer Statistics combined data from CDC's National Program of Cancer Registries and the National Cancer Institute's Surveillance, Epidemiology, and End Results program, which together cover nearly 100% of cancer incidence in the U.S. population (Appendix Table 1, available online). Only registries that met the U.S. Cancer Statistics publication criteria were included for estimation.[35] The estimation was stratified by insurance type and by Surveillance, Epidemiology, and End Results-Summary Stage at diagnosis (local, regional, and distant).[36] The prevalence of Medicaid and private health insurance by stage of cancer was estimated using results from a recent paper.[37]

In Step 3, the annual medical care costs for alcohol-attributable breast cancer was estimated by multiplying the total number of breast cancer incident cases attributable to alcohol consumption by the incremental medical care costs associated with breast cancer treatment. The incremental medical care costs were obtained from two recent studies, which calculated the costs relative to healthy women within a 5-year age group (J Trogdon, University of North Carolina at Chapel Hill, unpublished observations, 2017).[27] Details of the medical care costs are presented in Appendix Table 2 (available online). These incremental cost estimates represent the average amount of medical care costs incurred per patient due to breast cancer. The point estimates are averages by insurance status and stage. The analyses were conducted in 2016 and all costs were expressed in 2014 U.S. dollars.

The methods outlined in this paper involved combining data and evidence from disparate sources; therefore, a Monte Carlo simulation approach was used to assess uncertainty around all estimates and produced 95% CIs around all reported estimates.[38] Appendix A4 and Appendix Tables 3 and 4 (available online) provide additional technical details around the distributional assumptions made in the Monte Carlo simulations.

RESULTS

The authors estimated that among younger women (aged 18–44 years) who are Medicaid beneficiaries, privately insured, and a combination of both, 8.7% (95% CI=7.4%, 10.0%), 13.8% (95% CI=13.3%, 14.4%), and 12.3% (95% CI=11.4%, 13.1%) of all breast cancer cases are attributable to alcohol consumption, respectively (Table 1). For older women (aged 45–64 years), the estimates were 6.9% (95% CI=6.2%, 7.5%), 7.3% (95% CI=6.8%, 7.8%),

and 7.1% (95% CI=6.7%, 7.5%), respectively. By insurance type, the estimated proportions of breast cancer cases attributed to alcohol were larger among privately insured younger women than those enrolled in Medicaid, but the Medicaid versus private insurance difference in AAF was minimal for older women. Additional details on the estimated results of AAF for the various age groups, race/ethnicity, and insurance status are presented in Appendix Tables 4 and 5 (available online).

The estimated total annual number of breast cancer incident cases attributable to alcohol consumption among younger women with Medicaid was 253 (95% CI=220, 288) (Table 2). These alcohol-attributable breast cancer incident cases accounted for an estimated annual medical care costs of $14.5 million (95% CI=$12.6 million, $16.6 million) (Table 2). Among the privately insured, the estimated total number of breast cancer incident cases was 1,383 (95% CI=1,325, 1,438), accounting for an estimated $133.9 million (95% CI= $126.5 million, $141.3 million) in annual medical care costs. Combining the health outcomes associated with alcohol consumption for Medicaid beneficiaries and privately insured younger women, 1,636 (95% CI=1,570, 1,703) breast cancer incident cases were attributable to alcohol consumption, accounting for an estimated $148.4 million (95% CI=$140.6 million, $156.1 million) in annual medical care costs. Across both insurance categories, the attributable incident cases were higher at the localized stage, with progressively smaller numbers at the regional and distant stages. However, the estimated annual medical care costs were higher for regional stage, particularly in privately insured women ($63.9 million) and in the combined Medicaid and private insurance ($71.0 million) than in the local stage ($60.6 million) and ($65.7 million), respectively (Table 2). The estimated incident cases and medical care costs of breast cancer attributable to alcohol consumption for older women are presented in Appendix Table 6 (available online).

DISCUSSION

In this paper, the authors estimated the number of breast cancer incident cases attributable to alcohol consumption among women aged <45 years and the annual medical care costs for these alcohol-attributable breast cancers based on their health insurance coverage (i.e., Medicaid, private insurance, and both groups together). The AAF of breast cancer incident cases was 1.8, 6.6, and 5.2 percentage points higher in younger than older women enrolled in Medicaid, privately insured, or a combination of both groups, respectively. The higher percentages observed in younger women are consistent with reports that younger women are more likely to consume alcohol and to binge drink than older women,[18] which was used as a comparison group in this study.

As stated earlier, alcohol use and binge drinking among younger women is a public health problem. A review study indicated that alcohol use and binge drinking is one of the factors that could increase the chances of breast cancer among younger women.[17] According to the estimates reported in this paper, one in 12, one in seven, or one in eight breast cancer incident cases occurring in younger women enrolled in Medicaid, privately insured, or combination of both groups, respectively, are associated with alcohol consumption. These estimates are significantly lower in older women, estimated to be one in 15 for those

enrolled in Medicaid and approximately one in 14 for those in privately insured or both insurance groups together.

In general, the estimated alcohol-attributable breast cancer incident cases and the associated annual medical care costs for privately insured younger women were significantly ($p<0.05$) higher than the incident cases for Medicaid-insured women. There are several potential explanations for this outcome. First, there are more women enrolled in private insurance than in Medicaid. Second, the estimated AAF of breast cancer incident cases is much smaller among women enrolled in Med-icaid than those privately insured. This may be explained by the fact that the prevalence and distribution of alcohol consumption is higher in high-income households compared with women in low-income households.[18,39] For example, a CDC study reported that alcohol use and binge drinking was most prevalent among young women from households with annual incomes of ≥$75,000[18] when compared with those whose incomes are below the poverty line.[41] Third, private health insurers tend to reimburse healthcare providers at a substantially higher rate than the reimbursement rate in Medicaid programs.[40]

The estimates reported in this paper indicate the medical care costs of treating breast cancer incident cases attributable to alcohol consumption are nearly $150 million per year. These treatment costs are substantial. However, the cancer impact of alcohol consumption among younger women is not limited to breast cancer; alcohol consumption also has been linked to cancers of the liver, mouth, pharynx, larynx, esophagus, and uterus.[41–46] In addition, intake of alcoholic beverages and binge drinking may be associated with other health, social, and behavioral consequences that adversely affect young women, such as unintended pregnancy, sexually transmitted diseases, and heart disease.[18,20,47]

Interventions designed to reduce alcohol consumption among young women, such as those recommended by the U.S. Preventive Services Task Force and the Community Preventive Services Task Force, are expected to reduce the frequency, intensity, and excessive alcohol consumption and related harms, including healthcare costs related to the treatment of alcohol-attributable conditions.[48–50] In addition to the evidence-based clinical and community intervention strategies recommended by the U.S. Preventive Services Task Force and the Community Preventive Services Task Force to reducing alcohol consumption particularly among women and girls, there are many factors that can influence a woman’s risk of breast cancer over her lifetime, and the timing of exposures to carcinogens and chemicals that act as endocrine disruptors influence lifetime breast cancer risk.[51,52] Other factors that can increase breast cancer risk include weight gain during adult life, combined estrogen and progestin hormone therapy, and physical inactivity.[53]

As reported in this paper, the estimated total annual medical care cost among younger women with breast cancer attributable to alcohol consumption was nearly $150 million per year. These treatment costs could be reduced if recommended evidence-based intervention strategies were effectively implemented. For example, clinicians could adopt some of the recommended interventions, such as screening and behavioral counseling, which may include discussing the negative consequences of alcohol intake. Further, adoption of other Community Preventive Services Task Force evidence-based recommendations, such as

increasing the unit price of alcohol through an increase in excise tax, has been demonstrated to be effective and economically efficient to decrease the demand for excessive alcohol consumption, as well as to decrease alcohol-related outcomes.[50] Similarly, conducting alcohol screening and brief intervention with patients could help to reduce patients' cancer risk.[54] The implementation of these interventions could contribute to the prevention of alcohol-attributable breast cancer and the associated treatment costs in younger women.

Limitations

This study has several limitations. First, the findings reported in this paper are based on the assessment of alcohol consumption at a point in time. An ideal approach would be to model a lifetime risk of alcohol consumption among younger women and its impact on breast cancer. As a result, the estimated AAF may be overstated. However, in the study, the assumption was that regardless of the level of drinking, there is a risk of developing breast cancer.[33,34] Second, the results presented in this paper are based on the estimate of the AAF; however, development of breast cancer is a result from a complex interplay of factors rather than from a single factor. Some of these risk factors are physical inactivity[45] and obesity,[55] which are often associated with excessive alcohol use,[56,57] later age at first birth,[58] and family history of breast cancer.[59] This has important implications regarding the interpretation of the AAFs and associated attributable cases and medical care costs. Specifically, these results do not distinguish between breast cancer cases that could be eliminated by removing alcohol exposure only versus cases that could be eliminated by removing alcohol exposure or by removing exposure to one or more of the alternative causative factors. Third, currently there is no RR of breast cancer for younger women by alcohol consumption status. As a result, RR estimates of breast cancer for women of all ages were used. Therefore, the impact of this limitation depends on the shape of the dose–response curve with regard to alcohol use as women age. Fourth, it is well documented that breast cancer has multiple subtypes.[60] The estimates reported in this paper did not distinguish which breast cancer subtype is most susceptible to alcohol consumption. Studies have reported that even with a moderate amount of consumed alcohol, women are at increased risk of estrogen receptor–positive/ progesterone receptor–positive breast cancer.[10,14,61,62] Fifth, currently in the literature there are limited data on incident-based breast cancer costs by stage at diagnosis for younger women. Therefore, the cost data used in this paper were obtained from two recent studies that estimated medical costs of treating breast cancer among younger Medicaid beneficiaries and privately insured women in North Carolina, and their generalizability may be limited (J Trogdon, University of North Carolina at Chapel Hill, unpublished observations, 2017).[27] However, the authors note that private insurance and Medicaid cancer treatment costs in North Carolina are close to median cancer treatment costs across the country.[63] Finally, the reported costs only focused on healthcare costs from Medicaid beneficiaries and the privately insured, and did not account for the broader costs and consequences of alcohol consumption, such as medical costs for uninsured women or those with other insurance, productivity and mortality costs associated with breast cancer among younger women,[64,65] and costs of non-cancer–related alcohol-induced harms. Therefore, the economic cost associated with alcohol consumption reported in this paper likely underestimates the true cost.

CONCLUSIONS

The alcohol-attributable breast cancer cases and medical care costs of nearly $150 million per year for treating these incident cases reported in this paper may have far-reaching consequences to younger women and society in general. These women could spend years living with clinical, reproductive, physical, social, and emotional effects of breast cancer diagnosis and its treatment, which may lead to loss of economic well-being and shortened life expectancy. Alcohol use is potentially a modifiable behavior. The data reported in this paper suggest a substantial benefit from increased use of already existing effective evidence-based interventions to address and reduce alcohol consumption in younger women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2013 Incidence and Mortality Web-based Report. Atlanta, GA: U.S. DHHS, CDC, and National Cancer Institute; 2016. www.cdc.gov/uscs [Accessed July 14, 2016]
2. Breast Cancer Education and Awareness Requires Learning Young (EARLY) Act of 2009 (H.R. 1740, S. 994). www.congress.gov/bill/111th-congress/house-bill/1740
3. Holman DM, White MC, Shoemaker ML, Massetti GM, Puckett MC, Brindis CD. Cancer prevention during early adulthood: highlights from a meeting of experts. Am J Prev Med. 2017; 53(3S1):S5–S13. [PubMed: 28818246]
4. Partridge AH, Gelber S, Peppercorn J, et al. Fertility and menopausal outcomes in young breast cancer survivors. Clin Breast Cancer. 2008; 8(1):65–69. https://doi.org/10.3816/CBC.2008.n.004. [PubMed: 18501060]
5. Valentini A, Finch A, Lubinski J, et al. Chemotherapy-induced amenorrhea in patients with breast cancer with a BRCA1 or BRCA2 mutation. J Clin Oncol. 2013; 31(31):3914–3919. https://doi.org/10.1200/JCO.2012.47.7893. [PubMed: 23980083]
6. Hassett MJ, O'Malley AJ, Pakes JR, Newhouse JP, Earle CC. Frequency and cost of chemotherapy-related serious adverse effects in a population sample of women with breast cancer. J Natl Cancer Inst. 2006; 98(16):1108–1117. https://doi.org/10.1093/jnci/djj305. [PubMed: 16912263]
7. Ekwueme DU, Trogdon JG. The economics of breast cancer in younger women in the U.S: the present and future. Am J Prev Med. 2016; 50(2):249–254. https://doi.org/10.1016/j.amepre.2015.11.011. [PubMed: 26775903]

8. Hamajima N, Hirose K, Tajima K, et al. Alcohol, tobacco and breast cancer-collaborative reanalysis of individual data from 53 epidemiological studies, including 58,515 women with breast cancer and 95,067 women without the disease. Br J Cancer. 2002; 87(11):1234–1245. https://doi.org/10.1038/sj.bjc.6600596. [PubMed: 12439712]
9. Smith-Warner SA, Spiegelman D, Yaun SS, et al. Alcohol and breast cancer in women: a pooled analysis of cohort studies. JAMA. 1998; 279(7):535–540. https://doi.org/10.1001/jama.279.7.535. [PubMed: 9480365]
10. Suzuki R, Orsini N, Mignone L, Saji S, Wolk A. Alcohol intake and risk of breast cancer defined by estrogen and progesterone receptor status. A meta-analysis of epidemiological studies. Int J Cancer. 2008; 122(8):1832–1841. https://doi.org/10.1002/ijc.23184. [PubMed: 18067133]
11. Schutze M, Boeing H, Pischon T, et al. Alcohol attributable burden of incidence of cancer in eight European countries based on results from prospective cohort study. BMJ. 2011; 342:d1584. https://doi.org/10.1136/bmj.d1584. [PubMed: 21474525]
12. Dartois L, Fagherazzi G, Baglietto L, et al. Proportion of premenopausal and postmenopausal breast cancers attributable to known risk factors: estimates from the E3N-EPIC cohort. Int J Cancer. 2016; 138(10):2415–2427. https://doi.org/10.1002/ijc.29987. [PubMed: 26756677]
13. Falk RT, Maas P, Schairer C, et al. Alcohol and risk of breast cancer in postmenopausal women: an analysis of etiological heterogeneity by multiple tumor characteristics. Am J Epidemiol. 2014; 180(7):705–717. https://doi.org/10.1093/aje/kwu189. [PubMed: 25150269]
14. Lew JQ, Freedman ND, Leitzmann MF, et al. Alcohol and risk of breast cancer by histologic type and hormone receptor status in postmenopausal women—the NIH-AARP Diet and Health Study. Am J Epidemiol. 2009; 170(3):308–317. https://doi.org/10.1093/aje/kwp120. [PubMed: 19541857]
15. Horn-Ross PL, Canchola AJ, Bernstein L, et al. Alcohol consumption and breast cancer risk among postmenopausal women following the cessation of hormone therapy use: the California Teachers Study. Cancer Epidemiol Biomarkers Prev. 2012; 21(11):2006–2013. https://doi.org/10.1158/1055-9965.EPI-12-0418. [PubMed: 22832206]
16. Scoccianti CA, Lauby-Secretan B, Bello PY, Chajes V, Romieu I. Female breast cancer and alcohol consumption: a review of the literature. Am J Prev Med. 2014; 46(3 suppl 1):S16–S25. https://doi.org/10.1016/j.amepre.2013.10.031. [PubMed: 24512927]
17. Scoccianti C, Cecchini M, Anderson AS, et al. European Code against Cancer 4th Edition: alcohol drinking and cancer. Cancer Epidemiol. 2016; 45:181–188. https://doi.org/10.1016/j.canep.2016.09.011. [PubMed: 27816465]
18. CDC. Vital signs: binge drinking among women and high school girls—United States, 2011. MMWR Morb Mortal Wkly Rep. 2014; 63:16–22. [PubMed: 24402468]
19. White MC, Shoemaker ML, Park S, et al. Prevalence of modifiable cancer risk factors among U.S. adults aged 18–44 years. Am J Prev Med. 2017; 53(3S1):S14–S20. [PubMed: 28818241]
20. Tan CH, Denny CH, Cheal NE, Sniezek JE, Kanny D. Alcohol use and binge drinking among women of childbearing age—United States, 2011–2013. MMWR Morb Mortal Wkly Rep. 2015; 64(37):1042–1046. https://doi.org/10.15585/mmwr.mm6437a3. [PubMed: 26401713]
21. Baan R, Straif K, Grosse Y, et al. Carcinogenicity of alcoholic beverages. Lancet Oncol. 2007; 8(4):292–293. https://doi.org/10.1016/S1470-2045(07)70099-2. [PubMed: 17431955]
22. Subramanian S, Trogdon J, Ekwueme DU, Gardner JG, Whitmire JT, Rao C. Cost of breast cancer treatment in Medicaid: implications for state programs providing coverage for low-income women. Med Care. 2011; 49(1):89–95. https://doi.org/10.1097/MLR.0b013e3181f81c32. [PubMed: 21079524]
23. Jagsi R, Pottow JA, Griffith KA, et al. Long-term financial burden of breast cancer: experiences of a diverse cohort of survivors identified through population-based registries. J Clin Oncol. 2014; 32(12):1269–1276. https://doi.org/10.1200/JCO.2013.53.0956. [PubMed: 24663041]
24. Khanna R, Madhavan SS, Bhanegaonkar A, Remick SC. Prevalence, healthcare utilization, and costs of breast cancer in a state Medicaid fee-for-service program. J Womens Health. 2011; 20(5):739–747. https://doi.org/10.1089/jwh.2010.2298.

25. Sabik LM, Tarazi WW, Bradley CJ. State Medicaid expansion decisions and disparities in women's cancer screening. Am J Prev Med. 2015; 48(1):98–103. https://doi.org/10.1016/j.amepre.2014.08.015. [PubMed: 25441234]
26. Fu AZ, Jhaveri M. Healthcare cost attributable to recently-diagnosed breast cancer in a privately-insured population in the United States. J Med Econ. 2012; 15(4):688–694. https://doi.org/10.3111/13696998.2012.673524. [PubMed: 22397589]
27. Allaire BT, Ekwueme DU, Poehler D. Medical costs of treating breast cancer in younger, privately insured women by stage at diagnosis in North Carolina, 2003–2010. Breast Cancer Res Treat. 2017; 164(2):429–436. https://doi.org/10.1007/s10549-017-4249-x. [PubMed: 28432514]
28. Ezzati, M.Lopez, AD.Rodgers, A., Murray, CJL., editors. Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors. Geneva, Switzerland: WHO; 2004.
29. Center for Behavioral Health Statistics and Quality. 2012–2013 National Survey on Drug Use and Health: Methodological Resource Book. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014.
30. NIH National Institute of Alcohol Abuse and Alcoholism. [Accessed on April 7, 2017] A pocket guide for alcohol screening and brief intervention. https://pubs.niaaa.nih.gov/publications/Practitioner/PocketGuide/pocket.pdf
31. Greenland S, Longnecker MP. Methods for trend estimation from summarized dose-response data, with applications to meta-analysis. Am J Epidemiol. 1992; 135(11):1301–1309. https://doi.org/10.1093/oxfordjournals.aje.a116237. [PubMed: 1626547]
32. Bagnardi V, Rota M, Botteri E, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose-response meta-analysis. Br J Cancer. 2015; 112:580–593. https://doi.org/10.1038/bjc.2014.579. [PubMed: 25422909]
33. Shield KD, Soerjomataram I, Rehm J. Alcohol use and breast cancer: a critical review. Alcohol Clin Exp Res. 2016; 40(6):1166–1181. https://doi.org/10.1111/acer.13071. [PubMed: 27130687]
34. Wilsnack SC, Wilsnack RW, Kantor LW. Focus on: women and the costs of alcohol use. Alcohol Res. 2013; 35(2):219–228. [PubMed: 24881330]
35. U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2013 Incidence and Mortality Web-based Report. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2015. SEER*Stat Database: NPCR and SEER Incidence—Analytic file—1998–2013—jbk 051916 [Accessed October 14, 2016]
36. Young, JL., JrRoffers, SD.Ries, LAG.Fritz, AG., Hurlbut, AA., editors. SEER Summary Staging Manual–2000: Codes and Coding Instructions. Bethesda, MD: National Cancer Institute; 2001. NIH Pub. No. 01-4969
37. Robbins AS, Lerro CC, Barr RD. Insurance status and distant-stage disease at diagnosis among adolescent and young adult patients with cancer aged 15 to 39 years: National Cancer Data Base, 2004 through 2010. Cancer. 2014; 120(8):1212–1219. https://doi.org/10.1002/cncr.28568. [PubMed: 24474656]
38. MacKinnon DP, Lockwood CM, Williams J. Confidence limits for the indirect effect: distribution of the product and resampling methods. Multivariate Behav Res. 2004; 39(1):1–24. https://doi.org/10.1207/s15327906mbr3901_4. [PubMed: 26759933]
39. Schoenborn CA, Adams PF. Health behaviors of adults: United States, 2005–2007. National Center for Health Statistics. Vital Health Stat. 2010; 10(245)
40. Decker SL. The effect of physician reimbursement levels on the primary care of Medicaid patients. Review Econ Househ. 2011; 5(1):95–112. https://doi.org/10.1007/s11150-007-9000-7.
41. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Volume 96: Alcohol Consumption and Ethyl Carbamate. Lyon, France: International Agency for Research on Cancer; 2010.
42. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Volume 100E: Personal Habits and Indoor Combustion: Consumption of Alcoholic Beverages. Lyon, France: International Agency for Research on Cancer; 2012.

43. Boffetta P, Hashibe M. Alcohol and cancer. Lancet Oncol. 2006; 7(2):149–156. https://doi.org/10.1016/S1470-2045(06)70577-0. [PubMed: 16455479]
44. Curry, SJ.Byers, T., Hewitt, M., editors. National Cancer Policy Board. Fulfilling the Potential of Cancer Prevention and Early Detection. Washington, DC: The National Academies Press; 2003.
45. Llewellyn CD, Johnson NW, Warnakulasuriya KA. Risk factors for squamous cell carcinoma of the oral cavity in young people—a comprehensive literature review. Oral Oncol. 2001; 37(5):401–418. https://doi.org/10.1016/S1368-8375(00)00135-4. [PubMed: 11377229]
46. Weiderpass E, Ye W, Mucci LA, et al. Alcoholism and risk for endometrial cancer. Int J Cancer. 2001; 93(2):299–301. https://doi.org/10.1002/ijc.1334. [PubMed: 11410881]
47. Naimi TS, Lipscomb LE, Brewer RD, Gilbert BC. Binge drinking in the preconception period and the risk of unintended pregnancy: Implications for women and their children. Pediatrics. 2003; 111(5):1136–1141. [PubMed: 12728126]
48. Moyer VA. U.S. Preventive Services Task Force. Screening and Behavioral Counseling Interventions in Primary Care to Reduce Alcohol Misuse: U.S. Preventive Services Task Force Recommendation Statement. Ann Intern Med. 2013; 159(3):210–218. https://doi.org/10.7326/0003-4819-159-3-201308060-00652. [PubMed: 23698791]
49. Task Force on Community Preventive Services. Increasing alcohol beverage taxes is recommended to reduce excessive alcohol consumption and related harms. Am J Prev Med. 2010; 38(2):230–232. https://doi.org/10.1016/j.amepre.2009.11.002. [PubMed: 20117580]
50. McKnight-Eily LR, Henley SJ, Green PP, Odom EC, Hungerford DW. Alcohol screening and brief intervention: a potential role in cancer prevention for young adults. Am J Prev Med. 2017; 53(3S1):S55–S62. [PubMed: 28818247]
51. Elder RW, Lawrence B, Ferguson A, et al. The effectiveness of tax policy interventions for reducing excessive alcohol consumption and related harms. Am J Prev Med. 2010; 38(2):217–229. https://doi.org/10.1016/j.amepre.2009.11.005. [PubMed: 20117579]
52. Committee on Breast Cancer and the Environment: The Scientific Evidence, Research Methodology, and Future Directions, Board on Health Care Services, Board on Health Sciences Policy. Breast Cancer and the Environment: A Life Course Approach. Washington, DC: National Academies Press; 2012.
53. Forman MR, Winn DM, Collman GW, Rizzo J, Birnbaum LS. Environmental exposures, breast development and cancer risk: through the looking glass of breast cancer prevention. Reprod Toxicol. 2015; 54:6–10. https://doi.org/10.1016/j.reprotox.2014.10.019. [PubMed: 25499721]
54. National Institute of Environmental Health Sciences. [Accessed April 7, 2017] Breast Cancer and the Environment: Prioritizing Prevention. www.niehs.nih.gov/about/assets/docs/ibcercc_full_508.pdf
55. Innes K, Byers T, Schymura M. Birth characteristics and subsequent risk for breast cancer in very young women. Am J Epidemiol. 2000; 152(12):1121–1128. https://doi.org/10.1093/aje/152.12.1121. [PubMed: 11130617]
56. Dossus L, Boutron-Ruault MC, Kaaks R, et al. Active and passive cigarette smoking and breast cancer risk: results from the EPIC cohort. Int J Cancer. 2014; 134(8):1871–1888. https://doi.org/10.1002/ijc.28508. [PubMed: 24590452]
57. Gram IT, Park SY, Kolonel LN, et al. Smoking and risk of breast cancer in a racially/ethnically diverse population of mainly women who do not drink alcohol—the MEC Study. Am J Epidemiol. 2015; 182(11):917–925. https://doi.org/10.1093/aje/kwv092. [PubMed: 26493265]
58. Clavel-Chapelon F, Gerber M. Reproductive factors and breast cancer risk. Do they differ according to age at diagnosis? Breast Cancer Res Treat. 2002; 72(2):107–115. https://doi.org/10.1023/A:1014891216621. [PubMed: 12038701]
59. Rockhill B, Weinberg CR, Newman B. Population attributable fraction estimation for established breast cancer risk factors: considering the issues of high prevalence and unmodifiability. Am J Epidemiol. 1998; 47(9):826–833. https://doi.org/10.1093/oxfordjournals.aje.a009535.
60. Partridge, AH., Goldhirsch, A., Gelber, S., Gelber, RD. Breast cancer in younger women. In: Harris, JR.Lippman, ME.Morrow, M., Osborne, CK., editors. Diseases of the Breast. 5. Philadelphia, PA: Lippincott Williams & Wilkins; 2014. p. 1101-1111.

61. Zhang SM, Lee IM, Manson JE, Cook NR, Willett WC, Buring JE. Alcohol consumption and breast cancer risk in the Women's Health Study. Am J Epidemiol. 2007; 165(6):667–676. https://doi.org/10.1093/aje/kwk054. [PubMed: 17204515]

62. Ginsburg ES. Estrogen, alcohol and breast cancer risk. J Steroid Biochem Mol Biol. 1999; 69(1–6): 299–306. https://doi.org/10.1016/S0960-0760(99)00047-3. [PubMed: 10419006]

63. Tangka FK, Trogdon JG, Ekwueme DU, Guy GP, Nwaise I, Orenstein D. State-level cancer treatment costs: how much and who pays? Cancer. 2013; 119(12):2309–2316. https://doi.org/10.1002/cncr.27992. [PubMed: 23559348]

64. Ekwueme DU, Trogdon JG, Khavjou OA, Guy GP. Productivity costs associated with breast cancer among survivors aged 18–44 years. Am J Prev Med. 2016; 50(2):286–294. https://doi.org/10.1016/j.amepre.2015.10.006. [PubMed: 26775908]

65. Ekwueme DU, Guy GP Jr, Rim SH, et al. Health and economic impact of breast cancer mortality in young women, 1970–2008. Am J Prev Med. 2014; 46(1):71–79. https://doi.org/10.1016/j.amepre.2013.08.016. [PubMed: 24355674]

Table 1

Alcohol-attributable Fractions of Breast Cancer Cases by Insurance Status

Variable	Younger women,[a] %	Older women,[b] %
Medicaid	**8.71**[c] (7.41, 10.00)	**6.88**[d] (6.23, 7.51)
Private insurance	**13.83**[c] (13.30, 14.37)	**7.26**[d] (6.77, 7.81)
Combination of Medicaid and private insurance	**12.27**[c] (11.41, 13.11)	**7.09**[d] (6.69, 7.51)

Note: Values are estimate (95% CI). Estimates in boldface are statistically significantly different from zero ($p<0.05$).

[a] Aged 18–44 years.

[b] Aged 45–64 years.

[c] The estimate for younger women is statistically significantly different ($p<0.05$) from the corresponding estimate for older women.

[d] The estimate for women enrolled in Medicaid is statistically significantly different ($p<0.05$) from the corresponding estimate for women with private health insurance.

Table 2

Alcohol-attributable Breast Cancer Incidence Cases and Medical Care Costs in Younger Women by Stage at Diagnosis and Insurance Status

Variable	Medicaid insurance	Private insurance	Medicaid and private insurance
No. of alcohol-attributable breast cancer incidence cases			
Localized	**110**[a,b] (95, 125)	**763**[a,b] (731, 794)	**873** (839, 907)
Regional	**119**[a,b] (104, 136)	**554**[a,b] (531, 576)	**673** (646, 701)
Distant	**25**[a,b] (21, 28)	**66**[a,b] (63, 68)	**90** (86, 95)
Overall	**253**[a,b] (220, 288)	**1,383**[a,b] (1,325, 1,438)	**1,636** (1,570, 1,703)
Attributable annual medical care costs (in millions $)			
Localized	**5.11**[a,b] (4.39, 5.91)	**60.60**[a,b] (56.44, 64.82)	**65.72** (61.56, 70.06)
Regional	**7.08**[a,b] (6.08, 8.15)	**63.93**[a,b] (59.81, 68.07)	**71.01** (66.93, 75.25)
Distant	**2.30**[a,b] (1.93, 2.69)	**9.36**[a,b] (7.79, 11.16)	**11.66** (10.01, 13.48)
Overall	**14.50**[a,b] (12.61, 16.57)	**133.90**[a,b] (126.50, 141.30)	**148.40** (140.60, 156.10)

Note: Values are estimate (95% CI). Estimates in boldface are statistically significantly different from zero ($p<0.05$).

[a]The estimate for younger women (aged 18–44 years) is statistically significantly different ($p<0.05$) from the corresponding estimate for older women (aged 45–64 years). Estimates for older women are presented in Appendix Table 6 (available online).

[b]The estimate for women enrolled in Medicaid is statistically significantly different ($p<0.05$) from the corresponding estimate for women with private health insurance.