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The role of spatially-derived access-to-care characteristics in melanoma prevention and control in Los Angeles county

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ABSTRACT

Among 10,068 incident cases of invasive melanoma, we examined the effects of patient characteristics and access-to-care on the risk of advanced melanoma. Access-to-care was defined in terms of census tract-level sociodemographics, health insurance, cost of dermatological services and appointment wait-times, clinic density and travel distance. Public health insurance and education level were the strongest predictors of advanced melanomas but were modified by race/ethnicity and poverty: Hispanic whites and high-poverty neighborhoods were worse off than non-Hispanic whites and low-poverty neighborhoods. Targeting high-risk, underserved Hispanics and high-poverty neighborhoods (easily identified from existing data) for early melanoma detection may be a cost-efficient strategy to reduce melanoma mortality.

1. Introduction

Incidence rates of melanoma have been increasing worldwide at a faster rate than any other cancers, excluding lung cancer in women (Ries et al., 2000). In 2012, there were 232,000 new cases of melanoma worldwide. The highest incidence occurred in Australia (40.3 per 100,000) and New Zealand (30.5 per 100,000 respectively), followed by Northern America and Northern and Western Europe (> 10 per 100,000 in both sexes) (Ferlay et al., 2014). In the same year, there was an estimated 55,000 melanoma-specific deaths worldwide. In the United States, incidence rates of melanoma have been steadily increasing on average 1.4% each year since 1975 (Surveillance Epidemiology and End Results). It is currently the fifth and seventh most common cancers among males and females, respectively (Siegel et al., 2015).

Recent improvements in melanoma survival have been attributed to advancement in melanoma management, rather than to improved screening and prevention efforts (Lasithiotakis et al., 2007), despite the existence of screening modalities that are acceptable and well-suited to large scale implementation. The effectiveness of population-based skin cancer screening campaigns cannot be easily established and recommended by the U.S. Preventive Services Task Force (USPSTF), due to the lack of adequately-powered randomized clinical trials to examine the effects of population-based screening on melanoma outcomes (Wernli et al., 2016). One alternative is to focus screening efforts on high-risk subpopulations that have poor access to care and are more likely to present melanomas at later stages.

Studies evaluating the relationship between access-to-care and risk of late-stage diagnosis of screenable cancers (i.e. breast cancer, prostate cancer and cervical cancer) have defined access in terms of contextual access (or contextual barriers to access-to-care i.e. as area-based measures of poverty, education, race/ethnic composition, acculturation) (Barry and Breen, 2005; Greenlee and Howe, 2009; Hu et al., 2014; Pollitt et al., 2008, 2011; Reyes-Ortiz et al., 2008), potential access (i.e. health insurance coverage, wait times for appointment, affordability of services) (Fedewa et al., 2012; Plascak et al., 2015; Pollitt et al., 2008; Rouhani et al., 2010; Ward et al., 2010) and spatial access (i.e. travel distance to health care providers and neighborhood-level density of physician and screening facilities) (Amin et al., 2010; Plascak et al., 2015; Stitzenberg et al., 2007; Wan et al., 2013). We employed the same categorization of access-to-care in this study.

Access to care in the U.S. is primarily dictated by the type of health insurance one is enrolled in. The Patient Protection and Affordable

Abbreviations: BA, Bachelor's degree; CI, confidence interval; CSP, Cancer Surveillance Program; CT, census tract; HMO, Health Maintenance Organization; HW, Hispanic white; LAC, Los Angeles County; NHW, non-Hispanic white; OR, odds ratio; PPO, Preferred Provider Organization; SES, socioeconomic status; U.S., United States; USPSTF, United States Preventive Services Task Force

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Care Act (PPACA) (2010) covered more preventive services, extended funding to public health insurance programs, stopped insurers from denying coverage based on pre-existing conditions, mandated large employers to provide health insurance to their employees, and required individuals to have health coverage. Because most of the provisions of PPACA rolled out between 2013 and 2014, we are assuming that most of the study participants, diagnosed with melanoma between 2004 and 2013, have not been affected by changes brought about by PPACA. Health insurance in the U.S. is predominantly obtained through employers (i.e. employer purchases insurance from a private insurance company) using a Managed Care Organization (MCO) model (Askin and Moore, 2014). Under MCO, an individual may be enrolled in Health Maintenance Organization (HMO), Preferred Provider Organization (PPO) or Point-of Service (POS). HMO enrollees can only have their care covered if they receive them from physicians in the HMO network, and would need to get a referral from their primary care physician to see a specialist (e.g. dermatologist). PPO enrollees receive covered care from a network of physicians who negotiated contracts with the PPO, and can also receive care from out-of-network providers but would have a higher deductible, co-insurance and co-payments. Meanwhile, POS combines features of HMO (i.e. use of primary care physician from a network and requiring an authorization to see a specialist) and PPO (i.e. use of both in- and out-of-network providers), and is now increasingly being replaced by PPO.

Approximately 30% of Americans receive health insurance from public/government programs: Medicaid, Medicare, TRICARE (active military) and Veterans Health Administration (retired military) and Indian Health Service (American Indians and Alaska Natives) (Askin and Moore, 2014). Medicaid is a federal and state-run insurance program that covers low-income families, pregnant women and children (through the Children's Health Insurance Program or CHIP) (Centers for Medicare and Medicaid Services, 2016a). Medicaid covers cancer-related preventative services rated "A" or "B" by the USPSTF (i.e. breast, cervical and colorectal cancers), which excludes skin cancer screening, without cost sharing in 19 states, including California (Gates et al., 2014). However, skin examinations may be covered if done as part of a routine annual exam (American Medical Association, 2013). Medicare is the public health insurance for Americans who are aged 65 and older (some younger individuals are eligible if they have disabilities or end-stage renal disease) (Centers for Medicare and Medicaid Services, 2016b; Field et al., 2000). Funded through payroll and income taxes, and premiums paid by Medicare subscribers enrolled in certain plans, Medicare is characterized by considerable cost-sharing (i.e. Medicare, employer-sponsored, private insurance companies, Medicaid and/or Medigap purchased in the individual market), that is much more considerable compared to public health insurance found in other high-income countries (National Academy of Social Insurance Study Panel on Medicare's Larger Social Role, 1999). Only recently did Medicare start covering cancer-related preventive services (for breast, cervical, prostate, colorectal and lung cancer screenings) (National Cancer Institute Division of Cancer Control and Population Sciences) but routine examinations to screen for skin cancer are currently not covered. However, exceptions include patient-initiated visits to examine a suspicious lesion, subsequent physician visits to investigate a suspicious lesion found during a prior visit about an unrelated issue, and any skin biopsies (Field et al., 2000).

There are people for whom the private or public health insurance programs mentioned above are not suitable (unemployed, self-employed, retirees, or who work in companies that do not offer health insurance) and, therefore, have to purchase insurance through the individual market that traditionally has been expensive (Askin and Moore, 2014).

Improvements in case reporting, as well as better skin awareness and early detection, may result to increases in melanoma incidence rates, as in the case among non-Hispanic whites between 1992 and 2006 (Jemal et al., 2011). However, this increasing trend was not observed among Hispanic whites who experienced greater increases among thick than thin tumors (Cockburn et al., 2006). The low perception of melanoma risk, poor sun- protection behaviors and low rates of skin self-examination among HW (Friedman et al., 1994; Pipitone et al., 2002) do not warrant a reversal of this increasing trend anytime soon, unless we recognize and address the need in this subpopulation. This appears to be a logical step in Los Angeles County (LAC), where the study was conducted, given that it has the largest HW population of any county in the U.S. (United States Census Bureau, 2010). Most studies examining factors associated with melanoma severity at presentation (such as age, sex, marital status) were conducted among chiefly non-Hispanic white (NHW) populations (Baumert et al., 2007; Durbec et al., 2010; Geller et al., 2009a; Grange et al., 2012; Moreau et al., 2014; Reyes-Ortiz et al., 2007; Rouhani et al., 2008; Talaganis et al., 2014). We are addressing the gap in literature by conducting race-stratified analysis of the contextual, potential and spatial aspects of access-to-care in relation to melanoma severity at diagnosis using tumor thickness, the strongest predictor of melanoma outcome (Balch, 1992; Balch et al., 1978, 1982, 1981; Breslow, 1970). We also assessed how these effects differed between high- and low-poverty neighborhoods, in order to arrive at a clearer picture of how and where to best target available screening resources.

To date, very few studies have provided truly population-based analysis of contextual, potential and spatial access-to-care, concurrently, in relation with tumor thickness. Moreover, fewer studies have examined how race/ethnicity and poverty levels modify the association which may be critical because, while we cannot modify race/ethnicity and poverty, we can certainly easily identify neighborhoods that would potentially benefit from targeted screening interventions using these variables.

2. Methods

2.1. Study sample

There were 10,068 primary diagnoses of invasive melanoma occurring between 2004 and 2013 in LAC identified through the Cancer Surveillance Program (CSP), the population-based cancer registry for LAC, and were included in this study. CSP also provided patients' demographic characteristics (age, sex, race/ethnicity and marital status), residential address at diagnosis and address of diagnosing facility. There were 8,653 NHW, 896 HW and 519 other race/ethnicity (includes non-Hispanic Black, Asian/ Pacific Islanders, American Indian and other/unknown). NHW and HW definitions were based on medical records or Hispanic surnames (Cockburn et al., 2006). Cases were excluded if they had missing tumor thickness, summary staging information, or residential address at the time of diagnosis. Cases who resided in the off-shore islands of LAC were also excluded.

Patients' residential addresses at diagnosis were geocoded to obtain the geographic coordinates needed to generate the distance-based measures of spatial access to care described below (Texas A&M University Geoservices, 2013). The geocoding process also generated the geocoding accuracy (basis of coordinates): parcel, address range interpolation or street intersect, city, zip or state centroid, listed in descending order of accuracy (Goldberg, 2008).

Breslow tumor thickness was used to identify patients who presented with thin ($\leq$1 mm) or thick (> 1 mm) melanomas at diagnosis. The cutpoint was chosen because of the excellent prognosis for melanomas at or below 1 mm (Breslow, 1970; Day et al., 1981) and its clinical significance for sentinel lymphadenectomy, a widely-accepted staging procedure for advanced melanomas (Cochran et al., 2000). When tumor thickness was not reported, we used the combined American Joint Committee on Cancer's staging guidelines (4.6%) or the summary stage at diagnosis (5.0%) to classify tumors.