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Highlights From an Expert Meeting on Opportunities for Cancer Prevention Among Older Adults

Cancer Prevention During Older Adulthood Writing Group

Abstract

This paper provides highlights from an expert meeting to explore opportunities to reduce cancer risk and promote health at older ages. Factors that increase cancer risk among older adults include exposure to carcinogens from multiple sources, chronic conditions such as obesity and diabetes, and unhealthy behaviors. Emerging research points to chronic social stressors – social isolation, loneliness, and financial hardship – as being linked to accelerated biological aging and increased cancer risk later in life. Older adults may disproportionately encounter these stressors as well as barriers to preventive health care services, accurate health information, and environments that promote health. Researchers can use existing cohort studies of older adults to deepen our understanding of the relative benefit of modifying specific behaviors and circumstances. The evidence points to the value of comprehensive, transdisciplinary approaches to promote health and reduce cancer risk across the entire lifespan, extending through older adulthood. Clinical encounters with older adults provide opportunities for psychosocial and behavioral screening and counseling. In the presence of multiple morbidities, preventive health services may offer greater health benefits than cancer-screening tests. Strategies that involve families and caregivers, promote positive attitudes about aging, and engage many different community sectors have the potential to prevent or delay the development of cancer at older ages.

Keywords

Environment; Health promotion; Preventive healthcare; Psychosocial; Social factors

Introduction

Over the past decade, CDC's Division of Cancer Prevention and Control (DCPC) has partnered with experts across the country to better understand opportunities to reduce cancer incidence across the lifespan prevention continuum. The focus has spanned many life stages, from the prenatal period through midlife (https://www.cdc.gov/cancer/dcpc/prevention/lifetime.htm). Consistent with this life course approach (Shoemaker, Holman, Henley, &

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Conflict of Interest

None declared.

White, 2015), DCPC and the National Association of Chronic Disease Directors hosted a meeting of experts from multiple disciplines to examine opportunities for public health action to reduce cancer risk and promote health among older adults, here defined as adults aged ≥65 years. In this closing editorial, we share the themes that emerged during the transdisciplinary exchange of ideas at this April 2017 meeting, many of which are reflected in the papers in this supplement issue of *The Gerontologist*. The meeting highlighted factors that influence cancer risk later in life and opportunities to take action – to fill gaps in the scientific evidence, to create communities that support and facilitate health and well-being, to eliminate health disparities, to improve access to and use of preventive services, and to empower older adults to make healthy choices. Because the meeting did not aim to reach consensus, this paper attributes unique comments to specific experts.

The Status of Aging in America

Throughout the meeting, a recurrent theme was the urgent need to respond to major changes in the demographic composition of the United States population. By the year 2030, approximately one-fifth of the US population will be aged ≥65 years (U. S. Census Bureau, 2017a). The older adult population is becoming more racially and ethnically diverse (West, Cole, Goodkind, & He, 2014), and these demographic changes vary by geographic area and socioeconomic position. Because of increases in life expectancy over the last century, at age 65 years, men can expect to live, on average, another 18 years, and women another 20 years (Social Security Administration, 2014). Many adults with disabilities and chronic conditions, including a previous cancer diagnosis, now survive to older ages. Robyn Stone encouraged recognition of at least two distinct populations: the young-old (aged 65–79 years) and the old-old (aged ≥80 years). By the year 2040, one in five people in the United States will be 65 years of age or older, and the number of adults aged ≥85 years is projected to more than double, from 6.4 million in 2016 to 14.6 million in 2040 (The Administration for Community Living, 2018). Stone explained that this increase in the old-old will drive health care costs and challenge many sectors, including transportation, housing, and home health care. She described the lack of a geriatrically-trained health care workforce and the need for primary care providers and specialists who understand the unique aspects of caring for older adults and how to best engage older adults in preventative measures and appropriate treatment, when needed (Stone & Bryant, 2012; Stone, 2017). Roland J. Thorpe, Jr., noted that within the next thirty years, racial and ethnic minority groups will make up over half of the U.S. population and questioned whether health care or research systems currently in place are equipped for such changes. He also raised concerns about racial disparities in life expectancy and our lack of understanding about the etiology behind these differences (Cunningham et al., 2017).

Social and Environmental Influences

Social Isolation and Loneliness

Another recurrent theme was the social context of well-being, aspects of what is also referred to as social determinants of health. Paige Green suggested social isolation, loneliness, and living alone be thought of as risky social conditions. Research over the past

several decades has shown social isolation to be a major risk factor for premature death, similar in magnitude to well-documented clinical risk factors such as high blood pressure and cigarette smoking (Pantell et al., 2013). Lack of social connection is also strongly predictive of cancer mortality (Kroenke, Kubzansky, Schernhammer, Holmes, & Kawachi, 2006). These conditions are particularly relevant in older age, as many older adults experience social isolation or loneliness, whether or not they live alone.

Several plausible biological pathways link social isolation and loneliness to cancer. One pathway links social isolation and loneliness with poor health behaviors that influence cancer risk, such as inadequate physical activity (Theeke, 2010). Research also suggests a more direct relationship between social isolation and aging-relevant biological processes, including vascular function, inflammation, and immune suppression (Hawkley & Cacioppo, 2010). Loneliness can be thought of as being transduced to a biological signal that triggers neuroendocrine system processes such as pro-inflammatory gene expression pathways or other distinct transcriptional fingerprints associated with cancer risk (Hawkley & Cacioppo, 2010). Thus, we are only beginning to understand the biological effects of loneliness and social isolation.

The Biology of Aging

Elissa Epel pointed out that although chronologic age is the strongest predictor of most types of cancer, the underlying biology of aging is more important. Several biological pathways are involved in cell aging and cancer development including the shortening of telomeres, the protective caps at the ends of chromosomes (Blackburn, Epel, & Lin, 2015). Long telomeres are associated with longevity, while short telomeres play a small but reliably causal role in some types of human cancers (Willeit, Willeit, Kloss-Brandstatter, Kronenberg, & Kiechl, 2011). Telomere length is primarily determined by early life influences, but a growing body of evidence suggests that telomere attrition can be influenced throughout the life course (Epel, 2012). Increased social connectedness, psychological stress resilience, and healthy behaviors can reduce inflammation, oxidative stress, and insulin resistance, and are associated with longer telomeres (Puterman & Epel, 2012). In addition, short-term studies have shown that mind-body interventions such as mindfulness-based interventions in adults effectively stabilize telomere length, suppress inflammation, and boost telomerase activity (Conklin, Crosswell, Saron, & Epel, 2018; Schutte & Malouff, 2014). Psychosocial and behavioral interventions that increase meaningful activity and social connection have the potential to slow cell aging and cancer development.

Mental Health in the Context of Aging

Despite a decline in physical health that often accompanies aging, recent work has demonstrated that mental well-being increases with age, even among those with chronic illness (Moore et al., 2013). The key traits of resilience, optimism, and social engagement have been linked with healthier behaviors, better cardiovascular and cancer outcomes, and longer survival (Holt-Lunstad, Smith, & Layton, 2010). Dilip Jeste suggested that optimism and social engagement were two ‘pills’ that could expand the healthy lifespan by 10 years. Conversely, states of depression and anxiety, often associated with many common diseases and disabilities, severely affect overall well-being (Sinnige et al., 2013). Approaches such as

meditation, mindfulness-based-stress-reduction, cognitive behavioral therapy, relaxation techniques, biofeedback, and interventions to increase resilience are emerging areas of research on strategies to improve health and well-being (Casellas-Grau, Font, & Vives, 2014; Osborn, Demoncada, & Feuerstein, 2006). A key to the success of these interventions may be the ability to deliver them in the communities where older adults live and work.

Environmental Exposures

Michele Marcus described several recognized human carcinogens common in the ambient environment, including ionizing radiation (e.g., ultraviolet radiation from the sun), indoor radon, radiation from medical imaging procedures, and drinking water contaminants such as arsenic and trichloroethylene (International Agency for Research on Cancer, 2018). Occupational exposures to benzene and formaldehyde also increase risk of certain cancers (International Agency for Research on Cancer, 2018). Air pollutants such as ozone, sulfur oxides, nitrous oxides, and particulate matter increase risk of lung and kidney cancer as well as cardiovascular disease and inflammation (International Agency for Research on Cancer, 2018). Additionally, certain pesticides and chemicals used in consumer products are endocrine disruptors and have been linked to an increased cancer risk (President's Cancer Panel, 2010). In their forum article within this supplement issue, Prohaska and Peters (2019) describe the potential for harmful environmental exposures within the context of natural disasters – particularly wildfires and floods. Wildfires can result in chronic exposure to particulate matter in the air, and flood waters may expose individuals to chemical carcinogens such as dioxin (Prohaska & Peters, 2019). Those with multiple chronic conditions and those with social vulnerabilities such as poverty and isolation may be more dramatically affected by disasters compared to those without major health, economic, or social concerns.

The latency period between carcinogenic exposures and cancer development may span many years or decades. However, some carcinogens (including some air pollutants and endocrine disruptors) may act as cancer promotors rather than initiators (Panahi et al., 2016), increasing the chances of cell proliferation, inflammation, and decreased immune function once cancer has already initiated. Therefore, exposures later in life can still affect cancer development and progression.

Place as a Determinant of Health

Health research is often conducted by topic area and discipline which creates barriers to addressing cross-cutting public health issues such as social disadvantage. However, abundant evidence exists on the influence of social and geographic place on health. Roland J. Thorpe, Jr. drew the connection between place and cancer risk when he cited findings from the Exploring Health Disparities in Integrated Communities study. Researchers collected data on health behaviors (e.g., alcohol use, physical inactivity, smoking) and conditions (e.g., obesity) among samples of African American and white adults from two racially-integrated census tracts (LaVeist et al., 2008). Results from the study indicated a lack of differences in these behaviors and conditions when comparing the two racial groups, suggesting that racial differences in health and health behaviors observed at the national level are likely related to differences in local social conditions (LaVeist, Pollack, Thorpe, Fesahazion, & Gaskin,

2011). Another study found that adults living in non-metropolitan counties had a higher prevalence of moderate drinking, smoking, overweight/obesity, and physical inactivity compared to those living in metropolitan counties (Matthews et al., 2017). Changes to policies and other characteristics of social and physical environments to provide resources and create conditions that promote health for all may also help to reduce disparities in cancer risk.

Financial Hardship

Reginald Tucker-Seeley emphasized the importance of understanding material, psychosocial, and behavioral dimensions of household financial hardship. Financial hardships, including material (i.e., debt, bankruptcy, and inability to cover medical costs) and psychological states of being (i.e., worry about paying medical bills) have been associated with increased anxiety and distress (Ell et al., 2008; Shankaran et al., 2018; Yabroff et al., 2016). Further, financial hardship has been positively associated with non-adherence to medications, delays in medical care, and lower receipt of preventive services (Altice, Banegas, Tucker-Seeley, & Yabroff, 2017; Butterworth, Rodgers, & Windsor, 2009; Tucker-Seeley & Yabroff, 2016). In this supplement issue, Tucker-Seeley and Thorpe present a conceptual model to guide our understanding of the role of financial hardship in cancer prevention research and practice (Tucker-Seeley & Thorpe, 2019).

Health Literacy

Health literacy studies, as pointed out by Rima Rudd, indicate that the literacy skills of individuals are linked to and predictive of health outcomes (Berkman, et al., 2011). A majority of U.S. adults have limited literacy and numeracy skills and older adults have more limited skills than do those under the age of 55 (Kutner, Greenberg, Yin, & Paulsen, 2006). However, Rudd noted that literacy is not a character trait but is instead an interaction between a reader and a text, a speaker and a listener, as well as an interaction between individuals and the environment within which their activities take place. Findings from published studies of health materials indicate that a good deal of health information is inaccessible to the general public because of a mismatch between the documented literacy skills of U.S. adults and the reading demand of health materials (Rudd, 2007). Barriers to information delivered over the air waves or during the more intimate dialogue between patient and provider include medical vocabulary, assumptions about health knowledge, as well as the pace of busy health settings (Koh & Rudd, 2015). Each of these barriers place additional demands on those seeking information and care. Cancer prevention efforts are further stymied because of the relatively abstract notion of prevention and a reliance on numeric concepts such as risk and probability (Rudd, 2016). Consequently, older adults may find health messages about cancer prevention difficult to fathom.

What We Can Do

Identify and Close Gaps in the Evidence

A number of cohort studies of individuals enrolled in mid-life are underway to help scientists gain a better understanding of health outcomes such as Alzheimer’s disease and cognitive impairment among older adults. Michele Marcus noted that these efforts could be

expanded to study cancer risk factors. For example, the Healthy Aging Study at Emory University aims to learn more about the aging process and diseases that occur more commonly during older adulthood by collecting data on topics such as physical activity, sleep, the microbiome, diet, depression, and anxiety (Emory University, 2017). Although cancer may not be the primary outcome of interest, the linkage of these large cohorts to cancer registries can inform our understanding of the factors that influence cancer risk later in life.

Another pressing research need is evidence on the effectiveness of prevention strategies at older ages as well as more complex study designs and analyses that address both the context (i.e., systems and environmental factors) and the individual factors and their interactions. We also need to better understand and measure concepts such as optimism, resilience, and social engagement to effectively determine their influence on health.

Build Healthy and Safe Communities

Meeting participants noted the need for broad, ecological approaches to building physical environments that promote health and reduce cancer risk. From walkability to access to health care to environmental exposures, evidence points to the potential health benefits of community-based improvements. Just as researchers have begun looking at social drivers of health in a more comprehensive way, efforts to make communities healthier would have greater impact if multiple community sectors worked in coordination. By addressing problems on a larger scale, such efforts may garner greater public support and inspire more collective action than messages that focus solely on changing individual behaviors. For example, increased access to shade in outdoor community spaces could facilitate sun-safe behaviors among older adults (Holman, 2019). During the meeting, Greg O'Neill described another example in which a startup transportation company found a niche by providing transportation to older adults for medical appointments.

Eliminate Health Disparities

Factors that limit access to care and health information or increase harmful environmental exposures may disproportionately affect older adults. Such factors include geographic isolation, low health literacy, comorbidities, poverty, environmental contaminants, and employment discrimination. Moreover, these factors often occur together, making those affected more vulnerable. For example, rural Americans are more likely to be older, have lower incomes, education, employment rates, and insurance coverage compared with urban Americans (Eberhardt & Pamuk, 2004; Hertz, 2017; Kusmin, 2016; Marŕ e, 2017; U.S. Census Bureau, 2017b). Eugene Lengerich described some of the unique challenges faced by rural populations. In addition to growing aging populations, these rural communities also have fewer health care providers, particularly specialists, fewer health care facilities and services, a strong reliance on telemedicine, community health workers and safety-net hospitals, and limited access to broadband service (Paskett et al., 2011).

Low health literacy is also associated with cancer-related disparities (Simmons et al., 2017). During the meeting, Rima Rudd discussed an evolving concept of health literacy that does not focus solely on the skills of individuals but also evaluates the communication skills of

health professionals, the complexity of health materials, and characteristics of the health systems (Bach et al., 2012; Rudd, 2016). This conceptualization points to opportunities to remove unnecessary barriers and embeds health literacy within the creation of health policies, systems, and materials (Rudd, 2013). In her forum article within this supplement issue, Rudd further discusses how findings from health literacy studies can help to shape the strategies used to communicate cancer prevention information (Rudd, 2019).

Older adults, particularly racial/ethnic minorities, may face challenges in engaging in healthy behaviors such as physical activity and eating nutritious foods. For example, Latinos aged 55–74 years are less likely to engage in leisure time physical activity than non-Latino whites of comparable age (Marquez, Neighbors, & Bustamante, 2010). Certain demographic groups within the older adult population are also at greater risk for food insecurity, including those with limited income, African Americans, Hispanics, and persons living in the south (Ziliak, 2008). As noted by Elissa Epel, the success of efforts to reduce obesity and improve nutritional intake among older adults will be limited if they do not address issues related to food insecurity.

Older adults may also be more vulnerable to harmful environmental exposures, including those from natural disasters. In their forum article, Prohaska and Peters (2019) describe floods and wildfires as under-investigated threats to cancer risk and cancer care management among older adults. The authors propose a prospective, public health approach to assess the corresponding cancer risk and health disparities among older adults and inform disaster preparedness, response, and mitigation efforts (Prohaska and Peters, 2019).

Provide Evidence-Based Clinical and Community Preventive Services

Sei Lee discussed the complexities of colorectal and breast cancer screening decisions in older adulthood, given life expectancy and the lag time needed to realize the benefits of screening. Siran Koroukian also noted the importance of considering co-morbidities in the assessment of the benefits of screening for older adults. Although age thresholds often drive cancer screening decisions, the health status and life expectancy of individual patients can provide a more complete picture of the potential risks and benefits of cancer screening tests. In this supplement issue, Koroukian and her colleagues discuss the role of patients' perceived need in decisions regarding screening mammography (Warner et al., 2019), and Lee and his colleagues examine the perspectives of clinicians and older adults on communication around stopping cancer screening (Schoenborn, Boyd, Lee, Cayea, Pollack, 2019).

Koroukian also pointed out the value of addressing cancer risk behaviors among older patients, which may also influence risk for other chronic conditions. Tobacco and alcohol use are examples of common cancer risk factors among older adults that can be addressed through clinical preventive services (Henley et al., 2014; U.S. Preventive Services Task Force, 2018). Continuing this discussion, Peggy Toy emphasized the importance of collaborations across community sectors (e.g., health departments, community-based organizations, clinics, and businesses) to increase awareness and use of clinical preventive services in underserved communities, and an example of this collaboration is described in this supplement issue (Kietzman, Toy, Bravo, Duru, & Wallace, 2019).

Empower People to Make Healthy Choices

The choices people make about their health and health behaviors need to be considered in the social context in which such decisions are made. For example, social factors strongly influence how older adults perceive their own aging, which can in turn shape their behaviors and health (Dziechciaz & Filip, 2014). Research has shown that positive attitudes towards aging are associated with better health (Levy et al., 2016; Levy, Pilver, Chung, & Slade, 2014; Levy, Pilver, & Pietrzak, 2014) and healthier behaviors (Levy & Myers, 2004). Negative attitudes towards one's own aging are associated with poorer mental and physical well-being (Martin et al., 2019). Erwin Tan noted that negative perceptions of aging may negatively influence health behaviors such as lower levels of physical activity. In their paper in this supplement issue, Tan and his colleagues describe how self-perceptions of aging mediate the relationship between age discrimination and a range of health behaviors such as physical activity, smoking, and drinking (Hooker, Mejia, Phibbs, Tan, & Stevens, 2019). On this topic, Dilip Jeste commented that many older people still hold the ageist attitudes they first learned in childhood and that are reinforced in society. Findings from a recent study suggest that reducing the prevalence of ageism could have a substantial impact on the health of older persons and a monetary benefit for society through lowered healthcare costs (Levy, Slade, Chang, Kannoth, Wang, 2018). Public health interventions involving civic engagement, intergenerational contact and the involvement of older people in the co-design of products and interventions are promising strategies for reducing the stigma of aging and discrimination of older adults while improving the quality of life for participants of all ages (National Academies of Sciences, Engineering, and Medicine, 2018).

Older adult caregivers were discussed as a group that often faces circumstances that can create added barriers and challenges to prioritizing one's own health. Data from the Bureau of Labor Statistics indicate that more than 40 million unpaid caregivers provide care for adults aged ≥65 years in the United States (Bureau of Labor Statistics, 2015). Most caregivers are women, and about one-third are aged ≥65 years. As Linda Rhodes explained, family caregivers "are navigating both elder care and healthcare in large measure without a compass." She described the many challenges caregivers face, including the management of multiple chronic conditions and medications, the coordination of health care when providers practice "body parts medicine," the provision of care long distance, and end-of-life decisions. The situation becomes even more complicated in the context of complex family dynamics such as divorce, job changes, or other life events.

The caregiver population is aging and with time, caregivers become care receivers. The stresses of caregiving need to be mitigated socially, emotionally, and financially to protect the health and well-being of caregivers. As Rima Rudd shared from her own experience, "it was so much more challenging to be a working daughter than it was to be a working mother." Caregivers and care receivers often share family ties and both can benefit from health promotion and risk reduction efforts. Thus, approaches that engage families rather than individuals (including transgenerational approaches) may provide the greatest benefit.

Priorities for Public Health Action

This summary describes a variety of strategies to reduce cancer risk among older adults through many types and levels of intervention. The ideas and insights generated during the meeting and reflected in the papers in this supplemental issue call attention to fresh approaches to promote health and reduce cancer risk at this expanding stage of life. In the United States, the prevailing culture equates old age with disease and disability. Pervasive ageist attitudes perpetuate the discrimination of older adults in all sectors of society, including employment and health care. Age discrimination must be addressed at the societal level.

Public health researchers and agencies at the local, state, and national levels are uniquely positioned to lead efforts for health promotion and disease prevention at older ages. A transdisciplinary approach involving collaborations across sectors is essential and can produce innovative solutions to promote health for older adults and increase the number of years spent cancer-free. Safe, healthy, and age-friendly communities with features that facilitate transportation, stable and affordable housing, protection from exposures to harmful substances, healthy foods, access to health care, and community engagement can reduce cancer risk and support the overall health of older adults. Interventions of this type at the societal level can provide benefits not only for older adults, but for everyone in the community.

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References

Altice CK, Banegas MP, Tucker-Seeley RD, & Yabroff KR (2017). Financial hardships experienced by cancer survivors: A systematic review. Journal of the National Cancer Institute, 109(2). doi: 10.1093/jnci/djw205.

Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, & Crotty K (2011). Low health literacy and health outcomes: An updated systematic review. Annals of Internal Medicine, 155, 97–107. doi: 10.7326/0003-4819-155-2-201107190-00005 [PubMed: 21768583]

Blackburn EH, Epel ES, & Lin J (2015). Human telomere biology: A contributory and interactive factor in aging, disease risks, and protection. Science, 350, 1193–1198. doi:10.1126/science.aab3389 [PubMed: 26785477]

Bach C, Dreyer B, Schyve P, Hernandez L, Baur C, Lemerise A, & Parker R (2012). Attributes of a health literate organization Discussion Paper. IOM Roundtable on Health Literacy. Washington, DC: Institute of Medicine.

Bureau of Labor Statistics. (2015). Unpaid eldercare in the United States-−-2013–14 summary. Available at https://www.bls.gov/news.release/elcare.nr0.htm. Accessed September 7, 2017.

Butterworth P, Rodgers B, & Windsor TD (2009). Financial hardship, socio-economic position and depression: Results from the PATH Through Life Survey. Social Science & Medicine, 69, 229–237. doi:10.1016/j.socscimed.2009.05.008 [PubMed: 19501441]

Casellas-Grau A, Font A, & Vives J (2014). Positive psychology interventions in breast cancer. A systematic review. Psycho-Oncology, 23, 9–19. doi:10.1002/pon.3353 [PubMed: 23897834]

Conklin QA, Crosswell AD, Saron CD, & Epel ES (2018). Meditation, stress processes, and telomere biology. Current Opinion in Psychology, 28, 92–101. doi:10.1016/j.copsyc.2018.11.009 [PubMed: 30553080]

Cunningham TJ, Croft JB, Liu Y, Lu H, Eke PI, & Giles WH (2017). Vital signs: Racial disparities in age-specific mortality among blacks or African Americans - United States, 1999–2015. Morbidity and Mortality Weekly Report, 66, 444–456. doi:10.15585/mmwr.mm6617e1 [PubMed: 28472021]

Dziechciaż M, & Filip R (2014). Biological psychological and social determinants of old age: Bio-psycho-social aspects of human aging. Annals of Agricultural and Environmental Medicine, 21, 835–838. doi:10.5604/12321966.1129943 [PubMed: 25528930]

Eberhardt MS, & Pamuk ER (2004). The importance of place of residence: Examining health in rural and nonrural areas. American Journal of Public Health, 94, 1682–1686. [PubMed: 15451731]

Ell K, Xie B, Wells A, Nedjat-Haiem F, Lee PJ, & Vourlekis B (2008). Economic stress among low-income women with cancer: Effects on quality of life. Cancer, 112, 616–625. doi:10.1002/cncr.23203 [PubMed: 18085642]

Emory University. Healthy Aging Study: About the study. (2017). Available online: https://healthyaging.emory.edu/about-the-study/. Accessed September 7, 2017.

Epel E (2012). How “reversible” is telomeric aging? Cancer Prevention Research, 5, 1163–1168. doi: 10.1158/1940-6207. CAPR-12–0370 [PubMed: 23041472]

Hawkley LC, & Cacioppo JT (2010). Loneliness matters: A theoretical and empirical review of consequences and mechanisms. Annals of Behavioral Medicine, 40, 218–227. doi:10.1007/s12160-010-9210-8 [PubMed: 20652462]

Henley SJ, Kanny D, Roland KB, Grossman M, Peaker B, Liu Y,… Plescia M (2014). Alcohol control efforts in comprehensive cancer control plans and alcohol use among adults in the USA. Alcohol and alcoholism, 49, 661–667. doi:10.1093/alcalc/agu064 [PubMed: 25313255]

Hertz T (2017). Rural Employment and Unemployment. US Department of Agriculture, Economic Research Service. Available online at https://www.ers.usda.gov/topics/rural-economy-population/employment-education/rural-employment-and-unemployment/. Accessed October 30, 2017.

Holman DM, Ding H, Freeman M, & Shoemaker M (2019). Association between sun protection behaviors and sunburn among U.S. older adults. The Gerontologist, 59(Suppl 1), S17–S27. [PubMed: 31100136]

Holt-Lunstad J, Smith TB, & Layton JB (2010). Social relationships and mortality risk: A meta-analytic review. PLOS Medicine, 7, e1000316. doi:10.1371/journal.pmed.1000316 [PubMed: 20668659]

Hooker K, Mejia ST, Phibbs S, Tan E, & Stevens J (2019). Effects of age-discrimination on self-perceptions of aging and cancer risk behaviors. The Gerontologist, 59(Suppl 1), S28–S37. [PubMed: 31100138]

International Agency for Research on Cancer. (2018). Agents classified by the IARC Monographs volumes 1–123. Available online at http://monographs.iarc.fr/ENG/Classification/index.php. Accessed February 5, 2019.

Kietzman KG, Toy P, Bravo RL, Duru OK, & Wallace SP (2019). Multisectoral collaborations to increase recommended use of cancer screening and other clinical preventive services by older adults. The Gerontologist, 59(Suppl 1), S57–S66. [PubMed: 31100143]

Koh HK, & Rudd RE (2015). The arc of health literacy. JAMA, 314, 1225–1226. doi:10.1001/jama.2015.9978 [PubMed: 26247161]

Kroenke CH, Kubzansky LD, Schernhammer ES, Holmes MD, & Kawachi I (2006). Social networks, social support, and survival after breast cancer diagnosis. Journal of Clinical Oncology, 24, 1105–1111. doi:10.1200/JCO.2005.04.2846 [PubMed: 16505430]

Kusmin L (2016). Rural America at a Glance, 2016 Edition. US Department of Agriculture, Economic Research Service, Economic Information Bulletin 162. Available online at https://www.ers.usda.gov/webdocs/publications/80894/eib-162.pdf?v=42684/. Accessed on October 30, 2017.

Kutner M, Greenberg E, Jin Y, & Paulsen C (2006). The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy (NCES 2006–483) U.S. Department of Education. Washington, DC: National Center for Education Statistics.

LaVeist T, Pollack K, Thorpe R Jr., Fesahazion R, & Gaskin D (2011). Place, not race: Disparities dissipate in southwest Baltimore when blacks and whites live under similar conditions. Health Affairs, 30, 1880–1887. doi:10.1377/hlthaff.2011.0640 [PubMed: 21976330]

LaVeist T, Thorpe R Jr., Bowen-Reid T, Jackson J, Gary T, Gaskin D, & Browne D (2008). Exploring health disparities in integrated communities: Overview of the EHDIC study. Journal of Urban Health, 85, 11–21. doi:10.1007/s11524-007-9226-y [PubMed: 17999196]

Levy BR, Ferrucci L, Zonderman AB, Slade MD, Troncoso J, & Resnick SM (2016). A culture-brain link: Negative age stereotypes predict Alzheimer's disease biomarkers. Psychology and Aging, 31, 82–88. doi:10.1037/pag0000062 [PubMed: 26641877]

Levy BR, & Myers LM (2004). Preventive health behaviors influenced by self-perceptions of aging. Preventive Medicine, 39, 625–629. doi:10.1016/j.ypmed.2004.02.029 [PubMed: 15313104]

Levy BR, Pilver C, Chung PH, & Slade MD (2014). Subliminal strengthening: Improving older individuals' physical function over time with an implicit-age-stereotype intervention. Psychological Science, 25, 2127–2135. doi:10.1177/0956797614551970 [PubMed: 25326508]

Levy BR, Pilver CE, & Pietrzak RH (2014). Lower prevalence of psychiatric conditions when negative age stereotypes are resisted. Social Science & Medicine, 119, 170–174. doi:10.1016/j.socscimed.2014.06.046 [PubMed: 25189737]

Levy BR, Slade MD, Chang E, Kannoth S, Wang S (2018). Ageism amplifies cost and prevalence of health conditions. The Gerontologist. Published online November 13, 2018. doi: 10.1093/geront/gny131

Marquez DX, Neighbors CJ, & Bustamante EE (2010). Leisure time and occupational physical activity among racial or ethnic minorities. Medicine and Science in Sports and Exercise, 42, 1086–1093. doi:10.1249/MSS.0b013e3181c5ec05 [PubMed: 19997031]

Marŕ e A (2017). Rural Education at a Glance, 2017 Edition. US Department of Agriculture, Economic Research Service, Economic Information Bulletin 171. Available online at https://www.ers.usda.gov/webdocs/publications/83078/eib-171.pdf?v=42830. Accessed. October 30, 2017.

Martin A, Eglit GML, Maldonado Y, Daly R, Liu J, Tu X, & Jeste DV (2019). Attitude toward own aging among older adults: Implications for cancer prevention. The Gerontologist, 59(Suppl 1), S38–S49. [PubMed: 31100140]

Matthews KA, Croft JB, Liu Y, Lu H, Kanny D, Wheaton AG, et al. (2017). Health-related behaviors by urban-rural county classification—United States, 2013. MMWR Surveillance Summary, 66, No. SS-5, 2–8. doi:10.15585/mmwr.ss6605a1

Moore RC, Moore DJ, Thompson WK, Vahia IV, Grant I, & Jeste DV (2013). A case-controlled study of successful aging in older HIV-infected adults. The Journal of Clinical Psychiatry, 74, e417–e423. doi:10.4088/JCP.12m08100 [PubMed: 23759460]

National Academies of Sciences, Engineering, and Medicine. (2018). Aging and disability: Beyond stereotypes to inclusion: Proceedings of a workshop. Washington, DC: The National Academies Press. doi: 10.17226/25029.

Osborn RL, Demoncada AC, & Feuerstein M (2006). Psychosocial interventions for depression, anxiety, and quality of life in cancer survivors: Meta-analyses. International Journal of Psychiatry in Medicine, 36, 13–34. doi:10.2190/EUFN-RV1K-Y3TR-FK0L [PubMed: 16927576]

Panahi Y, Beiraghdar F, Amirhamzeh A, Poursaleh Z, Saadat A, & Sahebkar A (2016). Environmental toxicant exposure and cancer: The role of epigenetic changes and protection by phytochemicals. Current Pharmaceutical Design, 22, 130–140. [PubMed: 26561072]

Pantell M, Rehkopf D, Jutte D, Syme SL, Balmes J, & Adler N (2013). Social isolation: A predictor of mortality comparable to traditional clinical risk factors. American Journal of Public Health, 103, 2056–2062. doi:10.2105/AJPH.2013.301261 [PubMed: 24028260]

Paskett ED, Fisher JL, Lengerich EJ, Schoenberg NE, Kennedy SK, Conn ME,…Dignan M (2011). Disparities in underserved white populations: The case of cancer-related disparities in Appalachia. The Oncologist, 16, 1072–1081. doi:10.1634/theoncologist.2011-0145 [PubMed: 21873582]

President's Cancer Panel. (2010). Reducing environmental cancer risk: what we can do now. Bethesda, MD: US Department of Health and Human Services, Nationla Institutes of Health, National Cancer Institute.

Prohaska TR & Peters KE Impact of natural disasters on health outcomes and cancer among older adults. The Gerontologist, 59(Suppl 1), S50–S56. [PubMed: 31100141]

Puterman E, & Epel E (2012). An intricate dance: Life experience, multisystem resiliency, and rate of telomere decline throughout the lifespan. Social and Personality Psychology Compass, 6, 807–825. doi:10.1111/j.1751-9004.2012.00465.x [PubMed: 23162608]

Rudd RE (2007). Health literacy skills of U.S. adults. American Journal of Health Behavior, 31(Suppl 1), S8–18. doi:10.5555/ajhb.2007.31.supp.S8 [PubMed: 17931141]

Rudd RE (2013). Needed action in health literacy. Journal of Health Psychology, 18, 1004–1010. doi: 10.1177/1359105312470128 [PubMed: 23349399]

Rudd RE (2016). Numbers get in the way. Commentary National Academy of Medicine. Washington, DC.

Rudd RE (2019). Health literacy considerations for new cancer prevention initiatives. The Gerontologist, 59(Suppl 1), S7–S16. [PubMed: 31100142]

Schoenborn NL, Boyd C, Lee S, Cayea D, Pollack CE (2019). Communicating about stopping cancer screening: Comparing clinicians' and older adults' perspectives. The Gerontologist, 59(Suppl 1), S67–S76. [PubMed: 31100135]

Schutte NS, & Malouff JM (2014). A meta-analytic review of the effects of mindfulness meditation on telomerase activity. Psychoneuroendocrinology, 42, 45–48. doi:10.1016/j.psyneuen.2013.12.017 [PubMed: 24636500]

Shankaran V, Leahy T, Steelquist J, Watabayashi K, Linden H, Ramsey S,…Overstreet K (2018). Pilot feasibility study of an oncology financial navigation program. Journal of Oncology Practice, 14, e122–e129. doi:10.1200/JOP.2017.024927 [PubMed: 29272200]

Shoemaker ML, Holman DM, Henley SJ, & White MC (2015). News from CDC: Applying a life course approach to primary cancer prevention. Translational Behavioral Medicine, 5, 131–133. doi:10.1007/s13142-015-0309-0 [PubMed: 26029275]

Simmons RA, Cosgrove SC, Romney MC, Plumb JD, Brawer RO, Gonzalez ET,…Moore BS (2017). Health literacy: Cancer prevention strategies for early adults. American Journal of Preventive Medicine, 53, S73–S77. doi:10.1016/j.amepre.2017.03.016 [PubMed: 28818249]

Sinnige J, Braspenning J, Schellevis F, Stirbu-Wagner I, Westert G, & Korevaar J (2013). The prevalence of disease clusters in older adults with multiple chronic diseases–a systematic literature review. PLOS ONE, 8, e79641. doi:10.1371/journal.pone.0079641 [PubMed: 24244534]

Social Security Administration. (2014). Actuary life table: Period life table, 2014. Available online at: https://www.ssa.gov/OACT/STATS/table4c6.html. Accessed September 7, 2017.

Stone R (2017). Developing a quality direct care workforce: Searching for solutions. Public Policy & Aging Report, 27(3), 96–100. doi: 10.1093/ppar/prx015

Stone RI, & Bryant N (2012). The impact of health care reform on the workforce caring for older adults. Journal of Aging & Social Policy, 24, 188–205. doi:10.1080/08959420.2012.659144 [PubMed: 22497358]

The Administration for Community Living. (2018). 2017 Profile of Older Americans. Available online at https://acl.gov/sites/default/files/Aging%20and%20Disability%20in%20America/2017OlderAmericansProfile.pdf. Accessed February 5, 2019.

Theeke LA (2010). Sociodemographic and health-related risks for loneliness and outcome differences by loneliness status in a sample of U.S. older adults. Research in Gerontological Nursing, 3, 113–125. doi:10.3928/19404921-20091103-99 [PubMed: 20415360]

Tucker-Seeley R, & Thorpe R Material-psychosocial-behavioral aspects of financial hardship: A conceptual model applied to cancer prevention research. The Gerontologist, 59(Suppl 1), S88–S93. [PubMed: 31100144]

Tucker-Seeley RD, & Yabroff KR (2016). Minimizing the “financial toxicity” associated with cancer care: Advancing the research agenda. Journal of the National Cancer Institute, 108(5). doi: 10.1093/jnci/djv410

U.S. Census Bureau. (2017). Table 9. Projections of the Population by Sex and Age for the United States: 2015 to 2060. Available online at https://census.gov/data/tables/2014/demo/popproj/2014-summary-tables.html. Accessed October 30, 2017.

Census Bureau US. (2017b). 2011–2015 American Community Survey 5-Year Estimates. Aviailable online at https://www.ruralhealthinfo.org/topics/aging. Accessed October 30, 2017.

U.S. Preventive Services Task Force. (2018). Published recommendations. Available online at https://www.uspreventiveservicestaskforce.org/BrowseRec/Index/browse-recommendations. Accessed October 30, 2017.

Warner DF, Koroukian SM, Schiltz NK, Smyth KA, Cooper GS, Owusu C, Stange KC, Berger NA Complex multimorbidity and breast cancer screening among midlife and older women: The role of perceived need. The Gerontologist, 59(Suppl 1), S77–S87. [PubMed: 31100139]

West LA, Cole S, Goodkind D, & He W (2014). 65+ in the United States: 2010. US Census Bureau. Available online at https://www.census.gov/content/dam/Census/library/publications/2014/demo/p23-212.pdf. Accessed October 30, 2017.

Willeit P, Willeit J, Kloss-Brandstätter A, Kronenberg F, & Kiechl S (2011). Fifteen-year follow-up of association between telomere length and incident cancer and cancer mortality. JAMA, 306, 42–44. doi:10.1001/jama.2011.901 [PubMed: 21730239]

Yabroff KR, Dowling EC, Guy GP Jr., Banegas MP, Davidoff A, Han X,…Ekwueme DU (2016). Financial hardship associated with cancer in the united states: Findings from a population-based sample of adult cancer survivors. Journal of Clinical Oncology, 34, 259–267. doi:10.1200/JCO.2015.62.0468 [PubMed: 26644532]

Ziliak JP, Gundersen C, Haist M (2008). The causes, consequences, and future of senior hunger in America. Available online at https://pdfs.semanticscholar.org/8b96/75cf8502c5830aa48bfe59e3c3d4a3c99245.pdf. Accessed October 30, 2017.