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Cancer Prevention During Early Adulthood: Highlights From a Meeting of Experts

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Abstract

Using a life course approach, the Centers for Disease Control and Prevention's Division of Cancer Prevention and Control and the National Association of Chronic Disease Directors co-hosted a 2-day meeting with 15 multidisciplinary experts to consider evidence linking factors in early adulthood to subsequent cancer risk and strategies for putting that evidence into practice to reduce cancer incidence. This paper provides an overview of key themes from those meeting discussions, drawing attention to the influence that early adulthood can have on lifetime cancer risk and potential strategies for intervention during this phase of life. A number of social, behavioral, and environmental factors during early adulthood influence cancer risk, including dietary patterns, physical inactivity, medical conditions (e.g., obesity, diabetes, viral infections), circadian rhythm disruption, chronic stress, and targeted marketing of cancer-causing products (e.g., tobacco, alcohol). Suggestions for translating research into practice are framed in the context of the four strategic directions of the National Prevention Strategy: building healthy and safe community environments; expanding quality preventive services in clinical and community settings; empowering people to make healthy choices; and eliminating health disparities. Promising strategies for prevention among young adults include collaborating with a variety of community sectors as well as mobilizing young adults to serve as advocates for change. Young adults are a heterogeneous demographic group, and targeted efforts are needed to address the unique needs of population subgroups that are often underserved and under-represented in research studies.

INTRODUCTION

Cancer is a leading cause of suffering and premature death in the U.S.; the latest estimates suggest that, by 2020, more than 1.9 million Americans will be diagnosed with cancer each year.¹ The devastating impact cancer has on the health of Americans creates an imperative to identify missed opportunities to prevent or delay the development of cancer. The Centers for

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Disease Control and Prevention (CDC)'s Division of Cancer Prevention and Control established the Cancer Prevention Across the Lifespan workgroup to identify cancer prevention opportunities during each phase of life, from the prenatal period through older adulthood.² Using a life course approach, the workgroup examined prevention opportunities during early life,³ adolescence,⁴ and midlife.^{5,6} During 2015–2016, the workgroup collaborated with the National Association of Chronic Disease Directors to examine opportunities specific to early adulthood, an emerging field encompassing roughly ages 18–44 years. Given the heterogeneity of life experiences among adults across this broad age range, most project activities focused on behaviors, social influences, exposures, and other challenges that affect young adults as they transition into adulthood.

Activities included reviewing the literature on factors during early adulthood that influence cancer risk and convening a 2-day meeting in April 2016 with a group of 15 multidisciplinary experts to discuss the state of the evidence and ideas for putting that evidence into practice. This paper provides an overview of key themes from the meeting discussions, drawing attention to factors during early adulthood that may influence lifetime cancer risk and potential strategies for intervention during this phase of life.

Specific meeting goals were to:

1. explore the “state of the evidence” and identify cancer risk–related factors specific to young adults, including social drivers of health and inequalities;
2. identify actions, particularly policy, systems, and environmental changes that could be undertaken to intervene on cancer causes and risk factors among young adults; and
3. inform the planning of data collection, the design and implementation of interventions, or other actions by CDC, state health departments, and other partners to reduce lifetime cancer risk among young adults.

A professional meeting facilitator used a series of overarching questions to guide group discussions (Table 1). Meeting discussions on the first day focused on the cross-cutting theme of investing in the health and well-being of young adults, with an emphasis on the overarching questions “What’s important?” and “What’s missing?” Discussions on the second day focused on the overarching questions “What can we do now, and how do we do it?” and were organized within the context of the four strategic directions of the National Prevention Strategy: building healthy and safe community environments; expanding quality preventive services in clinical and community settings; empowering people to make healthy choices; and eliminating health disparities.⁷ This paper uses the same framework to organize themes from the meeting.

INVESTING IN THE HEALTH AND WELL-BEING OF YOUNG ADULTS

Early adulthood is a window of opportunity for early cancer intervention, and there are many important contextual factors to consider when targeting this age group. For example, early adulthood is a time of many life transitions, such as leaving home, entering the workforce, and perhaps becoming a parent, each with potential challenges and stresses.⁸ Furthermore,

young adults face health challenges such as high rates of certain chronic health conditions (e.g., obesity) but tend to have low use of preventive care services.⁹

Numerous social, behavioral, and environmental factors during early adulthood can influence cancer risk, and as the surveillance data presented in the paper by White et al.¹⁰ within this special issue illustrate, many of these cancer risk factors are common among U.S. young adults. Although the strength of the relationship between exposure and cancer development varies, factors recognized to contribute to different types of cancer include tobacco¹¹; ultraviolet radiation¹²; alcohol¹³; medical conditions (e.g., obesity¹⁴ and diabetes¹⁵); infectious agents (e.g., human papillomavirus [HPV], viral hepatitis, *Helicobacter pylori*)¹⁶; and numerous environmental carcinogens.¹⁷ Vigorous physical activity^{18,19} and breast-feeding^{20,21} are examples of factors associated with lower risks for some cancer types. The literature is extensive on dietary factors and cancer risk, indicating the carcinogenicity of red and processed meat^{22,23} and potential benefits of a plant-based diet and avoidance of sugary drinks.²²

In addition to these more established risk factors, there are others for which scientific evidence is emerging. One example is circadian rhythm disruption.^{24,25} The production of the hormone melatonin in the pineal gland is key in regulating the circadian clock.²⁶ Exposure to light at night suppresses melatonin production, which can disrupt the natural circadian rhythm. Evidence suggests that melatonin inhibits tumor growth. Therefore, decreasing circulating melatonin may increase cancer risk by affecting other hormonal systems.²⁷ Insufficient sleep, which can contribute to circadian rhythm disruption, is common among young adults.¹⁰ Night shift workers are a particularly high-risk population because they are exposed to light at night and experience sleep disruption.²⁸ Shiftwork involving circadian disruption has been classified by the International Agency for Research on Cancer as probably carcinogenic to humans, associated with breast, prostate, colorectal, and endometrial cancers.²⁹ Research is needed to better understand the underlying biological mechanisms, including possible genetic components, and particular aspects of shiftwork that increase cancer risk. Reducing exposure to light at night, including light from urban environments and the use of electronic devices, may reduce cancer risk.

Chronic stress is another example of a potential cancer risk factor for which evidence is emerging.^{30–32} Data from the Stress in America™ survey indicate that younger adults tend to report higher average stress levels than older adults.³³ Chronic stress is thought to influence cancer progression through underlying cellular and molecular processes that impact cancer biology and drive tumor growth.³⁴ Stress-related psychosocial factors have been shown to impact cancer incidence in some studies and patient survival in many studies, with the largest effects documented in liver, head and neck, ovarian hematopoietic and lymphoid, lung, and breast cancers.³⁰ Pathways activated in response to chronic stress have been linked to inflammation, tumor angiogenesis, protection of cancer cells from anoikis (a form of programmed cell death), increased nerve density, and altered tumor microenvironment; these mechanisms collectively can lead to poorer cancer outcomes.^{35,36} Chronic inflammation may mediate the observed relationship between stressors such as social isolation and cancer outcomes. Research supports the notion that social connections protect young adults against cancer risk and related mortality by reducing the physiologic

stress response.^{37–39} The effect of chronic stress during young adulthood on long-term cancer risk may be attenuated through behavioral interventions to reduce stress or increase social support. Additionally, pharmacologic interventions to reduce stress may have the potential to decrease cancer risk, but more research is needed.

Changing trends in cancer rates and risk factors in the U.S. can guide the focus of prevention efforts targeting young adults. Disparities in cancer incidence exist within certain groups (e.g., smaller declines in breast cancer incidence among black women compared with white women).⁴⁰ Additionally, although some cancer risk factors (e.g., tobacco use) and the corresponding racial disparities have declined with time, others (e.g., obesity) have persisted.^{38,40} As described in the paper by Yang et al.³⁸ in this special issue, socioeconomic disparities persist even after accounting for differences in health behaviors. These patterns underscore the importance of comprehensive prevention approaches that tackle social inequities and discriminatory practices at the community level (e.g., social and contextual factors related to income, education, housing, access to health care, transportation, and geographic location) and highlight policy and systems-level actions as appropriate focuses for interventions to improve health.^{41,42}

BUILDING HEALTHY AND SAFE COMMUNITY ENVIRONMENTS

Efforts to create healthier and safer community environments have the potential to modify or reduce cancer risk factors. Such efforts often require those working in public health to collaborate with other sectors within the community to maximize success. The promotion of physical activity, for example, can be addressed through collaboration across community sectors to create healthier community spaces. Physical activity is associated with a lower risk of several cancers, including breast, colorectal, and others, in addition to a lower risk of other chronic diseases such as heart disease, stroke, and Type 2 diabetes.⁴³

Though people may face individual barriers to physical activity such as competing demands on their time and physical limitations, addressing community-level barriers, such as lack of access to safe spaces suitable for physical activity, is particularly important.⁴⁴ The Guide to Community Preventive Services (www.thecommunityguide.org); National Prevention Strategy⁷; and most recently, *Step it Up! The Surgeon General's Call to Action to Promote Walking and Walking Communities*⁴⁵ outline strategies for increasing physical activity at the community level by improving the built environment. Walking has been highlighted as a strategy to improve physical activity given its ease; popularity; low injury risk; lack of requirements for special skills, equipment, or expensive facilities; and utility as both recreation and transportation.⁴⁵ To increase walking, the overall community design, street design, and local transportation policies and practices need to provide access to safe and attractive areas, such as well-maintained sidewalks, pedestrian crosswalks, and parks.⁴⁵ Collaboration across community sectors, including workplaces, schools, local government, and law enforcement, can promote community-wide strategies to facilitate physical activity.^{46,47}

To maximize success, efforts to create healthy environments should also take into account contextual factors that extend beyond the physical environment. One such example relevant

to young adults is the influence of marketing. Young adults are often direct targets of marketing efforts for a number of products that are legal but have harmful health effects, including a link to cancer risk (e.g., alcohol, tobacco, sugar-sweetened beverages, processed foods). Alcohol advertising often specifically targets young adults and is sometimes marketed as a health food or, even more ironically, as a way to promote breast cancer awareness (“pinkwashing”).^{48,49} The term “industrial epidemics” has been used to describe the adverse health consequences of the consumption of these products, characterizing corporations as vectors who make, distribute, and sell products that may increase risk for disease.⁵⁰

The multibillion-dollar advertising budgets of individual major corporations far exceed the entire federal budget for cancer control. Marketing efforts, however, extend well beyond advertising to address the “four P’s” of marketing: price, product, promotion, and place.⁵¹ Additionally, corporate social responsibility activities are sometimes used as part of marketing efforts.⁵² Many industries have adapted strategies learned from the tobacco industry: casting doubt on the science, influencing regulatory activities, delaying implementation through the courts, and reframing the issue as one of free choice.^{50,53,54} Counter-advertising efforts are needed to correct misinformation about the cancer risks of specific products and to shine a light on the deceptive and manipulative aspects of some commercial marketing practices. In addition, public health strategies need to identify and delegitimize industrial efforts aimed at opposing social, environmental, and policy initiatives to reduce exposure to carcinogens and promote healthy behaviors. The work of the University of California, San Francisco Tobacco Center is an example of understanding tobacco industry marketing to develop effective counter-marketing,⁵⁵ including using similar tactics to develop anti-tobacco social branding.⁵⁶ A social intervention used counter-marketing to promote smoke-free parties in San Diego and other locales.⁵⁷ As described by Schillinger and colleagues⁵⁸ in this special issue, strong partnerships with local leaders and youth engagement were critical to the success of this effort.

EXPANDING QUALITY PREVENTIVE SERVICES IN CLINICAL AND COMMUNITY SETTINGS

Preventive services in both clinical and community settings can play a role in cancer prevention targeting young adults. Partnerships among clinical providers, community organizations, and local public health agencies can more effectively help patients change unhealthy behaviors (e.g., tobacco use); help reach target populations for community services (e.g., immunization programs); and allow providers to direct patients to needed resources they are unable to provide in a clinical setting (e.g., nutrition and physical activity programs).⁷ Community and clinical linkages can also promote a shared goal of population health, cultivate community engagement, and foster the effectiveness and sustainability of available prevention strategies.⁵⁹ Additionally, such linkages can facilitate a collaborative use of data to improve the understanding of the most effective and appropriate strategies in a given population.⁵⁹

Specific examples relevant to young adults include addressing viral hepatitis and HPV infections. Viral hepatitis is the leading cause of liver cancer in the U.S.⁶⁰ Hepatitis B and C infections can progress to a chronic infection and remain asymptomatic for years until manifesting as liver disease or liver cancer. Populations at increased risk for viral hepatitis infection include immigrants and refugees from hepatitis B virus–endemic areas, Asian Americans, Pacific Islanders, African Americans, men who have sex with men, people living with HIV/AIDS, injection drug users, and the homeless.⁶¹ The nation’s first comprehensive action plan, *Combating the Silent Epidemic of Viral Hepatitis: Action Plan for the Prevention, Care, & Treatment of Viral Hepatitis*, was released by the U.S. DHHS in 2011 and updated in 2014.⁶¹ The plan outlines multiple strategies for cancer prevention, including promoting hepatitis B virus vaccination, reducing behaviors associated with viral hepatitis, diagnosing and treating hepatitis C virus infection early, improving surveillance of acute and chronic viral hepatitis, and screening those at risk of becoming infected.⁶¹

Although current recommendations encourage HPV vaccination for children, the vaccine is also recommended for young adults who have not yet received the vaccine.⁶² Specifically, the HPV vaccine is recommended for young men through age 21 years and the following individuals through age 26 years: young women, young men who have sex with men, young adults who are transgender, and young adults with certain immuno-compromising conditions.⁶² Little research has examined factors that influence young adults’ decisions to receive the HPV vaccine and strategies that could be used to increase catch-up vaccination in this age group.

EMPOWERING PEOPLE TO MAKE HEALTHY CHOICES

When young adults are empowered, they are able to take an active role in improving their health and leading community change.⁷ As illustrated in the paper by McCloud et al.,⁶³ mobilizing and organizing the target audience of prevention interventions to involve them in characterizing the problem and developing solutions is one empowerment strategy that has been successful among this age group. One example of this approach is The Truth Campaign, which aimed to reduce tobacco use.^{64,65} Young adults were involved in the development of the campaign, and their engagement facilitated the development of messages that resonated with this population.⁶⁶ Another example is The Bigger Picture, a novel partnership between the University of California, San Francisco Center for Vulnerable Populations and Youth Speaks (a youth empowerment group focused on youth literacy) to engage young adults in developing health-related messages.⁶⁷ The papers by Hiatt and colleagues,⁶⁸ Ling et al.,⁶⁹ and Falzone colleagues⁷⁰ in this special issue reiterate that communicating prevention messages in venues and via channels popular among young adults is critical to intervention success. Those developing such interventions should also consider accompanying behaviors to avoid inadvertently substituting one harmful product with another or missing an opportunity to promote healthy behaviors. For example, there is potential for alcohol use at a smoke-free party but also the opportunity to promote healthy behaviors like dancing.

As shared by Simmons et al.,⁷¹ improving health literacy is another key empowerment tool. Health literacy, the ability to read, understand, and act on health information, is a strong

predictor of health status,⁷² and many U.S. adults do not have proficient health literacy.⁷³ Health literacy affects the access and use of care, the patient–doctor interaction, and patient self-care, all of which influence health outcomes.^{72,74} Several evidence-based strategies have been shown to improve health literacy, including improvements in patient–provider communications in clinical settings and educating patients to be prepared for health encounters.⁷⁵ Messaging needs to be framed and delivered in a manner appropriate to the target population (e.g., using social media or smartphone applications to reach young adults and providing messages in the primary language of the target audience).

The use of information and communication technologies is nearly ubiquitous among people in early adulthood, but differences exist in the use of such technologies among subgroups based on racial, geographic, and socioeconomic characteristics. Differences among social groups in the manipulation and distribution of information at the population level and differences at the individual level in access to information or the capacity to use information create communication inequalities.⁷⁶ Even among young adults, not all have access to broadband Internet at home or continuous cell phone service. Understanding these differences among subpopulations is important when implementing cancer prevention strategies and determining which communication channels might be most effective.⁷⁷

ELIMINATING HEALTH DISPARITIES

Young adults in the U.S. are tremendously heterogeneous, and certain groups are disproportionately affected by harmful social and environmental factors. Racial and ethnic minorities; the lesbian, gay, bisexual, transgender, and questioning/queer community; low-income groups; the homeless; incarcerated individuals; migrant laborers; and those living with mental illness⁷⁸ are examples of groups who may benefit from targeted prevention efforts. For some of these groups (e.g., the lesbian, gay, bisexual, transgender, and questioning/queer community), the lack of adequate data add complexity to the issue. Because poor health often starts earlier in these groups, successfully addressing health disparities will necessitate starting prevention efforts early in the life span. For example, although tobacco use has decreased in recent years, young adults have the highest smoking prevalence nationwide, particularly among young minority populations.^{79,80} Just as industries target their marketing to these young adults, public health efforts need to target and address the unique needs and challenges faced by young adults, particularly those in minority groups or other at-risk populations. Many of these groups are not only underserved but also understudied, pointing to the need for more research to inform public health action.

The DHHS Action Plan to Reduce Racial and Ethnic Health Disparities and the National Partnership for Action to End Health Disparities⁸¹ can be leveraged to address disparities in health and health care specifically among minorities disproportionately affected by chronic diseases.⁸² The five goals of the action plan are to:

1. transform health care by increasing access to health care and insurance;
2. strengthen the nation’s health and human services infrastructure and workforce by addressing the shortage of healthcare providers, promoting the use of community health workers, and implementing and enhancing the National

Standards for Culturally and Linguistically Appropriate Services in Health and Health Care that addresses medical interpretation, health literacy, and other communication needs;

3. advance the health, safety, and well-being of the American people via community-based preventive care programs;
4. advance scientific knowledge and innovation by standardizing data collection practices on race and ethnicity; and
5. increase the efficiency, transparency, and accountability of DHHS programs.⁸³

Young adults in the criminal justice system are another example of an often overlooked group in need of more targeted public health efforts. About 50% of inmates are aged 26–40 years,⁸⁴ and as many as 60% of inmates are racial and ethnic minorities.⁸⁵ Incarcerated young adults tend to have high rates of chronic health conditions,^{86,87} and although inmates are entitled to healthcare services, research suggests that up to 69% of inmates with persistent medical conditions are not receiving care.⁸⁸ The environment and living conditions in corrections facilities may further contribute to poor health and increased cancer risk. Overcrowding creates conditions that may contribute to the spread of HIV, sexual violence among inmates, and lack of access to health care and may exacerbate certain chronic conditions.⁸⁹ Inmates are also likely to experience poor food choices, limited opportunities for physical activity, obesity, and weight gain.²² Additionally, a large percentage of incarcerated individuals report a history of tobacco use.⁹⁰ Many jails and prisons have instituted smoking bans.⁹⁰ However, recidivism in tobacco use remains a significant issue for this population,⁹⁰ and incarcerated individuals have an increased need for cancer prevention education and tobacco-cessation support.^{91,92}

PRIORITIES FOR PUBLIC HEALTH ACTION TO REDUCE CANCER RISK

The themes that emerged during the expert meeting demonstrated the value of engaging in transdisciplinary discussions to identify solutions to the complex challenge of translating scientific evidence for effective cancer prevention. Multiple factors may influence cancer risk, and this meeting was one step toward addressing the overarching questions that guided the group discussions. The amount of scientific research regarding specific cancer risk factors can be overwhelming, and the collective understanding about etiologic mechanisms is still evolving. Clear consensus exists about the importance of several highly prevalent factors among young adults, including tobacco use, sugar-sweetened and alcoholic beverages, obesity, and physical inactivity. These and other risk factors for which the evidence is emerging (e.g., sleep, stress) may be inter-related. Other than tobacco, however, the potential role that certain risk factors play in cancer development may not be fully recognized among young adults or even their healthcare providers.

A major cross-cutting theme was the heterogeneity of young adults and the social inequities that exist for certain population subgroups. The unique stresses of early adulthood can be exacerbated by poverty, discrimination, and social injustice. Many young adults lack access to the social and environmental conditions that support healthy choices. Mobilizing young adults to serve as advocates for change is one promising approach to health promotion

during this phase of life. Engaging disadvantaged communities in prevention efforts may be particularly effective at addressing health literacy and countering targeted advertising of harmful products.

The evidence base for interventions to address specific cancer risk factors is extensive. Environmental and policy interventions can have the largest population impact. Challenges exist in the implementation and scale-up of evidence-based interventions that currently exist and in sustaining positive changes over time. In addition, cancer risk factors often coexist and share common social drivers. More integrated approaches to cancer prevention are needed, as well as research to identify the most effective interventions that operate across multiple risk factors and enhance our understanding of the multi-factorial etiology of most cancers.

Environmental and policy interventions can occur at the national, state, and local levels, and real change will require the engagement of young adults in these efforts. Toward that end, CDC and other federal agencies can facilitate the dissemination of information about cancer risk factors and the successes or failures of different intervention approaches, develop tools and training for state and local organizations to support their efforts at organizing and mobilizing communities to effect change, and collect and provide surveillance data to target and evaluate cancer prevention efforts. The public health community has the added responsibility of undertaking additional research to examine social determinants of health and existing disparities.

Many of these themes are discussed in greater detail in other papers in this supplement. Collectively, these papers illustrate the challenges and opportunities that exist when tackling cancer prevention at this stage of life. The assembled wealth of wisdom and dedication reflected by everyone who contributed to this effort is both inspiring and illuminating. The authors hope that this overview of meeting themes and the other supplement papers provide guidance and encouragement for those seeking to reduce the incidence of cancer in the coming decades by adopting a life course perspective on prevention through early intervention focused on young adults.

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Table 1

Overarching Questions Used to Guide Meeting Discussions

What's important? What's missing?	
•	The primary prevention work of CDC's Division of Cancer Prevention and Control has focused on certain well-established cancer risk factors (e.g., ultraviolet radiation, tobacco use, human papillomavirus). In the context of a life span approach, what other exposures, personal behaviors, or life circumstances during early adulthood may influence subsequent cancer risk or the risk trajectory that a young person is on?
•	Are there specific exposures or risk factors of concern that may disproportionately affect certain at-risk populations (e.g., racial or ethnic minorities, active duty military, LGBTQ, incarcerated populations, the homeless, those with mental illness, those with genetic predispositions)?
•	Where is the evidence strongest, and what role might public health agencies play to translate the science into public health action?
•	What additional data or evidence in the short term could have the greatest impact or create tipping points for action? How do we overcome the methodological challenges (e.g., design and measurement issues) we face when collecting data on young adults and subgroups within this population?
What can we do now, and how can we do it?	
•	What are effective or promising strategies to put scientific findings into public health practice or influence policy, systems, and environmental change?
○	What barriers do we face in trying to implement these approaches?
○	How might such approaches be modified to address the unique needs of populations at increased risk?
○	How can these strategies be scaled up and sustained over time?
•	How can we develop the evidence base for prevention interventions? What are the lessons learned from other prevention efforts that target early adulthood?
•	What are some effective or promising communication strategies when targeting young adults?
•	How do we best coordinate with other health promotion and disease prevention efforts to be cost effective and improve health outcomes, and who might be some potential partners in this effort?

CDC, Centers for Disease Control and Prevention; LGBTQ, lesbian, gay, bisexual, transgender, and queer.

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