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The Role of Nutrition and Malnutrition as Determinants of Cancer Development, Prevention, and Survivorship

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Abstract

Nutrition and malnutrition are highly influential yet often under recognized determinants in the development, progression, and survivorship of cancer. Poor dietary patterns and nutritional deficiencies are leading modifiable risk factors for several types of cancers. These issues disproportionately affect vulnerable populations, intensifying existing health disparities. In Delaware, the Bureau of Cancer Prevention and Control addresses cancer across the continuum from education and prevention to screening, diagnosis, treatment, and survivorship. This is done through integrated programs such as the Delaware Comprehensive Cancer Control Program, Screening for Life, the Physical Activity, Nutrition and Obesity Prevention Program, and the Delaware Cancer Treatment Program.

This article explores the complex interplay between nutrition and malnutrition, and their impact on cancer. Highlighted are both the biological mechanisms linking dietary patterns to carcinogenesis and the socioeconomic factors that drive nutritional inequities. It also presents Delaware-specific cancer and nutrition data, highlighting how state-led efforts are evolving to incorporate nutrition education, food access partnerships, and community-based interventions into cancer prevention and control strategies. By aligning clinical, public health, and community resources, Delaware is creating a more holistic and equitable approach to reducing cancer incidence and improving outcomes. This article underscores the urgent need to treat nutrition as a foundational element of cancer prevention and presents opportunities for policy and practice to address malnutrition across the cancer care continuum.

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Introduction

Nutritional status is both a cause and consequence of disease. Deficiencies in dietary quality contribute to the onset of numerous cancers. Meanwhile, malnutrition increases treatment complications, weakens treatment outcomes, and leads to poorer survivorship.[1] This article will examine how the health determinants of nutrition and malnutrition function across the cancer continuum, highlighting both biological and structural drivers of disease. Drawing on Delaware's state-specific experience and programs led by the Bureau of Cancer Prevention and Control and the Physical Activity, Nutrition, and Obesity Prevention Program, a case for deeper investment in nutrition-based interventions spanning from prevention to survivorship care is presented. Strategies for health equity, access to healthy food, and integration with existing cancer infrastructure are emphasized.

Cancer remains one of the leading causes of death in the United States, yet much of its burden is preventable. Among the most modifiable risk factors for cancer are poor diet and nutritional deficiency. According to the Centers for Disease Control and Prevention (CDC), nearly one in five cancers is associated with lifestyle-related risk factors, including unhealthy eating patterns. On the opposite end of the continuum, malnutrition, characterized by the inadequate consumption of calories, proteins, and essential nutrients, furthers treatment complications, increases hospitalizations, and compromises survivorship.[1,2] Nutrition and malnutrition form a crossroad with other social determinants of health, such as poverty, race, geography, and education. These disparities affect cancer risk, diagnosis, treatment, and long-term outcomes. Detailed in this article is the central role nutrition plays in cancer prevention, treatment, and survivorship. It draws upon national data and Delaware's state-specific experience to illustrate how nutrition-based interventions can promote more equitable cancer outcomes.

Methods

This article is based on a synthesis of a variety of literature, secondary data sources, and internal program-specific data. A thorough review of current peer-reviewed literature was conducted via the Delaware Department of Health and Social Services Library access to EBSCO, PubMed, and Sage databases using the key terms cancer and nutrition, oncology dietician, and malnutrition in cancer. Delaware-specific public health reports were reviewed for current state-related obesity, nutrition, and cancer related state findings. These reports are publicly available on the State of Delaware website.

Data Sources

The Behavioral Risk Factor Surveillance System is the longest running random-digit dial telephone survey in the U.S. capturing health outcomes and associated risk factor data in all 50 states and four territories. Approximately 4,000 Delaware adults respond to the survey each year. These results are used to create prevalence estimates for a variety of health outcomes and risk factors.

CDC PLACES is a publicly available dataset in which small area estimates (SAE) are calculated for counties, census tracts, and ZIP Code Tabulation Areas. Crude prevalence SAEs for selected chronic disease indicators are available as a geodatabase and in tabular format.

The Social Vulnerability Index (SVI) is a composite measure aiming to determine social vulnerability by compiling 17 different indicators into four themes. These themes include

socioeconomic status, household characteristics, racial and ethnic minority status, and transportation. This composite measure is developed and maintained by the CDC and the Agency for Toxic Substances and Disease Registry. SVI allows researchers to identify census tracts with high social needs and allows programs to provide a targeted approach to resource allocation.

Relevant state programs, including the Delaware Comprehensive Cancer Control Program (CCCP), Screening for Life (SFL), the Physical Activity, Nutrition, and Obesity Prevention Program (PANO), and the Delaware Cancer Treatment Program, were reviewed to identify initiatives addressing nutrition and malnutrition across the cancer continuum.

Data Analysis

SAS 9.4 was used to analyze Delaware-specific BRFSS data for obesity, smoking, and nutrition trends, and identify disparities in these indicators among selected demographic factors. ArcGIS Pro v. 3.3.1 was used to visualize crude obesity prevalence and SVI by census tract. Shape files were obtained from the U.S. Census Bureau's 2020 TIGER/Line download website.

Results

Nutrition, Obesity, and Cancer Risk

One of the greatest public health successes in Delaware is the decrease in cigarette smoking prevalence over the past three decades. In 1995, 25.5% of Delaware adults reported smoking cigarettes, compared to 10.1% of Delaware adults in 2024.[3] However, most of the decrease in current cigarette smoking prevalence has been made within the past 13 years. In 2011, 21.2% of Delaware adults reported smoking cigarettes.[3] The change in prevalence between 1995 and 2011 was a 16.9% decrease. From 2011 through 2024, Delaware experienced a 52.4% decrease.[3]

Although progress has been made in cigarette smoking among Delaware adults, weight gain and increased body mass index (BMI) among Delaware adults has become a public health concern. Obesity is defined as having a BMI of 30.0 or more. In 2024, 36.6% of Delaware adults reported being obese, compared to 17.1% of Delaware adults in 1995.[3] This change in reported adult obesity is a 43.5% increase in the past three decades. While, not statistically different, a higher percentage of Delaware adult women have consistently reported having obesity, compared to Delaware men, since 2012.[3] Likewise, a higher proportion of non-Hispanic Black adults have consistently reported having obesity, compared to non-Hispanic White adults since 2011.[3]

Figure 1 shows the distribution of crude prevalence of obesity and SVI by census tract in Delaware in 2020. Census tracts in and surrounding the City of Wilmington indicate a high crude obesity prevalence and a high SVI in New Castle County. Western Sussex County shows areas of high crude prevalence and higher SVI. All but four census tracts in Kent County are in the top quintile for crude obesity prevalence.

Figure 1. Crude Obesity Prevalence and Social Vulnerability Index by Census Tract, Delaware, 2022[4,5]

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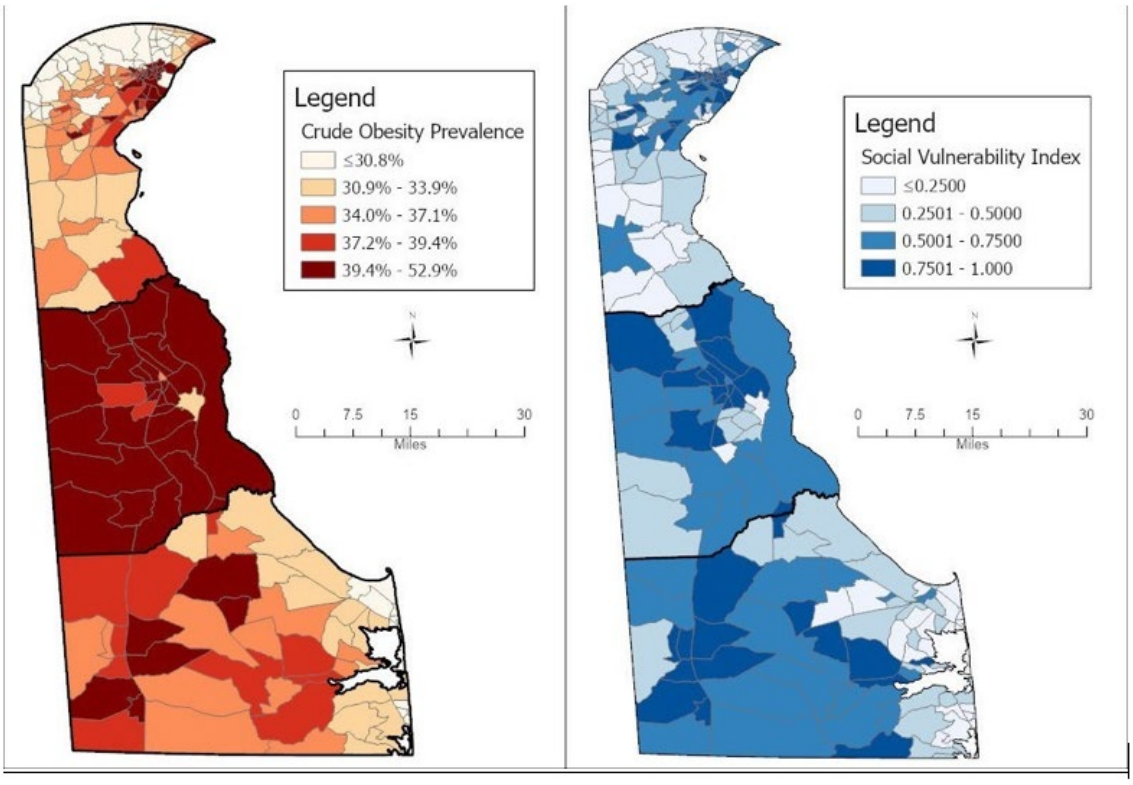

Note: The model-based estimates were generated using BRFSS 2020, Census 2010 population counts, or census county population estimates of 2020 or 2019, and ACS 2015-2019. Estimates are not available for areas shaded in gray. For more information visit https://www.cdc.gov/places. Credit: Centers for Disease Control and Prevention, National Center for Chronic Disease and Health Promotion, Division of Population Health, Atlanta, GA

Obesity is recognized as a risk factor for at least 13 different cancers including breast, colon and rectum, ovarian, and stomach. Delaware experiences a higher cancer burden related to obesity compared to the United States. In 2022, Delaware's obesity-associated cancer rate was 174.6 per 100,000 population which is higher than the comparable rate in the United States which was 170.1 per 100,000 population during the same period.[6] Additionally, in 2023, only 9% of Delaware adults consume the recommended daily intake of vegetables, and just 12% meet fruit intake guidelines.[3] These gaps underscore systemic barriers to healthy eating, especially among low-income households and communities.

Nutrition as a Determinant of Cancer Development

Nutrition plays a critical role in preventing obesity and maintaining a healthy weight. Excess caloric intake can lead to weight gain, increasing the risk of overweight and obesity, a well-established risk factor for cancer development. Scientific evidence also increasingly confirms the link between the dietary patterns and cancer incidence.[7] Diets high in processed meats, added sugars, and refined carbohydrates are associated with elevated risks for breast and colorectal cancers.[7] Conversely, diets rich in fruits, vegetables, fiber, and whole grains are protective factors against the development of cancer.[7] Nutritional status directly influences cancer risk through mechanisms including inflammation, stress, hormone regulation, and immune function.

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High glycemic diets promote insulin resistance and chronic inflammation. Both conditions are conducive for tumor growth. Diets lacking in antioxidants and phytochemicals fail to counteract DNA damage from environmental exposures. However, food insecurity heavily influences an individual's ability to make healthy food choices. Limited access to affordable, nutritious food often forces individuals to rely on calorie-dense, nutrient-poor options, which can contribute to the development of obesity, and further highlights the complex relationship between nutrition, obesity, and cancer development.

Structural Drivers of Nutritional Disparities

The lack of access to healthy food is shaped by structural inequities. Delaware's urban and rural regions face food insecurity in rates exceeding 11% with even higher prevalence in Black and Hispanic communities. Statewide, 42% of Delaware adults have low food access, defined as living beyond 1 mile in an urban setting, or 10 miles in a rural setting, of a supermarket.[8] Socioeconomic status, transportation barriers, and lack of food retail infrastructure contribute to these disparities. Food deserts, or areas where access to affordable, healthy food is limited, exist in both the city of Wilmington and throughout Sussex County. These inequities intersect with and influence cancer outcomes. Research shows that cancer patients from low-income households experience worse treatment outcomes and are more likely to be diagnosed with cancer at later stages. Malnutrition may also delay treatment initiation or result in dose reductions, further worsening cancer prognosis.

Discussion

Malnutrition in Oncology Care

Malnutrition affects up to 80% of cancer patients during the course of their treatment.[2] Consequences of malnutrition during cancer treatment include decreased tolerance to chemotherapy and radiation; increased risk of infection and delayed wound healing; longer hospital stays and higher readmission rates; and diminished quality of life and survival rates.[2] During treatment, adequate nutrition is essential for maintaining strength, mitigating side effects, and supporting immune response. Despite its prevalence, malnutrition is frequently underdiagnosed in oncological settings. Screening tools such as the Malnutrition Screening Tool (MST) and Patient-Generated Subjective Global Assessment (PG-SGA) are available but are not universally applied. Assessing a cancer patient's nutrition status and designing personalized early nutritional therapy to meet individual needs can help prevent or manage malnutrition, reduce its adverse effects, and potentially improve overall outcomes.[9] Addressing malnutrition requires early screening, interdisciplinary care, and access to food assistance. Increased use of MST and PG-SGA as part of an integrated comprehensive cancer care plan should include nutritional interventions by oncology dieticians.

In Delaware, oncology dieticians are present at major cancer centers but lack integration into broader care teams. There is a growing push to embed nutrition support into standard oncology protocols, particularly for underserved populations. Throughout the course of cancer care, oncology dietitians help to support and maintain patient quality of life by offering individualized nutrition guidance aimed at reducing eating-related discomfort.[10] While undergoing cancer treatment, every patient requires an individualized nutrition plan to address their specific disease and dietary circumstances to ensure the best possible treatment outcome and longest

survivorship.[11] Lower-income cancer patients are more at risk of experiencing malnutrition and its associated effects of reduced quality of life and increased risk of mortality but are least likely to have access to nutrition-related services and one-on-one dietary counseling.[11] Including oncology dieticians in cancer care teams can optimize nutrition and improve health outcomes in individuals with cancer.

Survivorship and Long-Term Outcomes

The importance of proper nutrition continues beyond prevention and treatment, and into survivorship. There are over 16 million cancer survivors in the United States. As survivorship grows, nutrition remains vital for reducing recurrence risk and managing comorbidities like cardiovascular disease and diabetes. A recent study published in the JAMA Health Forum conducted by researchers at the University of Pennsylvania Perelman School of Medicine investigated the impact of food insecurity on mortality rates in cancer survivors.[12] The study found that those experiencing food insecurity had a 28% higher mortality risk compared to those who were food secure.[12] Although this is the first study of its kind, it highlights the need for improved systems and comprehensive care plans that address the food and nutrition needs of cancer survivors throughout remission. However, many survivors lack post-treatment guidance. Efforts to provide this type of guidance, such as integrating Registered Dietitian Nutritionists (RDNs) into survivorship care plans, are underutilized strategies.

Delaware's Response: Integrating Nutrition into Cancer Care

Delaware has taken meaningful steps to bridge nutrition and cancer care. Key programs include Screening for Life, which offers free screening for breast, cervical, colorectal, lung, and prostate cancer, and follow-up for eligible individuals. Efforts are underway to integrate nutrition counseling. The PANO Program implements community-based interventions promoting healthy eating and physical activity through the Advancing Healthy Lifestyles (AHL) Initiative, an effort supported by the Delaware Cancer Consortium (DCC).

In 2021, the DCC's Cancer Risk Reduction Committee's Healthy Lifestyles Subcommittee (HLSC) was tasked with studying and recommending policies aimed at improving healthy lifestyles for Delawareans across the life course. The AHL Initiative was subsequently developed to facilitate implementation of these recommendations. Through this Initiative, the PANO Program has aided the development of healthy eating initiatives through state-funded projects such as healthy corner stores, community gardens, and nutrition education in schools. The Initiative has strengthened health system-community partnerships, notably through support of community-based programming and policy, systems, and environmental change initiatives spearheaded by hospital systems, Federally Qualified Health Centers, and community health workers. These programs, such as culinary medicine and nutrition education for healthcare providers, hybrid nutrition education programs for individuals at risk for breast cancer and other chronic diseases, food pharmacies, and produce prescription programs, have highlighted and addressed the connection between nutrition, food access, and health outcomes. They have laid the foundation for comprehensive, integrated care models that can be sustained and scaled statewide.

Concurrently, the Delaware Cancer Treatment Program covers cancer treatment costs for eligible Delaware residents with plans to integrate social determinants screening to include food insecurity during the application review process. One proposed pilot collaboration is between the

Delaware CCCP and a local food bank to offer medically tailored food boxes to newly diagnosed cancer patients. This proposed project seeks improvements in patient-reported energy, reduction in emergency department visits during cancer treatment cycles, and increased adherence to treatment plans. Delaware's Bureau of Cancer Prevention and Control and PANO Program continue to work collaboratively to identify needs and integrate healthy lifestyle programming with cancer prevention, care, and survivorship.

Public Health Implications

Recognizing nutrition as a cornerstone of cancer prevention and survivorship is a public health imperative. Delaware's experience illustrates how cross-sector collaboration between healthcare providers, public health agencies, food systems, and community organizations can improve cancer outcomes. The Centers for Disease Control and Prevention has a menu of evidence-based strategies and approaches public health practitioners can implement to support access to healthy foods and beverages. Fruit and vegetable voucher incentive programs and produce prescription programs, such as Food is Medicine initiatives, are proven to improve affordability of, access to, and consumption of healthy foods, and showcase the impact of coordinated partnerships between health systems, public health professionals, and community-based organization.[13] The Food is Medicine movement, which includes medically tailored meals, produce prescription programs, culinary medicine, and integration of nutrition into Medicaid and Medicare reimbursement, is gaining momentum nationwide. The movement aligns with a nationwide public health shift to better support food security by focusing on *nutrition* security, defined by the USDA as consistent access, availability, and affordability of foods and beverages that promote well-being, prevent disease, and, if needed, treat disease, particularly among racial/ethnic minority populations, lower income populations, and rural and remote populations including Tribal communities and Insular areas.[14] The shift in focus highlights the role proper nutrition plays in disease prevention, treatment, and maintenance, and further exemplifies the need for integrated, interdisciplinary cancer care teams. Delaware has the infrastructure to become a regional leader in this space. Policy priorities should include reimbursable nutrition counseling in oncology; integration of food insecurity screening in cancer centers; expansion of medically tailored meal programs; investment in community-based nutrition education and food access; and incentives for grocery store development in underserved areas.

Conclusion

Nutrition and malnutrition are fundamental determinants of cancer development, treatment, and recovery. They intersect with socioeconomic disparities, structural barriers, and healthcare access. Delaware has demonstrated promising models that integrate nutrition into cancer control through clinical, social, and community-based partnerships, but more work is needed to develop a system to integrate these efforts nationwide and develop an interdisciplinary standard of care. To reduce cancer incidence and improve survivorship, we must treat nutritional health as public health and improve nutrition security for all Delawareans. Addressing dietary deficiencies at the biological and structural levels can disrupt disease pathways and create a more equitable future for cancer care.

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