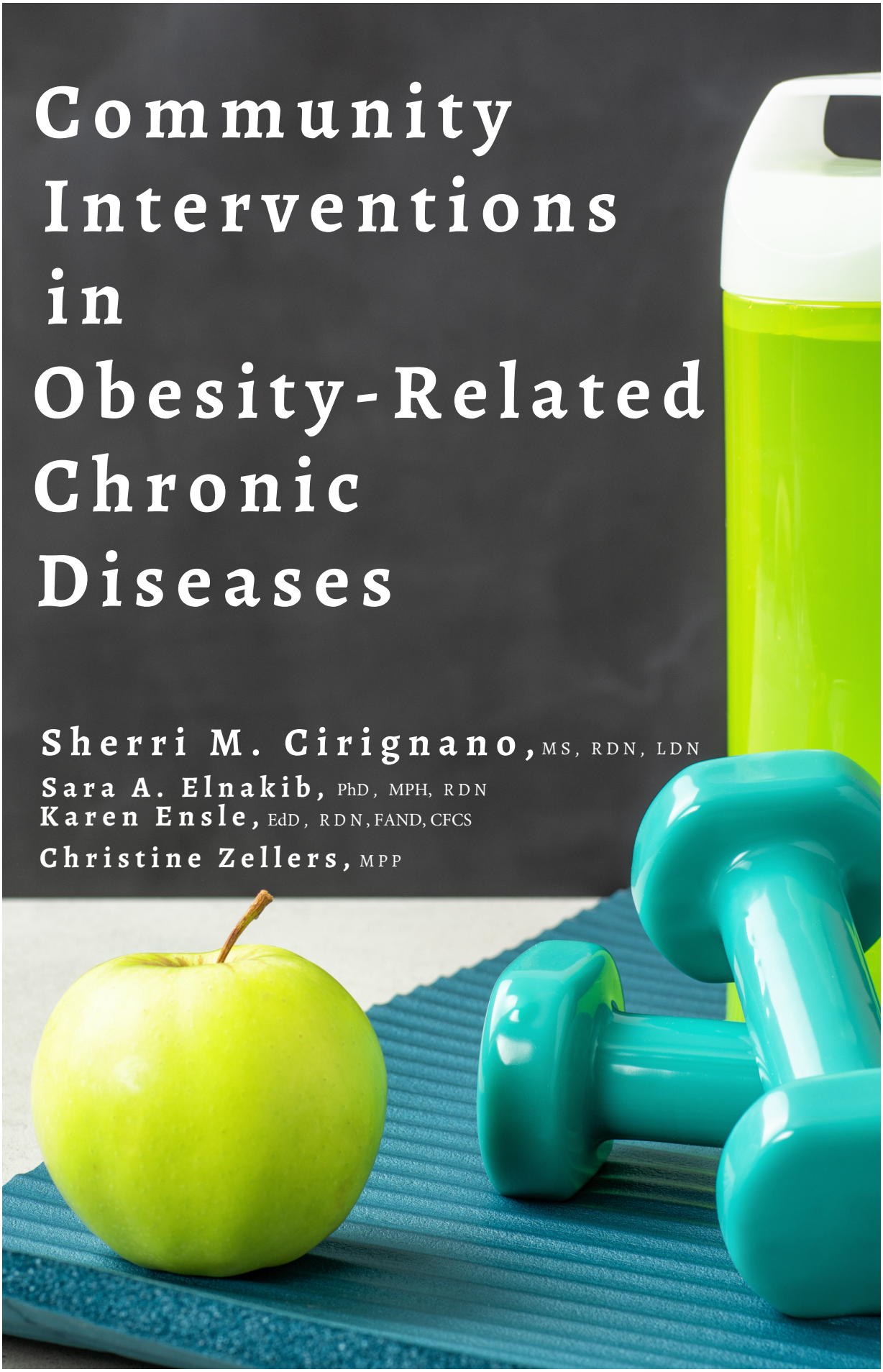
Community Interventions in Obesity-Related Chronic Diseases

Sherri M. Cirignano, MS, RDN, LDN
Sara A. Elnakib, PhD, MPH, RDN
Karen Ensle, EdD, RDN, FAND, CFCS
Christine Zellers, MPP



Community Interventions in Obesity-Related Chronic Diseases

Sherri Cirignano, MS, RDN, LDN; Sara Elnakib, PhD, MPH, RDN; Karen Ensle, EdD, RDN, FAND, CFCS; and Christine Zellers, MPP

Contents

Acknowledgments

First and foremost, I want to thank Rutgers University Libraries for promoting the importance of creating free Open Educational Resources for students and for providing me with an authoring award to assist in the creation of this OER. My idea for creating an e-book as opposed to a hard copy book was first conceived, and would not have occurred, without the knowledge I gained about the many benefits of OER's through the RU Library. In particular, I'd like to thank Lily Todorinova, OER Librarian, and Allia Nisa, Master of Information Student. I am indebted to both of these individuals for their guidance and assistance on this project.

Progressing from my idea to the actual creation of this e-book could not have been realized without the support of additional Rutgers colleagues. Many thanks to Dr. Laura Lawson, Dr. Brian Schilling and Dr. Sara Elnakib for their support of my six-month sabbatical which allowed me the time and attention needed to complete the planning, research and writing. In addition, colleagues and collaborators Dr. Karen Ensle, Dr. Sara Elnakib and Chris Zellers, who each researched and wrote a chapter of this e-book, are enormously thanked for finding a way to fit this commitment into their very busy schedules. I literally could not have created the book without them.

I was also very lucky to have several colleagues from the National Extension Association of Family and Consumer Sciences family agree to peer review one or two of the chapters. Many thanks to Dr. Yu Meng and Andrea Hoover for reviewing two chapters each, and to Lori Wiggins, Kristin Miller, Dr. Karen Lillemor Franck and Ali Mitchell for each of their chapter reviews. Your comments and suggested edits helped immeasurably to create a better text for our students.

And finally, I cannot imagine completing this project without the support and understanding of my loving and patient family. I feel incredibly fortunate to have you all in my life! To my sister Heather, my brother Mark, my children Nicholas, Cara and Jennifer, and my husband Nick I say thank you from the bottom of my heart for everything from your interest in the topics I was researching, to your ability to listen to the stories I had to tell about the process, and your encouragement to carry on when the inevitable stress occurred as life intervened and deadlines became difficult to achieve. And most importantly, to my Mom, whose never-ending enthusiasm for all that I do and why and how I do it has never faded throughout my life, I send immense gratitude for always believing in me.

- Sherri M. Cirignano, MS, RDN, LDN

Introduction

The rate of obesity continues to climb in the United States in all age groups. National reports, including the Trust for America's Health annual report *State of Obesity: Better Policies for a Healthier America*, highlight key findings and policy recommendations. The need to continue to work towards stabilization of the obesity epidemic could not be more important as consequences of this chronic disease can be dire, potentially affecting physical health with an increase in risk for chronic diseases including cardiovascular disease, type 2 diabetes and several types of cancer as well as potentially affecting behavioral health. Curbing the high rates of obesity is particularly of importance when considering the prevalence of childhood obesity, which is on the rise not only in the United States but is also increasing globally. Although there are certain risk factors such as genetics that are not modifiable in this group, there are many dietary, physical activity and environmental factors that are modifiable through lifestyle changes. This course will explore ways to address these lifestyle changes for children through adults with both federally- and NGO- based community interventions that are working towards combating overweight and obesity and how they aim to do so with a health equity lens in mind.

I.

Chapter One: Definition of Obesity: Current Trends and Statistics

Authored by Karen Ensle, EdD, RDN, FAND, CFCS
Edited by Sherri M. Cirignano, MS, RDN, LDN

Reader Objectives

Estimate the current obesity statistics in the United States and global trends

Summarize the obesity trends the last decade

Review overweight and obesity statistics by geographic regions of the US

Assess the effects of the current increase in childhood and adult obesity

Review overweight and obesity statistics relative to age, sex, ethnicity, socioeconomic status, and lifestyle

Chapter Outline

Obesity Prevalence in the United States

State of Obesity 2022: Better Policies for a Healthier America

The U.S. obesity epidemic in 2022 is growing and 19 states now have adult obesity rates above 35 percent which has increased from 16 states last year in 2021. The 19th annual *State of Obesity: Better Policies for a Healthier America* report, released by Trust for America's Health (TFAH), finds that obesity rates continue to climb nationwide and within population groups.[1] These persistent increases underscore that obesity is caused by a combination of factors including societal, biological, genetic, and environmental, which are beyond personal choice. Addressing the obesity crisis will require attending to the economic and structural factors of where and how people live.

The report amplifies the importance of the White House Conference on Hunger, Nutrition and Health.[2] The Conference and the TFAH report are intended to spotlight the links between hunger, nutrition, health, and diet-related diseases, including obesity, and recommend needed policy action.

Key Findings in the TFAH Report:[1]

- Nineteen states have adult obesity rates over 35 percent. West Virginia, Kentucky, and Alabama have the highest rate of adult obesity at 40.6 percent, 40.3 percent, and 39.9, respectively. The District of Columbia, Hawaii, and Colorado had the lowest adult obesity rates at 24.7 percent, 25 percent, and 25.1 percent, respectively. A decade ago, no state had an adult obesity rate at or above 35 percent.
- Obesity rates are highest in communities of color where barriers to healthy food choices and being physically active are often most prevalent.
- Obesity rates are also increasing among children and adolescents with nearly 20 percent of U.S. children ages 2 to 19 having obesity. These rates more than tripled since the mid-1970s, and Black and Latino youth have substantially higher rates of obesity than do their White peers.
- Structural and social determinants are significantly influencing the rates of obesity among adults and youth. Factors such as structural racism, discrimination, poverty, food insecurity, housing instability, and lack of access to quality healthcare are key drivers of the differences in obesity rates across racial and ethnic groups.

Key Recommendations:[1]

- Increase funding for the CDC's National Center for Chronic Disease Prevention and Health Promotion to prevent obesity and related chronic diseases. Funding increases need to be sufficient to put proven obesity prevention programs to work in every state and should prioritize those communities where the need is greatest to address health inequities.
- Make healthy school meals for all students a permanent policy, extend COVID-19 flexibilities that expand nutrition access for students and their families, strengthen school nutrition standards, and increase students' opportunities for physical activity during the school day.
- Expand the CDC's social determinants of health program to address the upstream, structural drivers of chronic diseases.

- Decrease food insecurity and improve the nutritional quality of available food by increasing funding for and participation in nutrition assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the Child and Adult Care Food Program.
- Fund active transportation projects like pedestrian and biking paths in all communities and make local spaces more conducive to physical activity, such as opening school recreational facilities to community groups outside of school hours.
- Expand access to healthcare and require insurance coverage with no cost sharing for U.S. Preventive Task Force recommended obesity prevention programs.

Defining Obesity

Obesity often results from taking in more calories than are burned by exercise and normal daily activities. Obesity occurs when a person's body mass index is 30 or greater. The main symptom is excessive body fat, which increases the risk of serious health problems. The mainstay of treatment is lifestyle changes such as diet and exercise.

The World Health Organization (WHO) defines obesity as "a condition in which a percentage of body fat (PBF) is increased to an extent in which health and well-being are impaired, and, due to the alarming increase in prevalence has declared obesity as a "global epidemic".[3]

The Centers for Disease Control and Prevention (CDC) defines obesity as a body weight that is higher than what is considered healthy for a person's given height which is described as overweight or obese. Body Mass Index (BMI) is a screening tool used to measure overweight and obesity. See Defining Adult Overweight and Obesity and Defining Childhood Weight Status for more information on these topics.

Body Mass Index (BMI)

Body mass index (BMI) is commonly used to determine childhood weight status. BMI is calculated by dividing a person's weight in kilograms by the square of their height in meters. For children and teens, BMI is age-and-sex-specific and is often referred to as BMI-for-age. A child's weight status is calculated differently from adult BMI categories. Children's body composition varies as they age and varies between boys and girls. Therefore, BMI levels among children and teens need to be expressed relative to other children of the same age and sex.

CDC Growth Charts are commonly used to measure the size and growth patterns of children and teens in the United States. BMI-for-age weight status categories and the corresponding percentiles, are based on expert CDC committee recommendations, and are listed in the Table 1 for an eight-year-old child as an example:[4]

Table 1. BMI-for-Age Eight Status Categories and the Corresponding Percentiles

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obesity	95th percentile or greater

Adapted from the Centers for Disease Control and Prevention. Defining Childhood Weight Status.

https://www.cdc.gov/obesity/basics/childhood-defining.html

In children, BMI percentile cutoffs for obesity are intended to reliably define a level above which a child is more likely to

have or be at risk of developing obesity-associated adverse health outcomes or diseases. For more information, see the National Collaborative on Childhood Obesity's page on Measures for Children at High Risk for Obesity.[5]

What is the Difference Between Overweight, Obesity and Morbid Obesity?

Obesity, having too much body fat, is defined as having a body mass index (BMI) of greater than 30. Morbid obesity is when a person has excessive weight with a body mass index of 35 to 40 or more. Table 2 defines the four categories of BMI.

Table 2. Four categories of obesity

Overweight (not obese), if BMI is:	25.0 to 29.9
Class 1 (low risk) obesity if BMI is:	30.0 to 34.9
Class 2 (moderate risk) obesity if BMI is:	35.0 to 39.9
Class 3 (high-risk) obesity if BMI is equal to or greater than:	40.0

Morbid obesity, which is also termed "clinically severe obesity," is typically defined as being more than 100 pounds overweight or having a BMI of 40 or higher. A clear definition of morbid obesity is very important because this definition is used to guide doctors in the selection of treatment options for people who are overweight. Individuals are usually considered morbidly obese if their weight is more than 80 to 100 pounds above their ideal body weight.

According to four phenotypes of obesity, based on body fat composition and distribution: (1) normal weight obese; (2) metabolically obese normal weight; (3) metabolically healthy obese; and (4) metabolically unhealthy obese. Sarcopenic obesity has been characterized, related to all the described phenotypes.

How Obesity Data are Collected

An Overview of Obesity Prevalence in the United States and Data Collection

According to the Trust for America's Health (TFAH) website, the rate of U.S. adult obesity now stands at 42.4 percent.[1] This is the first time the national rate has passed the 40 percent mark and is further evidence of our country's obesity crisis. According to the CDC the national adult obesity rate has increased by 26 percent since 2008. For an excellent overview of obesity, see *The State of Obesity: Better Policies for a Healthier America 2022* with a *Special Feature on Food Insecurity and its Connection to Obesity*. This current report will set the stage for understanding the breadth of the epidemic called obesity.

Obesity in the United States is a major health issue resulting in numerous diseases, specifically increasing the risk of certain types of cancer, coronary artery disease, type 2 diabetes, stroke, cardiovascular disease, as well as significant increases in early mortality and economic costs. Based in part on newly released 2019 data from the Centers for Disease Control and Prevention's Behavioral Risk Factors Surveillance System[6] (BRFSS) and analysis by TFAH, this report provides an annual snapshot of rates of overweight and obesity nationwide including age, gender, race, and state of residence. Obesity rates vary considerably between states and regions of the country. Mississippi has the highest adult obesity rate in the country at 40.8 percent and Colorado has the lowest at 23.8 percent. Twelve states have adult rates above 35 percent, they are: Alabama, Arkansas, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Oklahoma, South Carolina, Tennessee, and West Virginia. As recently as 2012, no state had an adult obesity rate above 35 percent; in 2000 no state had an adult obesity rate above 25 percent.

The Behavioral Risk Factor Surveillance System (BRFSS) is the nation's premier system of health-related telephone surveys that collect state data about U.S. residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Established in 1984 with 15 states, BRFSS now collects data in all 50 states as well as the District of Columbia and three U.S. territories. BRFSS completes more than 400,000 adult interviews each year, making it the largest continuously conducted health survey system in the world.

Rates of childhood obesity are also increasing with the latest data showing that 19.3 percent of U.S. young people, ages

2 to 19, have obesity. In the mid-1970s, 5.5 percent of young people had obesity. Being overweight or having obesity as a young person puts them at higher risk for having obesity and its related health risks as an adult. Furthermore, children are exhibiting earlier onset of what used to be considered adult conditions, including hypertension and high cholesterol.

Peruse the *State of Obesity 2021: Better Policies for a Healthier America Report*. Trust for America's Health's (TFAH) published this 18th annual report on the nation's obesity crisis and found that sixteen states have adult obesity rates at 35 percent or higher which is up from 12 states in 2019.[7] Notice also that social and economic factors linked to obesity were exacerbated by the COVID-19 pandemic. In 2020, 16 states had adult obesity rates at or above 35 percent, up from 12 states the previous year. These and other emerging data show that the COVID-19 pandemic changed eating habits, worsened levels of food insecurity, created obstacles to physical activity, and heightened stress, all exacerbating the decades long pattern of obesity in America. In the report, a call to action addressing the social determinants of obesity, for example, were cited ensuring access to no cost healthy school meals for all students, a program started during the pandemic. Systemic inequities and socioeconomic factors contribute to higher rates of obesity among certain racial and ethnic populations. According to the latest available national data – from the 2017 – 2018 National Health and Nutrition Examination Survey (NHANES), Black adults had the highest level of adult obesity nationally at 49.6 percent; driven mostly by an adult obesity rate among Black women of 56.9 percent. Hispanic adults have an obesity rate of 44.8 percent. White adults have an obesity rate of 42.2 percent. Asian adults have an obesity rate of 17.4 percent.

Rising obesity rates are also a problem among children and adolescents. According to the 2017 – 2018 NHANES data nearly 20 percent (19.3 percent) of U.S. children ages 2 to 19 have obesity. These data more than tripled since the mid-1970s and Black and Latino youth have substantially higher rates of obesity than do their White peers.

The National Center for Health Statistics (NCHS), Division of Health and Nutrition Examination Surveys (DHANES), part of the Centers for Disease Control and Prevention (CDC), has conducted a series of health and nutrition surveys since the early 1960's. The National Health and Nutrition Examination Surveys[8] (NHANES) were conducted on a periodic basis from 1971 to 1994. In 1999, NHANES became continuous. Every year, approximately 5,000 individuals of all ages are interviewed in their homes and complete the health examination component of the survey. The health examination is conducted in a mobile examination center (MEC) which provides an ideal setting for the collection of high-quality data in a standardized environment.

Obesity is associated with a range of diseases, including type 2 diabetes, heart disease, stroke, arthritis, sleep apnea, and many types of cancers. Obesity is estimated to increase healthcare spending by $149 billion annually (about half of which is paid for by Medicare and Medicaid). Furthermore, obesity is one of the underlying health conditions associated with the most serious consequences of COVID-19 infection, including higher risk of hospitalization and death.

The National Health Interview Survey (NHIS) is the principal source of information on the health of the civilian noninstitutionalized population of the United States and is one of the major data collection programs of the National Center for Health Statistics (NCHS) which is part of the Centers for Disease Control and Prevention (CDC). The National Health Survey Act of 1956 provided for a continuing survey and special studies to secure accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States and the services rendered for or because of such conditions. The survey referred to in the Act, now called the National Health Interview Survey, was initiated in July 1957. NHIS data are collected through personal household interviews. As an example, CDC uses data from the Special Supplemental Nutrition Program for Women, Infants, and Children Participants and Program Characteristics (WIC PC) for weight status surveillance among young children in families with lower incomes. Data is available for children aged 2 to 4 years and infants aged 3 to 23 months. The WIC PC data is included in the CDC's Division of Nutrition, Physical Activity, and Obesity (DNPAO) Data, Trends, and Maps. Since 1960, the survey has been conducted by NCHS, which was formed when the National Health Survey and the National Vital Statistics Division were combined.

The main objective of the NHIS is to monitor the health of the United States population through the collection and analysis of data on a broad range of health topics. A major strength of this survey lies in the ability to categorize these health characteristics by many demographic and socioeconomic characteristics.

NHIS data are used widely throughout the Department of Health and Human Services (HHS) to monitor trends in illness and disability and to track progress toward achieving national health objectives. The data are also used by the

public health research community for epidemiologic and policy analysis of such timely issues as characterizing those with various health problems, determining barriers to accessing and using appropriate health care, and evaluating Federal health programs.

While the NHIS has been conducted continuously since 1957, the content of the survey has been updated about every 15-20 years to incorporate advances in survey methodology and coverage of health topics. In January 2019, NHIS launched a redesigned content and structure that differs from its previous questionnaire design (1997–2018).

The National Center for Health Statistics includes many reports and linkages to several CDC websites such as the new report on life expectancy in the United States with a written report released in August 2021 on Provisional Life Expectancy Estimates for 2021. Another new website hosts the Health, United States program providing national trends in health statistics. Take a look and explore the latest analyses from *Health, United States, 2020–2021* in the online topic pages. Links to the *Health, United States, 2019* the most recent report and materials are available on the Annual Report page. This report presents trends and current information on selected measures of health in a 20-figure chartbook, with major findings summarized in Highlights.

Starting with the 2020–2021 edition, the *Health, United States Annual Perspective* will integrate selected analyses from the Health, United States topics released online. The theme for the 44th edition of *Health, United States* will be on health disparities.

Health, United States provides a wide array of trends in health statistics to policymakers, public health professionals, and the public. It presents statistics in four overarching areas: health status and determinants, health care utilization, health care resources, and health expenditures and payers. In addition to presenting key findings from the major data collection systems of the National Center for Health Statistics and other CDC programs, *Health, United States* uses data from other federal agencies, as well as private and global sources.

One of 28 topics on the CDC website on *Nutrition* is located within the *Health, United States* pages. It includes key findings from data collected up to 2020-2021. Nutrition covers the energy consumed in food which is supplied by three macronutrients: carbohydrates, proteins, and fats. Under-or-overconsumption of individual macronutrients may increase a person's risk of chronic diseases such as obesity, coronary heart disease, type 2 diabetes, and cancer according to the Institute of Medicine.[9]

See additional information at the National Academies of Sciences, Engineering, and Medicine 2016. *Assessing Prevalence and Trends in Obesity: Navigating the Evidence.*[10]

How Can We Improve Current Surveillance Systems and Data?

Current surveillance methods and infrastructure need to 1. become more nimble in responding to research findings, 2. provide data that are sufficiently timely and precise to evaluate obesity policies and programs at different geographic levels, and 3. link these data to policy measures. Below are proposed enhancements to existing surveillance systems that can maximize their utility.

Increase the Number and Scope of Environmental Measures and Surveillance Systems

Although much work has been focused on developing and evaluating environmental measures for food and physical activity environments, research and implementation gaps still exist. Recommendations from an expert meeting on environmental and policy research on obesity, physical activity, and diet call for surveillance systems with good measures of the environment, policy surveillance measures, and systems; surveillance to track changes in food industry activities over time; attention to minority and low-income populations; and measures of evaluation.[11] Another review identified gaps in research related to macroenvironments (city or larger) and within economic and political microenvironments in home, workplace, and neighborhood settings.[12] To address these issues, greater surveillance infrastructure is needed at the local and state levels, where these policies are often implemented first.

Considerations for socially disadvantaged and culturally diverse populations are often not adequately incorporated into surveillance systems and measures. Low numbers or regional locations of underserved populations, insufficient provisions for differences in language or culture, and lack of infrastructure must be anticipated, and surveillance systems should be monitored to be sure these elements are addressed.[13]

Harmonize Data Across State and National Surveillance Systems

Harmonization of data can be accomplished by coordinating efforts and standardizing protocols across different

surveillance and evaluation structures to minimize duplication of effort, leverage resources, and maximize data use.[13] Coordinating data sources can allow for pooling of data from different sources, leading to increased sample sizes that can facilitate the analyses of obesity determinants and consequences for underrepresented groups. Consistency of obesity-related measures is emphasized in the report *Assessing Prevalence and Trends in Obesity: Navigating the Evidence*,[10] which proposes 1. use of the new Assessing Prevalence and Trends framework, which integrates end user perspectives with assessment considerations; 2. designation of a national convener to organize stakeholders to standardize data collection methodologies; and 3. research focused on improving obesity assessment methodology.

Improve the Sensitivity and Relevance of Obesity Measures

One of the hallmarks of a robust surveillance system is the ability to measure the same variables over time in a consistent manner. However, recent studies suggest that the addition of new measures or methods can augment current data collection and amplify research and monitoring possibilities.

Additions to BMI Measures

Measurement of BMI has long been a consistent outcome of obesity surveillance systems, adding to the ease and low cost of directly measured height and weight or even obtaining these data via self-report. BMI misclassifies as nonobese one-quarter of adult males and nearly half of adults whose dual energy x-ray absorptiometry (DXA) measurements classify them as obese.[14] BMI has similarly poor sensitivity as a measure of adiposity in children.[15] In addition, BMI does not detect an accumulation of abdominal fat, which is known to correlate with insulin resistance even in lean individuals.[16] Surveillance science has been slow to take advantage of research that identifies alternative anthropometric measures of obesity.[17] Combining two or more different anthropometric measures, such as waist-to-hip ratio and waist-circumference-to-height ratio, works well and may be more sensitive to the accumulation of abdominal fat,[17–19] although these measurements are more invasive and require additional privacy.

Addition of longitudinal data include methods for longitudinal population-based analyses which are essential to assess the impact of policy-led interventions on the incidence of obesity during crucial developmental time periods, such as childhood or transitions from high school to college.[20] Developing cohorts with regularly assessed obesity measures over the lifespan would provide data on incidence of obesity that would coincide with obesity prevention initiatives. Longitudinal BMI measure analyses are uncommon, particularly among low-resource populations, which are at greater risk of obesity. More research on longitudinal BMI studies are needed on low-income individuals of all age groups and backgrounds.

Workforce Development in Surveillance Work

Although few data have assessed the size of the workforce that is engaged in surveillance work, similar studies have documented shortages in related disciplines, such as epidemiologists, public health nurses, and informaticians.[21] Investigators have estimated that three-quarters or more of the public health workforce do not receive adequate training in public health, and most clinical health professionals are not exposed to population health or public health concepts.[21,22] Initial actions that would help to achieve a competent surveillance workforce include developing learning competencies for surveillance; offering training opportunities for the existing workforce using webinars or online formats; setting up a continuous training process; and planning for future training needs.[21,23]

The Future of Obesity Surveillance

Data collection, storage and linkage advances depend on updated technology. Data is becoming more integrated into routine clinical care practices, school settings and obesity surveillance systems. Registries that contain individual data are then augmented or replaced by updated obesity surveillance systems of individual data. As the technology around data collection becomes more integrated, we can envision an aggregation of registries and as with most innovations, these offer both promise and challenges for researchers and practitioners.

Use of Electronic Health Records

EHRs are likely to play a key role in the future of obesity surveillance systems. As of 2014, 80% of physicians reported using EHRs,[24] and EHRs have been effective in identifying and flagging obesity.[25] As EHRs become more sophisticated, and eventually incorporated into big data analysis systems along with personal data from wearable devices and social media,[26] these data will be used for obesity surveillance as well as to inform both individual- and population-level interventions. Statistical analyses with such data are possible and include plotting individual and group-based weight

trajectories over the life course, examining demographic subgroups, and examining associations of weight trajectories with behavioral risk factors as well as clinical outcomes.[27,28]

Incorporation of Self-Measurements or Individualized Electronic Data Collection into Surveillance Efforts

Recent years have seen the development of a variety of consumer-friendly wearable devices and sensors for self-tracking of health, including activity trackers, smart watches, smart clothing, and smart implants,[23,29] which can provide usable health data. Consumer acceptability of these devices is high, and an intensely competitive market ensures that the cost of these devices stays low. Hence, there is considerable potential for their use in obtaining measures relevant to obesity in a general population. The use of these types of self-measurements has been feasible, even among low-income communities.[30] Data from social media postings of individuals offer another source of self-measured data. Social media and text analytics methods make it possible to search through social media postings and extract data relevant to health[31] and, potentially, to include such data as part of routine data collection systems.[23]

Privacy Considerations of Individual Data

The increased use of data registries and surveillance for assessing the effects of obesity initiatives is promising but can be troublesome to participants, especially with current news stories about data leaks and hacks. A recent survey across 27 European Union countries found that participants appreciated the usefulness of EHR data but are concerned about widespread availability of the data to others, especially insurance companies, pharmaceutical companies, and academic researchers.[32] To gain the public's trust, decision makers must emphasize the importance of the information to be gained, as well as put the provisions in place to safeguard the individual's privacy.[32]

Timely Feedback Loops to Data Consumers

Feedback loops to the end user or practitioner are a crucial part of the surveillance system. As previously mentioned, the BRFSS maps have provided an easily digestible visual to represent the rapid onset and widespread reach of the obesity epidemic in the United States.[33] Using GIS, as well as other advanced data visualization techniques, researchers and practitioners can display obesity data and environmental factors such as the density of fast-food restaurants and green space by region; the availability of such data has impacts for policy makers and municipal planners.[34,35] Data dashboards and report cards are also effective means of highlighting surveillance data in easily understandable summaries, especially when compared with standard recommendations.

Summary

Although the United States has robust surveillance of obesity and individual obesity-related behaviors, to fully understand the etiology of obesity and the effects of prevention efforts, we must expand current surveillance systems in terms of settings, measures, periodicity, and populations. Increases in funding and infrastructure for local surveillance would assist in obtaining data on under served populations to better understand health disparities in obesity and prevention efforts. Also critical is the addition of environmental and policy measures to surveillance systems to allow for a better understanding of the effects of obesity prevention initiatives.

With the emerging technological advances in measurements and data management, the ability to obtain more and better surveillance presents unlimited opportunities for obesity prevention efforts, especially when coupled with the presentation of this information using data visualization techniques and easy-to-understand dashboards. To capitalize on this convergence of technology and data collection, researchers will need to nurture the science of surveillance by providing increased funding for new methodologies and outlets for presenting and publishing the resulting findings. Facilitating the development and use of surveillance data for evaluating obesity prevention efforts has the potential to significantly advance action against obesity.

Critical Thinking Questions

1. What is the rate of obesity in your state? What are some explanations why obesity rates vary geographically in different states in the US?
2. As trends indicate, are certain populations more susceptible to moving from overweight to obesity? Name 3 reasons.
3. Has public health controlled some of the upward trends of obesity with nutrition education, encouragement of physical activity and additional prevention education?

Resources

Preventing Childhood Obesity: 4 Things Families Can Do
Preventing Childhood Obesity – Eating Better, Moving More
Promoting Healthy Behaviors
Whole School, Whole Community, Whole Child (WSCC)
School Health Index
Wellness Policy in Action Tool
Out of School Time
Parent-Perceived Stress and Its Association With Children's Weight and Obesity-Related Behavior
Obesity Among Young Children Enrolled in WIC
WIC Participant and Program Characteristics 2020 – Charts

References

1. Trust for America's Health. The State of Obesity: better policies for a healthier America 2022. Accessed November 2022. https://www.tfah.org/report-details/state-of-obesity-2022/
2. U.S. Department of Health and Human Services. White house conference on hunger, nutrition, and health. Accessed November 2022. https://health.gov/our-work/nutrition-physical-activity/white-house-conference-hunger-nutrition-and-health
3. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253. PMID: 11234459.
4. Centers for Disease Control and Prevention. Defining childhood weight status. Accessed December 2022. https://www.cdc.gov/obesity/basics/childhood-defining.html
5. National Collaborative on Childhood Obesity Research. Measures for children at high risk for obesity. Accessed December 2022. https://www.nccor.org/projects/measures-for-children-at-high-risk-for-obesity/
6. Centers for Disease Control and Prevention. Behavior risk factor surveillance system. Accessed December 2022. https://www.cdc.gov/brfss/index.html
7. Trust for America's Health. The State of Obesity 2021: better policies for a healthier America. Accessed November 2022. https://www.tfah.org/report-details/state-of-obesity-2021/
8. Centers for Disease Control and Prevention. National Center for Health Statistics. NHANES 2017-2018 overview. Accessed December 2022. https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/overview.aspx?BeginYear=2017
9. Institute of Medicine. *Dietary reference intakes: The essential guide to nutrient requirements.* Washington, DC: The National Academies Press. 2006.
10. The National Academies of Science, Engineering & Medicine. *Assessing Prevalence and Trends in Obesity: Navigating the Evidence.* Washington, DC: The National Academies Press. https://doi.org/10.17226/23505
11. Sallis JF, Story M, Lou D. Study designs and analytic strategies for environmental and policy research on obesity, physical activity, and diet: recommendations from a meeting of experts. *Am. J. Prev. Med.* 2009;36:S72–77.
12. Kirk SF, Penney TL, McHugh TL. Characterizing the obesogenic environment: the state of the evidence with directions for future research. *Obes. Rev.* 2010;11:109–17.
13. Institute of Medicine. *Evaluating Obesity Prevention Efforts: A Plan for Measuring Progress.* Washington, DC: Natl. Acad. Press. 2013.
14. Shah NR, Braverman ER. Measuring adiposity in patients: the utility of body mass index (BMI), percent body fat, and leptin. *PLOS ONE.* 2012;7:e33308.
15. Javed A, Jumean M, Murad MH, Okorodudu D, Kumar S, et al. Diagnostic performance of body mass index to identify obesity as defined by body adiposity in children and adolescents: a systematic review and meta-analysis. *Pediatr. Obes.* 2015;10:234–44.
16. Cnop M, Landchild MJ, Vidal J, Havel PJ, Knowles NG, et al. The concurrent accumulation of intra-abdominal and subcutaneous fat explains the association between insulin resistance and plasma leptin concentrations: distinct

metabolic effects of two fat compartments. *Diabetes.* 2002;51:1005–15.
17. Blundell JE, Dulloo AG, Salvador J, Fruhbeck G, EASO SAB Work. Group BMI. Beyond BMI—phenotyping the obesities. *Obes. Facts.* 2014;7:322–28.
18. Carmienke S, Freitag M, Pischon T, Schlattmann P, Fankhaenel T, et al. General and abdominal obesity parameters and their combination in relation to mortality: a systematic review and meta-regression analysis. *Eur. J. Clin. Nutr.* 2013;67:573–85.
19. Wolfgram PM, Connor EL, Rehm JL, Eickhoff JC, Zha W, et al. In nonobese girls, waist circumference as a predictor of insulin resistance is comparable to MRI fat measures and superior to BMI. *Horm. Res. Paediatr.* 2015;84:258–65.
20. Cunningham SA, Kramer MR, Narayan KM. Incidence of childhood obesity in the United States. N. *Engl. J. Med.* 2014;370:403–11.
21. Drehobl PA, Roush SW, Stover BH, Koo D. Public health surveillance workforce of the future. *MMWR Surveill. Summ.* 2012;61:25–29.
22. Institute of Medicine, Comm. *Assuring the Health of the Public in the 21st Century. The Future of the Public's Health in the 21st Century*. Washington, DC: Natl. Acad. Press. 2003.
23. Glanz K, Sallis JF, Saelens BE. Advances in physical activity and nutrition environment assessment tools and applications: recommendations. *Am. J. Prev. Med.* 2015;48:615–19.
24. Heisey-Grove D, Patel V. Any, certified, and basic: quantifying physician EHR adoption through 2014. *Data Brief 28, Off. Natl. Coord. Health Inf. Technol.* Washington, DC. 2015. https://www.healthit.gov/sites/default/files/briefs/oncdatabrief28_certified_vs_basic.pdf
25. Baer HJ, Cho I, Walmer RA, Bain PA, Bates DW. Using electronic health records to address overweight and obesity: a systematic review. *Am. J. Prev. Med.* 2013;45:494–500.
26. Poulymenopoulou M, Papakonstantinou D, Malamateniou F, Vassilacopoulos G. A health analytics semantic ETL service for obesity surveillance. *Stud. Health Technol. Inform.* 2015;210:840–44.
27. Nau C, Schwartz BS, Bandeen-Roche K, Liu A, Pollak J, et al. Community socioeconomic deprivation and obesity trajectories in children using electronic health records. *Obesity.* 2015;23:207–12.
28. Schwartz BS, Stewart WF, Godby S, Pollak J, DeWalle J, et al. Body mass index and the built and social environments in children and adolescents using electronic health records. *Am. J. Prev. Med.* 2011;41:e17–28.
29. Chiauzzi E, Rodarte C, DasMahapatra P. Patient-centered activity monitoring in the self-management of chronic health conditions. *BMC Med.* 2015;13:77.
30. Yingling LR, Brooks AT, Wallen GR, Peters-Lawrence M, McClurkin M, et al. Community engagement to optimize the use of Web-based and wearable technology in a cardiovascular health and needs assessment study: a mixed methods approach. *JMIR mHealth uHealth* 2016;4:e38.
31. Charles-Smith LE, Reynolds TL, Cameron MA, Conway M, Lau EH, et al. Using social media for actionable disease surveillance and outbreak management: a systematic literature review. *PLOS ONE.* 2015;10:e0139701.
32. Patil S, Lu H, Saunders CL, Potoglou D, Robinson N. Public preferences for electronic health data storage, access, and sharing—evidence from a pan-European survey. *J. Am. Med. Inform. Assoc.* 2016. http://dx.doi.org/10.1093/jamia/ocw012
33. Centers for Disease Control and Prevention. 2016. Obesity prevalence maps. Updated Sept. 1, CDC, Atlanta. https://www.cdc.gov/obesity/data/prevalence-maps.html
34. Burgoine T, Jones AP, Namenek Brouwer RJ, Benjamin Neelon SE. Associations between BMI and home, school and route environmental exposures estimated using GPS and GIS: Do we see evidence of selective daily mobility bias in children? *Int. J. Health Geogr.* 2015;14:1.
35. Sage WM, Balthazar M, Kelder S, Millea S, Pont S, Rao M. Mapping data shape community responses to childhood obesity. *Health. Aff.* 2010;29:498–502.

2.

Chapter Two: Measuring Obesity and Balancing Calories

Authored by Sherri M. Cirignano, MS, RDN, LDN & Karen Ensle, EdD, RDN, FAND, CFCS

Chapter Outline

Body Mass Index (BMI)

Body mass index (BMI) is commonly used to determine weight status. BMI is calculated by dividing a person's weight in kilograms by the square of their height in meters. For children and teens, BMI is age-and-sex-specific and is often referred to as BMI-for-age. A child's weight status is calculated differently from adult BMI categories. Children's body composition varies as they age and varies between boys and girls. Therefore, BMI levels among children and teens need to be expressed relative to other children of the same age and sex.

CDC Growth Charts are commonly used to measure the size and growth patterns of children and teens in the United States. BMI-for-age weight status categories and the corresponding percentiles, are based on expert CDC committee recommendations, and are listed in Table 1 for an eight-year-old child as an example:[1]

Table 1. Child BMI categories and corresponding percentiles

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obesity	95th percentile or greater

Adapted from the Centers for Disease Control and Prevention. Defining Childhood Weight Status.

https://www.cdc.gov/obesity/basics/childhood-defining.html

In children, BMI percentile cutoffs for obesity are intended to reliably define a level above which a child is more likely to have or be at risk of developing obesity-associated adverse health outcomes or diseases. For more information, see the National Collaborative on Childhood Obesity's page on Measures for Children at High Risk for Obesity.[2]

What is the Difference Between Overweight, Obesity and Morbid Obesity?

In adults, obesity is defined as having a body mass index (BMI) of greater than 30. Morbid obesity is when a person has excessive weight with a body mass index of 35 to 40 or more. Table 2 defines the four categories of BMI.

Table 2. Four categories of obesity

Overweight (not obese), if BMI is:	25.0 to 29.9
Class 1 (low risk) obesity if BMI is:	30.0 to 34.9
Class 2 (moderate risk) obesity if BMI is:	35.0 to 39.9
Class 3 (high-risk) obesity if BMI is equal to or greater than:	40.0

Morbid obesity, which is also termed "clinically severe obesity," is typically defined as being more than 100 pounds overweight or having a BMI of 40 or higher. A clear definition of morbid obesity is very important because this definition is used to guide doctors in the selection of treatment options for people who are overweight. Individuals are usually considered morbidly obese if their weight is more than 80 to 100 pounds above their ideal body weight.

Measuring Obesity[3]

Please click the above link for this topic.

Additions to BMI Measures

Measurement of BMI has long been a consistent outcome of obesity surveillance systems, owing to the ease and low cost of directly measured height and weight or even obtaining these data via self-report. BMI misclassifies as nonobese one-quarter of adult males and nearly half of adults whose dual energy x-ray absorptiometry (DXA) measurements classify them as obese.[4] BMI has similarly poor sensitivity as a measure of adiposity in children.[5] In addition, BMI does not detect an accumulation of abdominal fat, which is known to correlate with insulin resistance even in lean individuals.[6] Surveillance science has been slow to take advantage of research that identifies alternative anthropometric measures of obesity.[7] Combining two or more different anthropometric measures, such as waist-to-hip ratio and waist-circumference-to-height ratio, works well and may be more sensitive to the accumulation of abdominal fat,[7-9] although these measurements are more invasive and require additional privacy.

Addition of longitudinal data include methods for longitudinal population-based analyses which are essential to assess the impact of policy-led interventions on the incidence of obesity during crucial developmental time periods, such as

childhood or transitions from high school to college.[10] Developing cohorts with regularly assessed obesity measures over the lifespan would provide data on incidence of obesity that would coincide with obesity prevention initiatives. Longitudinal BMI measure analyses are uncommon, particularly among low-resource populations, which are at greater risk of obesity. More research on longitudinal BMI studies are needed on low-income individuals of all age groups and backgrounds.

Food and Metabolism[11]

The carbohydrates, lipids (or fats), and proteins in the foods you eat are used for energy to power molecular, cellular, and organ system activities. Importantly, the energy is stored primarily as fats. The quantity and quality of food that is ingested, digested, and absorbed affects the amount of fat that is stored as excess calories. Diet—both what you eat and how much you eat—has a dramatic impact on your health. Eating too much or too little food can lead to serious medical issues, including cardiovascular disease, cancer, obesity, anorexia, and diabetes, among others. Combine an unhealthy diet with unhealthy environmental conditions, such as smoking, and the potential medical complications increase significantly.

The amount of energy that is needed or ingested per day is measured in calories. The nutritional **Calorie** (C) is the amount of heat it takes to raise 1 kg (1000 g) of water by 1 °C. This

is different from the calorie (c) used in the physical sciences, which is the amount of heat it takes to raise 1 g of water by 1 °C. When we refer to "calorie," we are referring to the nutritional Calorie.

On average, a person needs 1500 to 2000 calories per day to sustain (or carry out) daily activities. The total number of calories needed by one person is dependent on their body mass, age, height, gender, activity level, and the amount of exercise per day. If exercise is a regular part of one's day, more calories are required. As a rule, people underestimate the number of calories ingested and overestimate the amount they burn through exercise. This can lead to ingestion of too many calories per day. The accumulation of an extra 3500 calories adds one pound of weight. If an excess of 200 calories per day is ingested, one extra pound of body weight will be gained every 18 days. At that rate, an extra 20 pounds can be gained over the course of a year. Of course, this increase in calories could be offset by increased exercise. Running or jogging one mile burns almost 100 calories.

The type of food ingested also affects the body's metabolic rate. Processing of carbohydrates requires less energy than processing of proteins. In fact, the breakdown of carbohydrates requires the least amount of energy, whereas the processing of proteins demands the most energy. In general, the amount of calories ingested and the amount of calories burned determines the overall weight. To lose weight, the number of calories burned per day must exceed the number ingested. Calories are in almost everything you ingest, so when considering calorie intake, beverages must also be considered.

Energy Requirements

To determine the exact energy requirements needed to achieve a healthy weight, it is necessary to consider an individual's age, gender, height, weight, and physical activity level, as well as goal weight if appropriate. Although determining energy requirements comes down to a matter of energy in through food eaten and energy out through both biological activities such as breathing and physical activities, it is not as easy as it sounds. There are mathematical formulas and other more precise methods that are used by registered dietitians and other healthcare professionals to determine an individual's everyday energy needs, but these are not practical for use by the general public. For a consumer to estimate their energy requirements, there are sources such as the Dietary Guidelines for Americans, (DGA) that provide a generalization of estimated needs throughout life.[12] This resource includes changes in daily calorie needs based on an individual's activity level whether it be sedentary, moderately active or active.

In general, energy requirements are higher for males than females, and according to the DGA, range from 1,000 to 2,000 calories per day for young children; up to 3,200 calories per day for adolescents; 2,600 to 3,000 calories per day for adult men; 2,000 to 2,400 calories per day for adult women; 2,000 to 2,600 calories per day for older adult men; and 1,600 to 2,000 calories per day for older adult women.[12] Keep in mind that calorie needs can be increased during the greatest periods of growth throughout life including during childhood and adolescence as well as during pregnancy and lactation. An increase in calories may also be needed when the body is experiencing stress as a result of major injuries and/or illnesses.

Balancing Calories[13]

Please click the above link for this topic.

Summary

Body mass index, (BMI) calculated by dividing a person's weight in kilograms by the square of their height in meters, is commonly used to determine weight status. For children, age and gender are also taken into consideration when determining BMI, and CDC Growth Charts are commonly used to measure the size and growth patterns of children and teens in the United States. Although BMI does not measure body fat directly, it has been found to correlate with more direct measures of body fat and because it is a non-invasive and inexpensive method, it has been beneficial and long been of use in national and other obesity surveillance systems.

The food we eat, in the form of carbohydrates, fats and protein, are used as the energy source for all metabolic processes in our bodies, with excess energy stored as fat. Determining the exact amount of food needed to meet our energy needs and maintain, gain or lose weight, dependent on individual specifications, can be estimated through a variety of precise calculations, web-based information or phone apps. Balancing intake is important for maintaining a healthy weight.

Resources

Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen

Centers for Disease Control and Prevention Adult BMI Calculator

References

1. Centers for Disease Control and Prevention. Defining childhood weight status. Accessed December 2022. https://www.cdc.gov/obesity/basics/childhood-defining.html
2. National Collaborative on Childhood Obesity Research. Measures for children at high risk for obesity. Accessed December 2022. https://www.nccor.org/projects/measures-for-children-at-high-risk-for-obesity/
3. Falcone K. *Introduction to Health.* Weight management: measuring obesity. LibreTexts; 2021. Accessed December 2022. https://batch.libretexts.org/print/url=https://med.libretexts.org/Bookshelves/Health_and_Fitness/Book%3A_Introduction_to_Health_(Falcone)/04%3A_Weight_Management/4.03%3A_Measuring_Obesity.pdf
4. Shah NR, Braverman ER. Measuring adiposity in patients: the utility of body mass index (BMI), percent body fat, and leptin. *PLOS ONE.* 2012;7:e33308.
5. Javed A, Jumean M, Murad MH, Okorodudu D, Kumar S, et al. Diagnostic performance of body mass index to identify obesity as defined by body adiposity in children and adolescents: a systematic review and meta-analysis. *Pediatr. Obes.* 2015;10:234–44.
6. Cnop M, Landchild MJ, Vidal J, Havel PJ, Knowles NG, et al. The concurrent accumulation of intra-abdominal and subcutaneous fat explains the association between insulin resistance and plasma leptin concentrations: distinct metabolic effects of two fat compartments. *Diabetes.* 2002;51:1005–15.
7. Blundell JE, Dulloo AG, Salvador J, Fruhbeck G, EASO SAB Work. Group BMI. Beyond BMI—phenotyping the obesities. *Obes. Facts.* 2014;7:322–28.
8. Carmienke S, Freitag M, Pischon T, Schlattmann P, Fankhaenel T, et al. General and abdominal obesity parameters and their combination in relation to mortality: a systematic review and meta-regression analysis. *Eur. J. Clin. Nutr.* 2013;67:573–85.
9. Wolfgram PM, Connor EL, Rehm JL, Eickhoff JC, Zha W, et al. In nonobese girls, waist circumference as a predictor of insulin resistance is comparable to MRI fat measures and superior to BMI. *Horm. Res. Paediatr.* 2015;84:258–65.
10. Cunningham SA, Kramer MR, Narayan KM. Incidence of childhood obesity in the United States. *N. Engl. J. Med.* 2014;370:403–11.
11. Betts JG, Young KA, Wise JA, Johnson E, Poe B, Kruse DH, Korol O, Johnson JE, Womble M, DeSaix P. *Anatomy and Physiology.* 2e. Houston, TX: Open Stax;2022. Accessed December 2022. https://openstax.org/books/anatomy-and-physiology-2e/pages/24-7-nutrition-and-diet
12. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition. 2020. Accessed September 2022.

13. DietaryGuidelines.gov
14. Falcone K. *Introduction to Health*. Weight management: balancing calories. LibreTexts; 2021. Accessed December 2022. https://med.libretexts.org/Bookshelves/Health_and_Fitness/Introduction_to_Health_1e_(Falcone)/04%3A_Weight_Management/4.02%3A_Balancing_Calories

3.

Chapter Three: Intro to the Consequences of Obesity

Authored by: Sherri M. Cirignano, MS, RDN, LDN

Chapter Outline

Introduction

The list of health and other consequences of obesity has continued to grow over the past several decades with an increasing impact on individual physical and behavioral health, the economics of health systems and even the United States military. With the Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity in 2001,[1] and the declaration of obesity as a chronic disease by the American Medical Association in 2013,[2] an ever-growing focus on obesity and its implications have been realized.

Obesity is Declared a Chronic Disease

The process towards regarding obesity as a chronic disease was many years in the making,[3] and its acceptance by

society at large is still in progress. This process was preceded by significant "milestones" that involved several non-medical organizations including the Healthcare Financing Administration, now the Centers for Medicare and Medicaid Services, which stated in the 1970's "obesity is not an illness." Later in the timeline, other milestones included the National Institutes of Health stating in its 1998 clinical guidelines, "Obesity is a complex multifactorial chronic disease," the Internal Revenue Service and the Social Security Administration, both in 2002, providing statements that supported obesity as a disease, and finally the CMS removing the statement "obesity is not an illness" in 2004. CMS allowed coverage for bariatric surgery under Medicare starting in 2006. Further support from the medical community helped to work towards the final determination by the AMA of declaring obesity as a chronic disease in 2013.[3]

Another organization that also played a role in the medical community towards the focus of obesity being viewed as a chronic disease was the Obesity Medicine Association (OMA). Created in 1950 as the National Obesity Society to focus on the clinical management of obesity, the group underwent five subsequent name changes[3] until its current name was chosen. The OMA is an organization for all healthcare professionals who "take a comprehensive, evidence-based approach to treating obesity" with a focus on nutrition, physical activity, weight behaviors and medication.[4]

Physical Health Consequences of Obesity

Obesity can arise from a number of factors, including overeating, poor diet, sedentary lifestyle, limited sleep, genetic factors, and even diseases or drugs. Severe obesity (morbid obesity) or long-term obesity can result in serious medical conditions, including, but not limited to, coronary heart disease; type 2 diabetes; endometrial, breast, or colon cancer; hypertension (high blood pressure); dyslipidemia (high cholesterol or elevated triglycerides); stroke; liver disease; gall bladder disease; sleep apnea or respiratory diseases; osteoarthritis; and infertility. Research has shown that losing weight can help reduce or reverse the complications associated with these conditions.[5]

The following sections will explore some of the most common health consequences of obesity.

Metabolic Syndrome

Hg or diastolic greater than or equal to 85 mm Hg, or both; 5) elevated fasting glucose (greater than or equal to 100 mg/dl or on medication for elevated glucose.[7]

In the US, the prevalence of MetS has increased by more than 35% over the past three decades, with one in three US adults currently meeting the above criteria.[7] The number of US adults with MetS and associated chronic diseases will likely continue to rise due to a large majority of the US population who are aging.

Cardiovascular Diseases

Cardiovascular diseases refer to a number of health conditions that are related to the heart and blood vessels including myocardial infarctions (heart attacks), strokes, hypertension, and dyslipidemia, which is the imbalance of lipids including cholesterol and triglycerides. Obesity is a leading contributor to hypertension, even in children,[8] and dyslipidemia has long been associated with obesity.[8] Both hypertension and dyslipidemia are considered to be risk factors for cardiovascular disease.[9] Obesity increases the risk for strokes, and some research has indicated obesity significantly increases the risk of stroke in American women aged 45 years or above.[8]

Type 2 Diabetes

Approximately one in ten Americans have diabetes with a majority (90-95%) having Type 2 Diabetes (T2D).[10] T2D is currently considered a world -wide pandemic,[11] and the rate of its diagnosis has been growing in proportion to that of overweight and obesity over the past several decades.

T2D occurs as a result of high blood glucose levels, also known as hyperglycemia, due to the body's inability to produce or effectively utilize insulin. Insulin is a hormone that is produced in the beta cells of the pancreas which work towards controlling the amount of glucose that is circulating in the blood. This insulin resistance can develop slowly over time, eventually leading to chronic hyperglycemia. Blood glucose circulating in the body in this way can be detrimental to multiple organs including the kidneys and the eyes. Previously thought to be a solely metabolic disorder, T2D is now viewed by some as an autoinflammatory disease that is occurring due to poor regulation of the metabolic system.[11]

Cancer

According to a report issued by the World Cancer Research Fund jointly with the American Institute for Cancer Research, cancer is responsible for one in eight deaths worldwide and is the leading cause of death over cardiovascular disease in many areas of the world.[12] Overweight and obesity are contributing to this growing statistic. The Report states

that "the evidence that greater body fatness is a cause of many cancers is particularly strong, and has grown stronger over the last decade." Because of current trends towards decreased activity and increased overweight and obesity, if these trends remain unchanged, overweight and obesity are expected to surpass smoking as the primary risk factor for cancer.

There is strong evidence that links overweight and obesity in adulthood with certain types of cancers. These include cancers of the esophagus, pancreas, liver, colon, kidney, lining of the uterus or endometrium, and breast cancer in women after menopause.[12] The evidence for each cancer site listed has been found by the distinguished panel of experts who reviewed and judged the currently available evidence to be strong or "convincing." Evidence of this type often results in recommendations and public health and policy implications.

Health Consequences of the Respiratory, Reproductive and Musculoskeletal Systems

Excess weight can also lead to an increased risk for several other disorders including those of the respiratory, reproductive and musculoskeletal systems.[9,13] Respiratory diseases such as asthma or sleep apnea can occur due to obesity.[9] Asthma is a breathing difficulty that affects the lungs by causing wheezing, breathlessness, chest tightness and coughing.[14] Obese children and adults can both be at an increased risk for asthma and, individuals who are asthmatics can have more symptoms, more frequent and severe asthma attacks, and a decreased response from medications if they are obese.[15]

Sleep apnea is a chronic disorder that can occur in obese individuals due to excess adipose tissue in the next region that can push the soft tissues towards the lumen of the airway, causing the trachea to narrow. This can occur in children or adults, may last for several seconds or several minutes, and is characterized by the cessation of breathing during sleep. Sleep apnea leads to poor sleep, which is reflected in the symptoms of fatigue, evening napping, irritability, memory problems, and morning headaches. In addition, many individuals with sleep apnea experience a dry throat in the morning after waking from sleep, which may be due to excessive snoring.[16]

Overweight and obesity can lead to issues that can result in reproductive disorders including delayed puberty in young boys, advanced puberty in young girls, infertility and subfertility. Subfertility refers to a prolonged timeframe to achieve conception and an accelerated aging process to the ovaries.[8] The risk of infertility is three times as high for women who are obese versus those who are not obese. Negative outcomes are also prevalent in women who are overweight or obese who undergo in vitro fertilization.[17] Overall, the probability of pregnancy is reduced in obese women.[8,17]

Musculoskeletal disorders such as osteoarthritis, a disabling degenerative disease of the joints, are also a potential health consequence of obesity[13] due to the added weight and pressure put on the musculoskeletal system.

Obesity and COVID-19

In addition to the above known impact obesity can have on chronic disease, it has more recently been discovered that having obesity can also increase the risk for infectious diseases, in particular, severe COVID-19 illnesses for adults[18,19,20] and children.[21,22] Obesity has previously been found to be associated with an increase in inflammation which can result in a decreased response by the immune system when presented with bacterial, viral and other infections.[20] Although still a fairly new area of research, studies prior to the COVID-19 pandemic did reflect a relationship between obesity and lung function[20] particularly among those <65 years of age[19] in times of illness. In addition, new information resulting from the pandemic indicate that overweight and obesity are at a higher risk for requiring invasive mechanical ventilation and obesity or severe obesity are at a higher risk for requiring hospitalization, ICU admission, and death for those ages 65 or above.[19,23] This was also the case for children aged 18 years and younger. Children with severe COVID-19 illnesses were more likely to be obese than those who were not.[22]

Behavioral Health Consequences of Obesity

Psychosocial Issues

There is also the potential for psychosocial issues for individuals with obesity. Those with obesity can suffer from "issues related to their mood, self-esteem, quality of life, and body image."[24] It has been estimated that between 20% and 60% of those with obesity or severe obesity suffer from a psychiatric illness including one of the following: depression, eating disorder and anxiety including social anxiety disorder.[24] These psychiatric disorders are also found amongst children who have obesity. Children can experience many other psychosocial issues related to their weight

including stress, body shape concerns and low self-esteem.[25] For all ages who suffer from obesity, quality of life can be significantly affected.

Weight Bias and Stigma

Although some progress has been made regarding the public's perception of obesity as a chronic disease, individuals with excess weight are faced with discrimination throughout many sectors of society. Weight bias and stigma can be found in educational institutions,[26] in the workplace[26,27] and in healthcare.[26,27,28] According to surveys of healthcare professionals, nurse practitioners and physicians report they have negative attitudes and beliefs regarding patients with obesity. Patients also rated physicians as the "second most common source of obesity bias."[28]

There are several movements underway to work towards ending weight bias and stigma, especially within healthcare. These efforts are being worked toward by organizations such as the National Association to Advance Fat Acceptance (NAAFA) and The Association for Size Diversity and Health (ASDAH). ASDAH includes the following five Health at Every Size (HAES) Principles and framework: 1) Weight inclusivity; 2) Health enhancement; 3) Eating for well-being; 4) Respectful care; and 5) Life-enhancing movement. Achievement of goals such as these hope to be realized through education of healthcare professionals with published studies and surveys including results of proof of bias[28] and through efforts by an international panel of 36 experts with a Consensus Statement in *Nature Medicine* by Francesco Rubino and colleagues.[29] The Consensus Statement includes a pledge which organizations and individuals are invited to sign to help end obesity stigma and recommendations for how to do so.

Economic Consequences of Obesity

Consequences of overweight and obesity include significant impacts financially to both individuals and the healthcare system. According to a review of costs associated with obesity-related medical care from the National Health and Nutrition Examination Survey (NHANES) 2011-2016, medical expenditures were estimated at nearly $173 billion for adults and $1.32

billion for children.[30] According to the Centers for Disease Control (CDC), productivity costs due to obesity-related absenteeism cost adults between $79 and $132 per individual with obesity and cost the United States between $3.38 and $6.38 billion annually.[9] Studies have found that as BMI increases, productivity decreases and healthcare costs increase.[31]

These economic impacts can be divided into two categories, direct and indirect costs. Direct costs are those that are related to services that a patient receives such as physician appointments, diagnostic testing and treatments including medications. These costs can be higher due to the increased frequency of visits and hospitalizations and care that is required with the chronic diseases that are associated with obesity including heart disease, diabetes and cancer.[32] Indirect costs include lost productivity when individuals are unable to work due to obesity-related illnesses, have decreased productivity while at work or succumb to obesity-related disability or premature death.[8,9]

Additional impacts on the healthcare system as a result of the increasing number of patients with severe obesity include those listed below.[32]

- Lifting injuries to healthcare workers
- Larger gowns and blood pressure cuffs
- Larger beds, operating tables, stretchers and wheelchairs
- Renovations to increase doorway sizes
- Scales able to accommodate higher weights
- Installation of overhead hoists and floor-mounted toilets

Implementation of preventive measures taken at the workplace, in communities and in society at large, could eventually work towards a reduction in the healthcare and personal costs of obesity. A supportive environment this would provide could be a key ingredient to creating a future where making the healthy choice could be the easy choice for all.

Other Consequences of Obesity

Military Readiness

There are growing concerns over the increasing number of young adults who are unfit to serve in the US military due to overweight and obesity. According to the CDC, just over one in three young adults aged 17-24 is too heavy to

serve in the US military. There is also an issue with a decreasing ability for young adults to meet the physical activity requirements needed to be able to participate in basic training. Overall, "only two in five young adults are both weight-eligible and adequately active" to serve.[9,33]

According to the 2018 Health Related Behaviors Survey, (HRBS) the survey used by the US Department of Defense to assess health and health-related behaviors of service members, of those in active duty, approximately 51% were in the category of overweight, 15% were obese and 33% were of normal weight.[34,35] Those in the overweight or obese categories are less likely to be fit to deploy. Musculoskeletal injuries are common among active-duty soldiers, with 3.6 million such injuries from 2008-2017. A study found that active-duty soldiers with obesity were 33% more likely to sustain this type of injury.[33]

These obesity-related issues within the US military are costly. The Department of Defense is reported to spend about $1.5 billion annually in obesity-related health care costs and $103 million each year on lost workdays.[33] Mission Readiness: Council for a Strong America, was created in 2009 by retired top military leaders to work towards strengthening national security through "evidence-based bipartisan state and federal public policy solutions" that will encourage youth to be able to serve in the military if desired.[36]

Summary

Obesity is a chronic disease that is widespread and has grown dramatically over the past four decades, nearly tripling over that timeframe.[13] Obesity can be a source of several other chronic diseases including cardiovascular disease, type 2 diabetes and several types of cancer as well as an increased risk for a severe response to infectious diseases including COVID-19. The rate of increase of the disease of obesity and its complications are found in both children and adults, resulting in potential debilitating psychosocial disorders for both age groups which can further lead to a compromised quality of life.

The economic burden that overweight, obesity and severe obesity has on both individuals and the healthcare system are significant. These financial consequences result in direct costs such as care and treatment for those with obesity and indirect costs that include lost productivity and obesity-related disability or premature death. Economic costs are also found in the US military, with not only an increasing amount of diagnosed obesity within the ranks of those in active duty, but also a decreasing number of young adults who are fit and eligible to enter the military.

Creating environments through policies, systems and environmental changes that encourage healthful food and physical activity choices can be beneficial for future generations who have preventable obesity. Increased study and understanding of genetic predisposition or disease-related acquisition of obesity are needed to continue to alter the prevailing discrimination of those with obesity in the US and throughout the world.

Resources

National Association to Advance Fat Acceptance
Mission Readiness: Council for a Strong America
Unfit to Serve: Obesity is Impacting National Security
The Association for Size Diversity and Health – Health at Every Size

References

1. U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity. [Rockville, MD]: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General. 2001. Accessed September 2022. https://www.ncbi.nlm.nih.gov/books/NBK44206/pdf/Bookshelf_NBK44206.pdf.
2. Pollack A.M.A. recognizes obesity as a disease. New York Times. June 18, 2013. Accessed September 2022. https://www.nytimes.com/2013/06/19/business/ama-recognizes-obesity-as-a-disease.html.
3. Kyle TK, Dhurandhar EJ, Allison DB. Regarding obesity as a disease: evolving policies and their implications. *Endocrinol Metab Clin North Am.* 2016. 45(3): 511–520.
4. Obesity Medicine Association. About Obesity Medicine Association. Accessed September 2022. https://obesitymedicine.org/about/about-oma/.
5. Betts JG, Young KA, Wise JA, Johnson E, Poe B, Kruse DH, Korol O, Johnson JE, Womble M, DeSaix P. *Anatomy and*

Physiology. 2e. Houston, TX: Open Stax;2022. Accessed September 2022. https://openstax.org/books/anatomy-and-physiology-2e/pages/24-7-nutrition-and-diet.
6. National Heart, Lung and Blood Institute. What is metabolic syndrome? Accessed September 2022. https://www.nhlbi.nih.gov/health/metabolic-syndrome.
7. Moore JX, Chaudhary N, Akinyemiju T. Metabolic Syndrome Prevalence by Race/Ethnicity and Sex in the United States, National Health and Nutrition Examination Survey, 1988–2012. *Prev Chronic Dis.* 2017;14:160287. DOI: http://dx.doi.org/10.5888/pcd14.160287.
8. Chu DT, Nguyet NTM, Dinh TC, Lien NVT, Nguyen KH, Ngoc VTN, et.al. An update on physical health and economic consequences of overweight and obesity. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews.* 2018;12:1095–1100.
9. Centers for Disease Control and Prevention. Consequences of obesity. Accessed September 2022. https://www.cdc.gov/obesity/basics/consequences.html.
10. Centers for Disease Control and Prevention. Type 2 Diabetes. Accessed September 2022. https://www.cdc.gov/diabetes/basics/type2.html.
11. Gonzalez LL, Garrie K, Turner MD. Type 2 diabetes: an autoinflammatory disease driven by metabolic stress. *BBA-Mol Basis of Dis*. 2018;1864:3805-3823.
12. World Cancer Research Fund/American Institute for Cancer Research. *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective*. Washington, DC: AICR, 2018.
13. World Health Organization: World Health Organization. Obesity and overweight. Accessed September 2022. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.
14. Centers for Disease Control and Prevention. Asthma. Accessed September 2022. https://www.cdc.gov/asthma/default.htm.
15. Peters U, Dixon A, Forno E. Obesity and asthma. *J Allergy Clin Immunol*. 2018;141(4): 1169–1179.
16. Betts JG, Young KA, Wise JA, Johnson E, Poe B, Kruse DH, Korol O, Johnson JE, Womble M, DeSaix P. *Anatomy and Physiology*. 2e. Houston, TX: Open Stax;2022. Accessed September 2022. https://openstax.org/books/anatomy-and-physiology-2e/pages/22-3-the-process-of-breathing?query=sleep%20apnea&target=%7B%22type%22%3A%22search%22%2C%22index%22%3A0%7D#fs-id1983836
17. Silvestris E, de Pergola G, Rosania R, Loverro G. Obesity as disruptor of the female fertility. *Reproductive Biology and Endocrinology*. 2018;16:22.
18. Centers for Disease Control and Prevention. Obesity, race/ethnicity, and COVID-19. Accessed September 2022. https://www.cdc.gov/obesity/data/obesity-and-covid-19.html.
19. Kompaniyets L, Goodman A, Belay B, Freedman D, Sucosky M, Lange S, et al. Body mass index and risk for COVID-19 related hospitalization, intensive care unit admission, invasive mechanical ventilation, and death – United States, March–December 2020. *MMWR*. 2021;70(10):355-361.
20. Curtin KM, Pawloski LR, Mitchell P, Dunbar J. COVID-19 and morbid obesity: associations and consequences for policy and practice. *World Medical and Health Policy*. 2020;12(4):512-531.
21. Centers for Disease Control and Prevention. Children, obesity and COVID-19. Accessed September 2022. https://www.cdc.gov/obesity/data/children-obesity-COVID-19.html.
22. Kompaniyets L, Agathis N, Nelson JM, Preston LE, Ko JY, Belay B, Pennington AF, et al. Underlying medical conditions associated with severe COVID-19 illness among children. *JAMA Network Open*. 2021;4(6).
23. Simonnet A, Chetboun M, Poissy J, Raverdy V, Noulette J, Duhamel A,
24. Labreuche J, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. *Obesity*. 2020;28(7):1195-1199.
25. Sarwer DB, Polonsky HM. The psychosocial burden of obesity. *Endocrinol Metab Clin North Am*. 2016;45(3):677–688.
26. Sagar R, Gupta T. Psychological aspects of obesity in children and adolescents. *Indian J Pediatr*. 2018;85(7):554–559.
27. Stern JS, Kazaks A. *Obesity*, 2nd *ed.* Santa Barbara, CA: ABC-CLIO, LLC; 2015.
28. Ending weight bias and the stigma of obesity. *Nat Rev Endocrinol*. 2020;16:253. https://doi.org/10.1038/

s41574-020-0347-7.
29. Fruh SM, Nadglowski J, Hall HR, Davis SL, Crook ED, Zlomke K. Obesity stigma and bias. *J Nurse Pract.* 2016;12(7):425–432.
30. Rubino F, Puhl RM, Cummings DE, *et al.* Joint international consensus statement for ending stigma of obesity. *Nat Med.* 2020;26:485–497. https://doi.org/10.1038/s41591-020-0803-x.
31. Ward ZJ, Bleich SN, Long MW, Gortmaker SL. Association of body mass index with healthcare expenditures in the United States by age and sex. *PLOS ONE.* 2021;16(3).
32. Gupta H, Garg S. Obesity and overweight—their impact on individual
33. and corporate health. *Journal of Public Health: From Theory to Practice*. 2020;28:211–218.
34. Kazaks and Stern, *Nutrition and Obesity: Assessment, Management and Prevention*, Jones and Bartlett Learning, LLC, an Ascend Learning Company, 2013.
35. Centers for Disease Control and Prevention. Unfit to serve: obesity and physical inactivity are impacting national security. Accessed September 2022. https://www.cdc.gov/physicalactivity/downloads/unfit-to-serve-062322-508.pdf.
36. Meadows SO, Engel CC, Collins RL, Beckman RL, Breslau J, Bloom EL, Dunbar MS, et al. 2018 Health Related Behaviors Survey: health promotion and disease prevention among the active component. *Forces and Resources Policy Center of the RAND National Defense Research Institute.* Accessed September 2022. https://www.rand.org/pubs/research_briefs/RB10116z2.html.
37. Clerc PG, Mayer SB, Graybill S. Overweight BMI (25–29) in active duty military: excess fat or more lean mass? a look at the evidence. *Military Medicine.* 2022;7/8:201-203.
38. Council for a Strong America. Mission Readiness: Council for a Strong America. Accessed September 2022. https://www.strongnation.org/missionreadiness.

4.

Chapter Four: Dietary Interventions for Obesity Prevention

Authored by: Sherri M. Cirignano, MS, RDN, LDN

Chapter Outline

Energy Requirements

To determine the energy requirements needed to achieve a healthy weight, it is necessary to consider an individual's age, gender, height, weight, and physical activity level, as well as goal weight if appropriate. Although determining energy requirements comes down to a matter of energy in through food eaten and energy out through both biological activities such as breathing and physical activities, it is not as easy as it sounds. There are mathematical formulas and other more precise methods that are used by registered dietitians and other healthcare professionals to determine an individual's everyday energy needs, but these are not practical for use by the general public. For a consumer to estimate their energy requirements, there are sources such as the Dietary Guidelines for Americans, (DGA) that provide

a generalization of estimated needs throughout life.[1] This resource includes changes in daily calorie needs based on an individual's activity level whether it be sedentary, moderately active or active.

In general, energy requirements are higher for males than females, and according to the DGA range from 1,000 to 2,000 calories per day for young children; up to 3,200 calories per day for adolescents; 2,600 to 3,000 calories per day for adult men; 2,000 to 2,400 calories per day for adult women; 2,000 to 2,600 calories per day for older adult men; and 1,600 to 2,000 calories per day for older adult women.[1] Keep in mind that calorie needs can be increased during the greatest periods of growth throughout life including during childhood and adolescence as well as during pregnancy and lactation. An increase in calories may also be needed when the body is experiencing stress as a result of major injuries and/or illnesses.

Calculating individual calorie needs is easier than ever with an extensive variety of phone apps and online sources including the MyPlate Plan on the USDA's MyPlate website.[2] How these estimated calorie needs translate to the food we eat is also important to consider. What portion of these calories should come from each food group? The MyPlate Plan can also help with this by linking to an individualized calorie-specific plan including daily recommended amounts to include for each food group. Numerous phone apps, books, websites, and other resources can also be utilized to help determine a specific plan. For example, the Nutrition Facts Label provides calorie as well as other nutritional information on the majority of food packages. Updated in 2016, the changes to the Nutrition Facts Label have worked to achieve a more consumer-friendly look and to provide information that reflects "the link between diet and chronic diseases, such as obesity and heart disease."[3] The goal of the updated label is to make it easier for consumers to make informed food choices.

Dietary Recommendations

Historically, weight management guidelines created to address adult obesity were first offered in the late 1990's by the National Heart, Lung and Blood Institute and other guidelines followed in 2003 by the US Preventive Services Task Force, the American College of Physicians in 2005 and the Academy of Nutrition and Dietetics (formerly the American Dietetic Association) in 2009.[4] These guidelines were created to assist healthcare professionals with planning for weight management and obesity treatment.

Further assistance regarding dietary recommendations is available for healthcare professionals and consumers in the DGA. The DGA are published jointly by the US Department of Health and Human Services and the US Department of Agriculture approximately every five years. The DGA are published as a requirement under the 1990 National Nutrition Monitoring and Related Research Act, and they are based on the "preponderance of current scientific and medical knowledge."[5] Utilized to create Federal nutrition education materials by the HHS and USDA, the DGA's intended purpose is to promote health and prevent disease.

Although some information in the Guidelines have remained fairly constant over the years, the current evidence points each new DGA update in a specific direction. The 2020-2025 DGA were created with a lifespan approach, are the first DGA to provide guidelines for every life stage, from birth through older adults, have a focus on the importance of healthy dietary patterns over individual nutrients and were created with the high prevalence of chronic diseases, including obesity, among Americans in mind.[5]

The 2020-2025 DGA offer a "customizable framework" that can be adjusted to meet individual needs as well as make choices that are affordable and fit within individual and family traditions and customs. The Guidelines are summarized in the Executive Summary of the 2020-2025 DGA and as follows:

1. Follow a healthy dietary pattern at every life stage.
2. Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.
3. Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits.
4. Limit food and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages.

Putting the DGA into practice has been made easier over the past decade since the creation of USDA MyPlate[7] (add graphic to pg.) The USDA MyPlate graphic was born out of the 2010 DGA and its use by consumers has been found

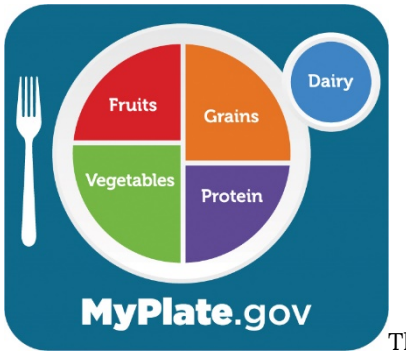
to be beneficial in determining individual needs through the MyPlate plan[6] perhaps due to its simple design. MyPlate is meant to represent a virtual daily plate that includes five food groups-fruits, vegetables, grains, protein, and dairy foods. It's accompanying resources are updated with each new DGA and can be found on MyPlate.gov. Resources include print materials in both English and Spanish, a mobile app to assist with daily choices, tools to test consumers' nutrition knowledge and assist with healthy shopping, and MyPlate Kitchen, which includes many healthful recipes and how-to videos.

The current nutrition messages that are provided by MyPlate are as follows:

The benefits of healthy eating add up over time, bite by bite. Small changes matter. Start Simple with MyPlate.

- *Make half your plate fruits and vegetables: focus on whole fruits.*
- *Make half your plate fruits and vegetables: vary your veggies.*
- *Make half your grains whole grains.*
- *Vary your protein routine.*
- *Move to low-fat or fat-free dairy milk or yogurt (or lactose-free dairy or fortified soy versions).*

Food Groups



The basis for meeting DGA guidelines and the visuals and recommendations of MyPlate are food groups. From an early age, food groups help us to understand the different food categories from which to choose our daily intake and, with the MyPlate graphic, the recommended amounts to consume from each food group are illustrated. A healthy dietary pattern will include nutrient-dense forms of foods and beverages across all food groups. The 2020-2025 DGA define a nutrient-dense food as follows:

"*Nutrient-dense foods and beverages provide vitamins, minerals, and other health-promoting components and have little added sugars, saturated fat, and sodium. Vegetables, fruits, whole grains, seafood, eggs, beans, peas, and lentils, unsalted nuts and seeds, fat-free and low-fat dairy products, and lean meats and poultry—when prepared with no or little added sugars, saturated fat, and sodium— are nutrient-dense foods.*"[6]

Vegetables

The 2020-2025 DGA encourage intake of all forms of vegetables-fresh, frozen, canned, raw and/or cooked-and encourage consuming a variety of colors and types of vegetable including dark green; red and orange; beans, peas and lentils; starchy and other vegetables. Vegetables are nutrient-dense foods, and non-starchy vegetables provide 4 calories per gram of food. Research has indicated that vegetables may have many health benefits including a decreased risk of certain types of cancers, heart disease and obesity.

Data on vegetable intake and heart disease risk was reviewed from the National Health and Nutrition Examination Survey from 1999-2014.[8] This is a very large ongoing study that assessed the vegetable intake of 38,981 adults during

that timeframe. Results showed that those who reported eating dark green vegetables had a lower chance of having cardiovascular disease and coronary heart disease in comparison to those who reported eating no green vegetables.[8] A review of studies also indicated that the use of educational interventions to promote vegetable (and fruit) intake significantly reduced weight in overweight and obese individuals.[9,10]

As a nation, our vegetable intake is not meeting current recommendations. According to the *State Indicator Report on Fruits and Vegetables, 2018* released by the Centers for Disease Control and Prevention, surveys indicate that nationally only one in ten adults get enough fruits or vegetables, an average of only 9.3% of adults are eating the recommended amount of vegetables and only 2.0% of high school students meet the vegetable recommendations.[11] The report also indicated that those below or close to the poverty level were found to be less likely to meet the vegetable intake recommendations with 11.4% of adults in the highest household income category eating the recommended amount and only 7.0% of those below or close to the poverty level doing so.[11]

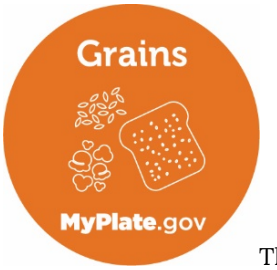
Fruits

The 2020-2025 DGA encourage intake of all forms of fruits-fresh, frozen, canned, and/or dried and 100% fruit juice. Guidelines also encourage consuming at least one-half of fruit consumed as whole fruit, rather than 100% juice. Whole fruits are nutrient-dense foods, providing 4 calories per gram of food.

Many studies on the potential health benefits of fruits are conducted in tandem with vegetables. As mentioned above, studies that include both fruits and vegetables indicate their consumption promotes the prevention of heart disease and obesity.[9,10] Specific fruits, such as berries, have been the topic of many research studies. Studies on berries have indicated that their consumption specifically provides possible benefits to health including decreasing the risk of certain types of cancer,[12,13] heart disease,[12-16] obesity, diabetes and in turn metabolic syndrome.[16]

Approximately only 20% of fruit recommendations are met by the US population, however over 60% of all fruit intake comes from whole forms of fruit, as is recommended.[1]

Grains

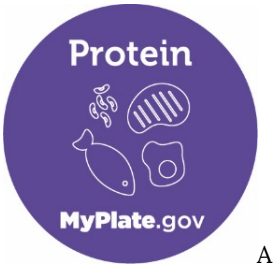


The 2020-2025 DGA recommends focusing on whole grains and limiting intake of refined grains, with the goal of at least one-half of all grains consumed as whole grains. Examples of whole grains include brown rice, popcorn, and whole wheat breads and pastas. The ingredient list is the best way to determine if a food contains whole grains. If it is a whole grain, the grain type would be listed as a whole grain, for example "whole wheat flour", and would be either first or second in the ingredient list. Many whole grains and whole grain products can be nutrient-dense foods, but not all are considered nutrient-dense. This is dependent on the amount of whole grain in the product, other ingredients present in the product and its preparation method. Grains provide 4 calories per gram of food.

Grains play an important role in the diet by providing essential nutrients including dietary fiber, several B vitamins such as riboflavin, thamin, niacin and folate, and minerals such as iron, magnesium and selenium. Whole grains, when consumed as part of a healthy diet, may also reduce the risk of heart disease, contribute to weight management, and grain products fortified with folate can help to prevent neural tube effects when consumed before and during pregnancy.[17]

Although meeting overall grain intake recommendations is not an issue for most Americans, 98% do not meet recommendations for intake of whole grains.[1]

Protein Foods



A healthy dietary pattern with protein foods will include a variety of nutrient-dense foods derived from both animal and plant sources including meats, poultry, eggs, seafood, nuts, seeds, legumes and soy products. Legumes including beans, peas and lentils are part of both the protein and vegetable groups. Protein is also found in foods in other groups including dairy foods. The protein portion of a food from the protein and dairy groups provides 4 calories per gram of food.

The 2020-2025 DGA recommend protein intake is primarily from lean meats and poultry that are fresh, frozen or canned with avoidance of processed meats. Protein needs can be met for a vegetarian dietary pattern through plant intake, in particular an intake that is higher in soy products; beans, peas and lentils; nuts and seeds; and whole grains.

Protein is important in our diet, providing essential amino acids as well as other nutrients that promote growth, especially in increased times of growth including childhood, adolescence, and pregnancy. However, an excess of protein is not encouraged. A review of studies has indicated that an excess of protein in infancy and early childhood may be associated with an increased risk of obesity in later life.[18]

Recommendations for intake of protein foods comes close to meeting overall needs in the US population, however, excess intake of protein foods that are high in saturated fat and those that are not in nutrient-dense forms are consumed.[1]

Dairy

This food group includes milk, yogurt and cheese, of the fat-free or low-fat variety for a healthy dietary pattern, and dairy alternatives including fortified soy products such as soy milk and soy yogurt. These soy products are included in the dairy group because of their similarity to milk and yogurt in use and nutrient composition. Choices from the fat-free or low-fat variety of this food group can be considered a nutrient-dense food. Consuming other plant-based "milks" such as almond, coconut or oat "milks" are not included in the dairy group, thus do not contribute to meeting dairy group recommendations.[1]

Studies undertaken to determine if there is a link between dairy consumption and obesity in children and adolescents have not been conclusive.[19,20] At this time, there is limited evidence to support a need to limit milk and/or yogurt consumption in children and adolescents.

Americans do not meet current dairy recommendations. Approximately only 20% of adults, 34% of adolescents, and 65% of young children drink milk on a daily basis and a majority of dairy consumption is derived from cheese in products such as pizza or in high fat products such as ice cream or flavored, sweetened yogurts.[1]

Limiting Added Sugars, Fats, Oils and Alcoholic Beverages

Foods with added sugars and/or fats and oils are not included on MyPlate and are often categorized as foods that are calorie-dense and thus provide "empty calories." Added sugars can be found in a variety of products and include the following top sources and average intakes from the US population starting at age one: 24% from sugar-sweetened beverages, of which 16% is from soft drinks; 19% from desserts and sweet snacks, including 6% from cookies and brownies, 5% from ice cream and frozen dairy desserts and 4% from cakes and pies.[1] The updated Nutrition Facts Label now includes the amount of added sugars in food products in addition to the amount of naturally occurring sugars.

Similar to added sugars, foods with added fats and oils, especially saturated fats, add significantly to the American diet. One reason for this is that all fats provide 9 calories per gram of food, more than twice the amount of calories per gram from vegetables, fruits, grains, protein and dairy foods. The top sources and average intakes of saturated fat in the US, ages one and older, are as follows: 19% from sandwiches, of which 4% is burgers and tacos and 3% is burgers and chicken and turkey sandwiches; 11% from desserts and sweet snacks; and 7% from rice, pasta and other grain-based mixed dishes.[1]

There is significant evidence indicating a link between a high intake of sugar-sweetened beverages and weight gain[21] and although weight gain can occur due to the oft high caloric value of foods that have a high fat content, including saturated fats, the direct link between saturated fat and cardiovascular disease have not been supported by recent evidence.[22]

Alcohol provides a significant amount of energy with 7 calories per gram. Additional calories in mixed drinks can come from the other ingredients, such as juice and soda. As a result, alcoholic beverages can be quite high in calories and thus contribute to weight gain if consumed generously. Light to moderate intakes of alcoholic beverages are not associated with weight gain whereas heavy drinking can be associated with weight gain.[23]

For those who drink alcohol, the 2020-2025 DGA recommend limiting intake to two drinks or less per day for men and one drink or less per day for women when alcohol is consumed. The following explains what constitutes one alcoholic beverage:

Alcoholic Drink Equivalents[1]

- 12 fluid ounces of regular beer (5% alcohol)
- 5 fluid ounces of wine (12% alcohol)
- 1.5 fluid ounces of 80 proof distilled spirits (40% alcohol)

For a healthful dietary pattern, a focus on overall diet quality that fits within the food group recommendations found on MyPlate and reviewed above is suggested.

Dietary Interventions for Obesity Management

Energy-Restricted Diets

Treatment for those suffering from severe obesity, also referred to as class 3 obesity, often includes medication and/or surgical interventions. If these treatments are contraindicated or unsuccessful, employing energy-restricted diets have been shown to offer some success.[24] Energy-restricted dietary patterns can include low energy diets (LEDs) and very low energy diets. (VLEDs) Defined by The United Nations food standards body Codex Alimentarius, these diets can restrict daily energy intake to between 1000 kcal to 1200 kcal for LEDs and 600 kcal to 800 kcal for VLEDs.[24] Total or partial meal replacements are often used in both LEDs and VLEDs and can include shakes, soups and bars as well as other prescribed food items.

A review of studies utilizing LED and VLED dietary patterns have indicated weight loss of 6-16% of initial body weight

at one year, with "clinically relevant" weight losses of 10% or more occurring with six weeks or more duration.[24] Due to mixed guidelines regarding the use of diets with severe energy restrictions, both in the US and in other countries, and a need for caution due to the nature of implementing energy restrictions, LEDs and VLEDs should be considered for those with severe obesity with caution and should be utilized under the care of a qualified healthcare professional.

Carbohydrate-Restricted Diets

Dietary patterns that restrict carbohydrates (CHO) have also been utilized for obesity weight management. These dietary patterns have employed varying degrees of CHO restriction. According to the National Lipid Association Scientific Statement on this topic, the degree to which CHO is restricted is based on a percentage of the total daily energy (TDE) intake that is coming from CHO. This can range from a moderate-CHO restriction with 26-44% TDE from CHO, to a very-low-CHO diet with less than 10% TDE from CHO. As a reference point, an acceptable CHO range of TDE from CHO for a healthy adult is 45-65%.[25]

Low- and very-low-CHO diets, including those that are medically supervised, have been used for weight management in obesity for many years. Although the NLA Scientific Statement reports some benefit to the use of these dietary patterns in weight loss, there are safety concerns with their use and overall outcomes have not been found to be superior to other diet methods.[25]

Intermittent Diet Strategies

In recent years, intermittent fasting (IF) and intermittent energy restriction (IER) have been used for weight management in overweight and obesity as an alternative to energy-restricted diets, where the energy, or calories, are restricted continuously, throughout each day. Because the ability to continuously restrict ones calories is often reported as being difficult to maintain long term, IF and IER have increased in popularity.[26] IF and IER refers to when an individual withholds food intake for longer than twelve hours in a day.[27] There are a number of IF/IER diet regimens, including when fasting occurs on alternate days, known as ADF (alternate day fasting),[26,27] and periodic fasting where fasting occurs two days in a week, also known as the 5:2 diet.[26,27] Each IF/IER diet regimen restricts energy intake at certain times and/or on certain days and may include a maximum of 500-600 kcal on a fasting day.[27]

When compared to continuous energy restricted dietary patterns in systematic reviews and meta-analyses, studies have indicated that although IF/IER regimens are associated with weight loss[26,27] and a reduction in waist circumference in some cases,[27] they did not show an overall difference in outcomes compared to continuous energy restricted diets.[26,27]

Meal Replacements

The use of meal replacements is another potentially effective weight management strategy for those with obesity. Defined as "commercially available products fortified with minerals and vitamins"[28] that can replace some of or all of meals, meal replacements are beneficial due to their ability to eliminate choice and control intake. Examples of these products include drinks, soups and bars and can also include portion-controlled, ready-to-eat meals.[29]

Two separate systematic reviews and meta-analyses concluded that the use of meal replacements can be an effective intervention strategy after one year of implementation, particularly when including supportive programming[29] and over a standard low-energy diet with ideally 30% to 60% of total daily energy from meal replacements.[28]

Emerging Interventions

Dietary interventions that focus primarily on some form of energy restriction have had some success in treatment of obesity over many years, especially in the short term, but have had limited success on a long term basis.[30] Weight neutral approaches to weight management has more recently been explored as a possible alternative, or addition to, traditional "diets." Examples of weight-neutral approaches include the practice of mindful eating or intuitive eating. These approaches have been explored in children,[31,32] adolescents[31-33] and adults[34,35] with varying degrees of success. Mindful eating occurs when one is focused on what they are eating and the experience they are having with their food.[34] Intuitive eating occurs when one is focused on their hunger and satiety cues as opposed to any diet prescription or calorie restriction.[34] Overall, systematic reviews exploring mindful and/or intuitive eating have suggested that these approaches to obesity management *could* be a beneficial approach to treatment and are in need of more research.[30-35] These topics will be explored further in Chapter 11.

Summary

Determining one's energy requirements and how to meet those requirements is essential in the management of weight, whether for the purpose of maintaining a healthy weight, or for the purpose of losing or gaining weight towards a healthy weight. Although various scientific formulas and other methods are available to precisely determine an individual's energy requirements, tools are available from a variety of sources including the Dietary Guidelines and MyPlate to quickly and easily estimate needs. Once these requirements are determined, one can then balance what is eaten to meet those needs by considering all of the food groups-vegetables, fruits, grains, protein and dairy-as well as avoidance of added sugars and saturated fats and the limitation of alcohol.

Management of obesity through various dietary patterns have had mixed results over many years. Restriction of both overall energy and carbohydrates have had some positive outcomes, but should be followed with caution and preferably with medical supervision. Newer to the diet scene are intermittent fasting and intermittent energy restriction regimens and diets employing meal replacements. Although intermittent dietary patterns are in need of further study, and initial reviews have not found them to be beneficial over continuous energy-restricted diets, meal replacements have shown some promise. Potentially more promising are the emerging interventions that focus on weight neutral approaches to weight management such as the practices of mindful eating and intuitive eating. At this time, all of these dietary intervention for the purpose of obesity management are in need of continued exploration.

Resources

2020-2025 Dietary Guidelines for Americans

The MyPlate Plan

Nutrition Facts Label

Reference

1. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition. 2020. Accessed September 2022. DietaryGuidelines.gov
2. U.S. Department of Agriculture. MyPlate Plan. Accessed September 2022. https://www.myplate.gov/myplate-plan
3. U.S. Food and Drug Administration. Changes to the nutrition facts label. Accessed September 2022. https://www.fda.gov/food/food-labeling-nutrition/changes-nutrition-facts-label
4. Kazaks and Stern, *Nutrition and Obesity: Assessment, Management and Prevention*, Jones and Bartlett Learning, LLC, an Ascend Learning Company, 2013.
5. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition. Executive Summary. 2020. Accessed September 2022. https://www.dietaryguidelines.gov/sites/default/files/2020-12/DGA_2020-2025_ExecutiveSummary_English.pdf
6. Schwartz J, Vernarelli, J. Assessing the public's comprehension of dietary guidelines: use of MyPyramid or MyPlate is associated with healthier diets among US adults. *J Acad Nutr Diet.* 2019;119(3):482-489.
7. U.S. Department of Agriculture. MyPlate. Accessed September 2022. https://www.myplate.gov/
8. Conrad Z, Raatz S, Jahns L. Greater vegetable variety and amount are associated with lower prevalence of coronary heart disease: NHANES, 1999-2014. *Nutrition Journal.* 2018;17:67. https://doi.org/10.1186/s12937-018-0376-4
9. Boeing H, Bechtold A, Bub A, Ellinger S, Haller D, Kroke, Leschik-Bonnet E, Muller MJ, Oberritter H, Schulze M, Stehle P, Watzl B. Critical review: vegetables and fruit in the prevention of chronic diseases. *Eur J Nutr.* 2012;51:637-663.
10. Arnotti K, Bamber M. Fruit and vegetable consumption in overweight or obese individuals: a meta-analysis. *Western J of Nursing Research.* 2020;42(4):306-314.
11. Centers for Disease Control and Prevention. State Indicator Report on Fruits and Vegetables, 2018. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2018. Accessed September 2022. https://www.cdc.gov/nutrition/downloads/fruits-vegetables/2018/2018-fruit-vegetable-report-508.pdf
12. Nile SH, Park SW. Edible berries: bioactive components and their effect on human health. *Nutrition.* 2014;30:134-144.

13. Baby B, Antony P, Vijayan R. Antioxidant and anticancer properties of berries. Critical Reviews in Food Science and Nutrition. 2018;58(15):2491-2507.
14. Kelly E, Vyas P, Weber JT. Biochemical properties and neuroprotective effects of compounds in carious species of berries. *Molecules*. 2018;23,26.
15. Rodriguez-Mateos A, Heiss C, Borges G, Crozier A. Berry (poly)phenols and cardiovascular health. *J Agric Food Chem*. 2014;62:3842-3851.
16. Yang B, Kortesniemi M. Clinical evidence on potential health benefits of berries. *Current Opinion in Food Science*. 2015;2:36-42.
17. U.S. Department of Agriculture. MyPlate: grains. Accessed September 2022. https://www.myplate.gov/eat-healthy/grains
18. Xu S, Xue Y. Protein intake and obesity in young adolescents: a review. *Experimental and Therapeutic Medicine*. 2016;11:1545-1549. Accessed September 2022. https://www.spandidos-publications.com/etm/11/5/1545
19. Dougkas A, Barr S, Reddy S, Summerbell C. A critical review of the role of milk and other dairy products in the development of obesity in children and adolescents. *Nutrition Research Reviews*. 2019;32(1):106-127.
20. Babio N, Becerra-Tomás N, Nishi S, López-González L, Paz-Graniel I, García-Gavilán J, et. al. Total dairy consumption in relation to overweight and obesity in children and adolescents: a systematic review and meta-analysis. *Obesity Reviews*. 2022;23(S1):e13400.
21. Malik VS, Hu FB. The role of sugar-sweetened beverages in the global epidemics of obesity and chronic diseases. *Nat Rev Endocrinol*. 2022;18:205-218.
22. Gershuni VM. Saturated fat: part of a healthy diet. *Curr Nutr Rep*. 2018;7(3):85-96.
23. Traversy G, Chaput JP. Alcohol consumption and obesity: an update. *Curr Obes Rep*. 2015;4:122-30.
24. Maston G, Gibson AA, Kahlaee HR, Franklin J, Manson E, Sainsbury A, Markovic TP. Effectiveness and characterization of severely energy-restricted diets in people with class III obesity: Systematic Review and Meta-Analysis. *Behav Sci*. 2019;9(12):144.
25. Kirkpatrick CF, Bolick JP, Kris-Etherton PM, Kikand G, Aspry KE, Soffer DE, Willard KE, Maki KC. Review of current evidence and clinical recommendations on the effects of low-carbohydrate and very-low-carbohydrate (including ketogenic) diets for the management of body weight and other cardiometabolic risk factors: a scientific statement from the National Lipid Association Nutrition and Lifestyle Task Force. *J of Clin Lipid*. 2019;13:689-711.
26. Schwingshackl L, Zähringer J, Nitschke K, Torbahn G, Lohner S, Kuhn T, et al. Impact of intermittent energy restriction on anthropometric outcomes and intermediate disease markers in patients with overweight and obesity: systematic review and meta-analyses. *Critical Reviews in Food Science & Nutrition*. 2021;61(8):1293-1304.
27. Enriquez Guerrero A, Martin ISM, Vilar EG, Camina Martin MA. Effectiveness of an intermittent fasting diet versus continuous energy restriction on anthropometric measurements, body composition and lipid profile in overweight and obese adults: a meta-analysis. *Eur J of Clin Nutr*. 2021;75:1024-1039.
28. Min J, Kim S-Y, Shin I-S, Park Y-B, Lim Y-W. The effect of meal replacement on weight loss according to calorie-restriction type and proportion of energy intake: a systematic review and meta-analysis of randomized controlled trials. *Journal of the Academy of Nutrition & Dietetics*. 2021;121(8):1551-1564.
29. Astbury NM, Piernas C, Hartmann-Boyce J, Lapworth S, Aveyard P, Jebb SA. A systematic review and meta-analysis of the effectiveness of meal replacements for weight loss. *Obesity Reviews*. 2019;20:569-587.
30. Dugmore JA, Winte CG, Niven HE, Bauer J. Effects of weight-neutral approaches compared with traditional weight-loss approaches on behavioral, physical, and psychological health outcomes: a systematic review and meta-analysis. *Nutrition Reviews* 2019:78(1):39–55.
31. Brantley C, Knol L, Douglas J. Influence of parental mindful eating practices on child emotional eating: a systematic review of the literature. *Cur Devel Nutr*. 2022;396.
32. Keck-Kester T, Huerta-Saenz L, Spotts R, Duda L, Raja-Khan N. Do mindfulness interventions improve obesity rates in children and adolescents: a review of the evidence. *Diabetes, Metabolic Syndrome and Obesity:Targets and Therapy* 2021;14:4621-4629.
33. Hoare JK, Lister N, Garnett SP, Baur LA, Jebeile H. Weight-neutral interventions in young people with high body

mass index: a systematic review. *Nutrition & Dietetics*. 2022;1-13
34. Grider HS, Douglas SM, Raynor HA. The influence of mindful eating and/or intuitive eating approaches on dietary intake: a systematic review. *J Acad Nutr Diet*. 2021;121(4):709-727.
35. Fuentes Artiles R, Staub K, Aldakak L, Eppenberger P, Rühli F, Bender N. Mindful eating and common diet programs lower body weight similarly: systematic review and meta-analysis. *Obesity Reviews*. 2019;20:1619-1627.

5.

Chapter Five: Physical Activity Interventions for Obesity Prevention

Authored by Christine Zellers, MPP
Edited by Sherri M. Cirignano, MS, RDN, LDN

Chapter Outline

Sedentary Lifestyle Implications and Physical Activity Recommendations

What is Physical Activity?

Recommendations for Physical Activity

Implications of American's Physical Inactivity Geographically, Ethnically and Racially

Types of Physical Activity

Aerobic/Cardiovascular

Muscle Strengthening

Bone Strengthening

Balance Flexibility

Measurements of Physical Activity Rates

Metabolic Equivalent of Task (MET)

Examples of Moderate and Vigorous Physical Activities

Heart Rate Estimating Heart Rate Other Exertion Indicators Trends and Safety

Physical Activity for Improved Health Outcomes and Chronic Disease Prevention

Obesity

Chronic Disease Prevention and Implications of Expanded Mortality

Improved Overall Health Outcomes/Longevity of Life – Metabolic Health

Benefits vs Risk of physical activity

Benefits

Risks

Behavioral Strategies for Physical Activity and its Impact on Disease Prevention

Policy, Systems and Environmental Change for Physical Activity

Policy

Systems

Environmental

Sedentary Lifestyle Implications and Physical Activity Recommendations

Physical activity has positive health implications for chronic disease prevention in the United States, yet Americans fall short of recommended amounts of movement. A sedentary lifestyle is inactive behavior where a person tends to spend most waking hours in a sitting or lying position and not moving regularly throughout the day. Technological advances, less manual labor, and easy access to basic human survival essentials like food and water coupled with urbanization and changing transportation patterns have decreased the amounts and types of physical activity Americans participate in daily. The World Health Organization (WHO) notes that worldwide, 1 in 4 adults and 3 in 4 adolescents (ages 11-17) do not currently meet the global recommendations for physical activity.[1] Sedentary lifestyles are associated with 117 billion dollars annually in healthcare costs and are the reported cause of 1 in 10 premature deaths according to the Centers for Disease Control and Prevention (CDC) in the United States.[2] Scientific evidence associates physical activity with chronic disease prevention making promotion of physical activity a critical component of community health interventions.

What is Physical Activity?

It is important to note that while both exercise and physical activity can be used somewhat interchangeably, the broad definition that both encompass are not exclusively right or wrong in defining movement. When used to encourage a less sedentary lifestyle both are beneficial definitions of movement. Exercise is defined by the CDC's National Center for Health Statistics (NCHS) and the Physical Activity Guidelines for Americans (PAGA) as, "a type of physical activity that involves planned, structured, and repetitive bodily movement done to maintain or improve one or more components of physical fitness."[3] Physical activity is defined by the CDC's NCHS as "any bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure."[3] Use of the phrase physical activity in place of exercise is being promoted by the United States Department of Health and Human Services through the Move Your Way Campaign. This campaign seeks to encourage Americans to move more within the limits of their everyday lives rather than being stringent in an exercise routine.[4] Messaging from this campaign is focused on movement in any form or duration to incorporate movement into personal daily routines versus exercise which must be in addition to regular movement and at a scheduled time. This campaign aims to take the stigma from exercise to get Americans to be more physically active.

The Move Your Way Activity Planner allows Americans to choose activities and duration of movement. It provides examples and ideas for movement that fit into everyday life to encourage all Americans to move more in a variety of ways. Activities in the planner are designated as aerobic or muscle strengthening activities with a meter that records achievement for users.

Recommendations for Physical Activity

The PAGA 2018 is produced by the U.S. Department of Health and Human Services through rigorous review and contributions from researchers and available scientific literature.[5] These guidelines are designed for health professionals and policy makers to use as guidance for program implementation and policy development. The first and overarching recommendation of the PAGA is to move more and sit less. The guidelines also establish types, amounts, and intensity levels for physical activity while providing suggestions for policies that make physical activity accessible to all Americans.

Physical activity is divided into two categories, aerobic or cardiovascular exercise and muscle strengthening exercises. Bone strengthening, flexibility and balance movements are important for both chronic disease prevention and healthy aging. These three activities often fall within the two main groups of exercise. For example, running is an aerobic exercise that is also bone strengthening and yoga is a flexibility activity as well as muscle strengthening.

General recommendations for adult physical activity are 150 to 300 minutes minimum of aerobic exercise each week and an additional two days that include weight bearing exercise.[5] Recommendations are spanned over the week to provide ample opportunities for adults to meet the minimum requirements rather than being grouped by day.

Recommendations for children are a minimum of 60 minutes of movement per day. Children and adolescents (ages 6-17) should engage in 60 minutes of moderate to vigorous exercise daily to support healthy growth and prevent obesity.[5] Youth should include aerobic activity, muscle-strengthening, and bone-strengthening activities as part of the 60 minutes of daily activity (see table 1) Children should include a mixture of all three types of movement at least three days per week each. Children under the age of 3 should engage in regular play throughout the day to provide ample movement. It is recommended that preschool aged children (ages 3-5) be physically active with a variety of activities throughout the day to support growth and development. It is important that children engage in a variety of age-appropriate movement that stimulates and supports interests to encourage movement throughout the life span.

Guidelines are further categorized by special groups such as women during pregnancy and postpartum period, adults with chronic health conditions and adults with disabilities. During pregnancy and the postpartum period women should engage in at least 150 minutes of moderate intensity aerobic activity per week, spread throughout the week. Those women who engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy can continue those activities during pregnancy and the postpartum period. These recommendations should be discussed with a physician who is overseeing the pregnancy and postpartum period to properly adjust activity levels as needed. Adults with chronic conditions or disabilities should participate in regular physical activity and recommendations are the same for this special group as those with no health-related conditions however, a physician should be consulted regarding the types and amounts of activity appropriate for specific individuals. Adults with chronic conditions or disabilities unable to meet the key guidelines should engage in regular physical activity according to their abilities and avoid physical inactivity. Older adults should follow the same recommendations as other adults within personal limits and fitness levels and include balance training along with aerobic and muscle-strengthening activities. [5]

Table 1. Examples of type and amounts of physical activities for youth ages 6-17

Type of Physical Activity	Recommended Amounts	Examples*
Aerobic	3 times per week as part of 60 minutes/day	Swimming, running, biking, dancing
Muscle-strengthening	3 times per week as part of 60 minutes/day	Body resistance like push-ups, weightlifting, resistance bands
Bone-strengthening	3 times per week as part of 60 minutes/day	Running, jumping rope, basketball

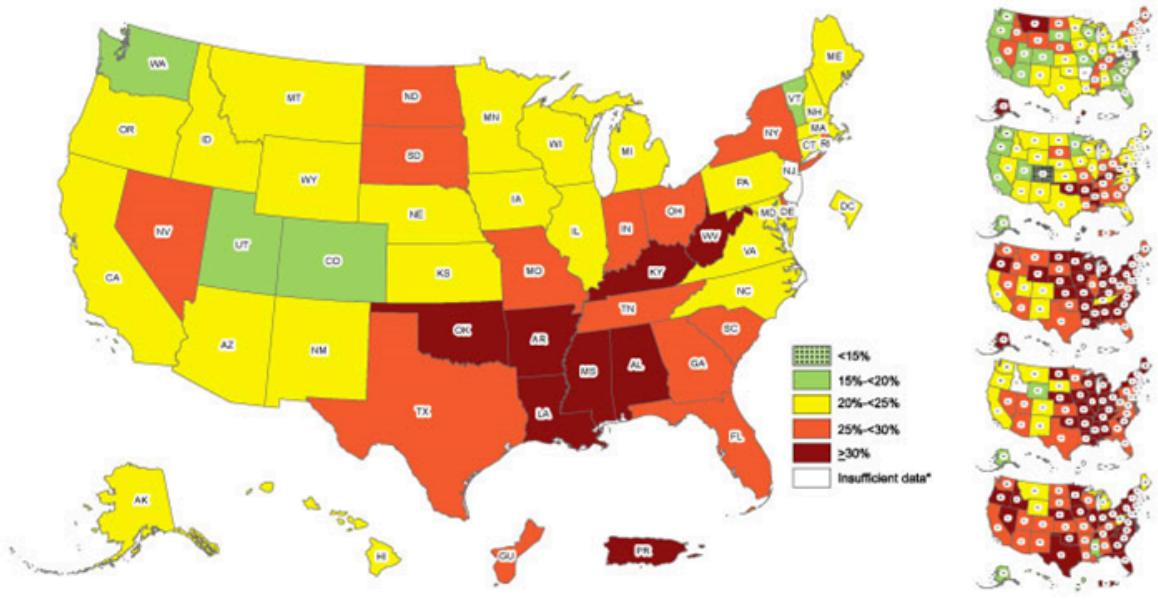
Adapted from Physical Activity Guidelines for Americans 2nd edition
to demonstrate examples of physical activity and duration for youth.
*Some examples may fit into more than one type of physical activity.

The Physical Activity Guidelines for Americans 2nd Edition (2018) w as created by the United States Department of Health and Human Services and serves as a resource for professionals to educate the public on physical activity guidelines.

Implications of American's Physical Inactivity Geographically, Ethnically and Racially

Current rates of inactivity have strong implications across the country both geographically, racially, and ethnically and serve as a marker for health inequities (see Figure 1) In 2022 the CDC created maps to demonstrate physical activity trends that were compiled in three separate sub-sections of race, ethnicity, and geographic area using data from the Behavioral Risk Factor Surveillance System (BRFSS).[6] These maps which used a marker of physical inactivity for adults, defined as a lack of participation in any leisure-time physical activities over a one-month period, concluded that there was a variable range between 17.3% and 47.7% of the adult population who were physically inactive. [6] BRFSS collected data for these maps using telephone surveys and concluded physical inactivity is most prevalent in Hispanic adults (32.1%), non-Hispanic Black (30%), non-Hispanic American Indian/Alaska Native (29.1%) non-Hispanic White (23%) and non-Hispanic Asian adults (20.1%).[6] Ethnic and racial statistical data on inactivity indicated higher prevalence of inactivity among specific groups may be precipitated by lack of accessibility to safe exercise options. Additionally, geographic results divided by states and territories concluded variable levels of physical inactivity across racial and ethnic groups whereby demonstrating states and territories that had greater levels of inactivity demographically. Finally, location specific data was collected to identify areas of the United States with the greatest levels of inactivity indicating Colorado had only 17% of residents who were inactive outside of work responsibilities and Puerto Rico recording the highest prevalence of physical inactivity at 49.4%. Location is divided further into geographic region with the south (27.5%) showing the most physical activity, Midwest (25.2%), Northeast (24.7%) and West (21.0%). In totality these data sets demonstrate the need for a reduction to barriers of physical activity where Americans work, live, and play.

Figure 1. Differences in the prevalence of physical inactivity in the United States exists by race/ethnicity and location according to CDC Maps (2022).[6]



Types of Physical Activity

Physical activity recommendations are grouped into two specific types, aerobic or cardiovascular and muscle

strengthening. Both aerobic and strengthening exercises provide varied but equally important contributions for reducing inactivity and preventing chronic disease. Physical activity terms such as intensity levels, frequency, duration, sets, and repetition are used to establish a range to measure how hard the body is working or for how long. Additionally, other important measurements of intensity levels include heart rate, exertion levels and metabolic equivalent of task (MET). Just as it is important to eat a variety of nutrient dense foods so is incorporating a variety of physical activities to support overall health across the lifespan.

Aerobic/Cardiovascular

Aerobic physical activity also referred to as cardiovascular, or cardio is the movement of large muscle groups in the body over a sustained period in a systematic rhythm.[5] Examples of aerobic physical activity include brisk walking, running, bicycling, or swimming. It is an activity that causes increased heart rate and breathing. Aerobic activity is divided into three components according to the PAGA, intensity level, frequency, and duration. [5] Intensity refers to how hard a person is working during the aerobic exercise while frequency is how often the activity occurs and duration is how long someone moves in a single session. While all three of these components represent a measure for aerobic movement, for purposes of the public, aerobic activity is recommended in total weekly movement of 150-300 minutes of aerobic physical activity.

Muscle Strengthening

Muscle strengthening activities include resistance training and weightlifting and are used to build muscle in the body for strengthening the various muscle groups. Activities that are considered muscle strengthening include weightlifting, resistance band exercises, or weight bearing exercises like push-ups. The repetitive nature of muscle strengthening coupled with lifting objects heavier than everyday activities assists with increasing muscle strength.

Similar to aerobic exercise, there are three identifiable components of muscle strengthening – intensity, frequency and sets or repetitions. Intensity is used to determine the amount of weight or how heavy the force is; frequency is how often a person engages in muscle strengthening activities; and sets or repetitions refers to how many times a person does the movement; for instance, 3 sets of 10 push-ups [5] Recommendations for muscle strengthening include participating in this physical movement at least 2 times per week and making sure to work all major muscle groups. The major muscle groups include abdomen, arms, back, chest, hips, legs, and shoulders. Opposing muscles should be developed for equal strength and to prevent injury from one muscle being stronger than the opposing muscle.

Bone Strengthening

No specific recommendations are given for amounts of bone strengthening activities in the Physical Activity Guidelines for Americans however these movements help prevent bone related diseases and promote overall strength and growth. Bone strengthening activities include impact movements and weight-bearing exercises such as running, brisk walking and weightlifting, these activities can be included in either the aerobic or muscle strengthening physical activity categories.

Balance

Incorporating balance activities becomes increasingly important as we age as well as throughout the lifespan. Balance activities prevent falls and can be completed by balancing on one leg, walking backwards, or standing from a seated position by engaging core muscles and not using one's hands to stabilize during the movement. Balance movements are supported by a strong core or abdomen and back, and strong legs to assist with everyday activities. [5]Poor balance is associated with falls in older adults therefore establishing good balance can aid in fall prevention and the ability to live independently. Much like bone-strengthening activities balance does not have a set amount of recommended time, however, better balance can improve movement in everyday life.

Flexibility

Much like good balance, flexibility is critical for increasing the capability to be more physically active and preventing injury or falls. There are not any specific guidelines for the amount of flexibility exercises, however activities such as stretching, yoga and tai chi can increase flexibility and support joints to enable full range of motion with all body parts.

Measurements of Physical Activity Rates

Moderate and vigorous are physical activity terms that broadly describe the intensity level of physical activity, however other measurements such as heart rate and Metabolic Equivalent of Task (MET) are also indicators of energy

expenditure that can be more accurate than a personal perceived rate of exercitation. Metabolic Equivalent of Task or MET describes the energy level expenditure in a specific physical activity.[5] While METs give a range for energy burned and intensity level, heart rate echelons provide a personal measurement of heart exertion levels during physical activity. Both METs and heart rate measurements will vary depending on a person's age, gender, and physical fitness level. Both can be used as indicators but neither creates a perfect means of measuring activity intensity levels. While participating in any type of movement is better than no movement at all, the intensity, duration, and frequency can increase energy expenditure as these components increase. For people who already participate in regular activity, knowing how to measure these areas of energy expenditure may assist with creating better endurance and fitness levels.

Metabolic Equivalent of Task (MET)

Metabolic Equivalent of Task (MET) are scaled depending on the amount of energy being expended to complete a task. METs are scaled using 1 as a resting level then increasing depending upon the level of energy expenditure. Moderate physical activity might expend 3.0-5.9 METs and vigorous exertion is considered 6.0 or more METs. [5] A MET score of over 8 is high intensity.[5] (see Figure 2) While METs give a range for energy burned and intensity level, heart rate echelons provide a personal measurement of heart exertion levels during physical activity and can assist with indicating MET levels.

Table 2. Examples of Moderate and Vigorous Physical Activities

Moderate Intensity 3.0 to 5.9 METs	Vigorous Intensity Greater than 6.0 METs
Walking 3-4.5 mph like walking the dog or for pleasure	Race walking 5 mph or faster
Race walking less than 5 mph	Jogging or running
Biking 5-9 mph on flat road, few hills	Wheeling a wheelchair
Aerobic dancing; Water aerobics	Biking more than 10 mph or on steep terrain
Yoga	Step aerobics; Water jogging
Weight training	Circuit weight training

Adapted from the CDC's General Physical Activities Defined by Level of Intensity[5,7]

Heart Rate

Exercise amounts, heart rate and exertion levels all contribute to the benefits of physical activity. Heart rate is measured by the number of times the heart beats during an activity or at rest. Resting heart rates can indicate a person's overall fitness level, higher fitness levels do not require the heart to work as hard because it is more efficient which creates a lower resting heart rate and better fitness level. Higher resting heart rates indicate the heart is working harder to pump blood through the body and isn't as efficient or physically fit. Target heart rate provides a guidance for exertion levels, but it is not a perfect science for determining intensity levels. By first determining the target heart rate for an activity an individual can regulate exertion levels at or below the target heart rate. Heart rate percentages indicate how difficult an activity is for the persons fitness level, age, and gender.

Estimating Heart Rate

Each person's exertion level will vary depending on their age, weight, and fitness levels. To find your heart rate, stop moving and take your pulse at your neck, wrist, or chest by counting the number of heart beats in a minute. To determine your *estimated maximum age-related heart rate*, subtract your age from 220.

For example, the formula for a 40-year-old would be:

220 – 40 = 180 beats per minute (bpm)

To determine moderate intensity, the target heart rate should be 64%-75% of maximum heart rate. To estimate moderate exercise rates, use the formula: *estimated maximum age-related heart rate x 0.64 = moderate exercise* or for a 40-year-old:

180 x 0.64 =115 *beats per minute for 64% exertion*

For vigorous physical activity levels, the heart rate should be between 77%-93% of estimated maximum age-related and estimating this can be done by using *estimated maximum age-related heart rate*:

Age-related heart rate x 0.77 (to 0.93) = vigorous exercise heart rate

Other Exertion Indicators

Wearable devices and talk tests are also used to estimate moderate and vigorous levels of movement. Similar to METs and heart rate these devices are useful but may not be an exact method for establishing exertion to the novice exerciser. Wearable devices sometimes called trackers have grown in popularity and like the Move Your Way Campaign were designed to increase activity levels. High level athletes often use wearable devices to determine practice levels and to encourage optimal performance. Devices used for elite athletes, much like those used by everyday novices, record and display information that includes heart rate, minutes of activity, minutes of vigorous activity or zone minutes, calories burnt, sleep activity and steps/miles taken in each period. Talk tests are a free and very subjective way to determine activity levels. According to the CDC if someone can talk but not sing the activity is moderate intensity, and vigorous intensity exercise means a person is unable to speak more than a few words without pausing to take a breath.[8]

Trends and Safety

The trend to move more and sit less has been met with opposition. To combat this continued sedentary lifestyle of Americans, the guidelines and marketing for physical activity are now being promoted to be less demanding and more inclusive through the Move Your Way campaign. The Move Your Way campaign from the US Department of Health and Human Services supports American's finding movement in varying increments and appealing methods for busy lifestyles. The program provides support materials and suggestions for enactment by not-for-profit agencies, educational institutions and others who might implement ideas for incorporating movement where and as often as possible. The campaign attempts to take the demand and stigma of routine exercise regimens and encourage physical activity, at personal physical fitness levels and within the time restraints of daily living.[4]

Safety during physical activity pertains to safe movement and a safe environment. Physical activity is safe for almost everyone and its benefits to health far outweigh the risks. Safe physical activity recommendations in the PAGA include topic areas like safe equipment, appropriate movement for fitness level, gradual increase, a safe environment, and being under the care of a physician.[5] Of special note in the safe physical activity recommendations is environment. Community interventions for physical activity should ensure a safe environment for movement, especially marginalized communities who may lack safe resources to access exercise opportunities. Consideration of safe exercise environment include green space, parks free from violence and safe sidewalks and bike lanes. Circumstances such as safe access should be considered when health care professionals encourage physical activity so that recommendations are inclusive and equitable.

Physical Activity for Improved Health Outcomes and Chronic Disease Prevention

Obesity

Obesity rates in the United States continue to rise as Americans eat a high energy diet with poor physical activity

levels to counteract calorie consumption. Between 2017-2020 the obesity prevalence in the United States was 41.9% according to the National Health and Nutrition Examination Survey 2017–March 2020.[9] Americans need to expend more energy to combat high caloric diets and consequently maintain a healthy weight to reduce the incidence of obesity in both adults and children. Physical activity that burns more energy can result in weight loss and the reduction of co-morbidities associated with obesity. As Americans sit more and move less, obesity has become a national epidemic. According to the State of Obesity: Better Policies for a Healthier America 2022 developed by Trust for America's Health:

- Nationally, 41.9 percent of adults are obese.
- Black adults had the highest level of adult obesity at 49.9 percent.
- Hispanic adults had an obesity rate of 45.6 percent.
- White adults had an obesity rate of 41.4 percent.
- Asian adults had an obesity rate of 16.1 percent.
- Rural parts of the country had higher rates of obesity than urban and suburban areas.[10]

Chronic Disease Prevention and Implications of Expanded Mortality

Physical activity has been associated with numerous health benefits in addition to healthy weight management. Symptoms of arthritis through joint friendly physical activities like walking or swimming have been shown to reduce symptoms, improve pain associated with arthritis and improve body function and mood.[11] Physical activity can improve sleep quantity and quality and improve cognitive and memory functions due to the increased blood flow physical activities create in the body.[12,13] It has also been found to reduce the risk of dementia, including Alzheimer's Disease.[13] Increasing daily step counts from 4,000 to 8,000 has been shown to decrease mortality from various chronic diseases.[15] Physical activity can improve aerobic function which supports better cardiovascular health and could prevent heart disease and stroke.[16] Systolic pressure and a stronger heart muscle from improved blood flow are also positive outcomes from physical activity. High-density lipoprotein (HDL) cholesterol (good) is raised through regular physical activity and low-density lipoprotein (bad) is lowered which balances cholesterol levels.[16] Movement assists the body with insulin burning which can improve blood sugar numbers whereby improving or preventing diabetes.[14] Lung function is improved through physical activity and there is evidence that movement like walking could improve lung function in adults with asthma for better asthma control.[17] Physical activity supports better bone density and muscle mass to stop the effects of bone loss or osteoporosis.[18] Updated in the 2nd edition of the PAGA are findings of 6 types of cancer that could be prevented through regular physical activity which include bladder, endometrium, esophagus, kidney, stomach and lung which were added to the already existing list that included breast and colon cancer.[14] The increased blood flow and overall euphoric feeling that physical activity can produce can increase energy and stamina for a better mood therefore physicians have started prescribing more physical activity as a preventative medicine intervention.

Improved Overall Health Outcomes/Longevity of Life – Metabolic Health

Metabolic syndrome has been defined in varying ways by different organizations however the common factors are a "high weight circumference, dyslipidemia, hypertension and insulin resistance."[16] According to the World Health Organization (WHO) "unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, elevated blood lips and obesity" which are metabolic risk factors that can lead to cardiovascular disease.[19] Metabolic syndrome increases a person's likelihood of death significantly depending on the disease factors but could be prevented or managed if behaviors were modified to reduce risk factors with interventions such as increased physical activity and a nutrient dense diet.

Benefits vs Risk of Physical Activity

American adults are not active enough and as a result suffer from chronic diseases and ailments associated with a sedentary lifestyle, the benefits of physical activity far outweigh the risks. As has been mentioned in this chapter the benefits of physical activity and impact on physical and mental health are numerous. Additionally, there are limited risk factors to physical activity especially after consulting a physician. Regular movement that is sustained for both children and adults will have positive long term health benefits and has the potential to extend the lifespan.

Benefits

While Americans seemly understand the benefits of physical activity such as improved quality of life, chronic disease prevention and a general sense of well-being this awareness does not appear to be enough to increase amounts of movement. As public health professionals it is important to educate the public and promote physical activity, but it is also critical to realize that information alone is not enough for behavior change. Later in this chapter information is provided on policy, systems, and environmental change which are critical components of public education to increase physical activity and adapt the built environment to support all Americans being more active.

Risks

Reasons for physical inactivity vary and typical barriers include lack of time, injury fears, pain while exercising or chronic pain, and lack of enjoyment. In most cases actual risk factors for exercise are limited.[20] Both aerobic and muscle strengthening physical activities support disease prevention and better health outcomes. To debunk the excuses for lack of physical activity public health professionals should promote moving in ways that are enjoyable so that it becomes consistent within everyday routines as is exemplified in the Move Your Way Campaign.

Behavioral Strategies for Physical Activity and its Impact on Disease Prevention

Just as fruits and vegetables are prescribed by doctors for better health outcomes so is physical activity and/or exercise. These non-pharmaceutical options are being prescribed to patients to lessen the effects of or prevent chronic disease, improve overall health, and establish proper weight management.[21] Likewise, as an alternative or in addition to pharmaceuticals, prescribing doctors often recommend physical therapy. Appointments with a physical therapist help to remedy an injury or pain by teaching exercises and movements to strengthen afflicted body areas for better mobility and health outcomes. Promotion of non-pharmaceutical interventions as a community intervention has potentially positive outcomes in both preventing obesity related chronic disease and encouraging more physical activity.

Policy, Systems and Environmental Change for Physical Activity

Promoting more physical activity should include teaching people to move more by explaining the recommendations for physical activity as well as providing examples on how to be active. While education is a needed and important component for encouraging healthier behaviors, as a standalone it can be ineffective for influencing long term behavior change. Given the likelihood that education has informed people of the needed behavior change does not mean that the change can be easily made. Community health outreach interventions have expanded to include both education and changes in the built environment. Policy, systems and environmental (PSE) initiatives are now recognized as an essential companion to educational efforts for equitable change. PSE changes are defined in various ways depending on the source; however, the basic premise of these changes is to make a healthy option easily available to everyone. PSE changes create more equitable and accessible means for healthy behavior changes, especially when accompanied with science-based education. Teaching the community while synchronously creating PSE for accessible and equitable physical activity better ensures American's ability to move.

Policy

Policy in the context of PSE is established on various levels of public or private institutions. Policy change is written and officially documented for implementation verses a suggestion or idea.[22] A policy change could include "legislative advocacy, fiscal measures, taxation, and regulatory oversight".[22] For example, in a school district a policy that might be put into place by the board of education could be to extend the length of time for physical education class in all schools. As a policy this would be voted on by the school board and implemented by all schools in the district. Agencies like the CDC provide suggestions on what and how to implement policy changes while individual institutions and agencies also create policies based on budget needs and available resources.[23] One of the most notable policy changes in the Unites States have been smoke free policies in public areas.[24] These policies, like many, were met with opposition initially but are now so commonplace that many people under the age of 25 in the United States have never been exposed to secondhand smoke while eating in a restaurant. The gradual introduction of smoke free policies has expanded so that implementing new policies prohibiting use of tobacco products in public spaces is more easily introduced and enacted. It is important to recognize that tobacco policies like other health behavior change policies were not always popular or mainstream and have taken decades to readily enact.

Systems

Systems changes are variations in the way something is done to create better health outcomes.[22] A systems change

may not be officially documented like a policy, but it could be. An example of a systems change might be having a walking meeting at work. This may not be a policy that is written down but if a supervisor encourages meetings to take place while walking it is changing the traditional system of how things are done. While that is a simple example, more complex systems might be a school making certain days of the week riding school bus days

whereby students ride bikes to school verses riding the bus. This systems change could be voluntary and not written down, although it may also be a policy to provide for proper student care. All three PSE components do have a likelihood to overlap but don't always. Some systems changes can become policies or environmental changes. For example, changing vending machines at an office to contain only healthy food options is systems change. However, policy makers might see a reduction of obesity levels when this systems change is made and in turn a reduction in health care cost whereby encouraging them to make it a policy that only healthy snacks be in the vending machine. Systems changes are sometimes the first step in creating a policy by providing evidence of positive modification worthy of permanent implementation.

Environmental

Environmental changes usually involve larger scale change; however, some can be small in nature too. Environmental change can involve the physical surroundings like creating a safe walking path for physical activity, as well as social and economic outcomes to change accessibility to better health behaviors and outcomes.[22] An example of environmental change are healthy corner store initiatives, that create better access to healthy food choices in food desserts or traditionally food insecure areas. Signs that label a park's inclusive exercise equipment, walking trails or biking trails and safely lit areas for people to be physically active are environmental changes too. Much like systems changes, sometimes the environment is part of a policy change or acts to make a policy change because of its positive effect on the community.

Policy Systems and Environmental Change for Creating Equitable Health Outcomes

To some people access to safe and affordable physical activity may not require a second thought, however for some physical activity is out of reach due to limitations beyond their control. For instance, in some areas safe outdoor play for children is not available, and in others just going for a walk could be hazardous due to neighborhood violence, traffic dense roads or poorly lit walkways. PSE initiatives and community interventions designed by public health professionals, schools and government agencies establish more equitable physical activity opportunities for all Americans. When educating the public on being more physically active and less sedentary it is important to consider the built environment of the audiences. For instance, are there bike lanes for safe biking, are sidewalks well-lit and free of hazards or is there any green space available? An inability to have access to safe affordable physical activity prohibits people of color and minority groups that are already at high risk for chronic disease from being able to exercise. Inequities in physical activity just like biases in health care, food access and safe living prohibit vulnerable populations from moving to prevent diseases and can disproportionately lead to an un-healthy life. While PSE work has been established in various initiatives nationally, it often is implemented in upper-middle class areas where fewer minority groups live, work and play. To create equity for physical activity, PSE change needs to support accessibility through built environments that are safe and practical for all to use. Policy initiatives seeking to improve physical activity levels through a "built environment should address poverty, safety and social cohesion" to provide more active communities.[25]

Implications and Outcomes of Built Environments

Creating an Active America

The goal of the CDC is to get 27 million people moving by 2027. The CDC tool kit provides ideas for stakeholders to support this initiative and reduce chronic disease and obesity with more movement.

According to the Environmental Protection Agency (EPA) built environment is the "man-made or modified structures

that provide people with living, working and recreational spaces."[26] Built environments are important in the context of physical activity because poor access reduces the likelihood that people will move. People who live in neighborhoods with inadequate access to "quality housing, sidewalks and parks were up to 60% more likely to be obese or overweight."[27] Policy, Systems and Environmental efforts can improve built environments by encouraging and supporting land use for walkability, less car dependent neighborhoods, active transportation options and policies like safe routes to schools and complete streets.[10] In the early 2010s the Robert Wood Johnson Foundation, Center on Society and Health and Virginia Commonwealth University created maps of major cities to demonstrate the disparities that may occur around a large city depending on the exit of the highway, train stop or zip code. These maps demonstrate how the built environment and access to healthy food and healthcare can drastically change life expectancy within a short geographic distance.[27] These maps demonstrate health disparities from one train stop to the next, can make the difference between living 75 years and 85 and amplifies the discrepancy in mortality due to inadequate living, working, and playing standards

Physical Activity Community Interventions

Policy, systems, and environmental changes are designed to make healthier choices easy and community interventions on the national, state, and local level support and encourage Americans to be more active. The Complete Streets program is a national initiative implemented by the U.S Department of Transportation. This effort seeks to make streets safer though evaluation and financial support for bike lanes, sidewalks, crosswalks and even landscaping while promoting walking and biking. It also encourages community planning to ensure sustainability of safe accessible streets for years to come within the infrastructure of municipalities.[28] States like New Jersey created specific Complete Streets Policy so that future roadways are accessible and safe to residents, demonstrating how national programs can be implemented and structured for state and local use by planning for the future using policy such as complete streets. New Jersey Safe Routes. The Safe Routes to School from the National Center for Safe Routes to School supports infrastructure as it pertains to children safely walking and biking to and from school and is further demonstration of PSE initiatives that support a more physically active community. The Supplemental Nutrition Assistance Program – Education (SNAP-Ed) supports national physical activity interventions that are implemented on the state and local levels in addition to community nutrition interventions. The SNAP-Ed Toolkit encourages agencies who implement the SNAP-Ed grant to develop physical activity interventions that best serve the state and local community while also funding projects that support movement using parks and public spaces.[29] Evidence based strategies for community interventions support behavior change for increased physical activity and chronic disease prevention.

State and Local Examples of Community Interventions

The Complete Streets Movement in New Jersey

Local NJ City Complete Street Example and Process

Local NJ Complete Streets Program that improves city access and economy

Summary – Public Health Implications of Physical Activity

Physical inactivity has become a health crisis in the United States as lack of movement and a sedentary lifestyle contribute to incidence of chronic disease and early morbidity. Obesity due to high caloric diets and poor activity habits have combined to make the perfect storm of a public health crisis. The price of inactivity is evident through loss of work, early onset of chronic diseases and increased healthcare costs for treatment of preventable illnesses. Public health professionals can have a direct effect on the reduction of obesity and chronic disease through educational efforts and PSE initiatives that encourages more deliberate and inclusive access to physical activity. People are constantly looking for a quick and easy way to be fit but the simple solution to better health is regular movement accompanied by a nutrient dense diet that is not higher in calories than the expended amount of energy.

As this chapter has demonstrated there are many promotional and educational programs created by the US Department of Health and Human Services, the United States Department of Agricultures, and Trust for America's Health, as well as other public health agencies. It is critical for physical activity promotion and PSE initiatives to be consistent and produced by reliable evidence-based sources. Reliable information that can positively influence inclusivity so that all Americans have access to reliable, safe, and affordable physical activity is needed to increase movement to recommended levels.

Resources

Physical Activity Guidelines for Americans 2nd edition
School-based Programs to Increase Physical Activity
Rural Health Information Hub PSE Toolkit

Critical Thinking Questions

- Policy, systems, and environmental change interventions create improvements to make the healthy choice the easy choice. For physical activity what policy, systems and environmental changes could be made to create greater access to safe physical activity for at risk populations? How might these PSE interventions be executed to make change?
- Give an example of a systems change at a school that would create more physical activity.
- Give an example of a systems change that could create more accessibility to all physical activity at a business.
- Give an example of an environmental change that a municipality could create safer access to physical activity.
- Using the Adult Physical Inactivity Prevalence Maps https://www.cdc.gov/physicalactivity/data/inactivity-prevalence-maps/index.html discuss how these maps might be used to create a community intervention to decrease the likelihood of obesity in specific groups, and in specific geographic areas? How might this data be used to support funding for community change?

References

1. World Health Organization. Let's be active. More active people for a healthier world. Accessed October 20, 2022. https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf?sequence=1&isAllowed=y
2. Centers for Disease Control and Prevention. Why should people be active? Published July 12, 2022. Accessed September 2, 2022. https://www.cdc.gov/physicalactivity/activepeoplehealthynation/why-should-people-be-active.html
3. Centers for Disease Control and Prevention. National Center for Health Statistics. National Health Interview Survey: glossary. Published May 10, 2019. Accessed August 18, 2022. https://www.cdc.gov/nchs/nhis/physical_activity/pa_glossary.htm
4. U.S. Department of Health and Human Services. Move your way activity planner. Accessed September 10, 2022. https://health.gov/moveyourway/activity-planner
5. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans – 2nd edition. Published 2018. Accessed September 1, 2022. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf
6. Centers for Disease Control and Prevention. Adult physical inactivity prevalence maps by race/ethnicity. Published October 20, 2022. Accessed October 20, 2022. https://www.cdc.gov/physicalactivity/data/inactivity-prevalence-maps/index.html
7. Centers for Disease Control and Prevention. General physical activities defined by level of intensity. Accessed October 1, 2022. https://www.cdc.gov/nccdphp/dnpa/physical/pdf/pa_intensity_table_2_1.pdf
8. Centers for Disease Control and Prevention. Target heart rate and estimated maximum heart rate. Accessed October 20, 2022. https://www.cdc.gov/physicalactivity/basics/measuring/heartrate.htm
9. Stierman B, Afful J, Carroll MD et al. National Center for Health Statistics (U.S.) national health and nutrition examination survey 2017–March 2020 pre-pandemic data files development of files and prevalence estimates for

selected health outcomes. Centers for Disease Control and Prevention. Published Date: 06/14/2021. Accessed October 2, 2022. NHSR No. 158. https://stacks.cdc.gov/view/cdc/106273

10. Trust for America's Health. State of obesity 2022: Better policies for a healthier America. Published September 27, 2022. Accessed October 21, 2022. https://www.tfah.org/report-details/state-of-obesity-2022/
11. Centers for Disease Control and Prevention. Physical activity for arthritis. Published February 20, 2019. Accessed October 20, 2022. https://www.cdc.gov/arthritis/basics/physical-activity-overview.html
12. Wang F, Boros S. The effect of daily walking exercise on sleep quality in healthy young adults. *Sport Sci Health*. 2021;17(2):393-401. doi:10.1007/s11332-020-00702-x
13. Di Liegro CM, Schiera G, Proia P, Di Liegro I. Physical activity and brain health. *Genes (Basel)*. 2019;10(9):720. Doi:10.3390/genes10090720
14. U.S. Department of Health and Human Services. Top 10 things to know about the second edition of the physical activity guidelines for Americans. (n.d.). Health.gov. Retrieved October 24, 2022. https://health.gov/our-work/nutrition-physical-activity/physical-activity-guidelines/current-guidelines/top-10-things-know
15. Saint-Maurice PF, Troiano RP, Bassett DR Jr, et al. Association of daily step count and step intensity with mortality among US adults. JAMA. 2020;323(12):1151-1160. doi:10.1001/jama.2020.1382
16. Myers J, Kokkinos P, Nyelin E. Physical activity, cardiorespiratory fitness, and the metabolic syndrome. *Nutrients*. 2019;11(7):1652. doi:10.3390/nu11071652
17. Panagiotou M, Koulouris NG, Rovina N. Physical activity: A missing link in asthma care. *J Clin Med*. 2020;9(3):706. doi:10.3390/jcm9030706
18. Pinheiro MB, Oliveira J, Bauman A, Fairhall N, Kwok W, Sherrington C. Evidence on physical activity and osteoporosis prevention for people aged 65+ years: a systematic review to inform the WHO guidelines on physical activity and sedentary behaviour. *Int J Behav Nutr Phys Act*. 2020;17(1):150. doi:10.1186/s12966-020-01040-4
19. World Health Organization. Noncommunicable diseases. September 16, 2022. Accessed October 20, 2022. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
20. Schwartz J, Rhodes R, Bredin SSD, Oh P, Warburton DER. Effectiveness of approaches to increase physical activity behavior to prevent chronic disease in adults: A brief commentary. *J Clin Med*. 2019;8(3):295. doi:10.3390/jcm8030295
21. Lucini D, Pagani M. Exercise prescription to foster health and well-being. A behavioral approach to transform barriers into opportunities. *Int J Environ Res Public Health*. 2021;18(3):968. doi: 10.3390/ijerph18030968
22. Rural Health Information Hub. Policy, systems, and environmental change. Accessed October 20, 2022. https://www.ruralhealthinfo.org/toolkits/health-promotion/2/strategies/policy-systems-environmental
23. Centers for Disease Control and Prevention. School-based programs to increase physical activity. Published September 26, 2022. Accessed October 20, 2022. https://www.cdc.gov/policy/opaph/hi5/physicalactivity/index.html
24. Centers for Disease Control and Prevention. Tobacco free. Smokefree policies improve health. Published September 2, 2022. Accessed October 20, 2022. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/protection/improve_health/index.htm
25. Foh EP, Brown RR, Denzongpa K, Echeverria S. Legacies of environmental injustice on neighborhood violence, poverty and active living in an African American community. *Ethn Dis*. 2021;31(3):425-432. doi:10.18865/ed.31.3.425 26.
26. Virginia Commonwealth University. Center on Society and Health. Mapping life expectancy. Accessed October 20, 2022. https://societyhealth.vcu.edu/work/the-projects/mapping-life-expectancy.html
27. United States Department of Transportation. Federal Highway Administration. Complete streets in FHWA. Accessed November 21, 2022. https://highways.dot.gov/complete-streets.
28. United States Department of Agriculture. SNAP-Ed Connection. Physical activity. Accessed November 21, 2022. https://snaped.fns.usda.gov/nutrition-education/nutrition-education-materials/physical-activity.

6.

Chapter Six: Community Interventions in Obesity Prevention

Authored by: Sherri M. Cirignano, MS, RDN, LDN

Introduction

Community interventions that work towards the prevention of overweight and obesity are implemented at the local, state and/or national level and can be found in a variety of settings, targeting populations that include individuals throughout their lifespan. Some of these interventions were created for the specific purpose of creating healthful choices and/or environments that would promote a decrease in overweight and obesity, while others are longstanding initiatives that have been updated to include healthful changes to work towards obesity prevention. In this chapter, we will explore community interventions in a variety of settings and their associated target population and what is known about their rates of success.

Settings for Obesity Prevention Interventions

"*To reverse the obesity epidemic, community efforts should focus on supporting healthy eating and active living in a variety of settings.*"[1]

Early Care Sites

A majority of young children, ages birth through age 5, spend time each week away from their parents or guardians at an early care site. It is estimated that 3 out of 5 children, or about 12.5 million children, in this age category receive center-based care at least once a week.[2] With a national rate of obesity among 2-4 year old children at 12.8% and an even higher rate of 15% in children of the same age range who participated in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in 2020, early care sites are an ideal setting to assure healthy eating and physical activity practices are in place to work towards decreasing these numbers.[3]

All 50 states and the District of Columbia have state-mandated licensing requirements for early care sites to operate and may already include those that promote healthy eating and physical activity. The Centers for Disease Control and Prevention (CDC) has developed evidence-based standards for states to include in their licensing requirements that will promote healthy behaviors and the prevention of obesity. The CDC reports on the progress of states in adopting these high-impact obesity prevention standards through State Licensing Scorecards**.** There are 47 total standards that can be adopted focusing on the following topics: healthy infant feeding; nutrition; physical activity; and screen time limits. Based on these four issues, state scores can have an overall total score of 100. In 2019 state scores ranged from a high of 80 out of 100 to a low of 30 out of 100.[4] The CDC also offers a guide to assist states with ways they can "embed" obesity prevention standards at their early care sites. This guide, the Spectrum of Opportunities Framework, includes ways to incorporate healthful practices that encompass healthy eating, physical activity, breastfeeding, and reduced screen time among young children in early care settings.[5]

The CDC offers funding for several obesity prevention programming efforts for early care sites. They include the State Physical Activity and Nutrition (SPAN) Program and the Racial and Ethnic Approaches to Community Health (REACH) program. SPAN is a CDC grant program that provides funding for 16 statewide evidence-based initiatives that focus on improving nutrition and physical activity in the state's early care sites.[6] REACH, started in 1999, is a national CDC program that works towards reducing racial and ethnic health disparities such as diabetes and obesity. REACH programming between 2014-2018 has improved healthy access to food and drink to over 2.9 million people and increased physical activity opportunities for about 1.4 million people.[7]

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is a national program provided by the Food and Nutrition Service department of the United States Department of Agriculture (USDA.) WIC was created in 1974 to provide nutritious foods, nutrition education and healthcare referrals to low-income pregnant and postpartum women and infants, and children to age 5 who are at nutritional risk. WIC also promotes breastfeeding as part of its nutrition education programming. States receive federal grants from the USDA to implement WIC in locations such as county health departments, hospitals, mobile clinics and community centers throughout their state.[8]

WIC designates specific foods that participants can receive. Changes to the WIC food package were implemented in 2010. As a result of these revisions, researchers have found an increase of availability of healthy foods by some WIC-authorized vendors,[9] an increase in consumption of whole grain products, fruits and vegetables and a decreased intake of juice.[10] During the time period of 2010-2016, there was also a decrease in the prevalence of obesity and severe obesity in WIC participant children aged 2 to 4 which may be due to the changes in the food package.[10] Continued research on this topic is needed.

Other nationally run programming that include an element of obesity prevention includes Early Head Start and Head Start, administered by the Administration for Children and Families, an agency within the US Department of Health and Human Services. Head Start participants receive healthy food through either the Child and Adult Care Food Program (CACFP) or the National School Lunch Program (NSLP) and the Head Start program is required to "actively engage in obesity prevention both in the classroom and through its family-partnership process."[11] The CACFP offers nutritious food at early care sites with meal and snack standards based on the Dietary Guidelines for Americans.

Schools

Children aged 5 and older spend a significant amount of time at school, making it an ideal location for implementing obesity prevention measures and assuring an overall healthful environment that promotes nutritious foods and physical activity. This is important for all children, but is especially important for lower-income and minority children who have been found to be at a higher risk for obesity in comparison to other children.[12] The 2022 report *The State of Obesity: Better Policies for a Healthier America* from the Trust for America's Health states that 17% of children in the US live below

the poverty level and up to 23% of children are food insecure.[11] Obesity levels in US children continues to be elevated. Between 2017-2020, data indicate obesity prevalence was 20.7% among 6–11 year-old children and 22.2% among 12-19 year old children. These numbers rise to a prevalence of 26.2% among Hispanic children and 24.8% among non-Hispanic Black children during the same timeframe.[13]

National efforts that have worked to reverse the obesity epidemic for children include the Healthy, Hunger-Free Kids Act of 2010 (HHFKA). The primary goal of this legislation was to set policy and authorize funding to improve child nutrition in USDA's primary child nutrition programs including the NSLP, the School Breakfast Program, (SBP) the Summer Food Service Program, WIC, and the CACFP. Since its implementation, which was required of the NSLP by 2012, researchers have looked at the possible effects of the HHFKA over the past several years. Findings indicated an overall increase in the quality of school meals,[10,14] and in improved consumption of school meals.[10] In addition, one study found a "substantially" decreased risk of obesity prevalence among children in poverty.[12] These findings overall indicate that sweeping federal policy changes such as the HHFKA can potentially result in long-term benefits.

In 2019, through the NSLP, schools provided over 4.8 billion lunches to children nationwide[15] and through the SBP, provided over 2.4 billion breakfast meals.[16] Other federal programs that provide opportunities to increase healthful choices for children include the Summer Food Service Program, serving free healthy meals and snacks to children in low-income communities throughout the summer; the Fresh Fruit and Vegetable Program, providing fresh fruits and vegetables as school snacks; and the Farm to School Grant Program, providing opportunities for schools to improve their access to local foods.[11]

The HHFKA also strengthened a requirement for schools participating in the NSLP and/or the SBP to develop wellness policies.[17] School Wellness Policies are individualized for a school's specific needs, should include specific nutrition and physical activity goals and should be created by the school community with a school representative leading the group who has the authority to assure school compliance. A review of the effect of school wellness policies shortly after implementation of the HHFKA found that schools were "largely successful" in the implementation of policy changes consistent with the HHFKA.[18]

The Supplemental Nutrition Assistance Program also known as SNAP, and its educational component, SNAP-Ed are national programs of the USDA that assist food insecure children and their families. SNAP, created in 1975, was updated October 2021 for the first time since its inception by increasing the amount of the SNAP benefit an individual receives, with a goal to increase the possibility for participants to achieve a healthy diet. The Thrifty Food Plan is used for SNAP benefits and is a food plan that estimates the cost of "a nutritious, practical, cost-effective diet prepared at home for a family of four."[19]

SNAP-Ed partners with state and local organizations to provide evidence-based nutrition education and obesity prevention programs for those who are eligible for SNAP benefits. In addition to programing, SNAP-Ed also promotes healthy eating and physical activity through social marketing and working towards policy, systems and environmental changes. (PSE) PSE are interventions that work to impact the economic, social, or physical environment with a goal to improve a community's health.[20]

The Expanded Food and Nutrition Program (EFNEP) was started in 1969 as the first national nutrition education program for low income populations. This community outreach program is funded by the USDA and the National Institute of Food and Agriculture (NIFA) and managed by Land Grant Universities. (LGU's) LGU's are located in the District of Columbia and all US states and territories and includes Cooperative Extension. Cooperative Extension is the outreach arm of the LGU's. Many LGU's use paraprofessional staff in Cooperative Extension to implement EFNEP programming to adults and youth in a variety of settings including schools.

Both EFNEP and SNAP-Ed report success in their programming. In 2021, EFNEP educators reported working directly with close to 150,000 youth and 40,000 adults[21]with outcomes including improvement in their diets and nutrition practices and an increase in their physical activity levels.[22] SNAP-Ed has a larger reach and in some states, SNAP-Ed, like EFNEP, is managed by their LGU's. In 2019, SNAP-Ed LGU educators reported providing direct education to 1.7 million people, with nearly one-half of all participating in SNAP-Ed as children. Many outcomes were reported including decreasing consumption of sugar-sweetened beverages and increasing physical activity and leisure sport through direct education. Thousands of PSE changes related to nutrition and physical activity were also reported.[23]

Senior Nutrition Sites and Community Centers

In addition to implementing programming in early care sites and schools, SNAP-ED educators also implement programming in the community in settings such as Senior Nutrition sites and community centers. SNAP-Ed programming for older adults covers topics including nutrition and physical activity with educational content that is geared specifically to this population. A majority of older adults who attend SNAP-Ed educational programs have increased nutrition knowledge[24] and research has found that the programming significantly influences their ability to overcome barriers to access, shop for and prepare food.[25]

The Commodity Supplemental Food Program (CSFP) provides supplemental nutritious USDA foods and nutrition education to low-income adults over the age of 60. Under the USDA, states administer the CSFP through various agencies such as health, social services, education or agriculture departments, storing and distributing the food to local agencies. The local agencies determine participant eligibility, distribute the food and coordinate the required nutrition education. Nutrition education is provided through a contract with the local agency. Another USDA program specifically geared towards older adults is the Seniors Farmers' Market Nutrition Program. (SFMNP) For low-income seniors, the SFMNP provides coupons that can be used to acquire eligible foods including locally grown fruits, vegetables, herbs and honey at farmers' markets, community supported agriculture (CSA) programs, and roadside stands. These coupons are also available through the WIC program for young families.

As a result of the 2006 Reauthorization of the Older Americans Act, nutrition education that is geared towards healthful choices and encourages physical activity is required at congregate meal sites such as Senior Nutrition sites and community centers throughout the country.[26] This education requirement is often fulfilled by educators who are Registered Dietitians (RDs) from organizations such as the Department of Family and Consumer (or Community Health) Sciences (FCS) from Cooperative Extension and/or RDs who are employed by local grocery stores. These educators generally provide monthly or quarterly sessions on topics including fat or sodium in the diet, reading food labels, or healthful eating on a budget. The ability to assess behavior change when providing nutrition education to older adults in a congregate meal setting can be a challenge and is not frequently attempted. Some results have indicated that use of creative educational displays can be an effective tool in increasing knowledge of specific health-related topics[27] and delivery of a nutrition curriculum in several consecutive weeks can lead to an increase in knowledge and behavior regarding reducing intake of fat and increasing fruits and vegetables.[28]

Worksites

In the same manner that early care sites and schools are ideal settings for the implementation of obesity prevention programming for children, worksites are ideal settings to promote wellness for adults. Worksites are encouraged to promote a healthy work environment through support of healthy eating and activity. Some workplaces offer worksite wellness programs through worksite wellness policies and/or they are offered through employee benefits.

The CDC offers employers ways to improve their workplace environment to work towards employee wellness. Suggestions include increasing physical activity opportunities by adding walking paths and supporting gym access on- or off-site. They can also encourage walking meetings, walking clubs or competitions, and offer incentives to encourage physical activity. Those in charge of workplace cafeterias can consider if offerings are providing healthy food and beverage options for employees.[29]

Worksite wellness programs are also offered on the state level. For example, the State of New Jersey Department of Health has created a Working Well Toolkit, The toolkit provides examples of evidence-based best practices to work towards optimal productivity and decrease absenteeism and staff turnover.[30]

The success of worksite wellness interventions has been examined by researchers, including worksites with specific settings. The healthcare work setting is associated with a higher prevalence of obesity due to long work hours, shift work and work-related stress. A recent systematic review of wellness interventions for healthcare workers found that a majority of participants reported improvement in weight with all methods of intervention delivery including via phone, internet or face to face. They also found improvement in weight-related outcomes occurred when the intervention was provided by a trained professional.[31]

Another systematic review looked at the availability and effectiveness of wellness interventions for the low-income working population in the US. Low-wage workers in the US who are in positions such as food preparation and childcare

make up a higher incidence of such positions than in 31 other developed countries, and have a higher risk of chronic disease.[32] The review determined that the availability of wellness programs is limited at this time and much more needs to be done to develop and implement health promotion programming that is specific to and accessible to this population.

Worksite wellness programs for the general population have also been reviewed for their impact on participants' body composition[33] (eval of work well-US) and their return on investment (return on invest) for employers. Although there were inconsistencies in 23 studies reviewed for body composition impacts after participating in wellness programs, 13 studies reported results including significant changes in body composition such as decreases in BMI, body fat percentage and waist circumference. These changes were reported in interventions that were associated with longer periods of implementation, in those that included an interactive component for participants and for those that used the client-centered counseling style known as motivational interviewing.[33]

Employees with health issues, in particular those with noncommunicable diseases such as diabetes and heart disease, can result in high costs for employers in the form of absenteeism and employer-provided health insurance. A systematic review examining the potential return on investment of workplace wellness programs did not find any evidence in the studies reviewed to indicate that they were beneficial in providing improvement in the health of those studied and thus leading to a decrease in costs for employers. The authors of this review also concluded that more robust studies in this area are needed.[34]

Community Interventions in the Broader Community

Government-Based Guidance for Obesity Prevention Interventions

The obesity pandemic has resulted in a plethora of health focused interventions that are available in communities across the country for children, adolescents, and adults of all ages. Guidance for designing interventions that meet national objectives are provided from government-based entities such as the CDC, evidence-based reports such as the Dietary Guidelines for Americans (DGA) and large-scale initiatives such as Healthy People 2030. The DGA 2020-2025 is "designed for policymakers and nutrition and health professionals" and assists these groups and others on the state and local level to create associated policies and develop educational programming for the public.[35] (Please see a review of the DGA in Chapter 4.)

Healthy People 2030 is developed under the direction of the US Department of Health and Human Services, within their Office of Disease Prevention and Health Promotion. Healthy People's Mission is "*To promote, strengthen, and evaluate the nation's efforts to improve the health and well-being of all people.*"[36] To attain the goals of their Mission, Healthy People 2030 determines objectives that touch on every aspect of health and well-being including 358 measurable objectives under the following headings: health conditions; health behaviors; populations; settings and systems; and social determinants of health. Within each heading, there are topics with more specific goals and objectives, many of which can be cross referenced. For example, in the topic "Overweight and Obesity", the goal is to "Reduce overweight and obesity by helping people eat healthy and get physically active," and the objectives under this heading include Diabetes and Nutrition and Healthy Eating.[37] These goals and objectives help to drive the work that is planned and implemented regarding health and wellness nationwide.

The White House Conference on Hunger, Nutrition and Health, hosted by the Biden-Harris Administration and held in September of 2022, was the first conference of its kind in over 50 years. Participants of the conference included "elected officials; advocates and activists; and leaders of business, faith and philanthropy" from across the US[38] and resulted in the Biden-Harris Administration National Strategy on Hunger, Nutrition and Health. The "bold goal" of this strategy is to end hunger and increase healthy eating and physical activity by 2030, thereby decreasing the incidence of diet-related chronic diseases for all Americans. The strategy encompasses all individuals including those living in urban, suburban, rural and Tribal communities and territories and focuses on issues of equity, access and disparities.[39]

To meet the above goals, the National Strategy identifies the following five pillars:

- Improve Food Access and Affordability
- Integrate Nutrition and Health
- Empower All Consumers to Make and Have Access to Healthy Choices

- Support Physical Activity for All
- Enhance Nutrition and Food Security Research

The strategy recognizes that the federal government cannot meet these ambitious goals by 2030 alone or without resources, includes Calls to Action from all potential partners throughout the strategy and includes more than $8 billion in new commitments to do so. These commitments from the private and public sector include in-kind donations to community-based organizations to work towards completing the work of the strategy including community interventions from the start-ups Everytable and Wellory and the nonprofit organizations Action for Healthy Kids, Hunger Free Oklahoma and many more.[39]

Non-Government Organizations and Obesity Prevention Interventions

Many non-government organizations (NGO) have also been created, both on the national and local level, to assist in addressing the issues that lead to overweight and obesity. Share Our Strength was started in 1984 as a response to the famine in Ethiopia, and although their work continues to address national and international disaster relief efforts,[40] Share Our Strength is possibly best known for its national campaign to end childhood hunger, No Kid Hungry,[41] and its community cooking program Cooking Matters. Cooking Matters (CM) works to "make eating healthier fast for families everywhere" with their signature six-week cooking classes for small groups of children to older adults.[42] All classes include a nutrition education component and include an eating on a budget focus.

The impact of CM on children ages 9-13 from 2012-2017 was assessed in a large study with over 18,000 children. Outcomes indicated that from pre- to post-survey, the children studied had an improvement in both their attitudes towards healthy foods and self-efficacy for healthy eating and cooking.[43] CM also reports that in 2015, a national study of CM participants indicated "83% of parents and caregivers report readiness to adopt healthier, budget-friendly shopping techniques."[44] In addition to cooking classes, CM also offers grocery store tours, online professional development for caregivers and for those unable to join in-person classes, the CM website offers videos and healthy recipes.

The Food Trust is an NGO that was founded in 1992 in the Philadelphia, PA area, but now works to "ensure delicious nutritious food for all" nationwide by working with neighborhoods, institutions, retailers, farmers and policymakers.[45] The Food Trust has a community centered approach in all they endeavor to do and are perhaps best known for their Healthy Corner Store Initiative. This initiative works with small independently owned food stores, providing them with training and equipment to be able to purchase and store more produce and other healthful foods and marketing materials to promote the new items.[46]

Including the community in the planning process where an organization is seeking to implement an initiative is often a preliminary step that can assist in working towards a successful project. For example, focus groups and community surveys are often employed. In 2016, the Food Trust and Stanford University used a Photovoice technique in Camden, NJ whereby participants documented visits to corner stores with "geo-located photos and audio narratives" which helped to identify issues at, and potential solutions for, the stores involved.[47] The Photovoice technique offers an inclusive method for communities to engage residents who will ultimately benefit from the intervention.

Strategic placement of overweight and obesity prevention interventions in communities where food is found, such as in corner stores or at farmers' markets, is ideal for providing teaching opportunities. Education topics can include many aspects of the importance of good nutrition as well as the ability to feature foods that are healthful choices and how to prepare them. Community and school gardens have been successful in providing these opportunities and others including incorporating physical activity and mindfulness while gardening.[48] In a large garden project in South Dakota that was part of the CDC's High Obesity Program, the South Dakota State University Cooperative Extension worked with communities to plant thirteen gardens. The project included nutrition and physical activity lessons at the garden sites, grew an average of 138 pounds of produce from each garden and were able to donate much of the produce to food pantries. Through collaborations with community members, community organizations, city and tribal organizations and schools, this garden project increased their sustainability potential.[48] Determining routes to sustainability is often an issue with maintaining community and school gardens.

Summary

From early care sites to older adult settings and many places in between, there are community nutrition and physical

activity interventions being planned and taking place towards combatting overweight and obesity in the United States every day. Many taxpayer, donated, federal and NGO dollars are being allocated for this purpose with some progress slowly being realized over the past several years. However, much more needs to be done, especially for our youth, for those who are food insecure and for those who have high rates of obesity. Many with the greatest needs have not received equitable interventions or resources due to poverty, racism, and other social and economic factors.[11]

There is a renewed promise of progress towards these issues with the substantial plan from the Biden-Harris Administration National Strategy on Hunger, Nutrition and Health. This strategy will support the use of a systems approach, recommended in the TFAH State of Obesity Report 2022. This type of approach is necessary for communities to support healthy lifestyles for people across the lifespan and where they are because "the health of individuals and families are impacted by the communities in which they are born, live, work, learn, play, worship, and age."[11] When a host of players from all sectors of society work in tandem towards a common goal, the way forward and its results are packed with potential.

Resources

Early Head Start and Head Start
Child and Adult Care Food Program (CACFP)
National School Lunch Program (NSLP)
The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
SNAP-Ed
Expanded Food and Nutrition Program
Healthy People 2030
Biden-Harris Administration National Strategy on Hunger, Nutrition and Health

References

1. Centers for Disease Control and Prevention. Overweight and obesity: community efforts. Accessed October 2022. https://www.cdc.gov/obesity/strategies/community.html.
2. Cui, J., and Natzke, L. *Early Childhood Program Participation:* 2019 (NCES 2020-075REV), National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. 2021. Accessed October 2022. http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2020075REV.
3. USDA Food and Nutrition Service. WIC participant and program characteristics 2020 – charts. Accessed October 2022. https://www.fns.usda.gov/wic/participant-program-characteristics-2020-charts.
4. Centers for Disease Control and Prevention. State licensing scorecards for embedding high-impact obesity prevention standards in early care & education (ECE). Accessed October 2022. https://www.cdc.gov/obesity/strategies/early-care-education/state-scorecards.html
5. Centers for Disease Control and Prevention. State obesity prevention efforts targeting the early care and education setting. Accessed October 2022. https://www.cdc.gov/obesity/strategies/early-care-education/pdf/ECE_2018_QuickStartActionGuide_April2018_508.pdf
6. Centers for Disease Control and Prevention. State physical activity and nutrition (SPAN) program. Accessed October 2022. https://www.cdc.gov/nccdphp/dnpao/state-local-programs/span-1807/index.html
7. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion: REACH. Accessed October 2022. https://www.cdc.gov/chronicdisease/resources/publications/factsheets/reach.htm
8. USDA Food and Nutrition Service. Special supplemental nutrition program for women, infants, and children (WIC). Accessed October 2022. https://www.fns.usda.gov/wic
9. Schultz DJ, Shanks CB, Houghtaling B. The impact of the 2009 special supplemental nutrition program for women, infants, and children food package revisions on participants: a systematic review. *J Acad Nutr Diet.* 2015;115:1832-1846.
10. Dietz WH. Better diet quality in the healthy hunger-free kids act and WIC package reduced childhood obesity. *Pediatrics*. 2021;147(4):1-3.

11. Trust for America's Health. The State of Obesity: better policies for a healthier America 2022. Accessed October 2022. https://www.tfah.org/report-details/state-of-obesity-2020/.
12. Kenney EL, Barrett JL, Bleich SN, Ward ZJ, Cradock AL, Gortmaker SL. Impact of the healthy, hunger-free kids act on obesity trends. *Health Affairs*. 2020;39(7):1122-1129
13. Centers for Disease Control and Prevention. Overweight and obesity: childhood obesity facts. Accessed October 2022. https://www.cdc.gov/obesity/data/childhood.html.
14. Kinderknecht K, Harris C, Jones-Smith J. Association of the healthy, hunger-free kids act with dietary quality among children in the US national school lunch program. JAMA. 2020;324(4):359-368.
15. USDA. Food and Nutrition Service. National school lunch program. Accessed October 2022. https://www.fns.usda.gov/nslp.
16. USDA. Food and Nutrition Service. National school lunch program. Accessed October 2022. https://www.fns.usda.gov/sbp/school-breakfast-program.
17. USDA. Food and Nutrition Service. Local school wellness policies. Accessed October 2022. https://www.fns.usda.gov/tn/local-school-wellness-policy.
18. Mansfield J, Savaiano D. Effect of school wellness policies and the healthy, hunger-free kids act on food-consumption behaviors of students, 2006–2016: a systematic review. *Nutrition Reviews*. 2017;75(7):533–552.
19. USDA Food and Nutrition Service. SNAP and the thrifty food plan. Accessed October 2022. https://www.fns.usda.gov/snap/thriftyfoodplan.
20. USDA SNAP-Ed Connection. Policy, systems, and environmental change. Accessed October 2022. https://snaped.fns.usda.gov/snap-ed-works/policy-systems-and-environmental-change.
21. USDA. National Institute of Food and Agriculture. US Department of Agriculture. 2021 impacts: EFNEP: improving nutritional security through education. Accessed October 2022. https://www.nifa.usda.gov/sites/default/files/2022-07/EFNEP%202021%20Impact%20Report%20FINAL-508.pdf.
22. USDA. National Institute of Food and Agriculture. US Department of Agriculture. Impacts and reporting: national EFNEP reports. Accessed October 2022. https://www.nifa.usda.gov/grants/programs/about-efnep/impacts-reporting-national-efnep-reports.
23. USDA Food and Nutrition Service. SNAP-Ed FY2019: A retrospective review of LGU SNAP-Ed programs and impacts. Accessed October 2022. https://snaped.fns.usda.gov/sites/default/files/documents/LGU-SNAP-Ed-FY2019-Impacts-Report-12-16-2020_508.pdf.
24. Francis SL, Oates K, Heuer A. Promoting awareness of SNAP among Iowans age 50+ with the wellness and independence through nutrition (WIN) program. 2015;53(5). Accessed October 2022. https://archives.joe.org/joe/2015october/tt8.php.
25. Korlagunta K, Hermann J, Parker S, Payton M. Factors withing multiple socio-ecological model levels of influence affecting older SNAP participants' ability to grocery shop and prepare food. 2014;52(1). Accessed October 2022. https://archives.joe.org/joe/2014february/rb3.php.
26. US Department of Health and Human Services. Administration for Community Living. Older Americans Act. Accessed October 2022. https://acl.gov/about-acl/authorizing-statutes/older-americans-act.
27. Jung SE, Hermann J, Parker S, Smith BJ. Development and evaluation of an educational display for older adults: journey through health. 2015;53(5). Accessed October 2022. https://archives.joe.org/joe/2015october/iw2.php.
28. McClelland JW, Jayaratne KSU, Bird CL. Nutrition education brings behavior and knowledge in limited-resource older adults. 2013;51(2). Accessed October 2022. https://archives.joe.org/joe/2013april/a1.php.
29. Centers for Disease Control and Prevention. CDC workplace health resource center. Accessed October 2022. https://www.cdc.gov/workplacehealthpromotion/initiatives/resource-center/index.html.
30. State of New Jersey. Department of Health. Nutrition and fitness. Accessed October 2022. https://www.nj.gov/health/nutrition/services-support/worksites/.
31. Upadhyaya M, Sharma S, Pompeii LA, Sianez M, Morgan RO. Obesity prevention worksite wellness interventions for health care workers: a narrative review. *Workplace Health & Safety*. 2020;68(1):32-49.
32. Stiehl E, Shivaprakash N, Thatcher E, et al. Worksite health promotion for low-wage workers: a scoping literature

review. *American Journal of Health Promotion*. 2018;32(2):359-373.
33. Sandercock V, Andrade J. Evaluation of worksite wellness nutrition and physical activity programs and their subsequent impact on participants' body composition. *Journal of Obesity*. 2018;1-14
34. Baid D, Hayles E, Finkelstein EA. Return on investment of workplace wellness programs for chronic disease prevention: a systematic review. *Am J Prev Med*. 2021;61(2):256–266.
35. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition. Executive Summary. 2020. https://www.dietaryguidelines.gov/sites/default/files/2020-12/DGA_2020-2025_ExecutiveSummary_English.pdf. Accessed October 2022.
36. U.S. Department of Health and Human Services. Healthy people 2030. Accessed October 2022. https://health.gov/healthypeople.
37. U.S. Department of Health and Human Services. Healthy people 2030. Overweight and obesity. Accessed October 2022. https://health.gov/healthypeople/objectives-and-data/browse-objectives/overweight-and-obesity.
38. U.S. Department of Health and Human Services. White house conference on hunger, nutrition, and health. Accessed October 2022. https://health.gov/our-work/nutrition-physical-activity/white-house-conference-hunger-nutrition-and-health.
39. The White House, Washington. White House national strategy on hunger, nutrition, and health. Accessed October 2022. https://www.whitehouse.gov/wp-content/uploads/2022/09/White-House-National-Strategy-on-Hunger-Nutrition-and-Health-FINAL.pdf.
40. Share our Strength. About. Accessed October 2022. https://www.shareourstrength.org/about/.
41. Share our Strength. No kid hungry. Accessed October 2022. https://www.nokidhungry.org/.
42. Cooking Matters. Everyone deserves delicious, healthy food. Accessed October 2022. https://cookingmatters.org/.
43. Soldavini J, Taillie SL, Lytle LA, Berner M, Ward DS, Ammerman A. Cooking Matters for Kids improves attitudes and self-efficacy related to healthy eating and cooking. *Nutr Educ Behav*. 2022;54:211–218.
44. Cooking Matters. Ending childhood hunger through healthy food. Accessed October 2022. https://cookingmatters.org/about/.
45. The Food Trust. Our mission: delicious, nutritious food for all. Accessed October 2022. https://thefoodtrust.org/who-we-are/mission/.
46. The Food Trust. Health in the heart of the community. Accessed October 2022. https://thefoodtrust.org/what-we-do/corner-stores/.
47. Chrisinger BW, Ramos A, Shaykis F, Martinez T, Banchoff AW, Winter SJ, King AC. Leveraging citizen science for healthier food environments: a pilot study to evaluate corner stores in Camden, New Jersey. *Front Public Health*. 2018;6(89).
48. Stluka S, McCormack LA, Burdette L, Dvorak S, Knight N, Lindvall R, et al. Gardening for health: using garden coordinators and volunteers to implement rural school and community gardens. *Prev Chronic Dis*. 2019;16. https://www.cdc.gov/pcd/issues/2019/19_0117.htm.

7.

Chapter Seven: Community Intervention in Childhood Obesity

Authored by: Sherri M. Cirignano, MS, RDN, LDN

Introduction

Childhood obesity continues to be of serious concern in the United States, with a 42% increase over the past 20 years.[1] The factors that contribute to this continued rise are multifactorial and include those that are social, economic,

and environmental. Many of these factors are out of the control of children, increasing the challenge for changing the tide. Along with the reality of obesity in children comes the increased threat of their development of weight-related diseases such as type 2 diabetes, high blood pressure and depression,[1] and an increased risk of hospitalization and severe illness from infectious diseases such as COVID-19.[2] These facts lead to an urgency to work towards a slowing and eventual reversal of the obesity epidemic in children. In this chapter, we will explore factors that can lead to obesity in children, consequences of having obesity in childhood and review recommendations for, and overall effectiveness of, interventions that work to contribute to this change.

Childhood Obesity Prevalence

Domestic

According to the Centers for Disease Control and Prevention, (CDC) approximately one in five children and adolescents between the ages of 2-19 in the US are currently suffering from obesity. That amounts to close to 15 million children and adolescents overall, with a prevalence of 12.7% among those who are 2-5 years old; 20.7% among those who are 6-11 years old; and 22.2% among those who are 12-19 years old.[3] Certain populations have been found to be more apt to become overweight or obese. Within the 2-19-year-old age group, obesity prevalence was found to be highest among Hispanic and non-Hispanic black children, at 26.2% and 24.8% respectively, lower among non-Hispanic white children (16.6%), and lowest among non-Hispanic Asian children (9.0%).[3]

Global

According to the World Health Organization, (WHO) the prevalence of and projection for overweight and obesity in children worldwide continues to be alarming. In 2020, 38.9 million children under the age of five were overweight and an increase of one million more in this category is projected by 2030.[4] The amount of children aged 5-19 with obesity has tripled in the past 20 years, from 52.3 to 150 million, and is projected to increase another 100 million children in the 5-19 age category by 2030. Goals set by the WHO in the 2016 Report of the Commission on Ending Childhood Obesity are not on track to be met.[4] As a result, updated recommendations and goals were provided by the WHO in 2021 including adapting a "life-course" approach in all aspects of obesity prevention and management with a focus on diet and physical activity. More specifically, recommendations include decreasing added sugars to less than 10% of total energy, decreasing sedentary behaviors and working towards a goal of at least 60 minutes per day of moderate to vigorous activity daily for children and adolescents.[4]

Determining Obesity in Children

Methods to determine the weight status in children and adolescents relative to overweight and obesity include Body Mass Index (BMI) and growth charts. BMI is a measure of body weight in relation to height, calculated by dividing weight in kilograms by the square of height in meters. For children, age and gender are also taken into consideration when determining BMI. Although BMI is considered to be a reliable source, it is only one factor in determining if a child is obese.[5] Growth charts developed by the WHO and the CDC are also used. The WHO growth charts are recommended for use when monitoring infants and children to age two and the CDC growth charts are recommended for use when monitoring children over the age of two.[6] A child who is found to be above the 95th percentile for BMI would be in the obese category. The purpose for monitoring this result in children is to determine their likelihood of developing health-related issues as a result of having obesity.

Risk Factors Contributing to Childhood Obesity

Unmodifiable Risk Factors

Genetics

There are a multitude of risk factors that contribute to childhood obesity. These factors include those that are not modifiable such as genetics. Researchers have discovered that there is evidence that points towards a genetic predisposition for determining an offspring's body fat content and the way their body ingests and expends energy as well as their likelihood of becoming obese. Studies have also indicated that genetics may play a role in certain populations' higher probability for developing metabolic syndrome, a resistance to insulin, and type 2 diabetes.[7] Metabolic syndrome (MetS) is defined by the National Heart, Lung, and Blood Institute as "a group of conditions that together raise (the) risk of coronary heart disease, diabetes, stroke and other serious health conditions,"[8] and when an individual has three of the following five factors present: 1) elevated waist circumference (35 inches for women; 40 inches for men); 2) elevated

triglycerides (150 mg/dl) or on medication for high TG; 3) low HDL cholesterol (<50 mg/dl for women; <40 mg/dl for men; 4) elevated blood pressure (systolic greater than or equal to 130 mm Hg or diastolic greater than or equal to 85 mm Hg, or both; 5) elevated fasting glucose (greater than or equal to 100 mg/dl or on medication for elevated glucose.[9] MetS is an important potential consequence of obesity in children and adults alike.

Modifiable Risk Factors

Early Factors

There are risk factors that can contribute to overweight and obesity in children that have been identified through research and can be modified primarily through changes in lifestyle. There has been a consistent presence in the research of the need to start with prevention as early as possible, including as early as prior to conception.[1,10,11] Parental factors for which a consistent association has been demonstrated include a higher maternal pre-pregnancy BMI, prenatal maternal exposure to tobacco,[1,10,11] and maternal excess gestational weight gain.[1,10] Other factors with a consistent association include a high infant birth weight and an accelerated weight gain by the infant.[1,10] Although there are several other potential associated factors such as gestational diabetes, breastfeeding, sleep, and feeding and sedentary behaviors, these factors have been less consistent in the literature.[10,11] Systematic and other reviews on breastfeeding's role in obesity in children or adolescents is an important possible modifiable risk factor with results that have been mixed in the literature. Some reviews indicate a benefit of breastfeeding reducing obesity risk[1,11] and others indicate it is unclear at this time.[7,10]

Dietary Factors

Early assumptions regarding the contributing factors of increasing childhood obesity levels after the early years of a child's life have been reexamined to include more specific potential factors. Dietary factors that may contribute to obesity, although important to consider in all aspects of a child's diet, have been found to be particularly connected to calorie-dense foods such as those containing trans-fats and added sugars.[7] Even more specifically, studies indicate eating fast foods more than twice a week,[7] especially among white children,[12] or having an increased intake of sugar sweetened beverages, are associated with increasing weight measurements in children.[7]

Other dietary factors with possible associations to decreasing the risk of a child having obesity include addressing patterns of eating. This includes not using food as a reward, encouraging eating only when hunger is present, and providing regular mealtimes, such as always including the breakfast meal.[7] Breakfast intake, in particular breakfast meals that include nutrient dense as opposed to energy dense foods, continue to be considered beneficial in modifying being overweight and other health indicators in children.

Environmental Factors

Environmental factors have also been found to play a role in childhood obesity. Where and how children spend their time, whether at home with family and caregivers, in school, or in their neighborhood can be important predictors of their future health and tendency towards obesity. Children spend a majority of their time with their family. Evidence indicates that family dynamics such as single-parent households and low amounts of time that are devoted to regular physical activity can play a role, as can approaches towards screen time.[7] There is a clear relationship between low levels of physical activity and high levels of sedentary behaviors with rates of obesity. Children who spend much of their free time watching television, or using computers, tablets or phones may contribute to less physical activity and increased sedentary behaviors. Television viewing and its relationship to obesity may also be impacted by the food and beverage advertisements of items of often poor nutritional quality. Children, in particular those who are overweight, have been found to respond favorably to this advertising, affecting their choices long term.[7]

The school environment can mold food choices made by children due to influences from available foods and beverages in vending machines and physical activity behaviors of children due to influences from their peers.[7] Along with a decrease in being physically active, changes in neighborhood planning and concerns over safety in most areas over the past several decades has led to children being transported rather than walking or biking to and from school, friends' houses and as a part of playtime.

Another contributing factor to childhood obesity is the high incidence of food insecurity in the US that is affecting children and adolescents. Some research has indicated that food insecurity is an indicator of obesity due not only to a variety of socioeconomic factors including poverty, but also potentially due to some underlying causes.[1] According to the

Trust for America's Health report The State of Obesity: Better Policies for a Healthier America 2022, this association may be due to 1) our bodies storing extra fat as "an evolutionary response" to the expectation of times of lower amounts of food; 2) the theory that those who are food insecure also do not have access to grocery stores with healthful choices or places to be physically active; 3) the social environment one lives within promotes certain habits and learned behaviors; 4) the realities of financial instability such as stress, anxiety and possible emotional responses to these realities including stress eating; 5) and studies suggest that the method of monthly food access via the Supplemental Nutrition Assistance Program (SNAP) may promote overeating during the first few weeks of the month and then a lack of food in the final weeks before more SNAP benefits are available.[1]

Consequences of Obesity in Children and Adolescents

Health Consequences

As with adults, the potential consequences of obesity in children and adolescents, including those that are health-related and otherwise, can be significant and life-altering. In most cases, the health consequences children are experiencing as a result of obesity today were found only in adults a generation ago. The potential health consequences include type 2 diabetes, cardiovascular risk factors including hypertension and high cholesterol, breathing problems such as asthma and sleep apnea, joint issues, gallbladder disease[13,14] and a liver disorder known as nonalcoholic fatty liver disease.[14,15] A recent systematic review reported by Sharma et al in *Obesity Reviews* suggested that the prevalence of certain health-related issues were associated with a child's or adolescent's weight level as follows: those with obesity were "1.4 times more likely to have prediabetes, 4.4 times more likely to have high blood pressure, 26.1 times more likely to have nonalcoholic fatty liver disease and 1.7 times more likely to have self-reported asthma."[14]

A recent systematic review found that although persistent obesity from childhood to obesity is associated with risk factors of cardiovascular disease, this risk can be "reduced or completely removed" if normal weight is achieved in adulthood.[16] This finding underscores the importance of working towards the prevention of obesity in children in the first place but also continuing measures that work towards weight management of those children and adolescents with obesity.

Another important potential consequence of childhood obesity includes an increased risk for a severe case of COVID-19.[17,18] According to the CDC, children under the age of eighteen with obesity "had a 3.1 times higher risk of hospitalization and a 1.4 times higher risk of severe illness when hospitalized."[17] A "severe illness" was defined as being admitted to the intensive care unit, needing to receive medical ventilation or dying from the disease. It has been hypothesized that the COVID-19 pandemic may have also led to an uptick in overall childhood obesity levels. One study showed that the rate of BMI in a group of over 400,000 children ages 2-19 years almost doubled from March 1, 2020-November 30, 2020 in comparison to the pre-pandemic period of January 1, 2018-February 29, 2020.[19] This may have been due to many factors that include increased screen time due to virtual learning, decreased physical activity due to lockdowns and for those living in apartments or homes without a space for activity, and increased snacking and consumption of food not previously consumed in the same quantities due to pandemic-related issues with obtaining groceries and an increase in food security.[19,20,21]

Psychological and Social Consequences

Additional potential issues include those of a psychological nature including anxiety and depression, low self-esteem, a lower quality of life[22] and social issues including being bullied[22,23,24] and experiencing weight bias.[22,24] A recent review of 26 studies worldwide that looked at the risk of weight status for school bullying showed that children and adolescents with obesity or those who were overweight were more likely to experience bullying than their healthy weight peers. This was also more likely to occur with boys with overweight or obesity than with girls with overweight or obesity.[23] The stigma that can be associated with obesity, even in children, has been found to be present in the classroom as early as kindergarten and "that teachers may serve as a significant source" of this bias, especially in girls. This bias has in turn been found to affect the academic achievement of these young girls.[24]

Economic Consequences

Does family income have a role in having childhood obesity and is having childhood obesity a predictor in an individual's future economic success? Some research has indicated that although income is considered by the CDC[25] and Healthy People 2030[26] to be one of many social determinants of obesity, it is not always the case. Improvement

in a family's income and thus expendable income, as shown in a study conducted by a Pennsylvania State University researcher,[27] did not result in any change in youth obesity rates. Although more research is needed in this area of study, this finding indicates a need to look at other reasons why family income seems to be linked to childhood obesity levels. The author suggests considering the educational level of the parents and the community's environment and support, or lack thereof, towards obesity prevention.

On the other hand, obesity in childhood may affect an individual's future economic success as indicated in two separate studies, one in the United Kingdom[28] and one in the United States.[29] The UK study found that there was an association between obesity at age sixteen and having a significantly lower income. This was true for women, not men, and was linked to both their lower likelihood of marriage and their spouse's lower income if they were married.[28] The study in the US compared bankruptcy by consumers in counties with high obesity rates and found that there is an association between the two. After controlling for factors such as county demographics and the economic conditions of the counties, those counties with higher obesity rates also had higher bankruptcy rates.[29]

Recommendations for the Prevention of Childhood Obesity

Federal Guidance

Guidance for designing interventions that meet national objectives are provided from government-based entities such as the CDC, evidence-based reports such as the Dietary Guidelines for Americans, (DGA) and large-scale initiatives such as Healthy People 2030. The CDC provides the Spectrum of Opportunities Framework to assist states with ways they can "embed" obesity prevention standards at early care sites[30] and School Health Guidelines to Promote Healthy Eating and Physical Activity for students in grades K-12.[31] The Spectrum of Opportunities Framework provides ways to incorporate healthy eating, physical activity, breastfeeding, and reduced screen time among young children in early care settings. The School Health Guidelines include nine guidelines that provide a starting point for schools to create, implement and evaluate policies to promote healthful environments in schools.

The Dietary Guidelines for Americans 2020-2025, (DGA) compiled by the United States Department of Agriculture, includes "healthy dietary patterns" for ages across the lifespan, including for infants and toddlers for the first time in DGA history.[32] The key recommendations in summary for infants and toddlers in the current DGA are 1) exclusively feed infants human milk for at least the first six months; 2) introduce solid foods to infants at about six months; 3) encourage infants and toddlers to consume a variety of foods from all food groups; 4) avoid foods and beverages with added sugars and limit sodium.[33] These recommendations are the basics of building a foundation for creating a healthy dietary pattern for children for the rest of their lives. Continuing with this premise in children and adolescents with an overall healthy dietary pattern that includes nutrient-dense foods and beverages is recommended. Use of the DGA for these age groups can be helpful in incorporating them into obesity prevention dietary interventions for children of all ages.[34]

Healthy People 2030 is developed under the direction of the US Department of Health and Human Services, within their Office of Disease Prevention and Health Promotion. Healthy People's Mission is "*To promote, strengthen, and evaluate the nation's efforts to improve the health and well-being of all people.*"[26] This includes reducing the proportion of children and adolescents with obesity. Evidence-based strategies for achieving this objective include making changes to policies and curriculums in schools to allow for consuming healthy foods and being physically active.[35]

Non-Government National Guidance

Recommendations are also provided from non-government entities such as the Trust for America's Health. (TFAH) TFAH is a "nonprofit, nonpartisan public health policy, research, and advocacy organization that promotes optimal health for every person and community…"[1] In its report, The State of Obesity: Better Policies for a Healthier America 2022, TFAH outlines recommendations including those that aim to promote obesity prevention community programs for children and their families. The report stresses the importance of addressing many aspects of childhood nutrition including the benefits of providing healthful meal options to children, whether at home or through national programs such as the National School Breakfast (NSB) and National School Lunch Program, (NSLP) to promote examples of healthy choices to work towards lifelong healthful eating habits. To achieve the recommendations put forth by the TFAH 2022 report, requires a systems approach to assure any policy changes within a community will benefit all. Recommendations from the report are provided for future planning by federal, state and local governments and are focused on the following five areas:[1]

1. Advance health equity by strategically focusing on efforts that reduce obesity-related disparities;
2. Decrease food insecurity while improving nutritional quality of available foods;
3. Update marketing and pricing strategies that lead to health disparities;
4. Make physical activity and the built environment safer and more accessible for all;
5. Work with the healthcare system to close disparities and gaps in clinic-to-community settings.

A number of federal programs that benefit children are mentioned within the report's more specific recommendations to achieve the above goals including expanding access and eligibility for national summer food programs such as the Seamless Summer Option, increasing investments in the educational portion of the Supplemental Nutrition Assistance Program (SNAP-Ed) and enhancing benefits and access to the Special Supplemental Nutrition Program for Women, Infants, and Children also known as WIC.[1]

Registered Dietitians Nutritionists (RDN) are a professional group of individuals who are often involved in the development and implementation of community interventions towards preventing overweight and obesity throughout the lifespan, including for children. Guidance for the RDN when creating educational programming or seeking community level policy changes comes from many sources including those mentioned above and the professional organization of the RDN, the Academy of Nutrition and Dietetics. (AND) The AND has provided the position paper Prevention of Pediatric Overweight and Obesity: Position of the Academy of Nutrition and Dietetics Based on an Umbrella Review of Systematic Reviews with a review of the current literature regarding this topic and includes the following Position Statement:

It is the position of the Academy of Nutrition and Dietetics that prevention of pediatric overweight and obesity requires multilevel, multicomponent, and culturally appropriate interventions with family involvement to improve and sustain intake of healthy dietary patterns and physical activity in a developmentally appropriate manner throughout childhood and adolescence. Registered dietitian nutritionists are uniquely qualified to advocate for and deliver nutrition counseling in child-based settings; develop and deliver theory-based nutrition education programs; and implement environmental and policy changes to improve access to healthy foods.[36]

Effectiveness of Obesity Prevention Interventions in Children

Interventions for the prevention of childhood obesity are numerous, many of which have been in place for over two decades. Interventions are created and delivered on the national, state and local level in a variety of locations and by a variety of government entities and non-government organizations. In Chapter 6, community interventions that work towards child obesity prevention in early care sites, schools and the community and evidence regarding their effectiveness are presented. This section will explore the evidence currently available in the literature regarding the effectiveness of community interventions.

Overall evidence for the effectiveness of interventions on obesity prevention in children indicate limited effectiveness for all age groups in the most recent systematic reviews.[37–40] Although past reviews of studies indicated "strong" child obesity prevention benefits in school-based interventions for children ages 6-12, caution of this interpretation was encouraged due to the studies' designs and limited availability of studies on interventions for all age groups to consider.[41]

The most promising evidence for decreasing the risk of obesity was found in interventions where the focus was on both diet and physical activity in young children ages 0-5,[38] and a small benefit to BMI with school-based interventions for children ages 6-18.[37] Over the past few years, there have been mixed outcomes reported from three separate literature reviews for older children.[38-40] Some studies reported benefits in reducing the risk of obesity from interventions that focused on physical activity alone for children ages 6-12 years and adolescents ages 13-18 years,[38] and while one review found limited benefit that was not statistically significant from physical activity interventions for adolescents ages 10-19 years of age,[39] another found little or no effect on obesity prevention of any interventions reviewed on this same age group.[40] All studies reported that there is a lack of studies, in particular high-quality studies, available for reviews of this nature.

Also of importance is to consider if obesity prevention interventions that target children are in any way detrimental to them. Some, but not all, studies include this aspect of research as a part of their interventions. Potential adverse effects of interventions for the prevention of obesity through the promotion of a healthful diet and/or increasing

physical activity could include developing negative body images or damaging views about themselves or their weight, experiencing high amounts of weight loss or bodily injury or suffering from psychological effects such as depression. Studies that included this were limited, but for those that did, no adverse effects were reported.[36-38]

Summary

The rate of obesity in the US and the world over continues to be alarmingly high with goals set by the WHO in 2016 not on track to be met. According to the WHO, globally, childhood obesity has tripled over the past two decades. The list of modifiable risk factors that may work towards preventing childhood obesity is growing as studies on the subject also grow. Risk factors regarding weight start prior to conception and during pregnancy and include modifying parental pre-pregnancy weight and monitoring gestational weight, a high weight of the infant at birth and quickly after birth, as well as eating and sleeping behaviors of the infant. Whether or not breastfeeding is a modifiable risk factor is recently being further scrutinized as some systematic reviews have found the results of studies on this topic to be mixed at this time. Other risk factors that can be addressed during a child's preschool and school years include decreasing calorie-dense foods, especially fast foods and sugar sweetened beverages, (frontiers in endo) and decreasing screen time and increasing physical activity. Another risk factor that is not easily modifiable but critical to address is the high incidence of food insecurity that is affecting children and adolescents in the US.

Health and other consequences of childhood obesity include type 2 diabetes, cardiovascular disease, asthma, sleep apnea, joint issues, and gallbladder and liver disease, an increased risk for a severe case of COVID-19, as well as psychological issues including anxiety and depression and social issues such as being bullied and experiencing weight bias.

Many recommendations and guidelines are available for professionals to develop evidence-based interventions including from the Dietary Guidelines, Healthy People 2030 and the Academy of Nutrition and Dietetics. Interventions that have been implemented over the past twenty or more years have been reviewed to determine their effectiveness. The most current review suggests there is limited effectiveness for all age groups in the most recent systematic reviews, with a small benefit to BMI with school-based interventions for children ages 6-18. Despite this information, it continues to be imperative for the work to continue towards the prevention of overweight and obesity in children of all ages through interventions that focus on education and policy changes.

Resources

Dietary Guidelines for Americans 2020-2025

Trust for America's Health. The State of Obesity: Better Policies for a Healthier America 2022 from the Trust for America's Health

The World Health Organization

Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen

Centers for Disease Control and Prevention Healthy School Guidelines

Healthy People 2030

Academy of Nutrition and Dietetics

References

1. Trust for America's Health. The State of Obesity: better policies for a healthier America 2022. Accessed November 2022. https://www.tfah.org/report-details/state-of-obesity-2022/.
2. Kompaniyets, Lyudmyla, Nickolas T. Agathis, Jennifer M. Nelson, et al. "Underlying Medical Conditions Associated With Severe COVID-19 Illness Among Children." *JAMA Network Open*. 2021;4(6): e2111182. Accessed November 2022. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2780706
3. Centers for Disease Control and Prevention. Overweight and obesity: childhood obesity facts. Accessed November 2022. https://www.cdc.gov/obesity/data/childhood.html.
4. World Health Organization. Political declaration of the third high-level meeting of the General Assembly on the prevention and control of noncommunicable diseases. 2021. Accessed November 2022. https://apps.who.int/gb/ebwha/pdf_files/EB148/B148_7-en.pdf.
5. Centers for Disease Control and Prevention. Defining childhood weight status. Accessed November 2022.

https://www.cdc.gov/obesity/basics/childhood-defining.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fobesity%2Fchildhood%2Fdefining.html.
6. Centers for Disease Control and Prevention. WHO growth standards are recommended for use in the U.S. for infants and children 0 to 2 years of age. Accessed November 2022. https://www.cdc.gov/growthcharts/who_charts.htm.
7. Gregory JW. Prevention of obesity and metabolic syndrome in children. *Front Endocrinol.* 2019;10:669.
8. National Institutes of Health. National Heart, Lung and Blood Institute. What is metabolic syndrome? Accessed November 2022. https://www.nhlbi.nih.gov/health/metabolic-syndrome#:~:text=Metabolic%20syndrome%20is%20a%20group,also%20called%20insulin%20resistance%20syndrome.
9. Moore JX, Chaudhary N, Akinyemiju T. Metabolic Syndrome Prevalence by Race/Ethnicity and Sex in the United States, National Health and Nutrition Examination Survey, 1988–2012. *Prev Chronic Dis.* 2017;14:160287. DOI: http://dx.doi.org/10.5888/pcd14.160287.
10. Woo Baidal JA, Locks LM, Cheng ER, Blake-Lamb TL, Perkins ME, Taveras EM. Risk factors for childhood obesity in the first 1,000 days: a systematic review. *Am J Prev Med* 2016;50(6):761-779.
11. Mihrshahi S, Baur LA. What exposures in early life are risk factors for childhood obesity? *J Paed and Child Health.* 2018;(54):1294–1298.
12. Pineros-Leano M, Grafft N, Aguayo L. Childhood obesity risk factors by race and ethnicity. *Obesity (Silver Spring).* 2022;(30):1670–1680. doi:10.1002/oby.23500.
13. Centers for Disease Control and Prevention. Consequences of obesity. Accessed November 2022. https://www.cdc.gov/obesity/basics/consequences.html.
14. Sharma V, Coleman S, Nixon J, Sharples L, Hamilton-Shield J, Rutter H, Bryant M. A systematic review and meta-analysis estimating the population prevalence of comorbidities in children and adolescents aged 5 to 18 years. *Obesity Reviews.* 2019;20:1341-1349. https//doi.org/10.1111/obr.12904.
15. Faienza MF, Chiarito M, Molina-Molina E, Shanmugam H, Lammert F, Krawczyk M, et al. Childhood obesity, cardiovascular and liver health: a growing epidemic with age. *World J Ped.* 2020;16:438-445.
16. Sun J, Xi B, Yang L, Zhao M, Juonala M, Magnussen CG. Weight change from childhood to adulthood and cardiovascular risk factors and outcomes in adulthood: a systematic review of the literature. *Obesity Reviews.* 2021;22. https://doi.org/10.1111/obr.13138.
17. Centers for Disease Control and Prevention. Children, obesity, and COVID-19. Accessed November 2022. https://www.cdc.gov/obesity/data/children-obesity-COVID-19.html.
18. Kompaniyets L, Agathis N, Nelson JM, Preston LE, Ko JY, Belay B, Pennington AF, et al. Underlying medical conditions associated with severe COVID-19 illness among children. *JAMA Network Open.* 2021;4(6).
19. Lange SJ, Kompaniyets L, Freedman DS, Kraus EM, Porter R, Blanck HM, et al. Longitudinal Trends in Body Mass Index Before and During the COVID-19 Pandemic Among Persons Aged 2–19 Years — United States, 2018–2020. *MMRW Morb Mortal Wkly Rep.* 2021;70:1278-1283. http://dx.doi.org/10.15585/mmrw.mm7037a3.
20. Cuschieri S, Grech S. COVID-19: a one-way ticket to a global childhood obesity crisis? *J Diab & Metab Disorders.* 2020;19;2027-2030. https://doi.org/10.1007/240200-020-00682-2.
21. Patterson RR, Somalingam S, Cooper M. COVID-19 and obesity epidemic: consequences of covid-19 on the childhood obesity epidemic. *BMJ.* 2921;373:n953. doi:10.1136/bmj.n953.
22. Centers for Disease Control and Prevention. Consequences of obesity. Accessed November 2022. https://www.cdc.gov/obesity/basics/consequences.html.
23. Cheng s, Kaminga AC, Liu Q, Wu F, Wang Z, Wang X, Liu X. Association between weight status and bullying experiences among children and adolescents in schools: an updated meta-analysis. *Child Abuse & Neglect.* 2022;134. https://doi.org/10.1016/j.chiabu.2022.105833.
24. Yu B. Kindergarten obesity and academic achievement: the mediating role of weight bias. *Front Psychol.* 2021;12:640474. doi: 10.3389/psyg.2021.640474.
25. Centers for Disease Control and Prevention. Overweight and obesity: causes of obesity. Accessed November 2022.

https://www.cdc.gov/obesity/basics/causes.html.
26. U.S. Department of Health and Human Services. Healthy people 2030. Accessed November 2022. https://health.gov/healthypeople.
27. Martin MA. What is the causal effect of income gains on youth obesity? Leveraging the economic boom created by the Marcellus Shale development. *Soc Sci & Med.* 2021;272:113732. https://doi.org/10.1016/j.socscimed.2021.113732.
28. Black N, Kung CSJ, Peeters A. For richer, for poorer: the relationship between adolescent obesity and future household economic prosperity. *Prev Med.* 2018;111:142-150. https://doi.org/10.1016/j.ypmed.2018.02034.
29. Kuroki M. Obesity and bankruptcy: evidence from US counties. *Econ and Human Bio.* 2020;38:100873. http://dx.doi.org/10.1016/j.ehb.2020.100873.
30. Centers for Disease Control and Prevention. The spectrum of opportunities framework for state-level obesity prevention efforts targeting the early care and education setting. Accessed November 2022. https://www.cdc.gov/obesity/strategies/early-care-education/pdf/TheSpectrumofOpportunitiesFramework_May2018_508.pdf.
31. Centers for Disease Control and Prevention. School health guidelines. Accessed November 2022. https://www.cdc.gov/healthyschools/npao/strategies.htm.
32. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition. Executive Summary. 2020. Accessed November 2022. https://www.dietaryguidelines.gov/sites/default/files/2020-12/DGA_2020-2025_ExecutiveSummary_English.pdf.
33. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition: infants and toddlers. 2020. Accessed November 2022. DietaryGuidelines.gov.
34. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans*, 2020-2025. 9th Edition: children and adolescents. 2020. Accessed November 2022. DietaryGuidelines.gov.
35. U.S. Department of Health and Human Services. Healthy people 2030: reduce the proportion of children and adolescents with obesity – NWS-04. Accessed November 2022. https://health.gov/healthypeople/objectives-and-data/browse-objectives/overweight-and-obesity/reduce-proportion-children-and-adolescents-obesity-nws-04
36. Hoelscher DM, Brann LS, O'Brien S, Handu D, Rozga M. Prevention of pediatric overweight and obesity: position of the Academy of Nutrition and Dietetics based on an umbrella review of systematic reviews. JAND. 2022;122(2):410-423.e6.
37. Hodder RK, O'Brien KM, Lorien S, Wolfenden L, Moore HMT, Hall A, et al. Interventions to prevent obesity in school-aged children 6-18 years: an update of a Cochrane systematic review and meta-analysis including studies from 2015–2021. *The Lancet.* 2022;(54). https://www.thelancet.com/action/showPdf?pii=S2589-5370%2822%2900365-0.
38. Brown T, Moore THM, Hooper L, Gao Y, Zayegh A, Ijaz S, et al. Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews.* 2019;7:CD001871. doi: 10.1002/14651858.CD001871.pub4.
39. Hayba N, Rissel C, Farinelli MA. Effectiveness of lifestyle interventions in preventing harmful weight gain among adolescents: a systematic review of systematic reviews. *Obesity Reviews.* 2021;22:e13109. https://doi.org/10.1111/obr.13109.
40. Flodgren GM, Helleve A, Lobstein T, Rutter H, Klepp KI. Primary prevention of overweight and obesity in adolescents: an overview of systematic reviews. *Obesity Reviews.* 2020;21:e13102. https://doi.org/10.1111/obr.13102.
41. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. *Cochrane Database of Syst Rev.* 2011;12:CD001871.
42. doi: 10.1002/14651858.CD001871.pub3.

8.

Chapter Eight: Cancer and its Relationship to Obesity

Authored by: Sherri M. Cirignano, MS, RDN, LDN

History of the Link Between Nutrition, Physical Activity and Cancer

The first mention of food and nutrition and their link to cancer dates to as early as the time of the Song Dynasty in China from 960-1279 AD when Yong-He-Yan, a physician of the time, believed that poor nutrition was the cause of esophageal cancer.[1] In the 17th century Dr. Richard Wiseman, a British surgeon, believed that cancer might arise 'from an error in diet' and advised abstention from 'salt, sharp and gross meats.'[2] In more recent history, laboratory studies on animals, known as in vivo studies, in the 1930's revealed a possible influence of diet on cancer development. This led to population studies, the results of which were first presented in the 1970's, igniting rapid development in this field and furthering the knowledge we have today on the link between what we eat and the disease of cancer.[1] Although the importance of the link between nutrition and cancer has been recognized for centuries, the more robust study of it is still considered to be in its early years.

As with nutrition, the relationship between physical activity and health have been documented since ancient times. '*Eating alone will not keep a man well; he must also take exercise. For food and exercise, while possessing opposite qualities, yet work together to produce health…*' Hippocrates, 'the father of medicine' said this, and although it is not specifically about cancer prevention, this proposed role of physical activity in health promotion first appeared as early as the 2nd century.[3] The role of physical activity specific to cancer prevention was explored in the 1920's with the publication of two studies that suggested that "cancer mortality rates among men with different occupations decreased with increased physical activity."[4] Since that time, many studies have explored the role of physical activity and cancer prevention with "substantial evidence" that increased physical activity can lower the risk of certain cancer types.[4]

Cancer Overview[5]

Please click the above link for this topic.

Types of Cancer[6]

Please click the above link for this topic.

Cancer Rates

United States

Cancer is the second leading cause of death in the United States, just behind heart disease, the leading cause of death in the United States. In 2019, the latest year for which cancer incidence data are available in the United States, over 1.7 million new cases of cancer were reported, and close to 600,000 people died of cancer. For every 100,000 people, 439 new cancer cases were reported and 146 people died of cancer.[7]

The top four cancer types in the US by rates of new cancer cases of male and female, (all races and ethnicities) are: 1) female breast cancer; 2) prostate cancer; 3) lung and bronchus cancers; and 4) colon and rectal cancers. The top five cancers by rates of cancer deaths for males and females, (all races and ethnicities) are: 1) lung and bronchus cancers; 2) female breast cancer; 3) prostate cancer; 4) colon and rectal cancers; and 5) cancer of the pancreas.[8]

In addition to looking at the color-coded map seen in Figure 1 below, with the darkest color showing where the most incidence or rate of cancer is found, you can find out more information about the state where you live by going to the CDC site Cancer Statistics at a Glance.

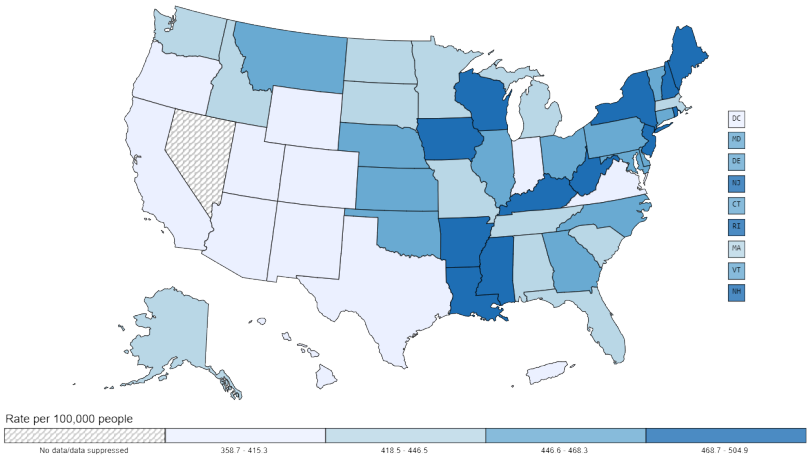


Figure 1: Source – U.S. Cancer Statistics Working Group. U.S. Cancer Statistics Data Visualizations Tool, based on 2021 submission data (1999-2019): U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; https://www.cdc.gov/cancer/dataviz, released in November 2022.

New Jersey

In NJ, rates of cancer are highest in the southern counties and the northeastern corner of the state. The darker the color of a county, seen in the map below in Figure 2, indicates a higher incidence or rate of cancer in that county. The following are facts about the age-adjusted incidence cancer rates in NJ from the National Cancer Institute and the Centers for Disease Control and Prevention:[9] (CDC)

All stages of cancer are higher in NJ than the incidence rates for the United States as a whole.

The leading cancer site for NJ women, and a leading cause of death, is breast cancer. The incidence rate for female breast cancer is also higher in NJ than the incidence rates for the United States as a whole.

The leading cancer site for NJ men is prostate cancer. And, similar as for women and breast cancer, the incidence rate for prostate cancer is also higher in NJ than the incidence rates for the United States as a whole.

The leading cancer sites in NJ are prostate cancer and female breast cancer.

The leading age-adjusted mortality rates by cancer site in NJ are 1) lung and bronchus; 2) female breast; 3) prostate; and 4) colon and rectum.

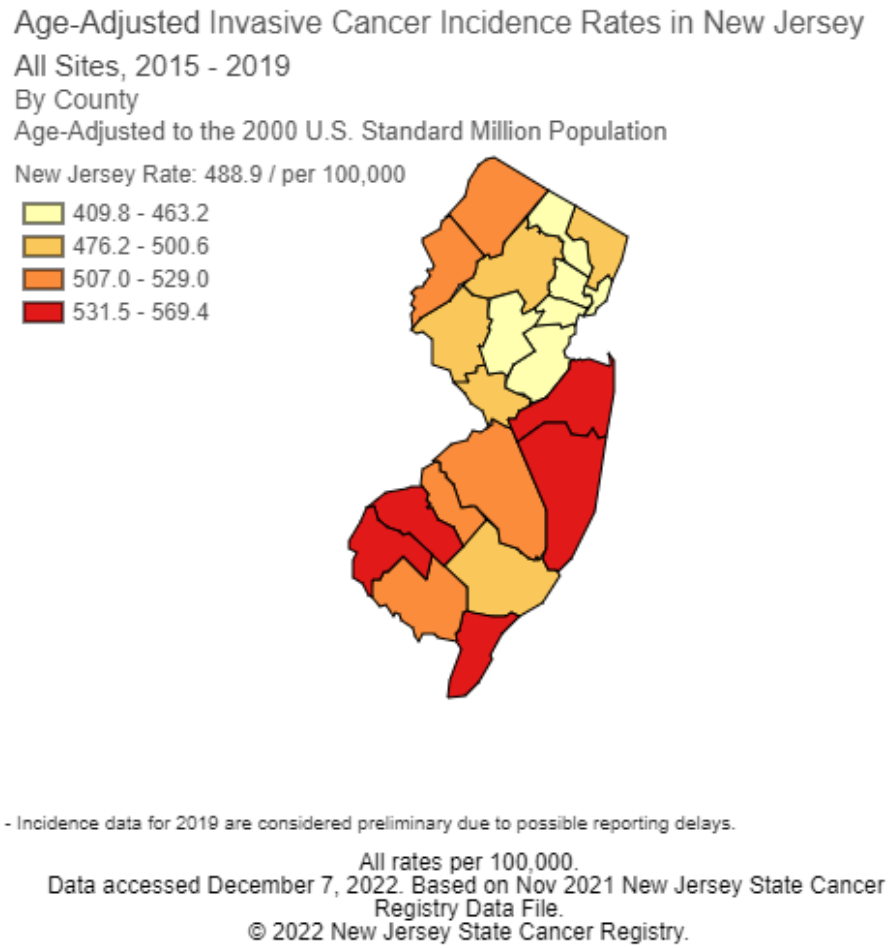


Figure 2: Age-Adjusted Invasive Cancer Incidence Rates in New Jersey All Sites 2015-2019 (NJ State Cancer Registry)

Energy Balance, Body Fatness and the Risk of Cancer

Several national and global organizations work to research cancer and to decrease its prevalence and educate the public about specific links towards cancer prevention. The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) are two organizations that join approximately every ten years to create a global report on the "very latest research, findings and cancer prevention recommendations."[10] Prior reports were released in the 1990's and again in 2007. The newest and Third Expert Global Report by the WCRF/AICR, Diet, Nutrition, Physical Activity and Cancer: a Global Perspective was presented in 2018. The Report is created by a distinguished panel of experts who undergo a comprehensive review of the literature to judge all available evidence on "preventing and surviving cancer" with which they determine and present the latest recommendations on diet, nutrition and physical activity. Between additions of the Report, there is continuous work being completed by these two organizations through the Continuous Update Project. The CUP is an ongoing program that analyzes global research on how diet, nutrition and physical activity affect cancer risk and survival.[11]

According to the WCRF/AICR 2018 Report, there are several cancer sites that are linked to overweight and obesity, termed "body fatness" in the Report. As a result, maintenance of a healthy body weight throughout life is recommended to work towards prevention of these cancer types. An important step in achieving a healthy body weight includes

attaining energy balance. Energy balance is the ability to match the intake of energy through the consumption of food and beverages with the output of energy through normal bodily functions and physical activity.

Energy balance is regulated by internal factors such as appetite, genetics, fetal weight and potentially even the bacteria from the colon, known as the gut microbiome. External stimuli that can affect energy balance can include factors such as stress, eating disorders, economic factors and the circumstances in which the food is being consumed.[12]

If there is an excess of energy consumed from food and beverages, the body stores it as fat in adipose tissue. How much fat is accumulated and where the body stores it in the body is somewhat individual. It can be stored around our organs or muscles or within tissues such as the liver.[12] This is mostly determined by genetic factors including gender. Women are known to mostly store more fat around their hips, buttocks and thighs than men resulting in a 'pear shape' and the distribution of fat in men tends to be around their abdomens, resulting in an 'apple shape.'[13]

Measuring body fat is difficult to do directly. As a result, Body Mass Index, (BMI) a measure of weight in relation to height, is often used. Other forms of measurement can include waist circumference, hip circumference, waist-hip ratio and percentage of body fat. See Chapter Two for more information. (link to chapter 2)

The WCRF/AICR Report presents its findings related to the strength of the evidence found in the research reviewed by the expert panel. This process of Judging the Evidence is a comprehensive and meticulous process which can result in a recommendation if the evidence is strong enough, or can result in the need for more research if the evidence is lacking. Findings are categorized using the following grading criteria:[14]

1. "Strong evidence…support(s) a judgement of a convincing or probable causal (or protective) relationship and generally justify making public health recommendations."
2. "Convincing evidence…support(s) a judgement of a convincing causal (or protective) relationship which justifies making recommendations designed to reduce the risk of cancer… (and) robust enough to be unlikely to be modified in the foreseeable future."
3. "Probable evidence…support(s) a judgement of a probable causal (or protective) relationship, which generally justifies goals and recommendations designed to reduce the risk of cancer."
4. "Limited evidence…is inadequate to support a probable or convincing causal (or protective) relationship."
5. "Limited – suggestive evidence is inadequate to permit a judgement of a probable or convincing causal (or protective) relationship, but is suggestive of a direction of effect…(and) generally does not justify making recommendations."
6. "Limited – no conclusion (indicates) there is enough evidence to warrant Panel consideration, but it is so limited that no conclusion can be made."
7. "Substantial effect on risk unlikely (indicates) evidence is strong enough to support a judgement that a particular lifestyle factor relating to diet, nutrition, body fatness or physical activity is unlikely to have a substantial causal (or protective) relation to a cancer outcome."

Judgements made in the Report regarding body fatness and weight gain and the risk of development of specific cancer types are found in Table 1.

Table 1: Body fatness and weight gain and the risk of cancer[13]

<table>
<tr><th colspan="5">BODY FATNESS AND WEIGHT GAIN AND THE RISK OF CANCER</th></tr>
<tr><th colspan="2" rowspan="2">WCRF/AICR GRADING</th><th colspan="2">DECREASES RISK</th><th colspan="2">INCREASES RISK</th></tr>
<tr><th>Exposure</th><th>Cancer site</th><th>Exposure</th><th>Cancer site</th></tr>
<tr><td rowspan="4">STRONG EVIDENCE</td><td rowspan="2">Convincing</td><td rowspan="2"></td><td rowspan="2"></td><td>Adult body fatness</td><td>Oesophagus (adenocarcinoma) 2016[1]
Pancreas 2012[1]
Liver 2015[2]
Colorectum 2017[1]
Breast (postmenopause) 2017[1,3]
Endometrium 2013[4,5]
Kidney 2015[1]</td></tr>
<tr><td>Adult weight gain</td><td>Breast (postmenopause) 2017[3]</td></tr>
<tr><td rowspan="2">Probable</td><td>Adult body fatness</td><td>Breast (premenopause) 2017[1,3]</td><td rowspan="2">Adult body fatness</td><td rowspan="2">Mouth, pharynx and larynx 2018[1]
Stomach (cardia) 2016[2]
Gallbladder 2015[2,7]
Ovary 2014[2,5,8]
Prostate 2014[1,9]</td></tr>
<tr><td>Body fatness in young adulthood</td><td>Breast (premenopause) 2017[3,6]
Breast (postmenopause) 2017[3,6]</td></tr>
<tr><td>LIMITED EVIDENCE</td><td>Limited – suggestive</td><td></td><td></td><td>Adult body fatness</td><td>Cervix (BMI> 29kg/m^2) 2017[2,5]</td></tr>
<tr><td>STRONG EVIDENCE</td><td>Substantial effect on risk unlikely</td><td colspan="4">None identified</td></tr>
</table>

1. Conclusions for adult body fatness and cancers of the following types were based on evidence marked by body mass index (BMI), waist circumference and waist-hip ratio: mouth, pharynx and larynx; oesophagus (adenocarcinoma); pancreas; colorectum; breast (pre and postmenopause); prostate (advanced); and kidney.
2. Conclusions for adult body fatness and cancers of the following types were based on evidence marked by BMI: stomach (cardia), gallbladder, liver, ovary and cervix (BMI > 29 kg/m^2).
3. Evidence for the link between body fatness, weight gain and breast cancer is presented separately for the risk of pre and postmenopausal breast cancer because of the well-established effect modification by menopausal status.
4. The conclusion for adult body fatness and endometrial cancer was based on evidence marked by BMI (including BMI at age 18 to 25 years), weight gain, waist circumference and waist-hip ratio.
5. There is no evidence of effect modification by menopausal status for body fatness and the risk of endometrial, ovarian or cervical cancer so the evidence for all women (irrespective of menopausal status) is presented together.
6. Evidence for body fatness in young adulthood and breast cancer (pre and postmenopause) comes from women aged 18 to 30 years and includes evidence marked by BMI.
7. Adult body fatness may act indirectly, through gallstones, or directly, either after gallstone formation or in their absence, to cause gallbladder cancer. It is not yet possible to separate these effects.
8. The effect of adult body fatness on the risk of ovarian cancer may vary according to tumor type, menopausal hormone therapy use and menopausal status.
9. The effect of adult body fatness on the risk of prostate cancer was observed in advanced, high-grade and fatal prostate cancers.

World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project Expert Report 2018. Diet, N

WCRF/AICR Diet, Nutrition and Physical Activity Recommendations for the Prevention of Cancer

From the *Diet, Nutrition, Physical Activity and Cancer: a Global Perspective* 2018 there are ten diet, nutrition and physical activity recommendations presented which will be reviewed in this section. Recommendations are meant to advise all individuals, families, health professionals, communities and policy makers on ways in which to adopt healthy living habits that can work towards decreasing cancer risk. The Recommendations are very practical, including goals and focusing on specific foods and beverages rather than on individual nutrients. They are meant to be thought of as a whole, with the goal for the Recommendations to be "adopted as a lifestyle package," with all of the Recommendations working together and not in isolation.[15]

The Report also includes matrices of summaries of both a Summary of Conclusions of the Report and more specifically, a Summary of Strong Evidence from the Report.

WCRF/AICR Diet, Nutrition, Physical Activity and Cancer Prevention Recommendations[15]

1. Be a Healthy Weight

This first recommendation encourages weight to be kept within a healthy range throughout life and avoiding weight gain as an adult. This includes ensuring that a healthy weight is maintained during childhood and adolescence. Weight maintenance may be one of the most important things we can do to protect ourselves from cancer. Because of current trends towards decreased activity and increased overweight and obesity, if these trends remain unchanged, overweight and obesity are expected to surpass smoking as the primary risk factors for cancer.

More specifically, this recommendation presents strong evidence that links being overweight with certain types of cancers. These include cancers of the esophagus, pancreas, liver, colon, kidney, lining of the uterus or endometrium, and breast cancer in women after menopause.

Goals include working towards maintaining a Body Mass Index (BMI) at the lower end of normal towards and through adulthood. A healthy BMI is 25 kg/m2 or less for most individuals. BMI may not be suitable for athletes, the elderly, pregnant women, or children and adults less than 5 feet tall. Additional goals include avoiding an increase in waist circumference through adulthood. A healthy waist measurement for most adults is less than 31.5" for women and 37" for men.

2. Be Physically Active

This second recommendation encourages us to be both physically active as part of everyday life by following or exceeding national guidelines and limiting sedentary behaviors. The World Health Organization recommendations and Physical Activity Guidelines for Americans advise adults engage in daily moderate intensity activity that adds up to at least 150 minutes each week or at least 75 minutes of vigorous physical activity weekly. Children and adolescents ages 6-17 should accumulate 60 minutes or more of physical activity every day with most activities being either moderate- or vigorous-intensity physical activity.

For cancer prevention, it is suspected that the greater amount of physical activity, the greater the benefit. Physical activity should be a part of everyday life by walking more and sitting less, working towards an *accumulation* of daily activities that add up to the weekly goals. The weekly goals include accumulating 150 minutes of moderate intensity activities or 75 minutes of vigorous activities each week. Besides walking, activities that are considered moderate intensity are the kind that gets your heart beating a bit faster and makes you breathe more deeply. They include cycling, household chores, gardening, swimming and even dancing. Vigorous activities include those that raise your heart rate and cause you to sweat and feel out of breath such as running, fast swimming, fast cycling, and aerobics.

Minimizing the time spent being sedentary is also strongly recommended. This is especially important for adults who have occupations that require long periods of sitting. Making sure to move throughout each day is very important.

This recommendation was made due to the strong evidence that physical activity helps protect against several types of cancer including colon and breast cancers.

3. Eat a Diet Rich in Whole Grains, Vegetables, Fruit and Beans

This third recommendation, and the next three after it, focus on diet choices. This recommendation encourages making wholegrains, vegetables, fruit, and legumes a major part of the diet. Unprocessed plant foods are rich in nutrients and fiber. If consumed as a main part of the diet in place of primarily processed foods that can be high in fat and refined starches and sugars, these whole plant foods can help to protect against weight gain, overweight and obesity and related cancers.

Research has indicated that vegetables may have many health benefits including a decreased risk of cancer, heart disease and obesity. There are specific recommendations regarding the type of vegetables to focus intake on. Non-starchy vegetables such as carrots, green beans and broccoli, are encouraged most often over starchy vegetable such as potatoes, corn, peas and yams. According to the WCRF/AICR Report, evidence for eating non-starchy vegetables is convincing for a decreased risk of cancers of the head and neck area, which includes the mouth, pharynx, larynx and nasopharynx, as well as of the esophagus, lung, stomach and colorectal area.

Foods, including fruits, with a high fiber content have a probable decreased risk of cancers of the mouth, pharynx, larynx and nasopharynx, as well as of the esophagus, lung, stomach and colorectal area. Possibly due to their high fiber content, whole grains can help with digestion and are thought to contribute to protection against colorectal cancer.

Overall diets high in wholegrains, non-starchy vegetables, fruit and beans are associated with a lower risk of certain types of cancer including that of the colon. These nutrient dense foods also help to prevent weight gain and overweight and obesity, in turn providing overall protection from many cancer types.

4. Limit Consumption of 'Fast Foods' and Other Processed Foods High in Fat, Starches or Sugars

The fourth recommendation encourages limiting the consumption of fast foods and processed foods, including many prepared or convenience foods, snacks, bakery foods, desserts and candy. Some popular snacking foods that are high in fat and calories, such as nuts and seeds, can be important sources of nutrients and a good choice if eaten in moderation.

Fat and calorie dense foods can contribute to weight gain and associated cancers as well as other chronic diseases. They can also raise blood sugar and insulin levels which can promote an increase in the risk of cancer in the lining of the uterus or endometrium.

5. Limit Consumption of Red and Processed Meat

This recommendation has been included by the WCRF/AICR Panel due to strong evidence that consuming red meat and processed meat are causes of colorectal cancer. More specifically, the recommendation encourages those who eat red meat including beef, pork and lamb, to limit it to no more than three lean portions equal to a total of 15-18 oz (cooked weight) each week and to have little, if any, processed meat. Processed meats are encouraged to be saved for special occasions only, if at all. Examples of processed meats are bacon, bologna, salami, hot dogs, sausages and ham. These meats are usually preserved by smoking, curing or salting or by the addition of preservatives. When meat undergoes this processing, cancer causing substances can be formed which in turn can lead to cell damage and the development of cancer. It is uncertain at this time what exactly about processed meats is cancer promoting.

Certain cancer-causing substances are formed on protein foods during grilling and other high heat cooking methods such as pan frying and broiling. Some of these substances are produced in "muscle meats" including red meat, poultry, game and fish during high heat cooking methods. Others are formed when the fat drips onto the hot stones or coals of the grill, accumulating onto the food when smoke and flare-ups occur. According to the AICR, cooking meats at high temperatures can cause two types of cancer-causing substances to form on or in the meat: 1) heterocyclic amines or HCAs; and 2) polycyclic aromatic hydrocarbons or PAHs. Charring and cooking meat, poultry and fish at high temperatures can lead to the formation of HCAs. PAHs typically get into the meat through the smoke that occurs while cooking on the grill. Research on these substances has shown that HCAs and PAHs can cause changes in DNA that may increase the risk of cancer.[16]

6. Limit Consumption of Sugar Sweetened Drinks

Limiting sugar sweetened drinks and drinking mostly water and other unsweetened drinks such as tea or coffee are encouraged in this sixth recommendation.

Examples of sugar sweetened drinks include soda, energy drinks, sports drinks, bottled teas and coffee drinks with added sugar. These beverages are high in sugar thus calorie-, not nutrient-, dense, and don't promote feelings of satiety even when consumed in large quantities. Researchers have found that our brains tend to register intake from liquids differently than solids. As a result, they have been found to be a cause of weight gain, overweight and obesity in both children and adults.

7. Limit Alcohol Consumption

For cancer prevention, it is best to limit alcohol consumption.

Alcohol is a cause of several types of cancer including cancers of the mouth and esophagus, liver, and breast in postmenopausal women. Water is the recommended beverage of choice. For those who choose to drink alcohol, the Dietary Guidelines state the following: limit intake to 2 drinks per day for men and 1 drink per day for women, A drink is generally defined as 12 ounces of beer, 5 ounces of wine or 1.5 ounces of 80 proof distilled spirits.[17]

Many choices you make to lower the risk of cancer also lower the risk of heart disease. But trying to make a smart choice about alcohol can be confusing because alcohol, especially red wine, has been promoted as a heart-healthy choice. Unfortunately, as previously stated, alcohol also presents a cancer risk. There is particular concern regarding the risk for women and breast cancer. The risk starts at relatively low amounts of alcohol intake. According to AICR, "Just 10 grams of pure alcohol consumed daily raises the risk of premenopausal breast cancer 5 percent, and the risk of postmenopausal breast cancer 9 percent."[18]

As a result, there are differences in opinion on how alcohol affects the risk of heart disease and cancer, but there is agreement about following guidelines that encourage moderation. Guidelines for heart health emphasize that alcohol, such as red wine, should not be consumed specifically for a potential cardiovascular benefit.[19]

8. Do Not Use Supplements for Cancer Prevention

This recommendation is derived from studies that have shown that high-dose supplementation has not consistently shown protection against cancer and may be detrimental. For example, some years ago, high dose beta carotene supplementation was shown to cause lung cancer in smokers.[20]

There have been some studies showing benefit from the use of supplements such as taking calcium for protection against colorectal cancer,[21] but primarily, benefits of nutrients and cancer prevention are demonstrated when the nutrients come from food.

This does not refer to the taking of supplements when they are recommended or ordered by a qualified health professional. For example, taking adequate calcium and vitamin D to promote bone health, taking iron for anemia or expectant mothers taking prenatal vitamins is a different matter. This recommendation is specifically to not use supplements as a way to prevent cancer and to meet nutritional needs primarily through diet.

9. For Mothers: Breastfeed Your Baby, if You Can

In addition to the many benefits of breastfeeding, including protecting the infant against infections and childhood diseases, there is strong evidence that breastfeeding protects the mother against breast cancer. In addition to this, a child who is breastfed is protected against later excess weight gain, overweight and obesity throughout childhood. This is important as excess weight gain in childhood often continues into adulthood.

10. After a Cancer Diagnosis: Follow Recommendations, if You Can

The tenth recommendation is for cancer survivors.

Cancer survivors should always check with their physician regarding diet, nutrition and physical activity, but the overall recommendation that has been made by the Expert Panel is that after a cancer diagnosis, cancer survivors should follow the other Recommendations as is possible after the acute stage of their treatment is over.

Each cancer survivor is unique, and their circumstances are all vastly different, but it is recognized that diet, nutrition and physical activity are an important part of recovery and in overall cancer survival. For example, for breast cancer survivors, there is some evidence that factors such as weight and physical activity levels may influence outcomes. The evidence for this is limited at this time and more studies are needed.

In addition, because more people are surviving cancer than ever before, following these cancer prevention recommendations may help to improve their survival and reduce their risk of another cancer diagnosis or the diagnosis of another chronic disease.

The WCRF/AICR Report also emphasizes the importance of avoiding other cancer-promoting lifestyle behaviors including smoking, exposure to tobacco and exposure to excess sun.

American Cancer Society Guideline for Diet and Physical Activity for Cancer Prevention[22]

The American Cancer Society (ACS) is another organization that works towards supporting and educating the public regarding cancer and cancer prevention. The ACS Guideline for Diet and Physical Activity for Cancer Prevention was developed in 2020 by national experts in the field of cancer and has aligned its recommendations within the Guideline with the WCRF/AICR recommendations, the 2015-2020 Dietary Guidelines for Americans, the Physical Activity Guidelines for Americans[23] and the Centers for Disease Control and Prevention Healthy Choices cancer prevention guidance[24].

There are four recommendations within the ACS Guideline and additional recommendations that address the need for community action to coincide with the recommendations for individuals.

Recommendations for Individual Choices[22]

1. Achieve and Maintain a Healthy Body Weight Throughout Life

This first ACS recommendation encourages individuals to keep their weight within a healthy range and to avoid weight gain as an adult. The recommendation cites dietary factors that are known to lead to excess body fat, namely sugar sweetened beverages, "fast foods" and other foods within a "Western" dietary pattern. Rather, individuals should aim to follow a "Mediterranean" dietary pattern that may reduce cancer risk.

2. Be Physically Active

This recommendation encourages all Americans, children through adults, to move more and sit less by limiting sedentary behaviors such as sitting, lying down, and engaging in screen-based entertainment. Recommended amounts of movement are 150-300 minutes of moderate-intensity physical activity weekly or 75-150 minutes of vigorous-intensity activity weekly for adults, and at least one hour of moderate- or vigorous-intensity activity each day for children.

3. Follow a Healthy Eating Pattern at All Ages

This ACS recommendation includes the following specifics regarding a healthy eating pattern:

A healthy eating pattern includes:

- Foods that are high in nutrients in amounts that help achieve and maintain a healthy body weight;
- A variety of vegetables – dark green, red and orange, fiber-rich legumes (beans and peas), and others;
- Fruits, especially whole fruits with a variety of colors; and
- Whole grains.

A healthy eating pattern limits or does not include:

- Red and processed meats;
- Sugar sweetened beverages; or
- Highly processed foods and refined grain products.

In addition to the above, this recommendation also presents similar information as in the WCRF/AICR recommendations regarding the use of dietary supplements stressing that although there is evidence that plant-based foods may reduce cancer risk, there is "limited and inconsistent" evidence regarding the use of supplements to reduce cancer risk.

5. It is Best Not to Drink Alcohol

This recommendation again echoes that of the WCRF/AICR Report in stressing the positive relationship between alcohol intake and the risk for developing cancer as well as other noncommunicable diseases.

For individuals who choose to drink alcohol, they should limit their intake to no more than one drink per day for women and two drinks per day for men.

Recommendations for Community Action[22]

The ACS Guideline includes information regarding the fact that some individuals may be unable to follow their four recommendations due to circumstances beyond their control. For example, the cost of affordable healthy foods and limited access to healthy choices is an issue for some as is the ability to engage in physical activity.

As a result, the ACS Recommendation for Community Action is as follows:

> "Public, private and community organizations should work collaboratively at national, state, and local levels to develop, advocate for, and implement policy and environmental changes that increase access to affordable, nutritious food; provide safe, enjoyable, and accessible opportunities for physical; and limit access to alcoholic beverages for all individuals."[22]

To achieve the above Recommendation in communities, the following are also recommended:

- Improving Healthy Eating and Active Living-Related Environments
- Increasing Access to Healthy, Affordable Foods
- Increasing Access to Opportunities for Physical Activity, Play, Leisure Time Activity, and Transportation
- Decreasing Access to Alcoholic Beverages

Finally, the ACS Guideline also recommends healthcare involvement by developing and implementing Clinical Strategies to Promote Healthy Eating and Active Living and Limiting Alcohol. Those in a position to create change in policies, are encouraged to endorse Public Policy Approaches to Promote Healthy Eating and Active Living.

Summary

There is a long history of those in the medical profession contemplating and researching the potential links between nutrition, physical activity and cancer. In more recent years, this research has grown dramatically, yielding extensive results that have been interpreted by current experts in the field and culminating in practical cancer prevention guidelines. One of many important findings include the link between energy balance, body fatness and the risk of cancer. With the growing worldwide obesity statistics, in children through adults, this information is both timely and instructive. As a result, both the WCRF/AICR Diet, Nutrition and Physical Activity and Cancer Prevention Recommendations and the Recommendations for Individual Choices within the ACS Guideline for Diet and Physical Activity for Cancer Prevention have chosen weight management as their primary recommendation, followed by the promotion of increased physical activity and decreased sedentary behaviors. Diet recommendations follow this theme, with recommendations to limit energy-dense foods and beverages such as bakery food, desserts, candy and sugar sweetened drinks as well as to avoid alcoholic beverages. All diet-related recommendations lean towards a plant-based, nutrient-dense diet that is low in processed foods, including processed meats. Both the WCRF/AICR Report and the ACS Guideline provide an excellent framework for promoting their recommendations in clinical and community settings.

Resources

Cancer Statistics at a Glance
World Cancer Research Fund
American Institute for Cancer Research
Continuous Update Project
ACS Guideline for Diet and Physical Activity for Cancer Prevention
NIH-National Cancer Institute, Cancer Prevention Overview (PDQ®)

References

1. Kiple KF, Ornelas KC. *The Cambridge World History of Food.* Cambridge University Press. Cambridge, UK. 2000.
2. Schatzkin, A. Division of Cancer Epidemiology and Genetics. National Cancer Institute, 2005.
3. Dishman RK, Washburn RA, Heath GW. *Physical Activity Epidemiology*, 2004.
4. Jurdana M. Physical activity and cancer risk. Actual knowledge and possible biological mechanisms. *Radiol Oncol.*

2021;55(1):7-17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7877262/
5. National Institutes of Health. National Cancer Institute. What is cancer? Accessed December 2022. https://www.cancer.gov/about-cancer/understanding/what-is-cancer.
6. National Institutes of Health. National Cancer Institute. What is cancer? Accessed December 2022. https://www.cancer.gov/types/common-cancers.
7. Centers for Disease Control and Prevention. Cancer data and statistics. Accessed December 2022. https://www.cdc.gov/cancer/dcpc/data/.
8. Centers for Disease Control and Prevention. Cancer statistics at a glance. Accessed December 2022. https://gis.cdc.gov/Cancer/USCS/#/AtAGlance/.
9. National Cancer Institute and Centers for Disease Control and Prevention. State cancer profiles. Quick profiles: New Jersey. Accessed December 2022. https://statecancerprofiles.cancer.gov/quick-profiles/index.php?statename=newjersey.
10. World Cancer Research Fund/American Institute for Cancer Research. *Diet, Nutrition, Physical Activity and Cancer: A Global Perspective.* Continuous Update Project Expert Report 2018.
11. World Cancer Research Fund/American Institute for Cancer Research. *Diet, Nutrition, Physical Activity and Cancer: A Global Perspective.* Continuous Update Project Expert Report 2018. A summary of the third expert report. Accessed December 2022. https://www.wcrf.org/wp-content/uploads/2021/02/Summary-of-Third-Expert-Report-2018.pdf.
12. World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project Expert Report 2018. *Diet, Nutrition, Physical Activity: Energy balance and body fatness.* Accessed December 2022. https://www.wcrf.org/diet-activity-and-cancer/global-cancer-update-programme/resources-and-toolkits/#accordion-1.
13. World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project Expert Report 2018. Diet, Nutrition, Physical Activity: Body fatness and weight gain and the risk of cancer. Accessed December 2022. https://www.wcrf.org/diet-activity-and-cancer/global-cancer-update-programme/resources-and-toolkits/#accordion-1.
14. World Cancer Research Fund International. Judging the evidence. Accessed December 2022. https://www.wcrf.org/diet-activity-and-cancer/global-cancer-update-programme/judging-the-evidence/.
15. World Cancer Research Fund/American Institute for Cancer Research. *Diet, Nutrition, Physical Activity and Cancer: A Global Perspective.* Continuous Update Project Expert Report 2018. Recommendations and public health and policy implications. Accessed December 2022. https://www.wcrf.org/diet-activity-and-cancer/global-cancer-update-programme/resources-and-toolkits/#accordion-1.
16. American Institute for Cancer Research. Cancer researchers issue yearly warning on safer grilling. Accessed December 2022. https://www.aicr.org/news/cancer-researchers-issue-yearly-warning-on-safer-grilling/.
17. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020-2025.* 9th Edition. 2020. Accessed December 2022. DietaryGuidelines.gov.
18. American Institute for Cancer Research. Mixed messaging on red wine: separating myth from fact. Accessed December 2022. https://www.aicr.org/resources/blog/mixed-messaging-on-red-wine-separating-myth-from-fact/.
19. American Heart Association. Drinking red wine for heart health? Read this before you toast. Accessed December 2022. https://www.heart.org/en/news/2019/05/24/drinking-red-wine-for-heart-health-read-this-before-you-toast.
20. Goralczyk R. Beta-carotene and lung cancer in smokers: review of hypotheses and status of research. *Nutr Cancer.* 2009;61(6):767-74. doi: 10.1080/01635580903285155. PMID: 20155614.
21. Bonovas S, Fiorino G, Lytras T, Malesci A, Danese S. Calcium supplementation for the prevention of colorectal adenomas: A systematic review and meta-analysis of randomized controlled trials. *World J Gastroenterol.* 2016 May 14;22(18):4594-603. doi: 10.3748/wjg.v22.i18.4594. PMID: 27182169; PMCID: PMC4858641.
22. Rock CL, Thomson C, Gansler T, Gapstur SM, McCullough CL, Patel AV, et. al. American Cancer Society guideline

for diet and physical activity for cancer prevention. CA Cancer J Clin. 2020;70:245-271.
23. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd edition. Washington, DC: U.S. Department of Health and Human Services; 2018. Accessed December 2022. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf.
24. Centers for Disease Control and Prevention. Cancer: healthy choices. Accessed December 2022. https://www.cdc.gov/cancer/dcpc/prevention/other.htm.

9.

Chapter Nine: A Health Equity Lens in Obesity Related Chronic Disease Prevention Programs

Authored by: Sara A. Elnakib, PhD, MPH, RDN; Edited by Sherri M. Cirignano, MS, RDN, LDN

Chapter Outline

Introduction

Throughout this book you have learned about the impact of obesity on individuals, and the connection between chronic disease and obesity. You have also learned about evidence-based interventions that can reduce obesity and improve health both on an individual level as well as a community level. The need to modify programs to support program participants from diverse backgrounds has been infused throughout the chapters. However, in this chapter

we will be making the case for why a health equity lens is a necessary construct in any obesity related chronic disease prevention program. Understanding the underlying issues of health disparities, the systems that have put them in place and the impacts they have had on historically marginalized populations is necessary to develop truly impactful programs. To do this we will define health equity and explain why it matters, the conceptual framework that underlies a health equity approach and finally what can be done in program planning, design, and evaluation to ensure that programming has a health equity lens.

What is Health Equity?

For many years health education has been focused on individual choice, framing health as a personal responsibility where good health is considered a personal success and poor health a personal failure.[1] However, this limited focus on individual health behaviors ignores the contextual factors that have a much larger impact on health. Imagine you are developing a program to promote fruit and vegetable consumption in a specific population. You can develop an evidenced based program, with accurate statistics and innovative ideas, but if your target population does not have access to fruits and vegetables, you will never reach your behavioral objective of increasing fruit and vegetable intake. Without addressing the social, institutional, and environmental factors that may influence your target populations direct behavior change, you will have a limited impact on their health.

Health Equity

According to the Centers for Disease Control and Prevention (CDC), "Health equity is achieved when every person has the opportunity to "attain his or her full health potential" and no one is "disadvantaged from achieving this potential because of social position or other socially determined circumstances".[2] This definition indicates that ?there are individuals who may be disadvantaged by a non-health related social factor. The United Nation's World Health Organization expands on this definition suggesting that health equity is the "absence of avoidable, unfair, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically or by other means of stratification".[3] The United Nation's World Health Organization definition explicitly highlights the fact that these inequities are avoidable and therefore solvable. The definition also indicates that the way resources are often provided or denied is based on factors that can be evaluated such as demographic, economic, and geographic factors. In a National Academies of Sciences Engineering and Medicine report on pathways to health equity, the authors unambiguously indicated factors such as "race, ethnicity, gender, employment and socioeconomic status, disability, immigration status, and geography"[4] as influencers of health equity.

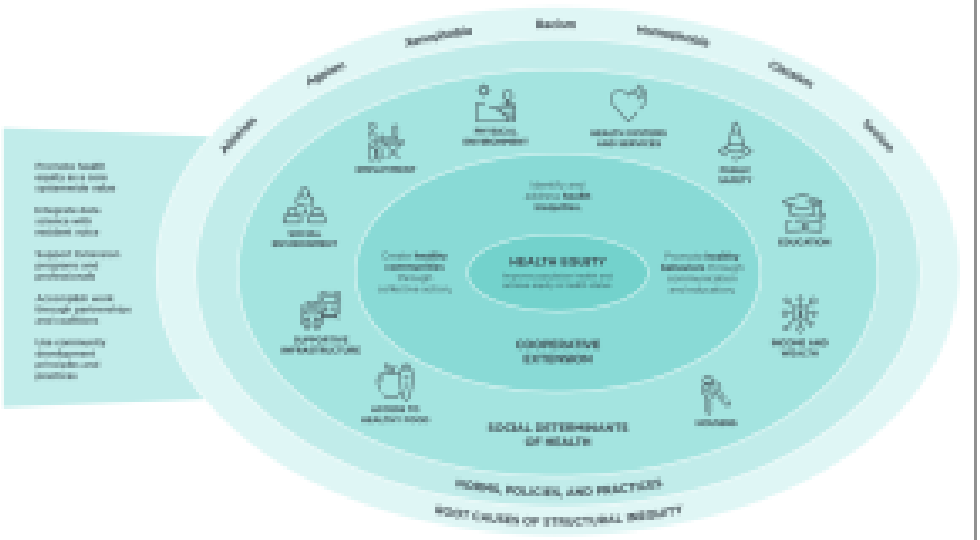
Social Determinants of Health

Factors that influence health outside of biological factors are also called social determinants of health. According to the World Health Organization social determinants of health are the "complex, integrated, and overlapping social structures and economic systems that are responsible for most health inequities. These social structures and economic systems include the social environment, physical environment, health services, and structural and societal factors. Social determinants of health are shaped by the distribution of money, power, and resources throughout local communities, nations, and the world".[5] Expanding our focus beyond individual behavior to include social determinants of health allows for a shift towards more "upstream" action that is the basis of public health interventions. This realization of how social factors and conditions in which we live, learn, work and play can shape our disease morbidity and mortality is a powerful realization. These conditions are shaped by policies, laws, investment, and cultural norms that have been influenced by structural racism. To support health equity, we need to address the system as a whole to "eliminate structural racism, reduce poverty, improve income equality, increase educational opportunity, and fix the laws and policies that perpetuate structural inequities"[4].

In figure 1, Cooperative Extension proposes a health equity and wellbeing framework that takes into consideration these social determinants of health.[6] As discussed in chapter 6, Cooperative Extension (CE) is the outreach arm of the Land Grant Universities, and the Department of Family and Consumer (or Community Health) Sciences is tasked with developing programs to support improved health in the community. In order to do that CE explicitly identifies the root causes of structural inequalities highlighting issues such as ableism, ageism, xenophobia, racism, homophobia, classism and sexism that have impacted our norms, policies and practices that have created inequity in our communities.[6] These inequities can be seen in social determinates of health such as access to quality housing, food and transportation, how

the physical environment is set up, and inequities in education, income, and employment. By framing CE programing with these larger issues in mind, CE professionals can identify health inequities and promote healthy behaviors through collective action.[6]

Figure 1: Cooperative Extension's Framework for Health Equity and Well Being



Source: *https://www.aplu.org/members/commissions/food-environment-and-renewable-resources/board-on-agriculture-assembly/cooperative-extension-section/ecop-members/ecop-documents/2021%20EquityHealth%20Sum.pdf*

Why Health Equity Matters?

Health Disparities and Inequities

According to the definition of health equity, there may be health differences between groups in a population which are linked to social, economic, or environmental disadvantages. These differences are called health disparities. Health disparities can be "differences in length of life; quality of life; rates of disease, disability, and death; severity of disease; and access to treatment".[2,7] We can find health disparities linked to chronic diseases such as diabetes, stroke, heart disease, cancer and obesity.[8] These disparities can be seen when segmenting the population by race or ethnicity[9], geography[10], income[11] and gender along with other factors. In order to address these disparities, we need to assess how these disparities impact the population we are interested in and then evaluate what interventions can be used to support the desired behavior change in the population.

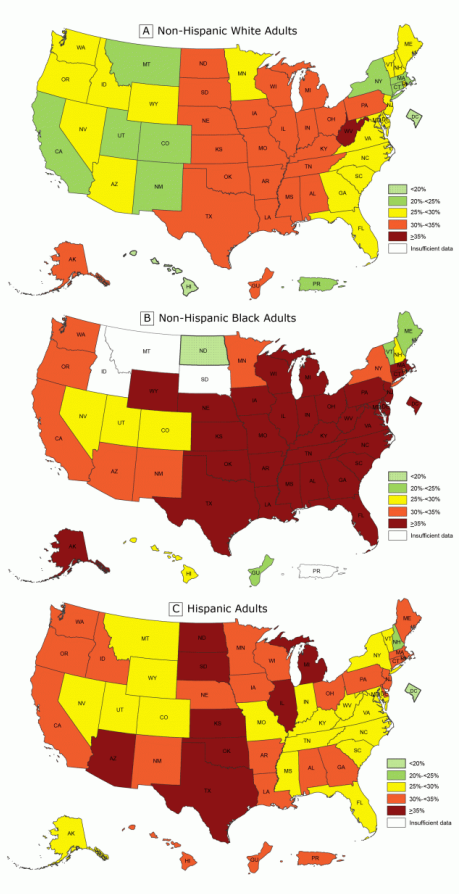
Health Disparities in Obesity

While there is consensus among scientists of the biological and genetic factors that influence obesity, there is a growing body of evidence indicating that there are many social, environmental and economic factors that influence obesity.[7] For example, we understand that obesity is a result of excess energy intake and limited energy expenditure, however the availability of energy dense foods and limited access to safe places to be physically active in a neighborhood may have a direct impact on an individual's likelihood of becoming obese. In fact, these factors have been recognized as "built environment" elements that can either facilitate or prevent obesity.[7] Research has shown that the presence of *food deserts*, an area with limited supermarkets and *food swamps*, an area with abundant fast food and convenience stores but limited supermarkets, can predict obesity rate.[7,12] Research indicates that food deserts and food swamps are predominately present in low-income communities.[12] Additionally, research has shown that neighborhood safety has a statistically significant impact on childhood BMI rates.[13] This indicates that children living in unsafe, low income

communities are more likely to develop obesity irrespective of personal choice due to the built environment. This reality can be seen through the stratification of obesity data across different social factors.

The Behavioral Risk Factor Surveillance System (BRFSS) has been used to assess obesity across the US over time, which the CDC publishes in state-specific maps since 1999.[14] State-specific prevalence ranges from a low of 22.6% in Colorado to a high of 38.1% in West Virginia. However, when stratifying the data by race and ethnicity there is a trend where black adults had the highest prevalence of obesity (38.4%) overall, followed by Hispanic adults (32.6%) and white adults (28.6%).[14] According to the CDC, racial and ethnic disparities in obesity risk are present as early as the age of 2 years old.[14,15] Figure 2 shows the states with the highest burden of obesity (35% or more) by adults' race and ethnicity. In this figure it is apparent that black adults have the highest burden of obesity in 31 states and the District of Columbia compared to only 8 states among Hispanic adults, and only 1 state among white adults.[14]

Figure 2: Obesity prevalence by state for black, Hispanic, and white adults in the United States



Source: https://www.cdc.gov/pcd/issues/2019/18_0579.htm

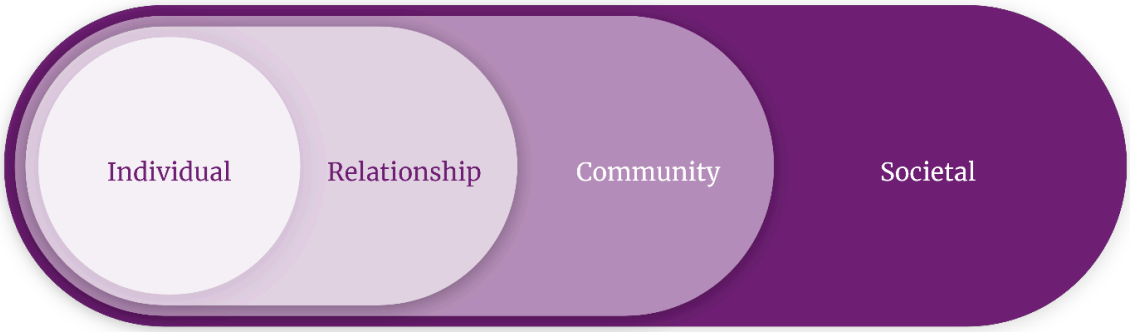
As we understand the different social factors that influence obesity, these health disparities need to be prioritized in the prevention and treatment of obesity and chronic diseases. However, understanding the theoretical framework in which

all these factors connect is an important first step in developing prevention and treatment programs with a health equity lens.

Conceptual Framework for a Health Equity Approach

As interventions move from a person centric approach to a public health approach there are many factors to consider. In an effort to organize these factors and their interactions, researchers have used the Social-Ecological Model. [16] The Social-Ecological Model is built on the premise that a person's health status is influenced by physical, social and cultural dimensions and that the same environment may have different effects based on an individual's financial resources. [16] It also considers that an individual is dynamic and operates in multiple environments including where they live, learn, work or play. [16] These environments may be a way to influence a person's behavior.[16] Figure 3 displays the four concentric circles that make up the different levels of the Social-Ecological Model. The first level is the individual factors that impact a person's health. These are factors specific to the person, including their age, gender, education, income and health history. The second level describes the relationship factors that may influence behavior. This may include a persons' family, friends, and partners. The third level specifies the community level influences, and that community can be defined in many ways. it could be their neighborhood or other physical characteristics that relate to a setting, such as their school or workplace. Finally, the last level portrays the Societal level which includes social norms, and policies that impact health.

Figure 3: The Social-Ecological Model: A Framework for Prevention



Source: https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html

Clarifying the relationship between an individual and the many factors that influence their behavior can help community health interventions target different factors to ensure improved health outcomes. This framework continues to reinforce the idea that these social determinants of health have a much bigger impact on health than an individual's health behaviors.

Focusing on Health Equity in Program Planning & Evaluation

Assess Needs

The first step to ensuring an intervention program has a health equity lens is to assess the data. Both quantitative

and qualitative data can be collected to assess the disease burden of obesity in different groups. As mentioned earlier, the Behavioral Risk Factor Surveillance System (BRFSS) has been used to assess obesity across the US over time, this data is publicly available and can be used to measure obesity in specific populations over time. Quantitative data should be stratified by the different social determinants of health to assess if a health disparity is present.[7] The County Health Rankings and Roadmaps, a program of the University of Wisconsin Population Health Institute, provides data on different social determinants of health for all counties in the United States, and can be used to highlight geographic disparities.[17] Qualitative data on the barriers to certain health behaviors can help identify the underlying social determinants of health that need to be addressed to improve health outcomes.

Developing Partnerships

Assuming that health education professionals have all the answers can create a major issue when working with the community. Partnering with community-based organizations as well as community members can only make the obesity program stronger. Having partners will allow for sharing of resources such as staff, time and money for implementing the program. It also provides a greater likelihood of success and sustainability for the program since partners are included from the beginning of the program planning process. Deciding on which partners to engage will depend on the type of intervention program and which social determinants of health factors the program will address.

Developing an Intervention

Using the data from the earlier steps and directly working with the community, one can collectively develop an intervention that is evidence based. Use the data from the assessment to decide which population to work with. Identify the health disparities that are present in that community and which social determinant of health the intervention will focus on. Once the intervention outcome has been determined, and the evidence-based policy, systems, or environmental changes have been researched and prioritized, the focus can then be on the desired outcome. This can be achieved by using a logic model to ensure each of the components of the intervention is outlined and will help plan the intervention more effectively. Working closely with community partners to design the intervention and communication plan, is essential. Additionally, communicating the results of the work to program participants as well as identified stakeholders needs to be included in the intervention plan.

Implementing and Monitoring the Intervention

Ensuring that the program goes according to plan is an important next step. Monitoring and collecting data on who is participating in the program, how the goals of the program are being met through the activities undertaken and checking in with the community partners will ensure the program is implemented in the way that it was planned. There are many different evaluation tools that can be used to assess that the implementation of the intervention stays true to it's intended process. A process evaluation reviews the program activities and compares them with the plan to assess if the program was delivered correctly.

Evaluating and Disseminating the Results

The field of health equity is still an emerging field, and in need of robust evaluation of policy, systems and environmental changes on positive health outcomes. Evaluation of the program to assess its impact on positive health outcomes is needed to develop and add to evidenced based solutions for health equity. Analyzing the data collected can contribute to the progress of the health equity field and obesity prevention and control. Focusing on the specific social determinates of health issues the intervention addressed, for which populations in what ways can help the entire field understand what we can collectively do to improve health disparities. Sharing the results with the scientific community through journal manuscripts, poster presentations and academic lectures should be part of the dissemination strategy. Translating the findings into easily understood factsheets and articles for stakeholders will ensure they not only recognize what was done but also ensure they can spread the word on the findings. Additionally, writing about the findings and their broader impacts in news media, social media and other public outlets can help move the conversation about health equity forward.

Sustaining the Efforts.

Sustaining the program needs to be considered from the very beginning of the planning process. That is why in the developing partnerships section sustainability was a consideration. Programs that have policy, systems and environmental changes tend to have sustainability embedded into them because of the nature of these changes.

However, support from coalitions and the target audiences can help ensure that these changes last. Empowering the people who are touched by these changes to speak up when policy or systems aren't being upheld can help ensure sustainability of the initiative. Additionally, many of these efforts need to adapt to the changes in the community, political environment and funding streams. That is why working with coalitions and developing partnerships can create internal accountability and a collective approach to problem-solving.

Summary

This chapter highlighted the impact of health disparities on different populations. Stratifying data to understand how different populations are impacted by different disease states can help identify health disparities. Using the social determinants of health framework to understand the social structures and economic systems that may underpin these disparities can help health educators find solutions that are sustainable and effective. Additionally, understanding that individual behavior is impacted by many factors and there are many models and frameworks that try to explain individual behavior. The Social Ecological model can be used to understand how to move programs from a person centric approach to a public health approach that may impact more people and have a sustainable impact. Finally, the chapter outlined considerations for program planning, design, implementation and evaluation to ensure that obesity prevention and control programs have a health equity lens to reduce health disparities in obesity.

Critical Thinking Questions

- What are a few health disparities that impact obesity in the United States?
- How are some ways to ensure an obesity prevention program has a health equity lens?
- Identify and explain the core components of the social ecological models of health behavior.

Resources

CDC's Health Equity Resource Toolkit for State Practitioners Addressing Obesity Disparities
Prioritizing Nutrition Security: Cooperative Extension's Framework for Health Equity and Well-Being
CDC's Logic Models Approach to Evaluation
The Health Equity Assessment Tool: A User's Guide

References

1. Temmann LJ, Wiedicke A, Schaller S, Scherr S, Reifegerste D. (2021) A Systematic Review of Responsibility Frames and Their Effects in the Health Context. *J Health Communication*. 2021. 26(12): 828-838. DOI: 10.1080/10810730.2021.2020381
2. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. Health Equity. Accessed March 2023.
3. https://www.cdc.gov/chronicdisease/healthequity/index.htm
4. World Health Organization. Social Determinants of Health. Accessed March 2023. https://www.who.int/health-topics/social-determinants-of-health
5. National Academies of Sciences, Engineering, and Medicine. Communities in Action: Pathways to Health Equity. The National Academies Press: Washington, DC. Accessed March 2023. https://www.nap.edu/read/24624/chapter/1
6. World Health Organization. Closing the gap in a generation: health equity through action on the social determinants of health – final report of the Commission on Social Determinants of Health. Accessed March 2023. https://www.who.int/publications/i/item/WHO-IER-CSDH-08.1
7. Burton et al. Cooperative Extension's National Framework for Health Equity and Well Being. [Report of the Health Innovation Task Force] Extension Committee on Organization and Policy: Washington, DC. Accessed March 2023. https://www.aplu.org/members/commissions/food-environment-and-renewable-resources/board-on-agriculture-assembly/cooperative-extension-section/ecop-members/ecop-documents/2021%20EquityHealth%20Sum.pdf
8. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health

Promotion, Division of Nutrition, Physical Activity and Obesity with Stephen James, Lisa Hawley, Rachel Kramer, and Yvonne Wasilewski at SciMetrika, LLC. *Health Equity Resource Toolkit for State Practitioners Addressing Obesity Disparities*. Accessed March 2023. https://www.cdc.gov/nccdphp/dnpao/health-equity/state-health-equity-toolkit/pdf/toolkit.pdf

9. Thorpe KE, Chin KK, Cruz Y, Innocent MA, Singh L. The United States Can Reduce Socioeconomic Disparities By Focusing On Chronic Diseases. *Health Affairs*. August 17, 2017. DOI: 10.1377/hblog20170817.061561
10. Price JH, Khubchandani J, McKinney M, Braun R. Racial/ethnic disparities in chronic diseases of youths and access to health care in the United States. *Biomed Res Int.* 2013. doi: 10.1155/2013/787616
11. National Institute of Health. National Library of Medicine. Challenges and Successes in Reducing Health Disparities: Workshop Summary. The Impact of Geography on Health Disparities in the United States: Different Perspectives. 2008. Accessed March 2023. https://www.ncbi.nlm.nih.gov/books/NBK215365/
12. Chokshi DA. Income, Poverty, and Health Inequality. JAMA. 2018;319(13):1312–1313. doi:10.1001/jama.2018.2521
13. Cooksey-Stowers K, Schwartz MB, Brownell KD. Food Swamps Predict Obesity Rates Better Than Food Deserts in the United States. *Int. J. Environ. Res. Public Health.* 2017. 14; 1366. https://doi.org/10.3390/ijerph14111366
14. Hilmers A, Hilmers DC, Dave J. Neighborhood disparities in access to healthy foods and their effects on environmental justice. *Am J Public Health.* 2012. Sep;102(9):1644-54. doi: 10.2105/AJPH.2012.300865
15. Petersen R, Pan L, Blanck HM. Racial and Ethnic Disparities in Adult Obesity in the United States: CDC's Tracking to Inform State and Local Action. *Prev Chronic Dis.* 2019;16:180579. DOI: http://dx.doi.org/10.5888/pcd16.180579
16. Pan L, Freedman DS, Sharma AJ, Castellanos-Brown K, Park S, Smith RB, et al. Trends in obesity among participants aged 2–4 years in the Special Supplemental Nutrition Program for Women, Infants, and Children – United States, 2000–2014. *MMWR.* 2016. 65(45):1256–60.
17. Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promo.* 1996. 10(4):282–298. https://doi.org/10.4278/0890-1171-10.4.282
18. County Health Rankings & Roadmaps. Accessed March 2023. https://www.countyhealthrankings.org/