MAYO CLINIC PROCEEDINGS:
INNOVATIONS, QUALITY & OUTCOMES

MAYO CLINIC

The Burden of Chronic Disease

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Abstract

Chronic diseases like diabetes, heart disease, stroke, and cancer have been and continue to be some of the major causes of worldwide morbidity and mortality. A transition between infectious and noncommunicable diseases occurred in the early 1900s as a result of improved public health and has persisted ever since. Now, as individuals live longer, the prevalence and cost of chronic disease continue to grow. The estimated cost of chronic disease is expected to reach $47 trillion worldwide by 2030. Individual lifestyle and behaviors and community factors play important roles in the development and management of chronic diseases. Many of these conditions (diabetes, heart disease, and respiratory diseases) are preventable, and their leading risk factors are physical inactivity, poor nutrition, tobacco use, and excessive alcohol. Unfortunately, the investment in prevention remains small compared with treatment, both from a lifestyle perspective and a social determinants of health perspective. Given the future trajectory of chronic disease, innovation in technology and pharmaceuticals with a concomitant investment in prevention will be required. Our future depends on it.

 ■ Mayo Clin Proc Inn Qual Out 2024;8(1):112-119

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Chronic diseases like diabetes, heart disease, stroke, and cancer are some of the major causes of morbidity and mortality in the United States.[1] This has been true since the early 1900s when there was an epidemiologic transition from infectious disease to noncommunicable diseases.[2] This transition was partly due to improved nutrition, sanitation, and other public health successes and medical technology and innovation. Since 1950, heart disease has been the leading cause of death in the United States.[3] Worldwide, this transition has also taken place, although often at a different pace depending on the individual country. Today, chronic noncommunicable disease is the leading cause of death worldwide.[4]

In the past several years, COVID-19 and the diseases of despair, such as overdose, suicide, and excessive alcohol use,[5,6] have contributed to a decline in the American lifespan. However, chronic diseases remain 8 of the 10 leading causes of death in the United States.[6,7] Even in the context of COVID-19, heart disease and cancer accounted for nearly 40% of all US deaths in 2022.[6] It is also important to remember that COVID-19 interacted extensively with chronic diseases. These diseases, such as diabetes and heart disease, were identified as major risk factors for severe morbidity and mortality from COVID-19.[8]

Part of the challenge moving forward is the demographic characteristic shift occurring in the United States and around the world. Longer lives and lower birth rates have translated to an increase in the average population age.[9] For example, the average age in the United States was 29.5 in 1960 and in 2021 it was 38.6.[10] As the population ages, so does the prevalence of chronic disease. In addition, many individuals have multiple chronic conditions. In 2018, it was estimated that 27% of adults in the United States had multiple chronic conditions.[11] The cost of chronic disease to the American medical system is enormous, accounting for more than $1 trillion every year.[12] Chronic disease accounts for the overwhelming percentage of preventable deaths and disabilities in the United States and around the world. According to the World Health Organization, 63% of worldwide deaths in 2008 were caused by major preventable diseases (cardiovascular disease, cancer, chronic respiratory diseases, and diabetes).[13] In 2011, the cost of chronic disease worldwide was estimated to reach $47 trillion by 2030.[14]

In addition to an older population, there are numerous risk factors that involve

individual behavior and lifestyle and community factors that affect the prevention and management of chronic disease. The leading risk factors for preventable chronic disease are physical inactivity, poor nutrition, tobacco use, and excessive alcohol use.[15] These account for more than 50% of preventable disease deaths in the United States, including those caused by cancer, chronic respiratory diseases, type 2 diabetes, and cardiovascular disease (CVD).[15] However, the worldwide financial contribution to ameliorating these risk factors, ranging from access to healthy food and places to exercise to smoking cessation and cancer screening, is minimal. The percentage of total national health care spending on public health initiatives in the United States and comparable countries ranged from 1.1% to 5.9% in 2018. In the United States, it was 2.9%.[16]

ARTICLE HIGHLIGHTS

- Chronic diseases are among the leading causes of death and disability worldwide.
- Chronic diseases such as heart disease, diabetes, cancer, and associated risk factors such as smoking and physical inactivity, increased the risk of severe COVID-19 morbidity and mortality.
- The cost of chronic disease worldwide is estimated to reach $47 trillion by 2030.
- Many preventable chronic diseases can be modified by addressing 4 major risk factors: physical inactivity, poor nutrition, tobacco use, and excessive alcohol.
- Lifestyle behavior change and nonmedical factors that influence health (social determinants of health) are critical to addressing rising rates of chronic disease.

Heart Disease and Stroke

In 2020, worldwide, an estimated 523 million people reported some form of CVD, and approximately 19 million deaths were attributable to CVD. This represents ~32% of all global deaths and is an absolute increase of 18.7% from 2010.[17,18] In the United States in 2021, 934,509 people died of CVD (including heart disease and stroke, the first and fifth leading causes of death, respectively), a 0.6% increase when compared with 2020. Figure 1 provides information on the rates of heart disease deaths from 2010-2020 by race and ethnicity and demonstrates large disparities.[19] Stroke was also one of the leading causes of death in the United States and 162,890 people died of stroke in 2021. Black adults are twice as likely to die of stroke as White adults.[19]

Annual CVD costs to the nation averaged $407.3 billion in 2018-2019, up from $378.0 billion in 2017-2018.[18] Over time, cardiovascular health has improved, but during the pandemic, there were slight increases in mortality related to heart disease. It is hard to determine if this was due to shifts in health care access, medication management, or other factors.[20]

Cancer

Despite downward trends in rates (Figure 2), cancer remains one of the leading causes of death both in the United States and worldwide. In the United States, cancer is the number 2 cause of death and is responsible for 1 in every 5 reported deaths, or about 600,000 deaths a year.[6] Of the leading cancers, the number 1 cause of cancer deaths remains lung cancer, followed by female breast cancer (Figure 3). Rates vary by race and ethnicity.[22] The cost of cancer in the United States was estimated at more than $180 billion in 2015, with a projected increase to $246 billion by 2030.[23] Worldwide, cancer is the second leading cause of death. In 2020, almost 10 million deaths were because of cancer.[24] The leading cause of cancer deaths worldwide was lung cancer, followed by colorectal cancer.[25] It is estimated that cancer incidence will rise by over 40% by 2040.[25]The total cost of global cancer is estimated to reach over $25 trillion between 2020 and 2050. In particular, 5 cancers: tracheal, bronchial, and lung; colon and rectal; breast; liver; and leukemia, represent almost half of the global cost.[26]

Diabetes

Diabetes was responsible for over 103,000 deaths in the United States in 2021. It is the eighth leading cause of death.[27] In 2019, over 37 million people in the United States had diabetes. Some 8.5 million adults aged 18 years or older met laboratory criteria for diabetes but were undiagnosed, and an estimated 96 million adults aged 18 years or older

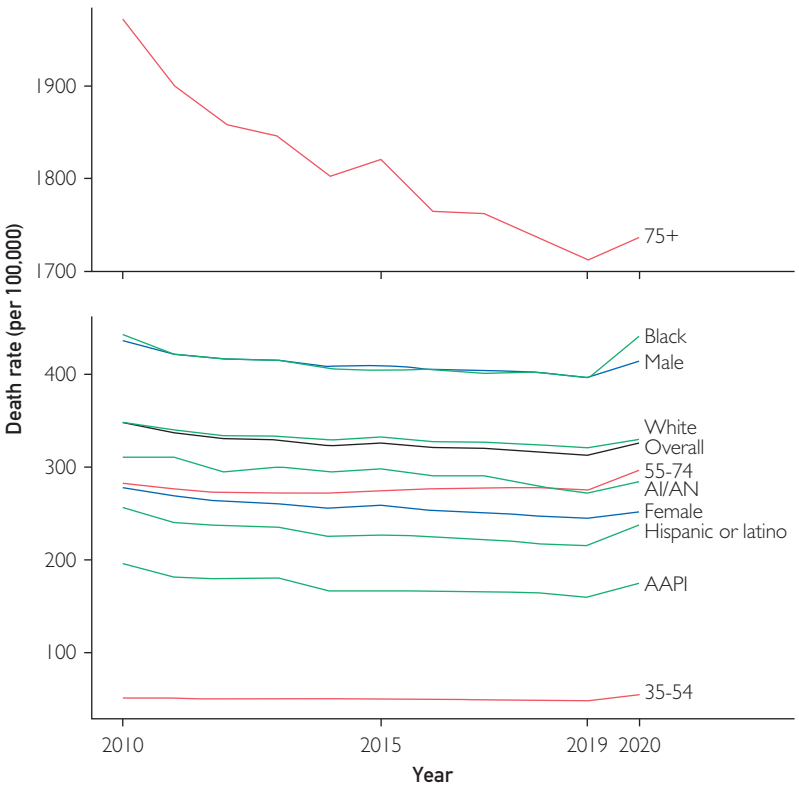

FIGURE 1. Heart disease death rates among adults aged ≥35 years of age, sex, and race and Hispanic ethnicity group—United States, 2010-2020.[20]

had prediabetes.[27] Diabetes is growing in prevalence in the United States with rates increasing among adults from 10.3% in 2001-2004 to 13.2% in 2017-2020 (Figure 4).[28] Worldwide, about 422 million people have diabetes and the prevalence has been increasing steadily.[29] A total of 1.5 million deaths worldwide are directly attributed to diabetes annually, as reported in 2019.[30] Estimates in 2016 suggested that if the trends continue, more than 700 million adults worldwide could have diabetes by 2025.[31] Cost estimates for the US health care system, last assessed in 2017, estimate a cost of $237 billion.[32] The global health expenditure on diabetes was estimated at $966 billion in 2021 for adults aged 20 to 79 years.[33]

Alzheimer Disease and Other Dementias

Alzheimer disease (which accounts for 60%-70% of dementias)[34] and other dementias represent a growing issue in chronic disease (Figure 5). Recent data suggest that 1 in 10 people over 45 years of age report subjective cognitive decline.[35] It is estimated that 6.7 million Americans aged 65 years and older are living with Alzheimer disease.[35] In 2022, Alzheimer disease was the 7th leading causes of death.[6] In 2023, it is estimated that Alzheimer disease and other dementias will cost the nation over $345 billion, and by 2050, cost could rise to nearly a trillion dollars.[36] According to the World Health Organization, there are currently more than 55 million people worldwide with dementia, and every year there are almost 10 million new cases.[34] In 2019, it was estimated that the burden of dementia was costing global economy $1.3 trillion.[34]

Effect of COVID-19 Pandemic on the Burden of Chronic Disease in the United States

The COVID-19 pandemic represented a major disruption to health care and

Mayo Clin Proc Inn Qual Out ■ February 2024;8(1):112-119 ■ https://doi.org/10.1016/j.mayocpiqo.2023.08.005
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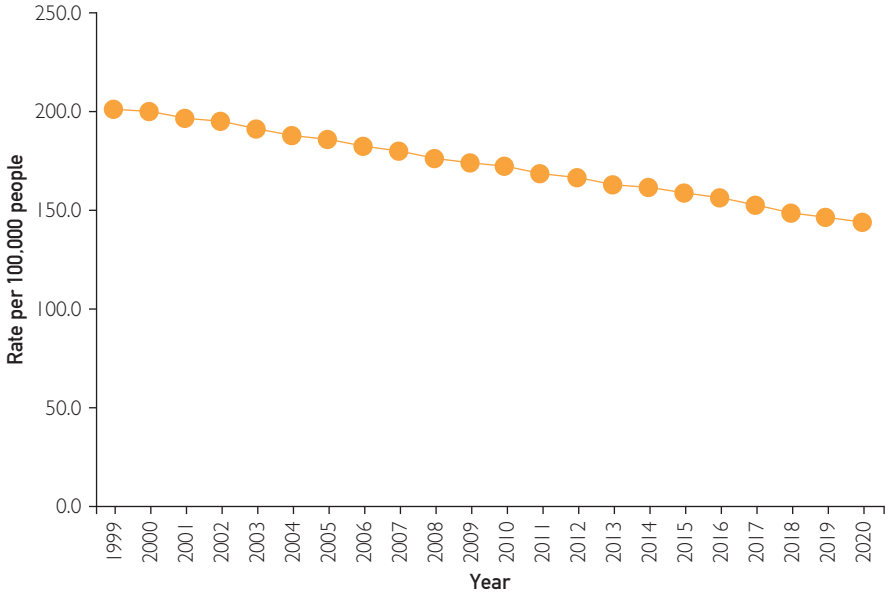

FIGURE 2. Annual rates of cancer deaths, 1999-2019. All types of cancer, United States.[21]

disproportionately affected people with chronic diseases. Older age, having a chronic disease (ie, diabetes, heart disease, cancer, and obesity), or having some of the risk factors for chronic disease (smoking and inactivity) put people at elevated risk for severe morbidity and mortality.[8] In addition, during the pandemic, people stopped or delayed health care.[37] Partly, this was because of fear of contracting COVID-19, but it was also because of delays and changes in access. Clinics closed, protocols changed, and individuals lost insurance when businesses closed. COVID-19 worsened chronic diseases by

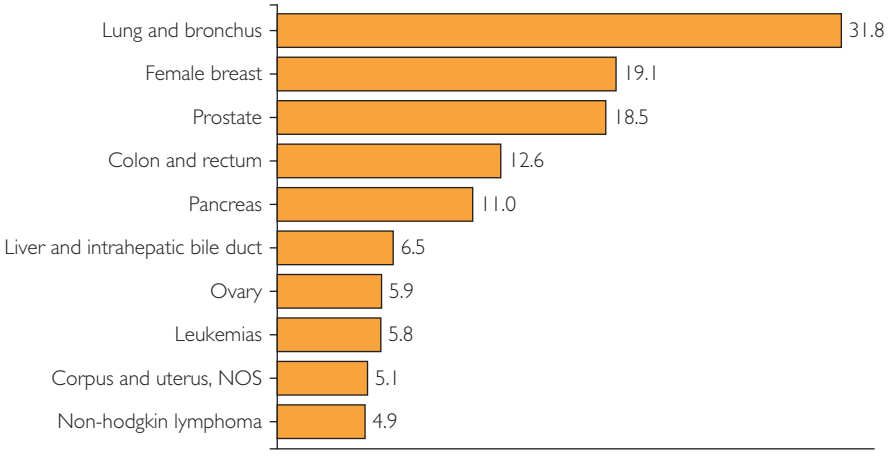

FIGURE 3. Top 10 cancers by rates of cancer deaths United States 2019, all races and ethnicities, man and woman.[21]

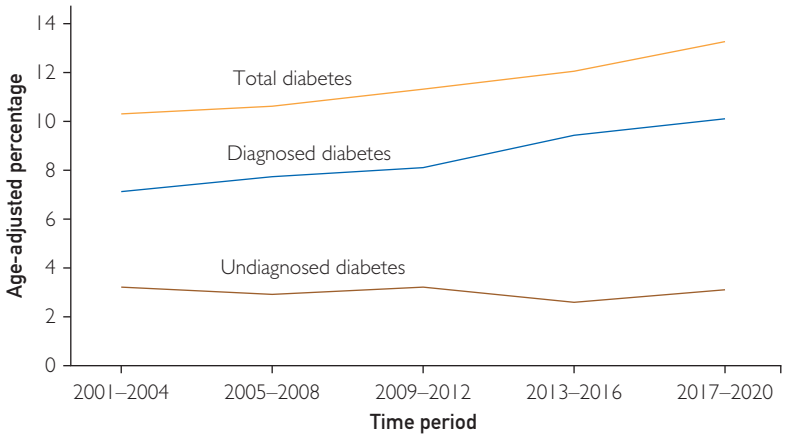

FIGURE 4. Trends in age-adjusted prevalence of diagnosed diabetes, undiagnosed diabetes, and total diabetes among adults aged 18 years or older, United States, 2001-2020.[28]

creating what has been called a health debt.[38] This resulted in a substantial decrease in preventive care, such as screening for breast and cervical cancer.[39] Long-standing health disparities were also exacerbated during the pandemic. African Americans, Hispanic or Latino, Native Americans, and people experiencing poverty bore a disproportionate burden of COVID-19 morbidity and mortality.[40]

To add to this, COVID-19 affected lifestyle behaviors including nutrition, alcohol consumption, and physical activity. Physical inactivity increased (at least for some of the population), as did alcohol consumption.[41] Studies suggest that childhood obesity increased during the pandemic.[42] Although the full effect of COVID-19 on individuals with existing chronic diseases is as yet unknown, early evidence suggests that both diabetes and heart disease increased during the pandemic.[41] There is even some suggestion that individuals with existing chronic diseases may have been more likely to get long-COVID

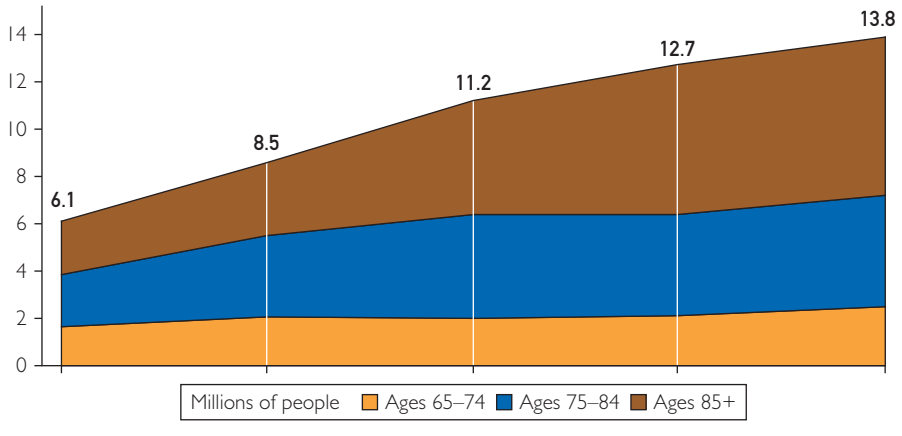

FIGURE 5. Projected number of people age 65 years and older (total and by age) in the US population with Alzheimer dementia, 2020-2060.[35]

Mayo Clin Proc Inn Qual Out ■ February 2024;8(1):112-119 ■ https://doi.org/10.1016/j.mayocpiqo.2023.08.005
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after a COVID-19 infection.[43] It is also possible that stress and anxiety associated with the pandemic played a role in lifestyle choices, but early data is not clear.[44-47] As we look to the future, it will be important to regain our losses and enhance prevention efforts.

Supporting Lifestyle Changes and Addressing Social Determinants of Health

The major risk factors for all of the aforementioned chronic diseases are intimately connected to lifestyle changes. Healthy eating, physical activity, smoking cessation, and alcohol reduction require individual action and lifestyle changes. The role of medical professionals in supporting these lifestyle behavior changes cannot be underestimated and is an important adjunct to treatment.[48] In addition, ensuring an equitable and respectful approach to care will help mitigate known health disparities and establish trust.[49] However, lifestyle changes also require opportunity. In jurisdictions without opportunity, behavioral change is difficult. For example, when you live in a food desert, it is difficult to engage in healthy eating behaviors, and when there are no safe and easily accessible places to exercise, it is difficult to enhance your physical activity. And, when your economic circumstances, your distance to health care, or your access to transportation get in the way of lifestyle changes, your road to health is uphill. Thus, if we do not address these factors, often called social determinants of health (SDOH) or nonmedical factors that influence health, individual and population-based behavioral change is elusive. The SDOH as defined by the Centers for Disease Control and Prevention are "the nonmedical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies, racism, climate change, and political systems."[50] Today, there is a movement to address both the SDOH and individual health-related needs. With the recognition that one's social needs have a direct effect on health outcomes, the health care system is moving toward screening for social needs and developing referral strategies with community partners. Simultaneously, community coalitions and public health and representatives from multiple sectors (ie, transportation, housing, and economic development), are aligning to address population-based SDOH.

The Future and Innovation

The epidemiology of preventable chronic diseases such as cancer, respiratory conditions, type 2 diabetes, heart disease, and stroke is deeply affected by shifts and changes in lifestyle related to diet, smoking, physical activity, and alcohol use. It is evident that these behaviors also effect the development of Alzheimer disease and other dementias.[51] In addition, large percentages of individuals are burdened with multiple chronic conditions, further complicating health care and health outcomes. As we look to the future to reduce the burden of chronic disease, we anticipate continued innovation. For example, there is an increasing focus on the self-monitoring of biometrics related to physical activity, diet, and blood pressure. As consumers take their health metrics into their own hands through wearable devices, technology applications, and automated messaging, we expect to see shifts in the use of health care, interoperability, and hopefully encouraging news in behavior change and chronic disease self-management. However, technology is costly, requires accessibility, and must be culturally competent. To date, disparities exist, such as internet access, insurance coverage, educational awareness, and other contributors. These disparities were amplified during the pandemic as specific populations, such as racial and ethnic groups, those living in low socioeconomic conditions, and specific geographic regions, were at higher risk for severe COVID-19 outcomes. To achieve health equity, these innovations must adopt nuanced strategies with health equity in mind.

As we look to the future regarding lifestyle changes, we will be contending with both the challenges to prevention and the opportunities that technological innovation brings. Simultaneously, the burgeoning pharmaceutical options for the treatment of diabetes and obesity, for example, may make prevention less urgent. After all, why focus on

environmental changes if treatment is available? Without prevention, across the world, we will likely continue to see increases in chronic diseases at younger ages and all the consequent results of growing morbidity and economic consequences. This will also be a challenge to lifestyle medicine given the public's appetite for easy fixes. But, as providers and public health professionals, our efforts are sorely needed now more than ever. Our future depends on it.

POTENTIAL COMPETING INTERESTS

The author reports no conflict of interest. The findings and conclusions in this report are those of the author and do not necessarily represent the views of [the Centers for Disease Control and Prevention.

Abbreviations and Acronyms: **CVD**, cardiovascular disease; **SDOH**, social determinants of health

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