**Research Article**

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# A Meta-analysis and Non-systematic Results for Prevention of Non-Communicable Diseases

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## Abstract

The overall purpose of this study was to determine the Non-Communicable Diseases' (NCDs) risk factors and the wider determinants of health by understanding what NCDs are and the burden they represent to low, middle, and high-income countries. This study explores the determinants of NCDs throughout the life course and the sociopolitical landscape, including the competing interests that can render NCD prevention more challenging. The major aims are to determine how the global response to NCDs is shifting from apathy to action and the important role of public health advocacy in tackling NCDs and taking a more operational look at how to define the problem in a particular context, through use of screening and/or surveillance; and addressing approaches to evaluating effectiveness and cost effectiveness and modeling different interventions.

## Introduction

Non-communicable diseases (NCDs) are chronic diseases that cannot directly be transmitted from one individual to another. Examples of NCDs are autoimmune diseases, Alzheimer's disease, and diabetes. Annually, most NCD's deaths are caused by cardiovascular diseases (17.9 million), cancers (9.0 million), respiratory diseases (3.9 million) and diabetes (1.6 million). Although these diseases are often linked to people who are older, all age groups may be affected by NCDs [1].

NCDs create the burden of being the leading cause of deaths globally, as they are accountable for approximately 41 million deaths yearly from heart attacks, stroke, cancers, chronic respiratory diseases, diabetes, and mental disorder. It is essential to study how one acquires NCDs, its effects on humanity, and how countries are responding to this epidemic [1]. Globally, NCDs killed nearly 57 million people in 2008 and nearly 80% of the deaths occur in low-and middle-income countries and of the total deaths of 57 million people globally in 2008, 36 million (63%) are known to be due to NCDs, especially cardiovascular diseases, cancers, diabetes and chronic lung diseases, as the combined burden of these diseases continues to rise fastest in lower-income countries, population and communities with large, avoidable costs in human, social and economic terms [2].

Furthermore, mortality and morbidity data reveal the growing and disproportionate impact of the epidemic in lower-resource settings. Over 80% of cardiovascular and diabetes deaths, and almost 90% of deaths from chronic obstructive pulmonary disease, occur in low- and middle-income countries. More than two thirds of all cancer deaths occur in low- and middle-income countries. NCDs also kill at a younger age in low- and middle-income countries, where 29% of NCD deaths occur among people under the age of 60, compared to 13% in high-income countries. The estimated percentage increase in cancer incidence by 2030, compared with 2008, will be greater in low (82%) and lower-middle-income countries (70%) compared with the upper-middle- (58%) and high-income countries (40%). However, with the belief that NCDs afflict mostly high-income populations, evidence as shown that nearly 80% of NCD deaths occur in low-and- middle-income countries and are the most frequent causes of death in most countries, except in Africa. NCDs are rising rapidly and are projected to exceed communicable, maternal, perinatal, and nutritional diseases as the most common causes of death by 2030 [2].

NCDs are increasingly becoming a worldwide problem, but even more so to low-income and middle-income countries (LMICs). Behavioral risk factors of NCDs include tobacco and alcohol use, an unhealthy diet, physical inactivity, hypertension, obesity, and hyperglycemia. Methods of preventing these risk factors from becoming implemented in people's lives, include the promotion of wellness, as well as the reduction of tobacco and salt production. It is now globally recognized as a worldwide problem motivating countries and organizations from all over the world to continue to research prevention methods and how to implement them. Some of the major goals of the World Health Organization (WHO) are to prevent the prevalence of diabetes and obesity from increasing, in addition to reducing mortality due to cancer, diabetes, chronic respiratory diseases, and cardiovascular diseases by a quarter [3].

Socioeconomic factors are often associated with an individual's dietary pattern, which are central components in the equation

of NCDs. While there are behavioral factors influencing food selection, economic factors are also accounted for in these decisions. Individuals from a lower socioeconomic background are more likely to sacrifice proper nutrition for caloric intake, choosing energy-dense food products with high saturated fats and cholesterol over nutrient-dense ones; practicing these dietary patterns increases the development of health complications.

Excessive alcohol consumption and its effects on an individual also differ based on socioeconomic backgrounds. In general, high alcohol consumption can increase the risk of damaging the gastrointestinal (GI) tract and lead to hepatitis, hepatic liver disease, and cirrhosis [4]. Regardless of the amount of alcohol consumed, individuals who are low and middle income are disproportionately suffering from alcohol-related complications compared to affluent groups [5].

Exposure to pollutants from the environment is another issue whose effects inflict more harm on different groups, based on race and income. A study from the Lancet Commission determined that the mortality rates from pollution are greater in minorities and in developing areas. About 92% of deaths associated with pollution occur in low-income and middle-income countries, and pollution-related NCDs are inflicting minorities at higher rates, irrespective of their income level [6].

Aside from the risk factors, citizens of LMICs face barriers to receiving treatment for their NCDs. For instance, in rural areas of developing countries, poor infrastructure to urban hospitals creates a physical barrier for individuals in those areas to receive adequate treatment. Access to modern medicine and formally trained healthcare professionals is limited in these regions. Healthcare systems in LMICs also have limited budgets and results in these groups of people relying on traditional medicine because modern healthcare is unaffordable for them [7].

NCDs are long-lasting diseases with a combination of behavioral, genetic, physiological, and environmental factors that cannot be directly transmitted from one individual to another; these diseases are associated with global healthcare issues and affect the healthcare workforce negatively, as they are prone to affect people of all ages, racial groups, regions, and countries [1]. With NCDs comprising the majority of deaths worldwide and LMICs disproportionately suffering from them, goals are needed to combat this global challenge. Goals for diminishing NCDs and their impact include incorporating all government departments rather than the health department in this challenge; reducing intake of cholesterol, saturated fats, sodium, and added sugars; and assisting patients in recognizing that they can improve their own health rather solely than relying on healthcare providers for treating conditions [8].

With a high death rate associated with NCDs, they have turned into a threat that requires immediate action by people from all around the globe. As NCDs ultimately increase poverty rates, the crisis jeopardizes social, economic, and environmental development throughout the world, especially in LMICs [9]. Since NCDs are mostly affecting LMICs, it has now become a global issue and needs the attention of countries all over the world to aid in helping people living in LMICs. Without aid and funding from higher-income countries, LMICs will continue to struggle with providing health care to those with NCDs. As NCDs continue to increase, global inaction will overwhelm LMICs and may ultimately slow down social and economic development.

NCDs have been a long concern in developed countries worldwide and within the United States, especially in recent years. According to Kaiser Family Foundation, non-communicable diseases caused more than two-thirds, around 41 million or 71%, of all annual deaths [10]. These diseases essentially jeopardize social, economic, and environmental development throughout the world, increase poverty rates, and may result in global pandemics similar to the ongoing coronavirus effective since December 2019. Because low- and middle-income countries are most affected by these NCDs and need the most attention and help, it becomes a huge burden globally within high-income countries, where they become responsible to provide affordability to healthcare and preventative resources.

## Purpose of the Study

NCDs are prone to affect people of all ages, racial groups, regions, and countries; however, people between the ages of 30 and 69 years are about 15 million of all deaths associated with NCDs. NCDs have a large impact, boosting healthcare outlays and undercutting productivity. These diseases are still rapidly on the rise and a serious threat to the health of people living in developing countries and to socio-economic development [1]. According to WHO, 41 million people die from heart attacks, stroke, cancer, chronic respiratory diseases, diabetes or a mental disorder annually, which approximately amounts to more than 70% of all deaths worldwide, and also creates a crippling economic impact [3]. Necessary action against NCDs is not only a moral imperative, but an economic imperative. Data from 194 countries highlights that there are only 2 indicators out of 10 that half of all countries are fully meeting. This is a grim sign, making it making it critical to advance the work on NCDs in all countries during this decade. Therefore, the purpose of this study is to conduct an in-depth analysis of the data & statistics reported concerning the issues around non-communicable diseases, global healthcare, and the healthcare workforce.

This study also explored the underlying conditions and other contributing factors to health inequities and the interdependent nature of the factors that create them by conducting a meta-analysis and non-systematic literature review from existing literature on health disparities and health inequities. Even though public services, such as health and health service provision in urban areas may be much better than those in rural areas; it has not been proven if that is the case for less disadvantage populations living in the urban cities. There is a need to reduce health inequities among high-middle- and low-income groups by providing or equalizing health opportunities across the socioeconomic groups globally.

## Conceptual Framework and Significance of the Study

The presence of multiple risk factors attributes to the acquisition of NCDs with social determinants being the prevalence of risk factors and NCDs. Risk factors are variables that increase an individual's susceptibility to a disease or infection. Risk factors that are behavioral-related include unhealthy dietary patterns, excessive alcohol consumption, smoking tobacco, and a sedentary lifestyle. These practices are precursors to developing biological risk factors, such as hypercholesterolemia, hypertension, and obesity that then increase the risk of developing NCDs [11].

Factors that increase the risk of non-communicable diseases include modifiable behavioral and metabolic lifestyle risk factors. Some modifiable behavioral risk factors include the lack of physical activity, unhealthy diet, tobacco use, and the consumption of alcohol. Unfortunately, physical activity at work

like walking and bicycling have declined dramatically in urban and industrialized societies, where transportation is highly available. According to Ezzati and Riboli, a high intake of salt like fast foods are individually responsible for the risk factors of overweight and obesity [12]. Smoking and alcohol consumption is a result of many NCDs like cancers, chronic liver diseases, unintentional injuries, and even death. Metabolic risk factors include high blood pressure, hyperglycemia, hyperlipidemia, and overweight/obesity. For instance, implementing structural changes, such as increasing the cost of alcohol and tobacco and prohibiting tobacco in public environments, can help decrease complications related to these substances. Reducing the salt content of products, replacing trans fats with polyunsaturated fats, and adding taxes to beverages with high amounts of added sugar could also improve nutrition. Promoting awareness and developing policies to encourage physical activity can decrease health complications associated with a sedentary lifestyle [8].

All risk factors of non-communicable diseases can all lead to cardiovascular diseases (like heart attacks and stroke), chronic respiratory diseases (like asthma and chronic obstructive pulmonary disease), cancers, and diabetes. The WHO specifies two types of risk factors that could potentially increase the chance of getting NCDs: modifiable behavioral risk factors and metabolic risk factors [1]. Modifiable behavioral risk factors include tobacco use, frequent alcohol consumption, an unhealthy diet with high salt intake, and a lack of physical activity. With the increase of tobacco use, especially among teenagers, there may be an increase in the number of people with NCDs. Buttar, Li, & Ravi noted that an individual's diet highly depends on the frequency of their physical activity, as well as their smoking habits [13]. The amount of physical exercise is connected to the prevention or slowing down of the development of a number of chronic NCDs, such as cardiovascular diseases. Other risk factors included hypertension (high blood pressure), obesity, hyperglycemia (high levels of blood sugar), and hyperlipidemia (high amount of fat in the blood) [1].

Similarly, there are determinants of behavioral risk factors, as well as determinants of biomedical risk factors [14]. According to the same study, the determinants of behavioral risk factors include the use of tobacco, frequent consumption of alcohol, low fruit and vegetable intake, and physical inactivity. The determinants of biomedical risk factors are high cholesterol, blood sugar, triglycerides, and hypertension and obesity.

While NCDs are a worldwide issue affecting people of various backgrounds, individuals who come from lower income classes or from low- and middle-income countries (LMICs) are more disadvantaged at battling NCDs. Non-communicable diseases (NCDs), also known as chronic diseases, kill about 41 million people each year and are long-lasting diseases with a combination of behavioral, genetic, physiological, and environmental factors that cannot be directly transmitted from one individual to another.

It is significant to see variations between urban and rural health; constitutional variations ensure that the health of individuals varies and especially, older people tend to be sicker than younger people due to the natural aging process; and most likely, the differences in health inequity may be related to the fact that health issues are systematic because they are not distributed randomly, but show a consistent pattern across the population of different socioeconomic groups. Health is socially produced by differential social circumstances and is not biologically determined and therefore modifiable. Finally, it is unfair because inequity is unfair, when no action was taken, even though research has shown how to reduce inequities with known intervention. It is increasingly unfair when it is avoidable and preventable and no action was taken.

## Research Problem
The challenges of urban cities among many are fast-growing populations and demand for limited housing, food and other resources to meet basic needs and placing pressure on transport systems and other forms of infrastructure. Also, the U.S. economic crisis has deeply affected the lives of millions in America, leading to financial burden that are associated with pay reductions, job layoffs, bankruptcies and skyrocketing foreclosures that plunged many families and individuals into severe economic hardship; especially those living in low-income communities. Deepening poverty is inextricably linked with rising levels of homelessness for many Americans in urban cities. These are major factors that contributed to having access to quality healthcare [15].

NCDs have a variety of risk factors, including use of tobacco, an unhealthy diet, little to no physical activity, and excessive alcohol use, which may result in obesity, high blood pressure, high cholesterol levels, and ultimately, a disease. WHO's assumption implies that more and more individuals will live in a way that does not benefit their health, and in addition, it also implies a decline in health among the world population [3].

Also, preventing and reducing non-communicable diseases is a major challenge with an estimated 38 million deaths annually due to tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol. Significantly, of these deaths mentioned, 16 million are under the age 70 that died prematurely. This burden falls mainly on developing countries where 82% of premature deaths of these diseases occur. However, if the developed countries through research can come up with ways of reducing the major risk factors for non-communicable diseases, it would indeed help in reducing the number of deaths globally [15].

## Research Methods
This study utilized a non-systematic meta-analysis literature review of research found in the major databases under the terms "global healthcare issues" and "non-communicable diseases and healthcare workforce" since the year 2010, and was conducted in order to report the major primary findings. The review for this study included peer-reviewed publications that studied and investigated new approaches to planning and development and they are part of the references listed for this study. Articles from non-peer-reviewed publications were excluded and not listed on this review. The remaining articles were retrieved for further screening and were included in the review, as they evaluated urban health. Other bibliographies included in this research were hand-searched and therefore, no limitations were placed on study scope. Most of the results generated for this study were extracted from world health organization progress monitoring reports between 2013 through 2020, as a result of comparative analysis. Other findings from peer review research were also compared with the findings from WHO in order to report accurate results for this research.

## Findings
Powerful economic tools are needed to combat the danger of NCDs and every dollar invested in primary health care, with its emphasis on promoting health and preventing disease, is the most inclusive, effective and efficient way to reduce premature mortality from NCDs and to promote mental health and well-

being. In addition to strong primary health care, countries need strong referral systems with other levels of care for early detection and prevention. If this investment can be implemented globally, it could yield a significant return globally that will save 10 million lives by 2025 and prevent 17 million strokes and heart attacks by 2030 [3]. Special attention is needed to address the root causes of NCDs by access the following:
- The food we eat
- The water we drink
- The air we breathe
- The conditions in which people live, work and play; and
- A whole-of-government approach is essential

The success and outcomes of these major areas heavily dependent on political leadership in each country and how serious they are to investing in primary health care, implementing the best buys and initiating creative partnerships with all sectors that will lead successful outcomes in eradicating NCDs pandemic.

WHO (2020) global NCD action plan included the following:
- Reduce affordability by increasing excise taxes and prices on tobacco products
- Eliminate exposure to secondary hand tobacco smoke in all indoor workplaces, public places and public transport
- Implement plain/standardized packaging and/or large graphic health warnings on all tobacco packages
- Enact and enforce comprehensive bans on tobacco advertising promotion and sponsorship; and
- Implement effective mass media campaigns that educate the public about the harms of smoking/tobacco, tobacco use and second-hand smoke

Strengthen health systems to address NCDs through people-centered primary health care and universal health coverage, building on guidance and evidence-based national guidelines/ protocols/standards/ for the management of major NCDs through a primary care approach to be recognized, and approved by government or competent authorities to ensure prevention. Provision must be provided from interior rural areas to dense populated areas in all regions by government to make sure that people have access to drug therapy, including glycaemia control and counseling for eligible persons at high risk to prevent heart attacks and strokes with emphasis on the primary care level. Other recommendations as implemented by member state to reduce unhealthy diets are significant:

- Adopt national policies to reduce population salt/sodium consumption
- Adopt national policies that limit saturated fatty acids and virtually eliminate industrially produced trans fatty acids in the food supply
- WHO set of recommendations on marketing of foods and non-alcoholic beverages to children, and
- Legislation/regulations fully implementing the International Code of Marketing of Breast-mil Substitutes [3].

NCDs remain a major health issue in the United States with high mortality rates associated with cardiovascular diseases, cancers, and chronic respiratory diseases. At the same time, NCDs are also a global threat, especially in (LMICs). More attention must be given to non-communicable diseases, just as much as given to all communicable diseases, such as the current COVID-19 that was discovered in December 2019, when countries responded in a matter of weeks to this pandemic. Meanwhile, NCDs have been an ongoing issue for years, yet millions of individuals suffer, and do not maintain healthy dietary patterns nor practice smoking cessation. Perhaps after the prevalence of COVID-19 cases subsides, then countries can concentrate their efforts into taking actions and enforcing measures on the ongoing basis to combat NCDs.

There are also the macroeconomic burdens of the five leading NCDs (cardiovascular diseases, cancer, chronic respiratory diseases, diabetes, and mental health conditions) of all NCDs in the U.S. According to Chen, Kuhn, Prettner and Bloom, a total loss of USD 94.9 trillion (in constant 2010 USD) due to all NCDs [17]. Mental health conditions and cardiovascular diseases impose the highest burdens, followed by cancer, diabetes, and chronic respiratory diseases. In per capita terms, the economic burden of all NCDs in 2015–2050 is USD 265,000. The total NCD burden roughly corresponds to an annual tax rate of 10.8% on aggregate income. They believe that Non-communicable diseases (NCDs) have decisively replaced infectious diseases and malnutrition as the dominant cause of death globally. Table 1 below demonstrated the estimates of NCDs total economic impact in the five leading categories and for all NCDs in the United States and these results indicate that the total economic cost of chronic conditions in 2015-2050 is USD 94.9 trillion.

**Table 1: Estimates of lost GDP due to five leading NCDs and due to all NCDs in the United States, 2015–2050 (in trillions of 2010 USD)**

| Disease | Total disease burden (trillions of 2010 USD) |
|---|---|
| Cardiovascular diseases | 11.3 |
| Cancer | 10.4 |
| Chronic respiratory diseases | 5.6 |
| Diabetes | 6.4 |
| Mental health conditions | 18.1 |
| All NCDs (including other NCDs)a | 94.9 |

**Note:** Data Source: Dieleman et al. (2016).

Table 2 shows the model estimates with the treatment costs excluded. In the U.S., treatment costs account for 39% of NCDs total economic burden by calculating the absolute value of the treatment cost effect as the output difference between the scenario in which all effects and a scenario in which only the mortality and morbidity impact is considered, but not the impact of treatment costs.

**Table 2: Estimates of foregone GDP due to the five leading NCDs and due to all NCDs excluding the treatment Cost effect in the United States, 2015-2050 (trillions of 2010 USD)**

| Disease category | Total disease burden excluding the impact of treatment cost (trillions of 2010 USD)a | Treatment cost effectb |
|---|---|---|
| Cardiovascular diseases | 7.0 | 38% |
| Cancer | 7.8 | 25% |
| Chronic respiratory diseases | 2.1 | 63% |
| Diabetes | 2.4 | 63% |
| Mental health conditions | 13.1 | 28% |
| All NCDs (Including other NCDs)c | 57.6 | 39% |

Note:  a Only consider the effect of mortality and morbidity
       b Treatment cost effect = the percentage of NCDs' total economic burden attributable to treatment costs

Table 3 shows the percentage of total deaths and disability-adjusted life years (DALYs) that NCDs have caused across countries at different stages of sociodemographic development over time according to Global Burden of Disease Study. Table 4 shows U.S. prevalence and mortality rates, deaths, and DALYs by specific NCD categories and table 5 displays the estimates of the treatment costs per capita and their growth rates based on U.S. spending on personal health care and public health. Spending estimates were adjusted to account for comorbidities and fixed annual growth rate of the disease-specific per capita treatment costs to adjust for rising medical costs over time.

**Table 3: Percentage of total deaths and DALYs caused by NCDs**

| Country group | % of total deaths caused by NCDs | | | %of total DALYs caused by NCDs | | |
|---|---|---|---|---|---|---|
| | 1990 | 2000 | 2016 | 1990 | 2000 | 2016 |
| Global | 58 | 62 | 72 | 44 | 49 | 61 |
| High SDIa countries | 88 | 89 | 89 | 82 | 84 | 86 |
| United States | 87 | 88 | 89 | 81 | 83 | 85 |
| High-middle SDI countries | 80 | 83 | 87 | 67 | 73 | 79 |
| Middle SDI countries | 64 | 72 | 80 | 52 | 61 | 73 |
| Low-middle SDI countries | 37 | 42 | 58 | 29 | 34 | 50 |
| Low SDI countries | 25 | 26 | 38 | 19 | 21 | 32 |

**Note:** Source: SDI (sociodemographic index) is constructed by Institute for Health Metrics and Evaluation and is a summary measure of a country's sociodemographic development. It is based on average income per person, educational attainment, and the total fertility rate (TFR). For example, zero SDI represents the lowest income per capita, lowest educational attainment, and highest TFR observed across all Global Burden of Disease geographies from 1980 to 2015, and one represents the highest income per capita, highest educational attainment, and lowest TFR.

**Table 4: Prevalence and mortality rates, deaths, and DALYs NCA categories in the United States**

| NCD categories | Prevalence rate (per 100,000) | | Mortality rate (per 100,000) | | Total deaths (thousands) | | DALYs (millions) | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | 2016 | 1990 | 2016 | 1990 | 2016 | 1990 | 2016 |
| Cardiovascular diseases | 9,321 | 10,433 | 357 | 279 | 892 | 901 | 15 | 15 |
| Cancer | 1,586 | 2,108 | 206 | 212 | 516 | 685 | 11 | 14 |
| Chronic respiratory diseases | 8,782 | 9,464 | 41 | 59 | 102 | 191 | 3 | 5 |
| Diabetes/urog/blood/endob | 35,832 | 37,385 | 43 | 63 | 108 | 203 | 4 | 7 |
| Mental and substance use | 19,785 | 19,793 | 5 | 14 | 13 | 45 | 8 | 12 |
| All NCDs | 88,227 | 89,337 | 749 | 760 | 1,858 | 2,442 | 60 | 79 |

**Note:** a Source: Global Burden of Disease Study 2016 results [1]
       b Diabetes, urogenital, blood, and endocrine diseases

**Table 5: Treatment cost in the United States by aggregated condition category**

| Disease Category | National total expenditure in 2013 (billions of 2010 USD)a | Annualized total of rate of change 1996-2013, % [a] | Treatment costs per capita in 2015 (in 2010 USD)[b] | Annualized per capita rate of change, %[c] |
|---|---|---|---|---|
| Cardiovascular diseases | 212.6 | 1.2 | 719.0 | 0.24 |
| Cancer | 106.2 | 2.5 | 359.2 | 1.52 |
| Chronic respiratory diseases | 121.6 | 3.7 | 411.2 | 2.71 |
| Diabetes | 93.6 | 6.1 | 315.5 | 5.09 |
| Mental health conditions | 172.8 | 3.7 | 584.4 | 2.71 |
| All NCDs (including other NCDs)[d] | 1353.3 | 3.4 | 4,576.7 | 2.38 |

**Note:**   [a] Data source: Dieleman et al. (2016)

[b] The 2015 estimates account for health expenditure growth between 2013 and 2015.

[c] The annualized per capita rate of change is adjusted for population growth from 1996–2013.

[d] In addition to the five leading NCDs that are singled out in the table, all NCDs include cirrhosis; digestive diseases; diabetes; urogenital diseases; blood diseases; endocrine diseases; musculoskeletal disorders; and other noncommunicable diseases, including congenital anomalies, skin and subcutaneous diseases, sense organ diseases, and oral disorders.

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Chen, Kuhn, Prettner & Bloom report indicated that a total loss of USD 94.9 trillion (in constant 2010 USD) due to all NCDs [17]. Mental health conditions and cardiovascular diseases impose the highest burdens, followed by cancer, diabetes, and chronic respiratory diseases. In per capita terms, the economic burden of all NCDs in 2015–2050 is USD 265,000. The total NCD burden roughly corresponds to an annual tax rate of 10.8% on aggregate income. They believe that Non-communicable diseases (NCDs) have decisively replaced infectious diseases and malnutrition as the dominant cause of death globally. They are also the world's main cause of disability, and their impact is growing over time. Chen, Kuhn, Prettner & Bloom estimates indicate that the costliest conditions in the United States are mental health conditions and cardiovascular diseases, followed by cancer and diabetes [17]. Chronic respiratory diseases generate the lowest burden. Cardiovascular diseases and mental health conditions have the highest treatment costs among these five disease categories, which partially explains these results. Furthermore, compared with other NCDs, mental health conditions have high morbidity rates in the working-age population, which explains why they generate such a high economic burden.

Although NCDs can potentially affect low-middle, and high-income countries, it mostly affects those in the low and middle-income countries (LMICs) due to costs of medicine. In LMICs, more than ¾ (32 million) of global deaths are caused by NCDs [1]. These deaths most likely occur due to the disadvantages of the people living in LMICs, such as an unhealthy, polluted environment. They are at more risk to be exposed to toxic products and have limited access to health care services. Furthermore, even with the existence of health services in LMCIs, the lengthy and expensive care they provide often drains the household's resources which puts them deeper into poverty [1]. Studies by Mendenhall et al., show that poverty is highly linked to depression, which increases the chance of some NCDs to grow faster, raising the risk for morbidity and mortality in those with NCDs [18].

Non-communicable diseases have disproportionate burdens among countries due to differences in social and economic development, governmental ruling, poverty, and availability of resources. The poor may be more vulnerable to NCDs due to psychosocial stress, unhealthy living conditions, material deprivation, limited access to high-quality health care, higher levels of risk behaviors, and reduced opportunity to prevent complications [19]. Groups of low and even middle socioeconomic status may more likely be exposed to tobacco products, become physically inactive, overweight and obese, and consume unhealthy foods. For both low- and middle-income countries, there is an increased risk of type 2 diabetes, CVDs, CRDs, and lung and gastric cancers, and due to the costs of medicine, these groups most likely are unable to afford treatments or support. In high income countries, death proportions are only 13% due to access to better healthcare and prevention programs [1].

According to Beaglehole, the most cost-effective way to prevent NCDs from increasing is to reduce the production rates of both tobacco and salt [9]. Policy changes, regulation, and market intervention are preventive interventions of highest priority. By doing so, individuals are less likely to develop NCDs because there is less risk. In addition, preventive actions can also include promoting healthy diets, physical activity, and reducing alcohol consumption. Since these are risk factors of NCDs, continuously promoting positive wellness and activity can lead to the prevention of the increase of NCDs throughout the world.

## Conclusion

As for world advocacy, WHO's 2030 Agenda for Sustainable Development sees NCDs as a critical challenge for the world to solve. By 2030, they aim to decrease premature mortality from NCDs by one third through preventative measures, as well as treatment. This goal was set during the United Nations' General Assembly both in 2011 and 2014. So far, WHO's Global action plan for the prevention and control of NCDs 2013-2020 has the largest impact on NCD mortality throughout the world. This plan has nine global targets that addresses ways of prevention and management of NCDs. By 2030, WHO's leadership and coordination role for the Agenda for Sustainable Development recognizes NCDs as a vital challenge for sustainable development. They aim to lower premature mortality from NCDs through treatment and prevention by one-third. WHO developed a Global action plan for the prevention and control of NCDs 2013-2020, that incorporates nine global targets which has the greatest impact on global NCD mortality [1].

NCDs are increasingly becoming a worldwide problem, but even more so to LMICs. Risk factors of NCDs include tobacco and alcohol use, an unhealthy diet, and physical inactivity. Methods of preventing these risk factors from implementing themselves into people's lives include the promotion of wellness, as well as the reduction of tobacco and salt production. Biological risk factors include hypertension, obesity, and hyperglycemia, which can also be prevented through the reduction of salt. As NCDs continue to increase, it is now globally recognized as a worldwide problem and countries and organizations from all over the world are continuing to research prevention methods and how to implement them.

The CDC also reported health gaps between rural and urban Americans, as those living in rural areas are more likely to die from five leading causes than those in urban areas [20]. Many deaths among rural Americans were potentially preventable including 25,000 from heart disease, 19,000 from cancer, 12,000 from unintentional injuries, 11,000 from chronic lower respiratory disease, and 4,000 from stroke. The percentages of deaths that were potentially preventable were higher in rural areas than in urban areas.

NCDs and their risks continue to push health care costs higher and the burden is strongly intertwined with economic conditions for good and for harm; understanding the multiple ways they are connected–through risk factor exposures, access to quality health care, and financial protection among others–will determine which countries are able to improve the healthy longevity of their populations and slow growth in health expenditure, particularly in the face of aging populations. NCDs are also associated with aging in high-income countries and this representation is often misleading. Over one-third of the 41 million annual deaths from NCDs occur prematurely, defined as under 70 years of age. Most of those deaths occur in low- and middle-income countries (LMICs) where surveillance, treatment, and care of NCDs are often inadequate. In addition to high health and social costs, the economic costs imposed by such high numbers of early deaths impede economic development and contribute to global and national inequity [21].

Araya and Paraje, identified the key topic in the economic analysis of tax impacts on health outcomes as the elasticity of demand for products linked to raising NCD risk [22]. Elasticity is referred to as the sensitivity of consumer demand to increases in factors such as price, tax or income and it vary across countries and sub-populations, so their estimation can be particularly useful when derived from local settings. Estimated price and expenditure elasticities of demand for beer, wine, and liquor in Chile for example using the Family Budget Survey of 2011–2012 suggested that consumers have many options to switch products, especially based on product quality, suggesting opportunities for tailored taxation strategies. The model used helped to assess how non-communicable diseases will affect U.S. productive capacity through 2015-2050 and in the framework, aggregate output is produced according to a human capital and augmented production function that account for the effects of projected disease prevalence. As a result, NCDs influence the economy through the following pathways:

- When working-age individuals die of a disease, aggregate output undergoes a direct loss because physical capital can only partially substitute for the loss of human capital in the production process.
- If working-age individuals suffer from a disease but do not die from it, then, depending on the condition's severity, they tend to be less productive, might work less, or might retire earlier.
- Current NCD interventions, such as medical treatments and prevention require substantial resources. Part of these resources could otherwise be used for productive investments in infrastructure, education, or research and development.

This implies a loss of savings across the population and hampers economy-wide physical capital accumulation. The findings also indicated a total loss of USD 94.9 trillion (in constant 2010 USD) due to all NCDs. Mental health conditions and cardiovascular diseases impose the highest burdens, followed by cancer, diabetes, and chronic respiratory diseases. In per capita terms, the economic burden of all NCDs in 2015–2050 is USD 265,000. The total NCD burden roughly corresponds to an annual tax rate of 10.8% on aggregate income [17, 23-25].

## References

1. World Health Organization (2018) Non-communicable diseases.

2. World Health Organization (2010) Global status report on non-communicable diseases.

3. World Health Organization (2020) Non-communicable diseases progress monitor.

4. Bajaj JA, Nita H Salzman, Chathur Acharya, Richard K Sterling, Melanie B White, et. al. (2019) Fecal microbial transplant capsules are safe in hepatic encephalopathy: A phase 1, randomized, placebo-controlled trial. American Association for the Study of Liver Diseases 70: 1690-1703.

5. Katikireddi SV, Skivington K, Leyland AH, Hunt K, Mercer SW (2017) The contribution of risk factors to socioeconomic inequalities in multi-morbidity across the life course: A longitudinal analysis of the Twenty-07 cohort. BMC Med 15:152.

6. Landrigan PJ, Richard Fuller, Nereus J R Acosta, Olusoji Adeyi, Robert Arnold, et. al. (2018) The Lancet Commission on Pollution and Health. Lancet 391: 462-512.

7. Oyebode O, Kandala N, Chilton P, Lilford R (2016) Use of traditional medicine in middle-income countries: A WHO-SAGE study. Health Policy and Planning 31: 984-991.

8. Checkley W, Hassen Ghannem, Vilma Irazola, Sylvester Kimaiyo, Naomi S Levitt, et. al. (2014). Management of NCD in low- and middle-income countries. Glob Heart 9: 431-443.

9. Beaglehole R, Ruth Bonita, George Alleyne, Richard Horton, Liming Li, et al. (2011). UN High-Level Meeting on Non-Communicable Diseases: Addressing four questions. Lancet 378: 449-455.

10. Kaiser Family Foundation (2019). Employer Health Benefits Survey.

11. Casas R, Castro-Barquero S, Estruch R, Sacanella E (2018) Nutrition and cardiovascular Health. International Journal of Molecular Sciences 19: 3988.

12. Ezzati M, Riboli E (2013) Behavioral and dietary risk factors for non-communicable diseases. The New England Journal of Medicine 369: 954-964.

13. Buttar H, Li T, Ravi N (2017) Prevention of cardiovascular diseases: Role of exercise, dietary interventions, obesity and smoking cessation. Experimental and Clinical Cardiology 10: 229-249.

14. Maimela E, Marianne Alberts, Sewela E P Modjadji, Solomon S R Choma, Sekgothe A Dikotope, et al. (2016) The Prevalence and Determinants of Chronic Non-Communicable Disease Risk Factors amongst Adults in the Dikgale Health Demographic and Surveillance System (HDSS) Site, Limpopo Province of South Africa. PLOS 11:e0147926.

15. O'Lawrence H (2019) The effect of poverty and war on global health: Systems, policies, and economics. Informing Science Press: Santa Rosa, California.

16. World Health Organization (2013) Global action plan for the prevention and control of Non-communicable diseases.

17. Chen S, Kuhn M, Prettner K, Bloom DE (2018) The macroeconomic burden of Non-communicable diseases in the United States: Estimates and projections PLOS 13: e0206702.

18. Mendenhall E, Brandon A Kohrt, Shane A Norris, David Ndetei, Dorairaj Prabhakaran (2017) Non-communicable disease syndemics: Poverty, depression, and diabetes among low-income populations. Lancet 389: 951-963.

19. Williams J, Allen L, Wickramasinghe K, Wickramasinghe B, Roberts N, et al. (2018) A systematic review of associations between non-communicable diseases and socioeconomic status within low- and lower-middle-income countries. Journal of Global Health 8: 020409.

20. CDC (2017) Rural Americans at higher risk of death from five leading causes: Demographic, environmental, economic, social factors might be key to difference.

21. Nugent RA, Husain MJ, Kostova K, Chaloupka F (2020) Introducing the PLOS special collection of economic cases for NCD prevention and control: A global perspective. PLOS 15: e0233141.

22. Araya D, Paraje G (2018) The impact of prices on alcoholic beverage consumption in Chile 13: e0205932.

23. Dieleman JL, Baral R, Birger M, Bui AL, Bulchis A, et al. (2016) U.S. spending on personal healthcare and public health, 1996-2013. JAMA 316: 2627-2646.

24. GBD 2015 Risk Factors Collaborators. (2016) Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: A systematic analysis for the Global Burden of Disease Study 2015. Lancet 388:1659-1724.

25. Institute for Health Metrics and Evaluation (2016) Global burden of disease study 2016 (GBD 2016) results. Seattle, Washington: Institute for Health Metrics and Evaluation.