

The Consequences of Growth: How China's Economic Boom
Has Prompted a Rise in Non-Communicable Diseases

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China's long struggle to take its place as a global power is proving to be successful, despite all the obstacles that stand in its path. Ever since former leader Deng Xiaoping instituted more market-based economic reforms, China's economy has been growing steadily, albeit slowing down in recent years. After joining the World Trade Organization in 2001, China's Gross Domestic Product (GDP) skyrocketed. Combined with these reforms has been a distinct focus on transforming China's economy from a Cold War industry to a new global economy with efficient and modern technology and infrastructure. In 2012, Xi Jinping labeled this goal of national rejuvenation the "Chinese Dream." Economically, these reforms have proven successful. According to the World Bank, China's GDP growth averages around ten percent, making it "the fastest sustained expansion by a major economy in history" (World Bank, 2018). In the last decade, China's economy has grown exponentially, from a 4.5 trillion dollar GDP to a 12.2 trillion dollar GDP, well exceeding other countries to become the second largest economy in the world, behind the United States.

China's economic growth is unprecedented, but China has many other factors that contribute to its unique nature. China leads the world in population size, being one of only two countries with over a billion residents (World Population Review, 2019). With about 2.2 million active military personnel, China also is home to the largest active duty military force in the world (Statistica, 2019). With a long history and distinct culture, China also sets itself apart from the rest of the world. An unusual country with such unusual economic growth deserves to be studied closely in order to determine the many effects of economic growth on a society.

This paper will delve into the relationship between public health and economic growth in China. As China's economy grows, there is an unmistakable impact on public

health. As will be discussed below, the link between economic growth and public health is strong; with the unprecedented economic growth China is experiencing, it is worthwhile to study how public health in China is being affected. As non-communicable diseases (NCD) are the number one health threat in China and, according to the Centers for Disease Control and Prevention (CDC), contribute to 88% of total deaths each year, this paper will focus on some of the most pervasive NCDs, including three of the five top causes of deaths in China: cardiovascular disease (heart disease), chronic respiratory disease (lung disease), and diabetes (CDC, 2019). The purpose of this paper is to show how economic growth in China has contributed to a rise in these three NCDs, and how the costs incurred by these diseases are impacting further growth.

This paper will begin with a discussion of the current state of China regarding diabetes, heart disease, and lung disease. The difference in trends between urban and rural areas will also be explored. Next, this paper will explain the causes of these diseases, including how dietary changes and obesity in China have led to the increase in heart disease and diabetes, and how pollution has contributed to lung disease. There will also be brief discussions on how Chinese culture has contributed to these diseases and on some of the ways public health has, in fact, improved in the past two decades. Throughout this paper there will be a discussion regarding how the economic growth that China has been experiencing during the last two decades has contributed to the dietary changes and increases in obesity and pollution that are affecting this rise in NCDs. There will be a specific focus on changes in imports, income, and spending trends in China. Lastly, there will be a discussion regarding the economic costs associated with this rise in NCDs, as well as what the predicted costs might be if rates continue to increase or remain the same. This paper will end with a

brief discussion about what the Chinese government is currently doing in order to alleviate these health issues.

I. Economic Growth and Public Health in China

Public health has long been studied as a catalyst for, and consequence of, economic growth. In simple terms, the better the health of a society, the more productive the workforce will be, and consequently, the better off the economy will be. Investing in health is analogous to investing in a more productive workforce. In a report published by the World Health Organization's (WHO) Commission on Macroeconomics and Health, it was found that "health causes economic growth because it reduces production losses caused by illness in workers, increases adult productivity through improved nutrition, increases school attendance and improves learning, maximizes the use of resources that were totally or partially unavailable due to illness, and frees up resources that would otherwise have to be allotted to treating illnesses" (WHO, 2004, p.48). The same report found that "between one third and one half of economic growth in England in the last 200 years is due to improved nutrition in the population" and that "health is responsible for approximately one third of long-term economic growth" in Mexico from 1970-1995 (WHO, 2004, p.48). This report continues with numerous examples of health affecting economic growth in a similar way throughout various eras. The trend holds true for the United States, where it has "been estimated that the increase in life expectancy between 1970 and 2000 contributed an additional USD 3.2 trillion per year to the national economy (after accounting for increased healthcare costs during that period)" (Martin, Grant & D'Agostino, 2012). The United Nations (UN) stresses this point by encouraging developing countries to invest in their public health infrastructure in order to

simultaneously increase the health of their population and their GDP. One example is investing in clean water. According to the UN, research suggests that “Investment in small-scale projects providing access to safe water and basic sanitation in Africa could offer an estimated economic return of about US\$28.4 billion a year, or nearly 5% of gross domestic product (GDP) of the continent” (UN Water, 2016). There are many other examples of public health development, such as increasing access to vaccines and instituting reforms to ensure food safety, which would eventually decrease healthcare costs and premature mortality, as fewer people would become afflicted by illness. These examples show the strong linkage between health and economic performance.

While it is true that increasing public health tends to increase economic growth, it is also true that economic growth often has a positive effect on public health. According to a research study, “Populations with greater economic opportunities tend to have ready access to quality healthcare, less exposure to environmental hazards, better access to clean water, and improved opportunities to develop better preventative behaviour patterns. This is perhaps most starkly illustrated by the changes seen in life expectancy following the industrial revolution, and the more recent improvements in child survival in West Africa” (Martin, Grant & D’Agostino, 2012). The causal relationship of increased wealth leading to increased health of a population is widely accepted, but as seen above, research indicates that the relationship goes in both directions. As wealthier countries are able to increase spending on their overall healthcare systems, wealthier countries tend to have healthier populations. This is proved by the Bloomberg Global Health Index.

The bi-directional relationship between health and national wealth can be seen when assessing a country’s Bloomberg Global Health Index. The Bloomberg Global Health Index

takes into account multiple factors when determining the health level of a country, including clean water availability, life expectancy, malnutrition, causes of death, and various health risks, such as tobacco use and obesity (World Population Review, 2019). The countries ranked highest on the list include Italy, Spain, Switzerland, and Australia, among others. All thirty-six of the top ranked countries, excluding one, are also considered high income economies by the World Bank. Of the bottom 30 countries, 27 are developing African countries, while the other three are also classified as low income by the World Bank (The World Bank, 2019). Interestingly, although only wealthy countries are at the top of the list and poorer countries are at the bottom, the United States and China, the two countries with the largest GDPs, are not at the top of the “Healthiest Countries” list. The United States is ranked 35th, while China comes in at 52nd. It is this discrepancy between China’s economy size and health status that will be explored in this paper.

As mentioned above, China’s economy has expanded rapidly since joining the World Trade Organization in 2001. In the last two decades, China has experienced unprecedented economic growth, giving China the second largest economy in the world, behind the United States. There is even evidence that suggests that China could overtake the United States as the world’s largest economy by 2030 (Paton, 2019). Despite China’s enormous economic expansion, however, China has run into many public health issues. There has been a sharp rise in several non-communicable diseases (diseases that are not transmittable directly from one person to another), including heart disease, lung disease, and diabetes. According to the WHO, “Noncommunicable diseases (NCDs), including diabetes, are China's number one health threat, contributing more than 80% of the country's 10.3 million annual deaths, and nearly 70% of its total disease burden” (Genchev, 2018). Each of these diseases results in an

increase in premature deaths, which also results in a decrease in the workforce. For example, the WHO determined that “Diabetes and complications from diabetes contribute to almost 1 million deaths in China each year. Alarming, nearly 40% of these deaths are premature (that is, in people below the age of 70)” (Genchev, 2018). According to Hird et al., these premature deaths relate directly to a loss in labor force productivity, as the workforce is decreasing. With a loss in productivity and increased healthcare costs, the economic growth that China is experiencing is limited.

a. Status of Cardiovascular Disease and Diabetes in China

The first NCD, cardiovascular disease, is the leading cause of death in China. According to the Mayo Clinic (2018), cardiovascular disease describes a range of health issues related to the heart, including, but not limited to, blood vessel diseases, heart rhythm issues, and genetic heart defects. Cardiovascular disease generally refers to conditions that lead to heart attack, stroke, or chest pain and is often caused by an unhealthy diet, lack of exercise, being overweight, and smoking. Almost half of all NCD related deaths in China are caused by cardiovascular disease. The World Heart Federation (2017) reports that one in five adults in China have a cardiovascular disease. These numbers have been rising in the past two decades. *China Daily* (2019) reports that there were 93.8 million cases of cardiovascular disease in 2016 in China, and that the “Chinese population with cardiovascular disease increased by nearly 15 percent from 1990 to 2016.” Numbers seem to keep growing each year, with the percentages of deaths caused in China by hypertensive heart disease and ischemic heart disease, two types of cardiovascular disease, increasing by 95.7% and 54%, respectively, between the years of 2007-2017.

The divide between rural and urban and low and high income communities regarding prevalence of heart disease is discussed by Yan et al. in a 2017 study. Yan et al. (2017) found that “Compared with urban communities, rural communities in low income regions had lower risk factor burdens but similar prevalence of total cardiovascular disease,” meaning that lower income rural communities had a lower chance of developing heart disease. The study determined risk-factor burden by testing blood pressure and surveying participants on factors such as diet and physical exercise. One study claims that “China’s most recent [cardiovascular disease (CVD)] report estimated that 290 million people suffered from CVD, with fatality and mortality rates higher in rural areas than those in urban areas since 2009,” (Jiang et al., 2018), but the World Health Organization (2019) reports that heart disease accounts for 20.9% of total deaths in urban areas and 17% of total deaths in rural areas. Mortality rates, fatality rates, and total death rates can differ, as the mortality rate is a measure of deaths in a specific population, scaled to the size of that population, per unit time and the fatality rate is the proportion of deaths within a designated population with a certain disease. The contradiction between these data sets could be due to better, and more accessible, healthcare options in urban areas, which prevents death among those suffering from heart disease. Regardless, these numbers do indicate that cardiovascular disease has hit both the urban and rural areas similarly. The WHO also predicts that cardiovascular disease will increase by “50% between 2010 and 2030 based on population aging and growth alone in China” (2019). Elaborating on this prediction, the WHO (2019) reports that in China, “Projected trends in blood pressure, total cholesterol, diabetes (increases), and active smoking (decline) would increase annual cardiovascular disease events by an additional 23%, an increase of approximately 21.3 million cardiovascular events and 7.7 million

cardiovascular deaths.” These high rates of cardiovascular diseases imply high costs to the healthcare system in China. Jiang et al. (2018) even finds that “inpatient CVD expenses had increased faster than the growth in GDP since 2004.” The economic costs combined with the large number of deaths caused by cardiovascular diseases makes this a major issue for the Chinese government to combat in the coming years.

Another NCD, Type 2 diabetes, has quickly become a major health concern in China. Type 2 diabetes is characterized by either the body’s inability to produce sufficient insulin (the hormone that regulates sugar uptake by cells) or the body’s resistance to insulin. Obesity and inactivity are some of the main risk factors for this disease, although research suggests there may be a genetic component as well (Mayo Clinic Staff, 2019). According to a report published by the American Diabetes Association, “the overall prevalence of diabetes in adults is 9.1%, implying that 415 million adults suffer from diabetes globally” (Jia & Hu, 2018). Moreover, out of all countries, China is home to the most diabetics, with “an estimate of 109.6 million adults with diabetes.” This, however, is a relatively new development. According to the same report by Weiping Jia and Cheng Hu, “The prevalence of diabetes was reported to be less than 1% in 1980, 5.5% in 2001, 9.7% in 2008, and 10.9% in 2013, according to the latest published nationwide survey.” The International Diabetes Federation confirms that the current prevalence rate of diabetes in China is 10.9% with 114, 394, 800 total cases of diabetes in adults in 2017. That means there was a 98.2 percent increase in the prevalence of diabetes since 2001, the year China joined the WTO. Later in this paper, there will be a discussion of other economic developments that occurred in this period that contributed to this sharp rise in the prevalence of diabetes in China.

Jia and Hu's (2018) study also comments on prediabetes, a condition in which a person has higher than normal blood sugar levels and is therefore at an increased risk of developing diabetes. According to the study, "The estimated prevalence of prediabetes in 2013 was 35.7%, which was much higher than the estimate of 15.5% in the 2008 survey" (Jia & Hu, 2018). Interestingly, Jia and Hu continue to report that prevalence rates for diabetes is higher among seniors, men, urban residents, individuals living in economically developed areas, and overweight and obese individuals.

The data regarding diabetes rates in China point to interesting trends. Diabetes rates, as well as prediabetes rates, have increased sharply in the past two decades, with a larger increase occurring in urban areas. An additional study on trends in the prevalence of diabetes type 2 and prediabetes in Qingdao, a city in China's eastern Shandong province, found that the "prevalence of diabetes and pre-diabetes in urban areas was 12.2 and 15.4% in 2002, whereas the prevalences were 18.8 and 28.7% in urban areas and 14.1 and 20.2% in rural areas in 2006" (Gao et al., 2009). There is a clear trend of diabetes rates increasing far more in urban areas--areas most affected by the economic boom--right after entry into the WTO spurred economic growth in 2001. While rural areas are also being affected by China's economic growth, it is the urban areas there are constantly being modernized and built up. Throughout this process, people from all over the country have been flocking to these urban centers looking for opportunities for vertical mobility. In an article focused on China's recent urbanization trends, Peter Farrar (2016) reports: "Between 1990 and the end of 2015 the proportion of China's population living in urban areas jumped from 26 percent to 56 percent, and there are currently estimated to be more than 200 million rural migrants working in China's biggest cities." These urban areas are most strongly influenced by economic growth,

which is why recent health changes in this area are more likely to be related to the recent increase in wealth. In time, as the effects of the economic growth spread, these health issues should also affect the rural areas. As diabetes rates increase in urban areas at the same time as the GDP increases, resulting in increases in wealth among urban citizens, the connection between economic growth and public health becomes clear. There must be something about the urban areas that are causing diabetes and heart disease rates to be increasing more so than in rural areas. What is in fact happening is that people in urban areas are seeing increases in both income and accessibility to a wider variety of “Western” foods, causing an overall dietary shift across China.

b. Causes of Heart Disease and Diabetes

1. Dietary Shift

In 2001, China’s entry into the WTO sparked a rapid economic expansion; but the economy is not the only thing to have changed in China since that year. Over time, the Chinese diet has become more “westernized,” as intake of sugar, sodium, and meat have risen along with the increase in wealth. The Chinese were long known to adhere to the “Eastern” diet, which is now typically associated with the Japanese, and focuses on “large amounts of rice, fruit and vegetables, soy-derived proteins and fish, and a low intake of oils or fats” (Wood, 2018). “Western” style diets, on the other hand, are characterized by a “high consumption of red and processed meats, high-fat dairy products, refined grains, and high-sugar drinks and desserts besides alcoholic beverages, and relatively low intakes of fruit, vegetables, whole-grain foods, fish and poultry” (Wood, 2018). While the “Eastern” diet is known to promote a healthy lifestyle, the “Western” diet is infamous for increasing the risk of obesity, type 2 diabetes, and cardiovascular diseases. This is precisely what is taking place

in China. As dietary changes accompany an increase in wealth, it is no surprise that NCDs, such as diabetes and heart disease, are on the rise.

Economic growth brought changes in income, which led to changes in food demand and eating patterns. Increasing incomes allowed people in China to purchase alternate types of foods, and allowed for a more sedentary lifestyle. Urban households' disposable income per capita rose from close to 800 Chinese Yuan Renminbi (CNY) in 2001 to 39,251 CNY in 2018. Net national income per capita also increased significantly, from 133 (current US dollars) in 1978 to \$867 in 2001 to \$6,567 in 2018. These rises in income were met with changing consumption patterns, especially regarding food. As income rose, so did expenditures on food. The Australian Government Department of Agriculture, Fisheries and Forestry compiled a report on China's changing food consumption trends as a result of sustained economic growth. To summarize the effects of increased incomes on food consumption, the "changes include higher demand for food, demand for a more diverse range of food, demand for higher quality food, and the growth of away-from-home food consumption" (Zhou, Tian, Wang, Liu & Cao, 2012). The report showed that the consumption of food of animal origins is rising, but more so in urban areas, due to income differences, to the point where "Animal product consumption in rural China is about 30 years behind urban areas." This makes sense considering the literature on changes in the composition of food consumption in rapidly changing economies. One study on the relationship between food consumption patterns and economic growth explains:

"People in low income countries derive nutritional energy mainly from carbohydrates; the contribution of fats is small, that of protein the same as for high income countries and that of meat and dairy negligible. People in high income countries derive nutritional energy mainly from carbohydrates and fat, with substantial contribution of meat and dairy. Whenever and wherever economic growth

occurs, food consumption shows similar change in direction” (Gerbens-Leenes, Nonbehel & Krol, 2010).

China’s rapid economic growth resulted in similar income growth, which also led to changes in consumption patterns, specifically regarding animal products. As shown earlier, this dietary shift to a more “Western” style diet is affecting Chinese health and contributing to this sharp rise in NCDs, such as heart disease and diabetes.

Changes in China’s imports over the last two decades also mirror this increase in food expenditures, meat consumption, and overall dietary shift. Food imports have been steadily increasing over the years, but began sharply rising over the last two decades. In 2000, data from The World Bank shows that China was importing \$4,087,915 (in thousand dollars) worth of food and animals combined. This number increased to \$18,885,367 in 2010 and \$45,838,060 in 2017. As demand in China continued to grow and diets continued to shift toward a more “Western” style, food imports also grew to meet this demand. With a population increasing in size and wealth, these shifts are understandable. A larger population requires more food, so China must import more food to feed the growing population. A wealthier country demands higher quality food, usually meat and dairy. The General Administration of Customs in China is reported to have stated this very idea, saying “Chinese consumers' demand for imported food has been growing steadily as the standard of living in China improves,” and that the total foods annual import growth rate over the last five years is 5.7% (Chengcheng, 2018). A wealthier country also often consumes more food. These increases in consumption of “Western” foods, such as meats, sugars, salts, and fast food are causing the aforementioned rises in obesity, diabetes, and heart disease. As income rises and standard of living improves, food imports increase and consumption patterns change.

One indicator of the dietary changes in China is seen through the increasing meat consumption in China. The meat market in China has expanded, as more Chinese consume meats on a regular basis. Compared to the United States, and even the world, China is consuming an enormous amount of meat: As of 2017, China consumes “28% of the world’s meat, or 63 kilogrammes per person per year” (Bankman, 2017). According to data from the Organization for Economic Cooperation and Development (OECD) and the U.N.’s Food and Agriculture Organization, in 2001, the Chinese were consuming just under 40 kilograms per capita. In 2017, the number rose to just over 50 kilograms per capita with projections that “In 2026, an average Chinese citizen is expected to consume 55 kilograms (121 pounds) of meat per year, up 10% from 2017” (Yang, 2018). Consumption of pork specifically has increased tremendously. According to the OECD (2019), in 2000, the Chinese were consuming 24.5 kilograms per capita, and in 2019, the number has risen to 30.8 kilograms per capita. Japan, in comparison, currently consumes 15.5 kilograms per capita of pork, and the United States consumes 24.3 kilograms per capita. As meat consumption and demand is generally a reflection of income and living standards, as it is characterized by high production costs and output prices, it can be assumed that this increase in meat consumption in China is a result of the aforementioned rises in income due to urbanization and an increase in national wealth.

Consumption of meat could also be a reason for the increase in cardiovascular disease. The American Heart Association specifically recommends consuming less meat, especially red meats, like pork and beef, and other non-lean meats, as they increase the risk of developing heart disease. Intake of meat increases cholesterol levels which is associated with an increased risk of heart disease. Meat also contains a high proportion of saturated fat. The National Institutes of Health (2019) describes a study that further illuminates the

relationship between meat consumption and heart disease. This study found that the chemical, Trimethylamine N-oxide (TMAO), which is partly derived by nutrients abundant in red meat, is another main contributor to heart disease, along with saturated fat. Research has shown that one way by which TMAO affects heart disease is that TMAO promotes cholesterol deposits on the artery wall of the heart. Research also supports that TMAO interacts with platelets, blood cells that regulate clotting, which can cause clot-related health risks such as heart attacks and strokes. The study concluded that those who eat a red-meat rich diet have triple the level of TMAO in their body, further increasing the risk of heart disease. As more red meats, like pork, are being consumed in China, it makes sense that cardiovascular disease is rising as well, due to the strong connection between the two.

Another dietary change in China has been the increase in sodium, oil, and sugar consumption. The Chinese Dietary Guideline lists a healthy salt intake for an adult to be less than six grams; however the average daily salt intake in China is 10.5 grams (WHO, 2019). One study that compared sodium intake in China in 2000 and in 2009-2011 found that despite refrigeration replacing the use of salt for food preservation, high sodium intake has persisted due to added salts during food preparations during 2009-2011 and increased consumption of processed foods (Hipgrave, Chang, Li & Wu, 2016). China is also one of the top three consumers of edible oils and the second biggest consumer of sugar (Bloomberg News, 2019). Consumption of vegetable oil per capita was at 7.7 kilograms in 1996 and reached 25 kilograms in 2016 (PR Newswire, 2018). According to data from the U.S. Department of Agriculture, in 2000, China was consuming just over 2,500 thousand tons of soybean oil, and in 2018 had reached a high of about 17,500 thousand tons. Reporters from Bloomberg News (2019) explain that “The country’s consumption of soybean oil has

increased more than four times since the turn of the century, and the nation is also the third-largest consumer of palm oil.” *The Guardian* also reports about the new accessibility of a wide variety of foods, including pre-packaged, processed foods and drinks. As of 2015, the total volume of sales of processed foods and drinks with high quantities of fat, salt, and sugar have doubled the sales of vegetables and fruits over the previous 15 years (French, 2015). All of these shifts in consumption patterns mark the shift from the healthy “Eastern” diet to a more unhealthy “Western” diet, and a rise in NCDs.

This shift in consumption can also be seen through the increase in fast food restaurants in China. Fast food chains have begun popping up all over China, and with food rich in sugars, oils, and salt, their rise in popularity parallels this dietary transition. According to one study, the total revenue of the fast food industry in China “(in million US\$) increased from 10,464 in 1999 to 94,218 in 2013, and by 13% annually since 2008” (Wang, Wang, Xue & Qu, 2016). To further show how popular fast food is getting in China, as of 2016, “the parent company of KFC, Taco Bell, and Pizza Hut, has approximately 4,800 KFCs and 1,300 Pizza Huts, with a plan to open 20,000 restaurants in China. McDonald’s is expanding in China at a rate of approximately 10 new restaurants each week” (Wang et al., 2016). The same study also finds that there has been an increase in people eating out at restaurants, which makes sense considering the increase in popularity of the fast food industry. Specifically, the study finds that the “number of people who eat out more frequently due to rapid income growth increased by 40.20% from 2000 (14.70%) to 2008 (20.61%).” As more people consume increased levels of sodium, sugars, oils, and fast food in general, it is no surprise NCDs such as type 2 diabetes and heart disease are rising, especially when their main health risk, obesity, is rising.

2. Obesity

While the dietary shift itself is a major risk factor for these NCDs, such as how increased meat consumption and cholesterol increases the risk of heart disease, the dietary shift has also contributed to the creation of another major risk factor: obesity. Obesity has quickly become a significant issue in China. With levels rising sharply in the last two decades, China now has the second largest number of obese adults in the world, behind only the United States. China also is home to the most obese children in the world, with 15 million obese children in 2015 (Pinghui, 2017). To classify as obese, a person must have a body mass index of 30 or more. If the person has a body mass index between 25-29, the person is classified as overweight. Obesity rates have been increasing over the years, with national data showing that “the prevalence of overweight and obesity among adults increased from 20% in 1992 to 30% in 2002 and 42% in 2012 based on the Chinese BMI standard” (Wang et al., 2016). Research shows that there has been a four-fold increase in obesity among children in China between 1995 and 2014, and that now about one in five children and adolescents are obese or overweight (Dong et al., 2019). The same study found that provinces with a higher GDP per capita had a higher increase in their obese and overweight population, and the same was true regarding individuals with a higher socioeconomic status. This information aligns with the previous data, as people with increased income are able to purchase more foods, including meats and foods with higher fat contents, that increase the risk of obesity. The study also found that while urban areas at first had a higher prevalence of obesity, the gap between urban and rural areas was eventually reduced, possibly as a result of China’s increased wealth slowly spreading out from urban centers to rural areas.

Obesity is a consequence of increased consumption of salt, sugar, oil, and fast food. A consequence of obesity is often heart disease and type 2 diabetes. Obesity has long been linked to heart disease, with some research finding that “the risk of heart failure was 34 percent higher for overweight individuals and 104 percent higher for people classified as ‘obese’” (Woolston, 2019). Obesity can contribute to heart disease in many ways, including increasing low-density lipoproteins (bad cholesterol) while lowering levels of high-density lipoproteins (good cholesterol) and causing blood pressure to rise, as people suffering from obesity need more blood to carry oxygen throughout the body and increased pressure to move this blood. Heart disease and diabetes also often come together, as increased cholesterol and blood pressure can lead to either one. According to the American Heart Association, “at least 68 percent of people aged 65 or older with diabetes also have heart disease” and people with diabetes are “two to four times more likely to be at risk for heart disease” (Penn Medicine, 2019). Obesity is also the leading risk factor for type 2 diabetes, as the risk of diabetes is 93 times greater if the BMI is 35 kg/m (Barnes, 2011). There are many reasons given for why obesity can lead to diabetes, including that obesity promotes the process of gluconeogenesis, which is one way the body produces glucose, at inappropriate times. This can cause an influx of glucose that can lead to insulin resistance in the body (Salk Institute, 2009). Other studies have found that increased abdominal fat can cause fat cells to exhibit an inflammatory response, increasing insulin resistance as it disrupts the functions of insulin responsive cells (diabetes.co.uk).

c. Lung Disease

A third NCD that lands in the top five causes of deaths in China is chronic respiratory disease, otherwise known as lung disease. Chronic respiratory disease, like cardiovascular

disease, represents a range of diseases affecting the airways and other structures of the lungs. Some common lung diseases include chronic obstructive pulmonary disease (COPD), pulmonary hypertension, asthma, and occupational lung diseases. Lung diseases have no known cure, but many treatments are available to alleviate some of the symptoms. One study finds that 8.6% of the adult population, about 100 million people, in China suffers from COPD. This study names pollution and smoking as the two largest risk factors for COPD (Fang et al., 2018). The prevalence rate for COPD is higher among men and slightly higher in rural areas, with a percentage of 7.62% in rural areas and 6.09% in urban areas (Zhu, Wang, Ming, Chen & Zhang, 2018). However another study points out that in 2014, the age-standardized incidence rate by Chinese standard population “for all cancers combined was higher in urban areas (196.58/100000 vs. rural 182.64/100000),” and regarding lung cancer in particular, “The number of new cases in urban areas was 457,000, 1.4 times higher than that in rural areas” (Cao & Chen, 2019). This is again explained by the fact that urban areas are more largely impacted by economic growth and will therefore be the places where public health changes are the most prominent. Although it being widely accepted that lung disease rates have been increasing over the years, there is limited data on prevalence rates over time. One study finds that “Between 1990–2010, the total number of Chinese people living with COPD increased by 66.73%, from 30.90 million (95% CI = 21.28–40.02) in 1990 to 51.52 million (95% CI = 44.26–63.93) in 2010” (Chan et al., 2017).

d. Causes of Lung Disease

There is some debate over the main causes of lung disease. Many researchers place the blame on both smoking and pollution, and for this reason, most studies encourage government policies to address high smoking rates, especially among men, and exposure to

biomass fuel/solid fuel in order to lower rates of lung disease related deaths in China. As of recently, though, there has been reports of a rise in a certain lung cancer not associated with smoking. According to an article in *The Straits Times* (2017), over the past 15 years there has been a sharp rise in a lung cancer that is affecting groups not typically affected by common lung cancer, such as women, who have extremely low smoking rates in China, and non smokers. Medical officials worry that it is a result of long term exposure to air pollution, specifically PM2.5. PM2.5 refers to atmospheric particulate matter which is so small that it stays in the air for long periods of time, making it more likely humans will breathe it in. The reports are referring to a rise in lung adenocarcinoma. There are two types of lung cancer: squamous cell carcinoma and lung adenocarcinoma. While the former is associated with smoking, the latter is not. In recent years, lung adenocarcinoma cases have begun exceeding cases of the smoking-related cancer despite smoking rates remaining high (2017). Since this trend has begun in the last 15 years, it is plausible that the industrialization and modernization due to economic growth of the last two decades has contributed to this rise in non-smoking related lung cancer, as pollution rates have also been rising during the same period. Economic growth and pollution are often connected. One study reports that “Urban development has benefited from the rapid growth of industrialization and urbanization has also provided numerous production factors for industrialization. The two engines interact and enhance each other. However, pollutant emissions from industrialization have also made urban regions the most polluted geospatial units” (Yang et al., 2018). Burning coal and motor vehicle emissions (vehicle ownership has been increasing in the last decade) are major causes of this pollution.

While dietary changes and rising obesity are contributing to increases in heart disease and diabetes, rising pollution in China is contributing to increases in lung disease. As of 2016, the *South China Morning Post* reported that China topped the world in all types of air pollution and that “the Beijing-Tianjin-Hebei region’s -huge industrial output meant it was one of the most polluted areas in the world” (Jing, 2016). China’s pollution problem is largely a result of its reliance on coal to promote its economic development. China is the largest coal consumer in the world by far, consuming 1.91 billion metric tons of oil equivalent in 2018, rising from 673.4 million metric tons in 1998 (Statistica, 2019). The next largest consumer was India, consuming 452 million metric tons. In 2018, China accounted for 50.5% of the world’s coal consumption. This use of coal is increasing the levels of PM2.5 pollution in China, contributing to rising rates of lung cancer not associated with smoking. Air pollution causes people to breathe in contaminants that can damage the respiratory tract and affect lung development, which can lead to cancer. China is also the largest emitter of greenhouse gases, including carbon dioxide, in the world. Rising greenhouse gas emissions, coal consumption, and levels of PM2.5 over the last two decades have certainly contributed to high levels of lung disease in China. Without any intervention, as economic development spurs urbanization and industrialization, this trend will only continue.

II. Effects of Culture on NCDs

While dietary changes, obesity, and pollution are the main contributors to the rise in these three NCDs, Chinese culture also plays a small part in creating this reality. Smoking, for example, is so ingrained in Chinese culture that smoking rates among Chinese males remain high even in the United States. China is the largest producer and consumer of

tobacco, with about one third of all smokers in the world found in China. The Global Adult Tobacco Survey found that in 2010, about one third of the Chinese population smoked, including 52.9% of males and 2.4% of females (WHO, 2019). This number has decreased since then, but still remains high. The Tobacco Atlas (n.d.) reports that as of 2015, 44.8% of males and 2% of females in China smoke. In the United States, Chinese men smoke at higher rates than men or women of any other ethnic group, and as a result “Lung cancer deaths among Asian men in [New York] city have increased 70 percent in the last 15 years” (McNeil Jr., 2018). The New York City (NYC) Department of Health released a report on the health status of Asian New Yorkers which found that 27% of local Chinese men smoke, a higher rate than any other ethnic group (Deng & King, 2018). Since high smoking rates persist even outside of mainland China, it can be assumed that while smoking in China might have begun as a result of various factors related to life in China, such as low cigarette prices, and persisted due to the addictiveness of tobacco, smoking has become part of Chinese culture and is a lifestyle carried on by Chinese men even outside of China. These high levels of smoking are certainly a contributor to the high rates of lung disease in China, but as shown before, this is only one piece of the puzzle, as rates of lung disease not associated with smoking have been rising in recent years.

Culture also contributes to obesity rates in China. One study found that Chinese grandparents play a large role in childhood obesity. Since the older generation in China lived through a period of food insecurity, they have unique attitudes regarding food and eating. Based on research conducted by Kar Keung Cheng, Peymane Adab, and Bai Li (2015), it was found that children in China mainly cared for by grandparents are more likely to be overweight or obese. One reason used to explain this finding was that grandparents are likely

to believe that “fat children are healthy and well cared for.” Unlike smoking, though, which has roots in culture strong enough to make smoking pervasive across Chinese men even outside of China, obesity among Chinese people is mainly found in China. The report published by the NYC Department of Health found that “Among all racial/ethnic groups, Asians had the lowest prevalence of being overweight or obese” (Deng & King, 2018). The US Department of Health and Human Services Office of Minority Health also found that Non-Hispanic whites are 60% more likely to be obese compared to Asian Americans and that compared to the 23.6% of obese white Americans, there are only 4.2% of obese Chinese Americans. This trend holds true for the United Kingdom as well, with data showing that Chinese adults in the UK are least likely out of any ethnic group to be overweight or obese (Gov.uk, 2019). Since obesity rates are low outside of China, the causes of obesity must be more related to factors associated with living in China and less with Chinese culture. Even if attitudes among older Chinese people are contributing in small amounts to the obesity epidemic in China, these attitudes are either not rooted strongly enough in Chinese culture or not pervasive enough to affect Chinese people outside of China.

III. Improvements in Public Health

Despite this paper focusing on the economic changes that have taken place in China that have led to the rise in NCDs, it is important to note that this recent economic growth, has also, in fact, led to many improvements in public health. Child mortality has decreased in the last two decades, from 30.1 infants per 1,000 live births in 2000 to eight infants in 2017, and life expectancy has increased from 71 years in 2000 to 76 years in 2017 (The World Bank, n.d.). One study also finds that the mean hemoglobin concentration has increased, and the

prevalence of anemia has decreased, between 1995-2010 among school-aged children (Song, Wang, Dong, Wang, Ma, & Agardh, 2017). These shifts indicate a decrease in malnourishment among children in China, as malnourishment is negatively correlated with hemoglobin concentration. As hemoglobin concentration decreases, anemia could result. The study also found that “hemoglobin concentration was higher and the prevalence of anemia was lower in urban compared with rural children” (Song et al., 2017). This makes sense considering urbanization results in improved living conditions. As the study explains, although GDP per capita, average disposable income, and food expenditure per capita have increased in the past two decades in both rural and urban areas, living conditions in urban areas are still better than in rural areas due to increased economic development and industrialization.

One other indicator for improved living standards is the Engel coefficient. Engel’s Law states that as income rises, the percentage of income allocated for food expenditures decreases while the proportion allocated for other goods, such as luxury goods, increases (Kenton, 2018). This means that when a family makes more money, they might increase spending on food, but to a lesser percentage, and instead increase spending on other types of goods. This proportion of spending on food is called “Engel’s coefficient.” A lower Engel’s coefficient is indicative of a wealthier country and a higher standard of living. The Engel coefficient for urban and rural households in China in 1980, right after economic reforms were instituted, was 56.9% and 61.8%, respectively (stats.gov.cn, n.d.). The numbers decreased to 38.2% for urban households and 47.7% for rural households in 2001, the year China joined the WTO. The Engel coefficient further decreased to 35.7% for urban households in 2010 and 41.1% for rural households. These numbers prove that the standard

of living in China did improve as a result of economic growth in these years, and the standard of living improved more, and faster, for urban households, as these were the places more affected by economic development, but rural households did see improvement as well.

IV. Economic Costs of NCDs

Despite China's rapid economic growth and increasing wealth, these NCDs are causing an increase in deaths and injury that come with serious economic costs. Economic growth is overall beneficial to public health, as indicated by the increase in life expectancy and decrease in China's Engel coefficient, but in China, these rapid gains in wealth have been causing an increase in NCDs that is draining the healthcare system, causing a decrease in the labor force, and increasing premature mortality. Pollution is increasing rates of lung disease among people who would otherwise be unlikely to develop such a condition, and it has even been found to reduce crop yields as ozone can reduce the effects of photosynthesis in plants. The *South China Morning Post* reported on the economic costs of pollution, saying "Air pollution from smog-inducing ozone and fine particles may be shaving an estimated 267 billion yuan (US\$38 billion) off the Chinese economy each year in the form of early deaths and lost food production" (Kao, 2018). This number accounts for about .7% of national GDP in China. The same is true for the economic costs of diabetes and heart disease. As more people develop these diseases, their healthcare costs rise as they require more treatment, and since China's healthcare system is mainly paid for by the government, healthcare expenditures increase. According to Bankman (2017), "In China, 13% of medical costs are related to diabetes." Many NCDs are also the leading causes of premature mortality, including heart disease, COPD, lung cancer, and stroke. The majority of those who die

prematurely would have remained in the labor force. These deaths cause a decrease in both the labor force and productivity in China. Many studies have predicted the economic costs for NCDs in China, with one finding the “total economic burden, from 2012-2030, to be 27.8 trillion (in 2010 USD). This figure swamps the total health expenditure in China during the previous 19 years, which was approximately USD 2.2 trillion” (Bloom et al., 2013).

V. China’s Policies to Combat NCDs

These economic costs are limiting the economic heights China could be reaching due to its recent exponential growth. China must take measures now to halt the progression of NCD rates among urban and rural areas. The Chinese government has responded to these rising rates of NCDs by launching the Healthy China 2030 initiative. President Xi Jinping echoed the sentiments of this paper at China’s National Health Conference in Shanghai in 2016 where he discussed the importance of public health in the rapidly developing country. As reported by the WHO (2016), President Xi stated at the conference that “health is a prerequisite for people's all-round development and a precondition for economic and social development.” Xi continued to stress that “if the problems in the health sector are not effectively addressed, people’s health may be seriously undermined, potentially compromising economic development and social stability.” To this end, the Chinese government has set health as a political priority and has put forth a plan to increase public health and reduce these high NCD rates.

A substantive report on the Healthy China 2030 plan describes the goals of the new health plan: “The five specific targets of HC 2030 are to improve the level of health, control major risk factors, increase health service capacity, expand health industry scale, and perfect

the health service system” (Tan, Liu & Shao, 2017). Tan et al. explains that this plan is meant to make improvements in areas such as food and drug safety, health literacy, the development of a healthy lifestyle, and the elimination of serious illnesses, among others. Essentially the goal is to reach the same health standards as other developed countries by 2030. A national nutrition plan has been created in order to improve the people’s health conditions and prevent obesity. According to Xinhua, “The plan urged the schools nationwide to structure meal plans based on the age of students and the school’s location, and to launch an educational campaign on nutrition to students. It also called for schools to add more sport activities into the curriculum” (An, 2017). China is also taking steps to curb their pollution issue. The government released the Air Pollution Action Plan in 2013, and since then, PM2.5 levels have been reduced in many areas, including Beijing where the coal-fired power plants were closed down. The next stage of the plan, called the “2018-2020 Three-year Action Plan for Winning the Blue Sky War” calls for further decreased levels of PM2.5 in more cities than the previous plan. The new plan also focuses on decreasing ozone levels. (Hao, 2018). In addition, China is simultaneously focusing on climate change and environmental protections. At the start of Xi Jinping’s five year term in 2017, he announced that as part of China’s new Grand Strategy, China would be leading the global conversation on climate change. After President Trump withdrew the United States from the Paris Agreement, Xi quickly took on the leadership position. China has gathered countries together in Beijing in order to discuss uses for clean energy and has “committed to reaching its peak carbon dioxide emissions by 2030” (Worland, 2017). These efforts to curb pollution are expected to also curb rates of lung disease, as China hopes to reduce rates of NCDs by 2030.

VI. Conclusion

China's unprecedented economic growth increased national wealth, and income, to the point where not only did malnourishment decrease, but obesity rose. As people were able to spend more on higher quality food, their preferences turned toward an unhealthy "Western" diet consisting of meat and sugars, increasing the demand for these foods, resulting in a spike of imports for these goods. High rates of pollution, dietary changes, and rises in obesity quickly manifested themselves in rises in certain NCDs such as lung disease, diabetes, and heart disease. The extent of China's economic growth as well as their unusually large population allowed for these rates to be unusually high. These NCDs do have costs of their own, however. As people die prematurely or become unable to work, the labor force shrinks and healthcare costs grow. It is in China's best interest to prioritize this issue and work toward reducing rates of NCDs and improving public health as a whole. The Healthy China 2030 plan is the first step towards this goal. As China continues to grow its economy and develop into a world power, the government must take into account the strong bidirectional relationship between public health and economic growth. Investing money into the country's public health infrastructure and the people's health will further enhance the country's economic growth in the long run, even if there are some short run costs.

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