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POPULATION AGING AND HEALTHCARE COSTS IN CHINA AND JAPAN

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By Sean H. Brown

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Abstract

This study focuses on the natural demographic phenomenon known as population aging and its intersection with healthcare expenditures. Healthcare spending can be a major burden on a country's economy, so it is important to accurately assess the connection between these two factors. Population aging occurs when countries reach a point in their demographic transitions characterized by declining total fertility rates and high life expectancy. This natural but undesirable position has implications for virtually all aspects of society, and all countries are trending towards aging. This study examines the cases of China and Japan in an effort to assess the validity of the wider, global observation of the relationship between population aging and healthcare expenditures. Cross-sectional and time series quantitative analyses reveal a statistically significant, non-spurious correlation between the two variables with a high degree of magnitude. This study discusses the implications of those findings within the broader context of population aging as a global issue.

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Chapter 1: Introduction

This study focuses on the natural demographic phenomenon known as population aging. Population aging occurs when countries reach a point in their demographic transitions characterized by declining total fertility rates (TFR) and high life expectancy. The former stems from a combination of widespread contraceptive use, lifestyle choices influenced by economic prosperity, and more opportunities for women in the workforce, among others, which often means the delaying of childbearing until later in life and having fewer children total, while the latter results from advancements in medical technology and an economic transition away from manual labor jobs that are more dangerous than those found in the primarily service-based economies of the Global North (the term Global North refers to the world’s most developed and affluent countries) [Roser 2013].

Historically, only nations of the Global North have encountered this problem, with Japan being one of the most extreme examples of population aging in the world (Arai et al. 2015). Japan has a median age of 48.4 years old, meaning half of the country's entire population is that age or older, and 27.6 percent of the population is age 65 or above (United Nations 2019). To put this into perspective, the United States (a developed country that has been able to somewhat stave off population aging through immigration) has a median age of 38.3 years old and 15.8 percent of its total population at or above the age of 65, while on the other end of the spectrum the rapidly growing country of Niger sits at a median age of just 15.2 years old and only 2.6 percent of its population at age 65 or above (United Nations 2019). Even when compared with its fellow OECD member countries, Japan still ranks as the most aged among them.

As it stands, Japan is the second oldest population in the world as measured by both median age and percent of population age 65 and above, trailing only the tiny principality of Monaco, which has a median age of 55.4 years old and a population with 35.15 percent of people at age 65 or above (United Nations 2019). For reference, Italy comes in at number 5, France at 44, the United States at 62, China at 63, Brazil at 102, and Niger at 230, with the averages of all countries being 30.6 years old for median age and 8.75 percent for population age 65 and above (United Nations 2019). For developed nations, these are 42 years old for median age and 15 percent for population age 65 and above, and for East Asia and the Pacific the averages are 32 years old for median age and 11.6 for percent of population age 65 and above (United Nations 2019). This makes Japan's median age of 48.4 years old and the percentage of its population age 65 and above of 27.6 percent all the more striking.

The natural but undesirable position of having an aging society has implications for virtually all aspects of society, including those both economic and cultural (Roser 2013). These

include but are certainly not limited to the following: stunted economic growth or even decline, unhealthy fluctuations in inflation rates, a straining of the government's ability to provide adequate social and medical resources for elderly people, changes in the responsibilities and functioning of the family (often manifesting in the form of increased stress placed on younger members to care for elder members, as the latter grow in number while the former decline), and shifting practices of work and retirement [Vlandas 2018]. For example, because they are almost all retired, elderly people do not contribute nearly as much to a country's economy as do its working-age citizens. Thus, one of the main negative consequences of population aging is that a dwindling number of working-age people must prop up the economy of a society increasingly comprised of the elderly, which includes all of the healthcare provided for them. This creates a situation in which population sizes and economies shrink in tandem (Vlandas 2018). For example, Japan's current population of approximately 126 million people is expected to decrease to around or below 100 million by 2050 (Statistical 2017). Its economic output (as measured by GDP per capita) is also projected to see negative growth rates beginning in 2030 [Yasutake 2012].

However, it is important to note that while Europe and parts of Asia may have reached this point first, all countries are trending towards population aging as a natural byproduct of social and economic development (Roser 2013). Every society on Earth is in some stage of demographic transition that closely resembles past stages of the world's most aged populations, and while individual cases of course differ in their details, there have never been any exceptions to this rule (Vlandas 2018). As a result, as the world's population continues to get older, it is imperative to understand the far reaching impacts of the population aging phenomenon.

Arguably the most discussed aspect of population aging is the nature of its relationship with healthcare expenditures. Healthcare spending can be a major burden on a country's economy, so it is important to accurately assess the connection between these two factors. While much of the extant literature points to a causal relationship, many scholars are still debating exactly what those causes are, how that connection manifests, the strength of said connection, and what overall effect it has on a given nation's healthcare expenditures, particularly when factoring in that nation's unique economic, social, and cultural attributes.

To that end, this study will examine the situations of China and Japan in an effort to assess the validity of the wider, global observation of the relationship between population aging and healthcare expenditures. These two Northeast Asian neighbors are worthwhile case studies for the broader issue of population aging because while they have commonalities, their differences are much more pronounced, and they represent two contrasting aging situations. Culturally, both countries have long held a respect for the elderly, emphasizing the value and wisdom that comes with age (Hinton 2016). The concept of filial piety, or demonstrating respect for and deference to one's elders, in China is but one example (Chen 2010; Jiang 2011). China and Japan also share a similar importance placed on the nuclear family, meaning smaller familial units are prioritized over the extended family (Hinton 2016; LaFave 2017). Overall, aging occupies a similar cultural space in these neighboring East Asian nations. Furthermore, both are large, populous countries with two of the most influential economies in the world.

However, there exist important differences that make them useful as a critical test for the larger theory on the relationship between aging and healthcare spending. Generally, though both countries are considered populous nations, they still vary substantially in actual population size. Japan's current population of 126 million is only a fraction of China's enormous 1.4 billion

(United Nations 2019). They also contrast geographically, with China being much larger and diverse compared to the mountainous island nation of Japan, which is another factor that has influenced both nations' social and economic development throughout history.

The countries vary in terms of their governance as well. While they both have been under the control of a single dominant political party for much of their recent histories, those being the Liberal Democratic Party for Japan and the Communist Party for China, the superficial similarities end there. Japan is a liberal democracy with constitutionally protected freedoms of speech and the right to vote, whereas China is an authoritarian state that does not grant voting freedoms at the national level. When a free population like Japan ages, older cohorts naturally gain political power because members of older cohorts outnumber those of younger cohorts and thus are more likely to be elected. In contrast, a place like China, with only one political party, does not change power based on population age as much because political power is so centralized. This could affect how the popular pressure to increase healthcare spending plays out over time, and this difference makes the two nations even more useful for comparison.

Japan and China have also had different histories regarding economic growth and volatile political periods. In terms of the former, following World War II Japan experienced an economic boom up until the 1990s when that growth began to stagnate. That period is now referred to as the country's "lost decade", the ramifications of which have continued to plague the Japanese economy (信夫 2010). However, the country was at least in a much more stable position politically when compared to China during the same time period. In contrast, following China's "opening up" to the rest of the world in 1978, the reforms associated with which spurred the country's rapid economic growth that has, despite a significant but temporary lull during the

political unrest brought about by the 1989 Tiananmen Square protests, steadily continued to the present, only in recent years having begun to somewhat slow down (Jiang 2016; Shi 2018).

Moreover, since Japan has one of the oldest populations in the world, it is in many ways a glimpse into the near future for many countries just beginning to grapple with population aging (Arai et al. 2015). China is one of those countries, but it is facing a looming aging crisis wholly unique to its own circumstances. Specifically, China has not reached the same levels of aging as Japan or some other greying nations, but it is a special case, as its population aging is occurring prematurely (Kong 2019). China is not yet considered a developed nation, sitting somewhere in stage 3 of the demographic transition model, while developed countries are classified as stage 4 and 5. Figure 1 below shows in detail the population characteristics of each stage of the demographic transition model, with a focus on the movements of birth rates and death rates and how that impacts total population growth.

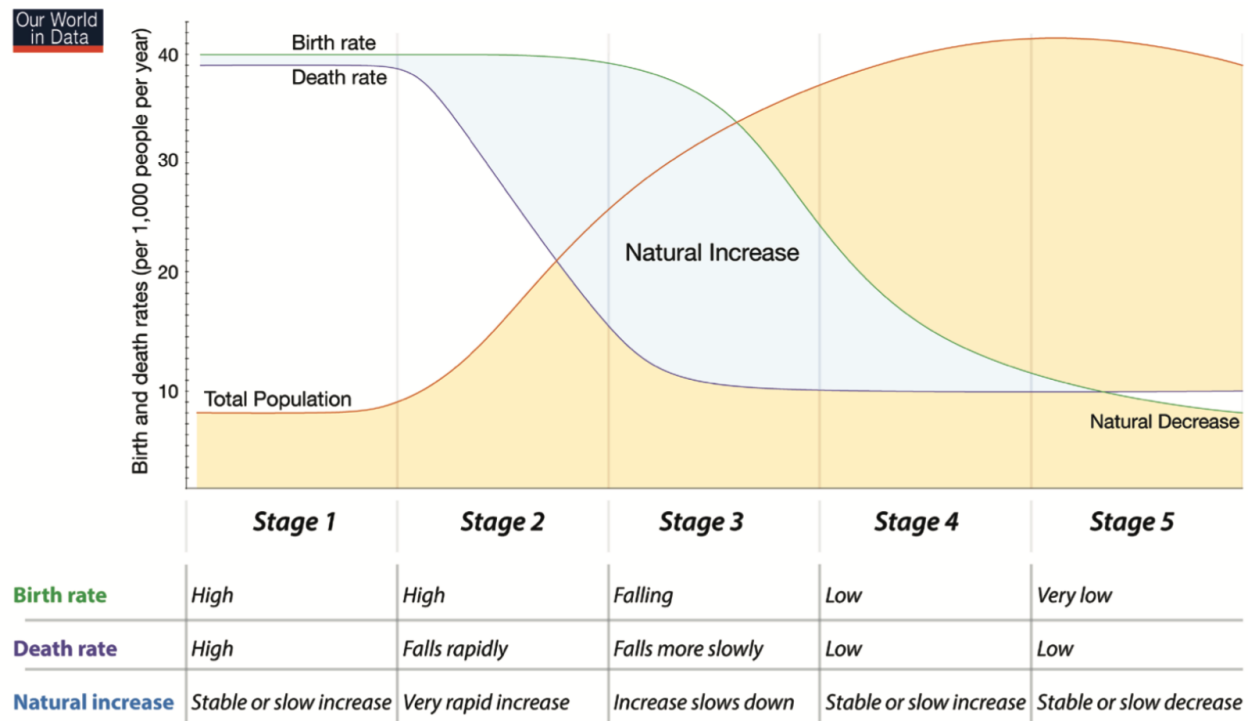


Figure 1: Demographic Transition Model.

Source: Roser, Max, Hannah Ritchie, and Esteban Ortiz-Ospina. "World Population Growth." Our World in Data, May 9, 2013. <https://ourworldindata.org/world-population-growth>.

Using China as an example to put the above chart in economic terms, China is currently ranked 79th in the world with a GDP per capita of \$10,500, which is far behind a nation like Japan, which is ranked 28th and, even with a recent decline, still has a GDP per capita four times that of China at \$40,113 (United Nations 2019). However, just like Japan, China is already grappling with the effects of population aging (Cheng 2019; Jiang 2011; Kong 2019). Recent literature suggests that the country's former One Child Policy, in effect from 1980 to 2015 and originally intended to slow China's then explosive population growth, actually functioned as an overcorrection (Feng et al. 2014). These analyses support the theory that by the time the policy was implemented, China had in fact already completed the bulk of its demographic transition and was going to see declining fertility rates anyway. This resulted in the artificial acceleration of the nation's aging as birth rates plummeted while the country continued to modernize, improving life expectancy but forcing upon the still developing nation a societal issue previously exclusive to already developed countries on a scale never before seen. Scholars question to what extent China's current healthcare infrastructure will be able to support a growing number of elderly people, especially in regards to long term care and elder care (Chen 2010; Cheng 2019; Nie 2016).

In many respects China and Japan are vastly different countries, varying greatly in population size, population distribution, geography, level of development, stage of demographic transition, and type of governance, among others, all of which have had an impact on each nation's social and economic development throughout history. However, despite all of their differences, they are both facing the same major societal problem. As such, it will prove worthwhile to examine to what extent the relationship between aging and healthcare spending manifests in these two otherwise contrasting nations. If, despite all their differences, the

relationship between said variables can still be seen in both countries, then it will allow for a higher degree of confidence in this study's findings. This makes China and Japan especially worthwhile as a least similar pair for comparison and analysis. The results of which could illuminate common trends across the two nations as well as effects unique to each. This would not only prove helpful in explaining China and Japan's respective situations, but it would also be generalizable to other countries, both those who have not yet encountered the aging population phenomenon and those who are already dealing with it.

The following research paper utilizes a quantitative analysis approach consisting of primary data analysis of data gathered from various governmental and non-governmental sources to examine the effects of population aging on healthcare expenditures in China and Japan. The primary data analysis consists of two main subsections - a cross-sectional portion and a time-series portion. The main methods used in each are linear regressions and correlations. This is done in order to answer the study's chief research question, which investigates the impact of increasing population aging on total annual healthcare expenditures both across the world and in China and Japan specifically, with the prediction being that a statistically significant relationship will be found that shows healthcare spending increases with an increasing severity of population aging. Indeed, the findings reveal a tight relationship between the two main variables, as well as a strong degree of magnitude, that together show definitively that population aging is a substantial driver of healthcare spending across all countries, including China and Japan, even when controlling for gross domestic product per capita.

Chapter 2: Literature Review

For the issue of population aging in general, there exists an ongoing debate over how healthcare expenditures will increase in the near future and how population aging will contribute to that trend. While there is little disagreement regarding the fact that healthcare expenditures and population aging are causally linked, much of the extant literature is divided over to what extent that causal relationship exists and in what ways it manifests. As population aging is not a phenomenon unique to China and Japan, it is beneficial to first examine how the topic is treated in the literature regarding other aging nations.

For example, de Meijer et al. look at population aging and healthcare expenditures in Western nations overall. While looking at these two variables, the authors do frame their relationship as being causal in nature, but they suggest it manifests indirectly rather than directly. In writing that “Population aging moderately increases expenditures on acute care and strongly increases expenditures on long-term care,” the authors are noting that the effects of aging on different subtypes of healthcare spending vary (de Meijer et al. 2013). They theorize that population aging first impacts the main societal factors responsible for changes in healthcare expenditures, such as advancements in medical technology (de Meijer et al. 2013).

Similarly, Milena et al. use a quantitative analysis model to evaluate the relationship between healthcare expenditures and population aging in Italy. Their results show that Italy’s healthcare expenditures are more closely correlated with population aging itself, rather than other similar metrics such as life expectancy or GDP per capita (Milena 2017).

In their study examining elder care spending in China, Jiang et al. also found that “Health-related bills are the major driver pushing up the elderly’s consumption,” which is “due to the changing population age structure” (Jiang et al. 2016). The study frames China’s rising

healthcare costs as a direct consequence of population aging, and they use health statistics to draw a causal link between health expenditures and demographic changes, stating that medical bills are primarily responsible.

Multimorbidity and Chronic Illness

A major trend seen in the literature is the association of multimorbidity (the condition of having more than one disease or illness) and chronic illness in the elderly with increased healthcare costs and usage. As Europe was the first continent to experience widespread population aging, much of the literature on said topic is based in the situations of European nations, especially those in western Europe.

For example, one study looked at the direct effects of multimorbidity, which is naturally more prominent in the elderly, on healthcare costs in Germany (Marengoni et al. 2011). Compiling a multimorbidity index and making use of multivariate linear regression models, the authors analyzed the impact of elderly multimorbidity on direct healthcare costs and health service and resource utilization. Their results found the following breakdown of individual patient costs among their cross sectional sample of persons age 72 and older: “25% of mean annual costs were due to inpatient care, 20% to outpatient physician services, 20% to pharmaceuticals, 12% to assisted living and transportation, 8% to healthcare products and dentures, 7% to rehabilitation services, 5% to outpatient nonphysician providers, and 3% to spending from compulsory long-term care insurance” (Nagl et al. 2012). They conclude that multimorbidity leads to increased personal healthcare costs as well as health service consumption, meaning that the elderly population are driving up healthcare costs and resource usage through the need for simultaneous care for multiple conditions (Nagl et al. 2012).

The topics of multimorbidity and chronic illness are closely intertwined, as people become more susceptible to both as they age. Graves and Zheng see similar findings in their assessment of chronic wounds and direct healthcare costs in Australia. They note that healthcare costs associated with chronic afflictions are substantial, stating that “As the elderly population grows, costs are likely to rise unless cost-effective intervention strategies are implemented as a matter of routine” (Graves 2014). Here the authors suggest that these chronic wounds and illnesses will become more commonplace, indicating a need for structural reform in healthcare provision as population aging continues.

A literature review of 35 studies on chronic illnesses and multimorbidity lends credence to the findings of the Nagl et al. and Graves studies. In looking at the relationship between elderly with multiple chronic conditions (MCCs) and healthcare cost and utilization, the review found that “almost all studies observed a positive association of MCCs and use/costs, many of which found that use/costs significantly increased with each additional condition. Several studies indicate a curvilinear, near exponential relationship between MCCs and costs” (Lehnert et al. 2011). This is further evidence that people with for the most part inherently elderly health complications are contributing to a noticeable increase in healthcare service and resource use costs that is not seen in any other age demographic.

The “Red Herring” Effect

I also came across papers discussing what is known as the “red-herring” effect, which is used by some social scientists to describe a perceived overstated emphasis on population aging as a driver for increased healthcare costs. However, this is a contested issue, as the literature on this specific topic is divided into camps that either accept or reject the red-herring theory.

For example, one study employed a multi-stage data modeling process to examine healthcare expenditures and population aging in South Korea. They found little evidence to support the claim that aging has a significant impact on healthcare expenditures (Hyun et al. 2016). Conversely, Aaron acknowledges the common argument among red herring proponents that healthcare expenditures are more closely tied to individual proximity to death rather than age, but he expresses uncertainty by stating, “available data provide no basis for assuming that the curve relating average health care spending to age will, or will not, flatten with increases in longevity,” which points to a general lack of agreement among scholars on the topic as a whole (Aaron 2009).

Studies that do find a positive relationship between the two variables often mention the limitations of this correlation. A report from the World Health Organization that looked at longitudinal health expenditure data for the European Union and Japan found that while population aging does appear to increase healthcare spending, it does so to a lesser extent than initially expected. Instead, the authors attribute the bulk of growth in spending to price changes and technological advancement, especially in the case of Japan, which is a conclusion also found in the de Meijer article (Williams et al. 2019). On the other hand, Breyer examines the body of literature on the red herring hypothesis itself and argues that it obscures the need for meaningful policy change to combat the intertwined and very real threats of population aging and rising healthcare costs, claiming that the bulk of studies on the red herring effect are inconclusive at best (Breyer 2020).

Japan and China’s cases are already interesting separately, so reexamining the issue of population aging through both of their situations together is illuminating, especially when there

is considerable debate among experts on the strength of the effect of population aging on healthcare expenditures as a broader issue facing nations.

Chapter 3: Theoretical Framework

The theoretical framework provides a more qualitative, descriptive analysis of the extant literature, with the primary function being to supplement the findings from the quantitative portion of this project through the identification of prevailing trends that, when put together, help paint a more complete picture of the impact of population aging on healthcare expenditures. Specifically, this section expounds upon the main theoretical trends within the relevant body of literature, which are as follows: old-age insurance and old-age healthcare systems across China and Japan, multimorbidity and chronic illness, and long-term care. The goal in doing so is to provide a theoretical framework to act as a foundation for my findings, against which the quantitative findings of the main analysis will be compared.

First, it is important to clarify what types of healthcare systems each country has and what reforms led to their current states. Starting with Japan, Western medicine found its way to the country following the Meiji Restoration of 1868, and employee health insurance was instituted in 1927. In 1961 the country's government established a modern and more or less equitably distributed universal health insurance system consisting of two main types of coverage: national and employer-based (Arai et al. 2015). Just as they sound, employer-based is provided through a person's workplace, while national health insurance is provided directly through the Japanese government. Private insurance does exist, but all citizens must enroll in either national or employee regardless (Arai et al. 2015). Furthermore, a person who has recently lost their job will have their insurance policy automatically switched over from that of their former employer

to that of the national health insurance provider, as they are no longer eligible for company-provided insurance (Arai et al. 2015). This system covers over 90% of Japanese citizens, who on average pay around ten percent to no more than a third of the total cost of any medical procedure or doctor's visit, the prices of which are set every one to two years by a government committee with the aim of maintaining affordability (厚生労働省 2014). Just as with company-provided insurance, Japan has a compulsory public long-term care insurance system established for retirees (Inoue 2013). Also, healthcare quality generally matches or exceeds that of the United States in most metrics (Shimizutani 2014; Steslicke 1984). Lastly of note is that under Japanese law, hospitals are not allowed to make a profit (Inoue 2013). This is to say that though not without its problems, the Japanese government has continued to refine its healthcare system into one of the best in the world today (Shimizutani 2014).

In China however, traditional Chinese medicinal practices did not give way to modern medicine until the 1950s after the Communist Party took control of the country. Then the state nationalized healthcare and sponsored programs aimed at improving the basic health and hygiene of Chinese citizens, but the nation's healthcare system was still very much in its infancy (Cheng 2019). The quality, affordability, and accessibility of urban and rural health coverage began to diverge significantly following the country's opening up, and these discrepancies went mostly unaddressed until 2006 when the Chinese government embarked on its ongoing mission to overhaul and modernize its healthcare system (Jiang 2016). Progress has been made, notably the granting of basic but affordable medical care to hundreds of millions of citizens under the New Rural Cooperative Medical Care System (国家卫生健康委 2021).

Currently in China, there exist both public and private healthcare and insurance institutions that together provide coverage to nearly all (97%) Chinese citizens [国家卫生健康

委 2021]. However, while the amount is steadily increasing, Chinese healthcare policies typically cover less of a given individual's total healthcare costs than seen in Japan, and this is even more true when discussing more serious illnesses and chronic conditions, the latter of which are more common in elderly populations than any other demographic cohort (Kong 2019; LaFave 2017). Large discrepancies in access to and scope and quality of insurance between urban and rural areas persist, although strides are slowly being made in this area (Cheng 2019; Shi 2018; Sun 2020; Zou 2020). Furthermore, the pension system in place for retirees has been buckling under the weight of the country's increasing older population (Jiang 2016). As a result, China's healthcare system cannot be described as fully developed in its current state.

The extant literature focuses heavily on the struggling pension system as a current economic and logistical pain point for China when it comes to managing and providing for its growing percentage of old people. There are many articles that focus on the increasing burden placed on China's old-age pension system, most of them pointing out that the system is so strained because an increasing percentage of the population is relying on the pension as their primary income source, while at the same time a decreasing amount of young people are paying into the system, creating an unsustainable situation in which more money is being withdrawn than is being put in or replenished (Jiang 2016, Shi 2018). This draws a causal link between the struggling old-age pension system and the ongoing inversion of China's population distribution. It also implies that the pension system and the country's healthcare infrastructure are unable to keep up with the current pace at which China's elderly population is expanding, and thus healthcare costs are rising while needs go unmet.

An interesting trend found in the literature is the focus on long-term care, which is closely tied to old age and multimorbidity, and its associated costs. The connection between

long-term care and healthcare expenditures is so readily apparent in most studies' results, in fact, that many authors seem as if they cannot overstate its importance, arguing for an even larger emphasis to be placed on long-term care costs when evaluating and predicting changes in healthcare expenditures over time (Mori et al. 2019). One study examined the factors that are related to higher dependence on and cost for long-term care at both the individual and municipal level. Its findings show that, at the individual level, those who are less financially well-off, are female, and have a higher care-need level are more likely to spend more on long-term healthcare services, while at the municipal level, those located within larger metropolitan areas, possessing a higher percentage of single elderly households, and with more nursing homes per capita generally saw a higher level of average spending on long-term care (Jin et al. 2020).

Elsewhere, studies that simulated the impacts of attempts to prevent dependence on long-term care through efforts to lower death rates even further and to prolong elderly people's years of good health before death, such as Japan's ongoing Health Japan 21 project, actually showed an associated increase in healthcare expenditures in the short term (Nishi et al. 2020). The reasoning behind this is that increases in good health outcomes in the oldest age cohorts would inadvertently alter the population structure to be even further skewed towards inversion, with the increase in healthcare demand brought about by a larger proportion of elderly members of society, even those in good health, outpacing the expected drop in costs from a decrease in long-term care usage (Nishi et al. 2020).

This is a key driver in short-term healthcare expenditure increases, with efforts by both China and Japan to improve the overall wellbeing of their respective elderly populations ending up simultaneously contributing to each nation's healthcare cost woes and the perpetuation of the aging population phenomenon that is contributing to it (Nishi et al. 2020). However, it is

important to note that these projects do show an overall decrease in associated healthcare expenditures as the percentage of elderly persons dependent on long-term care decreases and balances out the initial increase, pointing to a time-lag in this process.

Multimorbidity is a heavily focused-on topic in regards to drivers of healthcare costs, and there is ample evidence to support the claim that its prevalence increases with age (Wang 2014). This holds true for China and Japan as well. Both in terms of sheer number of times this relationship is brought up in the extant literature on China and Japan in comparison to other potential causal mechanisms, as well as how much each article on said topic stresses the impact of multimorbidity on healthcare expenditures, it is not out of line to conclude that multimorbidity is one of, if not the number one causal mechanism associated with population aging fueling rising healthcare costs in the two nations in question.

Regarding China in particular, various authors assert that the nation's healthcare system has yet to properly account for the major burden that is multimorbidity and its associated complications, despite the fact that up to "95% of healthcare expenditures on chronic conditions are spent on multimorbidity" in large population centers such as Beijing (Chen et al. 2018). Multimorbidity is widely accepted as being strongly associated with both "higher levels of health service use and a greater financial burden," with much of that increase in health service use coming in the form of long-term care (Zhao et al. 2020). This brings us to the next significant theoretical trend in the literature.

In addition to just looking at multimorbidity and/or long-term care usage in a vacuum, what many of these studies also touch on is the connection between the two factors, with the vast majority of the extant literature suggesting that the former contributes to an increase in the latter, which then contributes to an increase in healthcare expenditures (Chen 2018; Mori 2019; Nagl

2012). Furthermore, this trend is seen in studies on both China and Japan, despite one country being generally farther along than the other in the aging population process (Chen 2018; Mori 2019). That strengthens the evidence that there is not only a causal relationship between multimorbidity and healthcare costs and long-term care utilization and healthcare costs, but also between multimorbidity and long-term care utilization as its own distinct causal link that makes up a broader causal relationship.

This theoretical framework illuminates a one-two punch of long-term care and multimorbidity contributing directly to rising healthcare expenditures in China and Japan. The framework also shows that the two factors themselves are interlinked, with higher rates of multimorbidity in the elderly leading to higher dependency upon long-term care services, which ultimately leads to rising annual healthcare expenditures. While there are certainly other fairly prominent theoretical trends in the literature, the dual focuses on multimorbidity and long-term care, both separately and in conjunction with one another, are by far the most prevalent trends in the body of literature on population aging and healthcare expenditures in China and Japan. This makes sense, given that the majority of healthcare spending on the elderly in China and Japan is a result of either multimorbidity, long-term care, or in most cases a combination of both.

In summation, these will constitute the main theoretical framework for this paper, as each has a significant link to total healthcare expenditures and population aging. The findings of this section and the literature review will be analyzed in conjunction with the main results of the quantitative analysis portion, with the goal of forming a more comprehensive picture of the impact of population aging on healthcare costs, particularly in regards to what is driving said relationship.

Chapter 4: Methods and Findings

Specifically, this study addresses the question of how the aging population phenomenon affects total healthcare spending and eldercare needs as population aging progresses.

Additionally, in order to achieve a comprehensive and generalizable view of the interaction between the population aging phenomenon and healthcare spending, the main quantitative analysis of existing data is looked at in depth alongside the prevailing theoretical trends found in the extant literature in Chapter 3, with the theoretical framework being reevaluated in light of the quantitative findings. These are used as a framing device in order to suggest the likely causal mechanisms that drive the impact of aging on healthcare expenditures, the discussion of which will constitute Chapter 5. There is ample primary data to establish a clear broad picture of the relationship between population aging and healthcare expenditures, but secondary sources are necessary in order to gain a deeper understanding of the myriad of ways in which the two main variables (population aging and healthcare expenditures) are connected.

The independent and dependent variables, respectively, are operationalized as follows: population aging (percentage of a country's population age 65 and above) and total healthcare expenditures (combined public and private healthcare spending as a percentage of gross domestic product). The methods and findings portion of this paper consists of two main sections - a cross-sectional analysis for all countries and a time-series analysis of China and Japan. The benefit of doing both a cross-sectional analysis and a time-series analysis is that the latter can assess whether or not the theory holds over time rather than just as a snapshot. These chiefly utilize correlations, linear regressions, and tests of statistical significance.

On that note, primary data was sourced from the Organization for Economic Cooperation and Development, the United Nations, and World Bank databases, with the World Health

Organization and the Population Reference Bureau databases providing supplementary statistics. Health expenditures and percentage of population age 65 and above data were sourced from the OECD's health spending database and the World Bank staff estimates based on the age and sex distributions of the United Nations Population Division's World Population Prospects: 2019 Revision, respectively, while GDP per capita data were gathered from the World Bank's World Development Indicators database.

To sum up, below begins Chapter 4, the description and presentation of the quantitative data analysis, including key takeaways from each figure and explanations of their importance. Following that is Chapter 5, a discussion section that combines the main tenets of the theoretical framework discussed in Chapter 3 and applies them together with the results of the quantitative analysis to synthesize a broader understanding of the population aging issue as it affects total healthcare expenditures across the world and in China and Japan. This will include a discussion of what the results mean going forward for the two countries, as well as what lessons and trends can be extracted from their respective aging population crises and applied to other nations facing the same looming societal threat.

Population Aging Around the World

While this paper focuses on China and Japan as a least similar pair, ultimately the goal in doing so is to test the broader relationship between population aging and healthcare spending, which is a trend found all across the globe. Therefore, it is important to have a grasp on that relationship from a big picture point of view. To that end, a cross-sectional analysis was performed by using data from the United Nations, the World Bank, and the OECD on 173 countries. The United Nations data on percent of population age 65 and above show that Monaco

is the most aged society in the world, with approximately 35.15 percent of its population being age 65 or above. At the other end, Niger is the least aged society in the world, with only 2.6 percent of its population being age 65 and above. This variable has a mean of 8.75, a median of 6.2, and a standard deviation of 6.36. The OECD data on total healthcare expenditures show that the United States spends the most annually on healthcare, amounting to 16.9 percent of the country's GDP, while the Republic of the Congo spends the least annually on healthcare at just 2.14 percent. This variable has a mean of 6.45, a median of 6.23, and a standard deviation of 2.64. Lastly, the World Bank data show that Monaco has the highest GDP per capita at \$190,513, while Burundi has the lowest at \$780. This variable has a mean of \$21,051, a median of \$13,164, and a standard deviation of \$21,712.

Starting with healthcare spending and aging, the two charts below illustrate the relationship between healthcare expenditures as a percentage of GDP and percentage of population aged 65 and above as a percentage of total population. Figure 2 shows the relationship between the variables across all countries, while Figure 3 focuses on just developed nations.

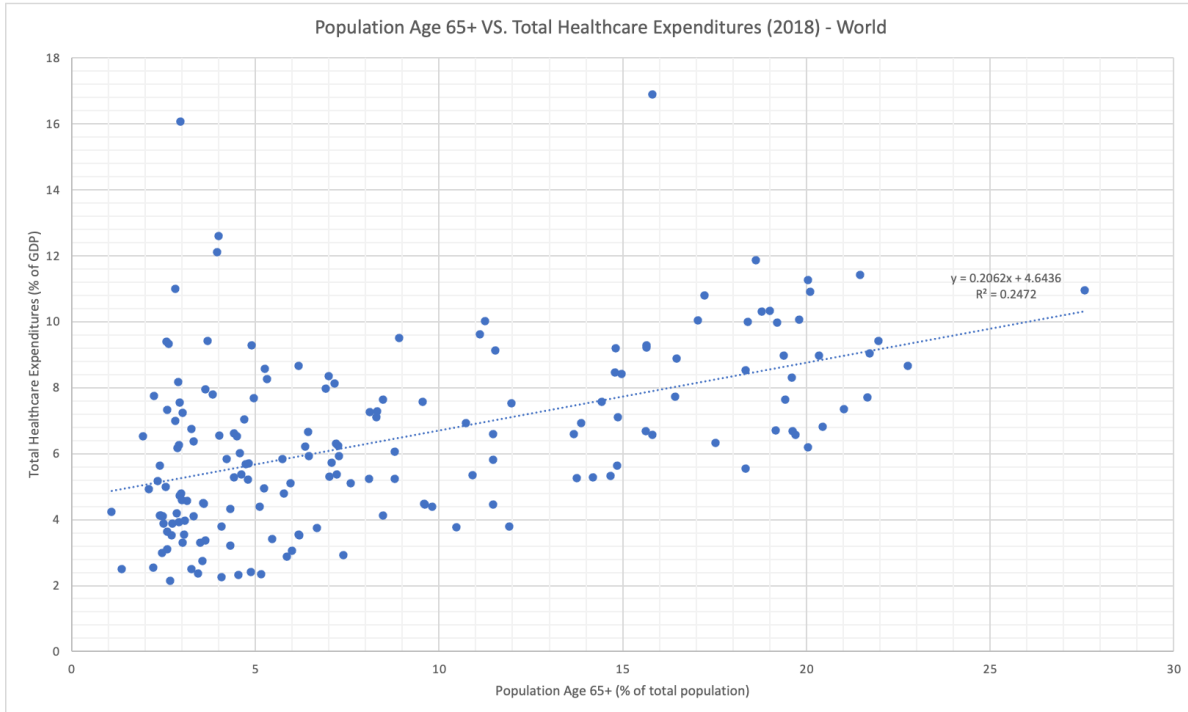


Figure 2: Population Age 65+ VS. Total Healthcare Expenditures (2018) - World.

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

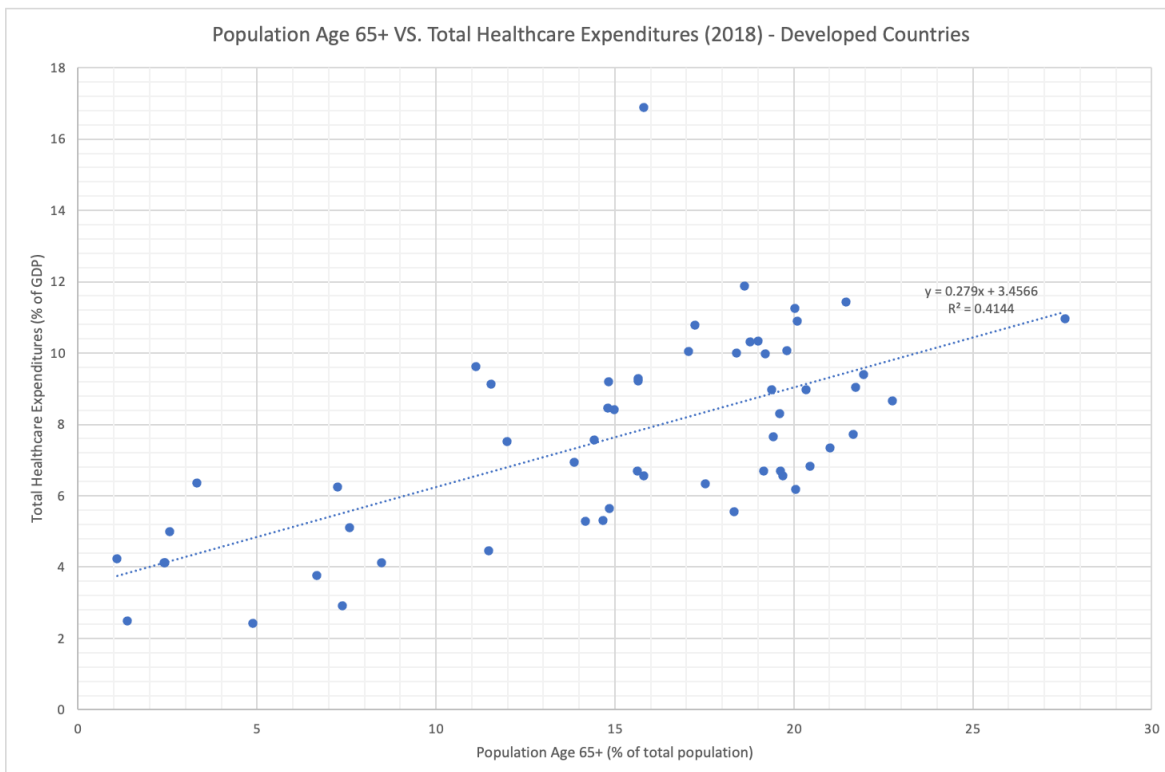


Figure 3: Population Age 65+ VS. Total Healthcare Expenditures (2018) - Developed Countries.

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

As shown above, the relationship between total healthcare expenditures and population aging exists across all nations, but the correlation is noticeably stronger when isolating it to just developed countries. For the world, changes in population aging explain about a quarter (0.247) of the cross-national variation in total healthcare expenditures. This jumps up to over forty percent when examining just developed nations (0.414). Such a significant increase was expected, and it makes sense given that developed countries have already completed their demographic transitions in accordance with the Demographic Transition Model, meaning that as a result people are living longer and having less children, which among other factors leads to population aging. The models of fit on the two graphs differ slightly, but the general trend across nations is still very clear.

Furthermore, even though the scatterplots above display a strong correlation between population aging and total healthcare expenditures, I cannot yet rule out the possibility that the relationship in question is spurious. In particular, a country's income level (as measured by GDP per capita) could be driving both population aging and healthcare spending. As such, it is important to control for this variable in order to ensure the relationship between aging and healthcare is statistically significant.

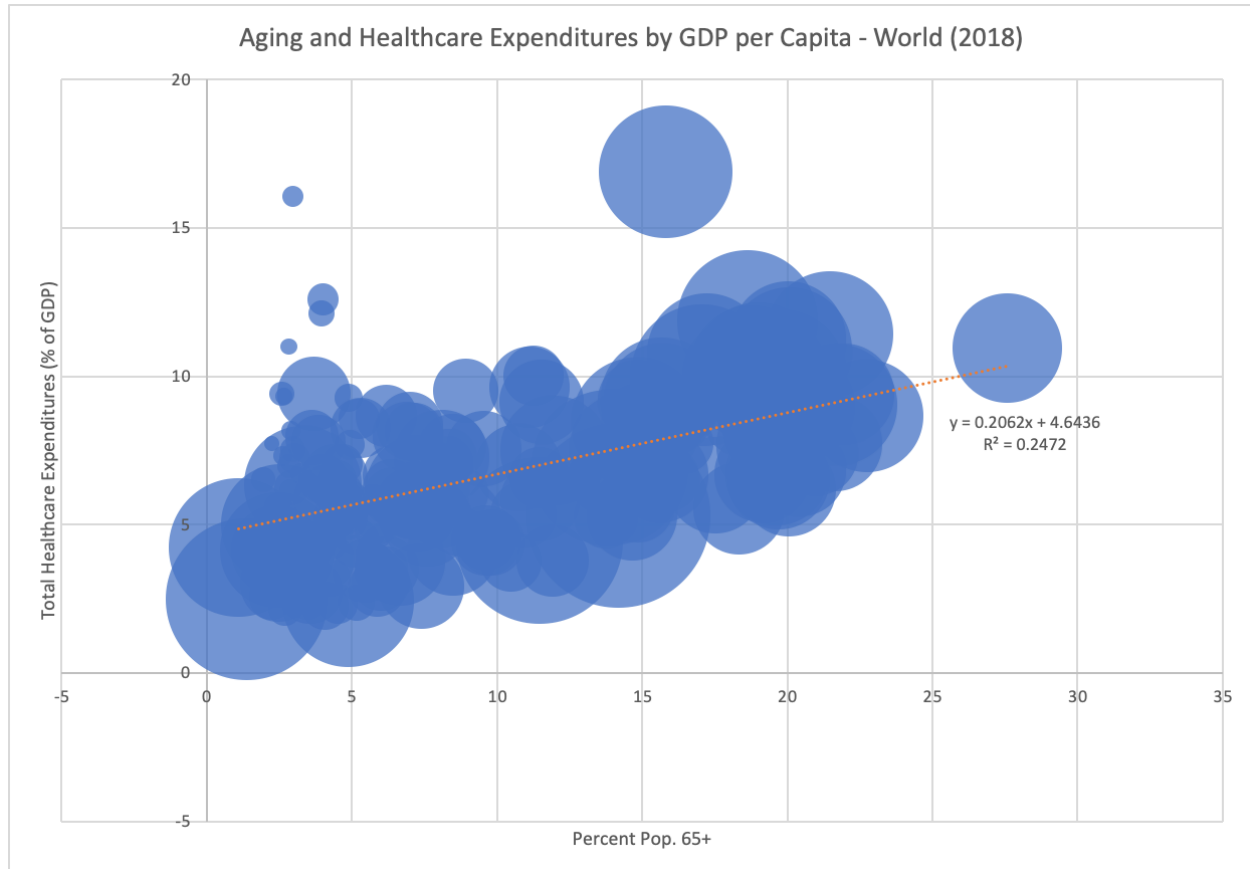


Figure 4: Population Age 65+ VS. Total Healthcare Expenditures (2018) - Developed Countries.

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

The bubble chart above shows the relationship between population aging and total healthcare expenditures, with each bubble representing a different country and its size corresponding to that country's GDP per capita. The size of the bubbles do not seem to correlate strongly with the Y axis whatsoever, with high and low GDP countries being equally scattered across the graph, such as Qatar being close to the origin while another high GDP country like Luxembourg is much farther to the right at point 14.2, 5.3. Even higher up is the United States at 15.8, 16.9. Low GDP countries fall all over as well, with Tanzania being at 2.6, 3.6 and Sierra Leone being at 3.0, 16.1. Visually this graph gives little indication of any significant connection between GDP per capita and total healthcare expenditures.

But in order to rigorously test this and control for GDP per capita, a linear regression was run using population aging (percentage of population age 65 and above) as the independent variable, total healthcare expenditures (percentage of GDP) as the dependent variable, and GDP per capita as the control variable to check for spuriousness as a result of countries with higher GDP seeming to have higher levels of population aging. I wanted to test whether or not GDP per capita was the actual influencer rather than population aging itself. Below is the linear regression equation, and I used functions in Microsoft Excel to estimate the beta coefficients, the results of which are displayed in Table 1 below.

$$\text{Health expenditures} = \beta_0 + \beta_1 * \%65\&\text{above} + \beta_2 * \text{GDPperCapita}$$

Regression Analysis with Healthcare Expenditures as Dependent Variable (World)

Variables	Coefficient	Standard Error	t statistic	p value
Constant	4.650	0.300	15.502	2.358E-34
Percent 65 and above	0.210	0.034	6.112	6.511E-09
GDP per capita	-1.896E-06	1.006E-05	-0.188	0.851
R ²	0.250			
Number of countries	173			

Table 1: Regression Analysis with Healthcare Expenditures as Dependent Variable (World).

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision, OECD (2021), Health spending (indicator) [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en), and International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme 2018.

According to this model estimation, if a country has zero percent of its population at age 65 and above and zero GDP, then its health expenditures would be about 4.6 percent of its total GDP. There are two key takeaways from this regression. First, for every percentage point increase in population 65 and above, health expenditures as a percentage of GDP increase by

approximately 0.21 percentage points. To put this into perspective, let us take Argentina, a well-off country that is just now beginning to grapple with the emergent effects of population aging, as an example. As of 2018, slightly over eleven percent of this South American nation's population consists of people aged 65 or above, qualifying it for aging population status. The country's annual total healthcare expenditures for that year accounted for 9.6% of its GDP. If Argentina's aging grew from its current level to that of, say, Switzerland, then the country would see a jump to almost nineteen percent of its population being aged 65 and above and almost twelve percent of its GDP being made up of healthcare expenditures alone.

Along the same lines, an even more extreme example would be that of Angola, a country still in the process of developing, and the United States, a country that has comfortably occupied developed status for decades. An increase in aging from the former to the latter would see Angola facing an approximate fourteen percent increase in population aging as measured by percent of people aged 65 and above, which would accompany a fifteen percent increase in total health expenditures as a percentage of GDP.

Returning to Table 1, the second key takeaway from this linear regression is that it shows that GDP per capita is not an influencing factor on the total health expenditures variable, as the p value for GDP per capita, 0.851, is much higher than it would need to be in order to be considered statistically significant in any way. In short, a p value is an indicator that assesses the probability that the relationship between two variables happened to occur by random chance. Generally, if this value is above 0.05, or a five percent chance, then the results are dismissed as statistically insignificant. Such is the case for GDP per capita and total healthcare expenditures.

What we can ascertain from this finding is that the common assumption that more developed countries spend proportionately more on healthcare in terms of GDP per capita when

compared to less developed countries is not supported by the data. Rather, these more developed countries have higher healthcare expenditures not because they are comparatively rich, but because their populations are comparatively old. We know this because the linear regression model produced a p value of 6.51E-09, which for all intents and purposes is essentially zero, for the population age 65 and above variable. This indicates a very high level of statistical significance, meaning we can conclude that not only is GDP per capita not a factor resulting in any kind of spurious relationship between population aging and healthcare expenditures, but also that population aging itself is a major driver of healthcare costs. These results are not only statistically significant and substantive, but such an impact is noteworthy for its magnitude as well, with population aging accounting for an average of nearly one fourth, or 25 percent, of all change in total healthcare expenditures across all countries in the world, as indicated by the R^2 value of 0.247, which denotes the magnitude of change.

With all of that said, however, the overall trend seen in the world at large cannot be assumed to be the same for any given individual nation, with there always being a potential for outliers. For that reason, I applied the same level of scrutiny to data for China and Japan as individual cases of population aging as I did for the data on aging as a global issue. The subsection below employs the same methods used above on the world data but in this case focusing solely on the two main case studies of this paper, beginning with the multivariable scatterplot below.

Population Aging in China and Japan

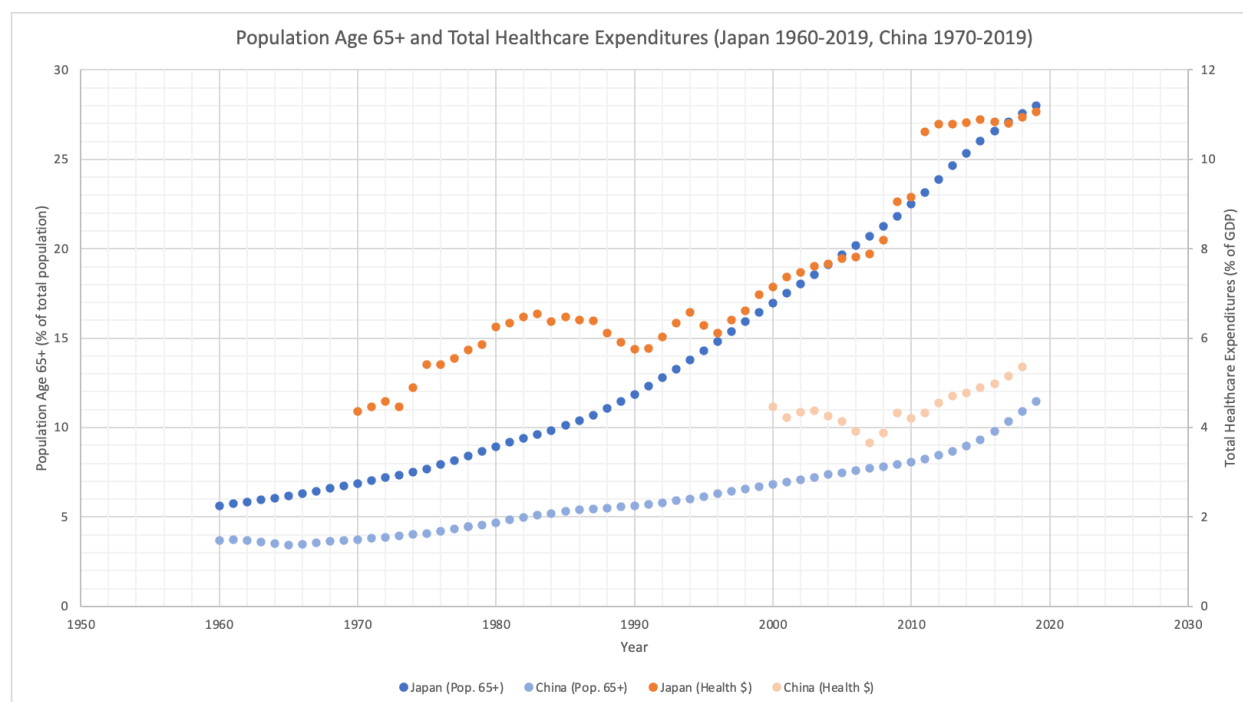


Figure 5: Population Age 65+ and Total Health Expenditures (Japan 1960-2019, China 1970-2019).

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

The time-series analysis in Figure 5 uses data that cover a period of 59 years. The graph above shows that from 1960 to 2019, the proportion of the total population aged 65 or over has steadily increased in both China and Japan, with the latter seeing an especially steep increase. In terms of when each country's aging became more pronounced, Japan's percentage of its population aged 65 and above began to increase more rapidly during the last decade, whereas the true effects of China's one-child policy on the nation's demographic transition did not show themselves until later into the 1990s at the earliest. In line with those increases are each nation's total healthcare spending as a percentage of gross domestic product, which follows the same

upward trend. Also noteworthy are the correlations for population aging and healthcare expenditures in China and Japan displayed in Table 2 below.

Correlation Between Population 65+ and Health Expenditures	
Country	Correlation
Japan	0.950
China	0.813

Table 2: Correlation Between Population 65+ and Health Expenditures.

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision, OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en), and International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme 2018.

Elsewhere, we can look at the correlation between the percentage of the population aged 65 or older and total healthcare expenditures as a percentage of GDP. Table 2 establishes a strong positive correlation between the two variables, which is found both in Japan and China's measurements. Figure 6 plots total healthcare expenditures as a function of population aging.

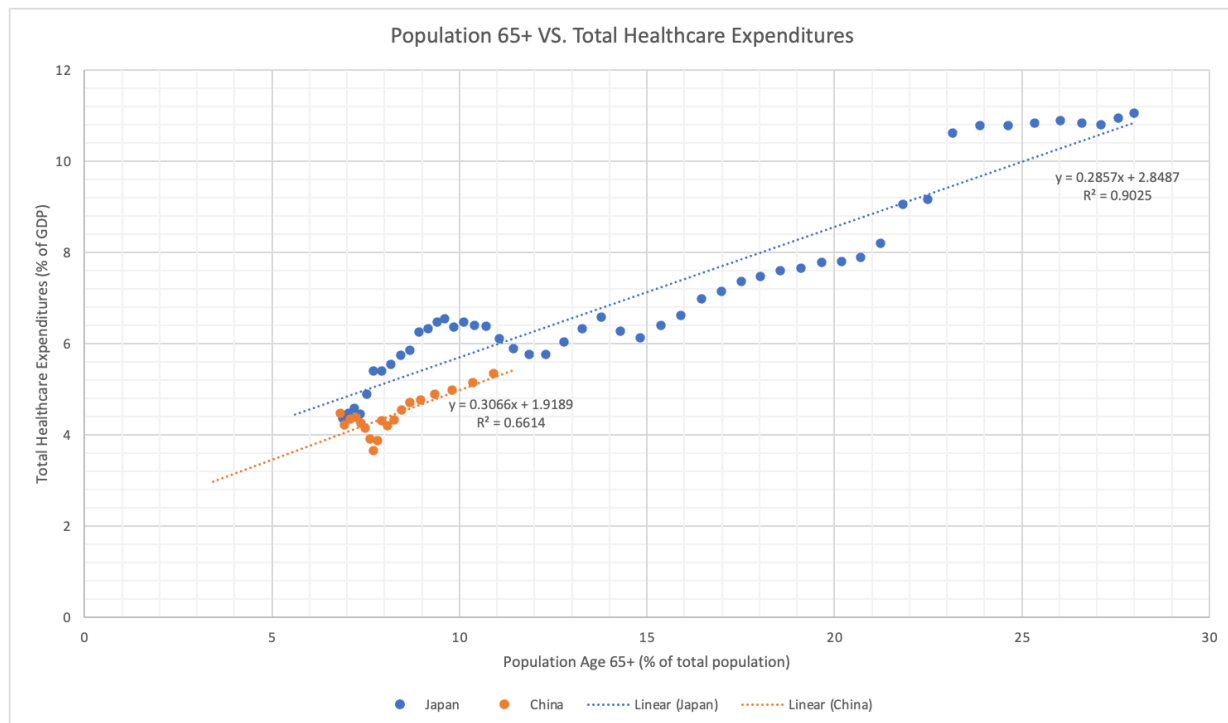


Figure 6: Population 65+ VS. Total Health Expenditures.

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

Figure 6 gives coefficients of determination for each country's aging and healthcare relationships. These values indicate a high goodness of fit for China and Japan's respective regressions, meaning that the regression models have high accuracy in predicting where the data will go. Japan in particular has a very high coefficient of determination at 0.9025. These preliminary results show a definite relationship between population aging and healthcare expenditures.

Just as I did previously with the data for all countries, I also performed a linear regression analysis, using the same equation, on the data for just China and Japan. Figure 6 only looks at the one to one, independent to dependent relationship between population aging and healthcare expenditures for China and Japan. As such, isolating these two in this way is necessary in order to control for the influence of GDP per capita and assess whether or not it has resulted in a spurious relationship between the two aforementioned variables. Identical to the early linear regression on all countries' data, I needed to see whether the relationship was still there even when accounting for GDP per capita. The results of this can be seen in Table 3 below.

$$\text{Health expenditures} = \beta_0 + \beta_1 * \%65\&\text{above} + \beta_2 * \text{GDPperCapita}$$

Regression Analysis with Healthcare Expenditures as Dependent Variable (China and Japan)				
Variables	Coefficient	Standard Error	t statistic	p value
Constant	2.531	1.0116	2.5021	0.0154
Percent 65 and above	0.286	0.045	6.387	4.062E-08
GDP per capita	1.800E-05	1.375E-05	1.309	0.120
R ²	0.432			
Number of observations	57			

Table 3: Regression Analysis with Healthcare Expenditures as Dependent Variable (China and Japan).

Source: World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision and OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en).

According to this model estimation, health expenditures would be around 2.53 percent of total GDP if the population did not consist of any persons aged 65 and above and if GDP was zero. This regression has two takeaways that mirror the results of the previous one. First, for every percentage point increase in population 65 and above, health expenditures as a percentage of GDP increase by approximately 0.29 percentage points, which is even higher than that of the all-countries regression. Furthermore, the second key takeaway from this linear regression is that it maintains the result that GDP per capita is not an influencing factor on total health expenditures, as the p value for GDP per capita in this case is 0.196, which is still much higher than it would need to be in order to be declared statistically significant. This means that there is no spuriousness with GDP per capita, as the relationship between population aged 65 and above and total healthcare expenditure remains significant, with a p value of 4.06E-8 (which is essentially zero), when controlling for GDP per capita.

This indicates a very high level of statistical significance, meaning we can conclude that not only is GDP per capita not a factor resulting in any kind of spurious relationship between population aging and healthcare expenditures, but also that population aging still presents as a major driver of healthcare costs, even more so here when looking at the data for China and Japan in comparison to the data for all countries. In this regression, the R^2 value is 0.432, meaning that across China and Japan, population aging accounts for a staggering 43 percent of the change seen in total healthcare expenditures. This is a large jump up from the already sizable 25 percent seen across all countries, which lends further evidence to the notion that population aging is a large influencer of total healthcare expenditures, especially in more developed, and therefore on average older, nations.

The quantitative analysis presented in this chapter grants valuable insights into the relationship between population aging and healthcare expenditures, both on the world stage, when looking only at developed nations, and also within China and Japan respectively. First and foremost, the results confirm that the population aging phenomenon and increases in total healthcare expenditures are related in a statistically significant manner, even when taking into account income level, on both the global level and for China and Japan specifically. Not only that, but the strength of that relationship is very strong. Scatter plots indicated a high goodness of fit, which was supported by the correlation results showing a close association (0.950 for Japan and 0.813 for China). The linear regressions strengthened the results even further by controlling for GDP per capita and showing p-values extremely close to zero, indicating a very high level of statistical significance and allowing for the conclusion that income level is not resulting in the existence of any spurious relationship. Furthermore, each regression revealed that not only does population aging have an impact on total healthcare expenditures, but that said impact is quite

substantial, with R^2 values showing that population aging accounts for 25 percent, or a whole fourth, of the entire change in total healthcare expenditures seen across the globe, with that figure rising to an even higher 29 percent when looking at just China and Japan.

Such a tight relationship between the two main variables, as well as with that degree of magnitude, show definitively that population aging is a substantial driver of healthcare spending. The question now is what exact aspects of population aging are fueling this trend, what that means for countries like China and Japan going forward as the severity of their respective aging population crises continues to worsen, and what lessons can be learned from their situations with the goal of mitigating the same level of impact in other countries that have either yet to face population aging or are just now grappling with it in earlier stages. The goal of the following chapter is to speculate upon and provide answers to these questions.

Chapter 5: Discussion

This chapter dives into the implications of the quantitative findings of Chapter 4 within the context of the prevailing ideas presented in the literature review (Chapter 2) and especially the theoretical framework (Chapter 3). It seeks to marry the strongest trends found in the extant literature with results from the quantitative analysis in order to delineate the causal mechanisms within the umbrella of population aging that are driving its impact on healthcare expenditures. Doing so will paint a comprehensive picture of the broader, complex societal issue at hand, thereby lending a high level of generalizability to this study's findings and as a result making it more beneficial when attempting to understand the relationship between aging and healthcare spending not just in China and Japan, but across the world as well.

Immediate Implications

This study adds to the existing literature by supporting the conclusion that population aging is a major contributor to trends of increasing healthcare expenditures, and the reinforcement of this finding allows for a higher level of confidence when discussing the issue of population aging and healthcare. Additionally, my work shows that these results hold true both worldwide and for China and Japan individually. Despite all their differences, the same trend among the main variables exists over a long term examination of trends in two countries that have almost diametrically different histories when it comes to aging, healthcare reform, and social and economic development. That fact naturally necessitates a discussion on what short-term and long-term implications population aging and its associated increase in annual total healthcare expenditures will have for both countries, as each face struggles unique to their own respective situations while also encountering some overlapping challenges.

From the information gathered in the literature review, it is likely that by virtue of being a developed nation with the level of healthcare infrastructure development to match, Japan, so long as the country makes adjustments in some key areas, will fare somewhat decently at least when it comes to accommodating the ever-growing, complex healthcare needs of a society that continues to grow older and older. With that said, while the country may be able to provide care for the ever-increasing proportion of elderly people in its society, its overall population decline shows no signs of stopping. Japan's population is expected to decrease from its current approximately 126 million people to around or below 100 million by the year 2050 (Statistical 2017). And as far out as 2100, United Nations estimates show Japan's population dipping down even further to 85 million unless it begins taking drastic steps now to address its aging population crisis (United Nations 2019). This precipitous drop down to two-thirds of its current population in the span of

less than a century will wreak havoc on the nation's economy, and its impact will be felt across all areas of society (厚生労働省 2014). Some major examples of this are most likely to include but are not limited to the following: stunted economic growth or even decline, unhealthy fluctuations in inflation rates, a straining of the government's ability to provide adequate social and medical resources for elderly people, changes in the responsibilities and functioning of the family (often manifesting in the form of increased stress placed on younger members to care for elder members, as the latter grow in number while the former decline), and shifting practices of work and retirement (Vlandas 2018).

If Japan wants to both manage its growing elderly population and mitigate the damage said aging population will cause on all aspects of its society, then the generally agreed upon changes the country needs to make are in regards to its outdated policies on immigration that are highly restrictive to foreigners (Milly 2020). Otherwise, those will continue to contribute to Japan's increasing annual healthcare expenditures and will place further unneeded economic strain on its rapidly dwindling working age population.

On the other hand, despite making strides in recent years to improve the baseline quality and accessibility of its healthcare, it is difficult to see China navigating these waters without some rough waves in the short term. Much of this is due to the fact that the country's aging has occurred prematurely, and thus it has not yet had the chance to put into place the infrastructure needed to attain neither healthcare quality nor health outcomes even close to being on par with that of Japan or even most developed nations (Kong 2019). China needs more time to prepare but simply does not have it. The other main problem China will face in the short term is a simple but daunting one - its sheer population size. Even at the country's current level of population aging of around 11 percent of its 1.4 billion people, China already possesses more total elderly persons

than the entire population of Japan, whose population currently sits at approximately 126 million people (United Nations 2019). This vast discrepancy alone is enough to cause China significant issues and increase its healthcare spending, especially when coupled with the consideration that its current healthcare system is marred by unequal access and quality based on geographical location (Cheng 2019; Shi 2018; Sun 2020; Zou 2020). And this all is on top of an old-age pension system that is in need of urgent reform, lest it collapse (Jiang 2016). Unless it can cut back on costs while simultaneously greatly bolstering its healthcare infrastructure, a task essentially impossible due to its very nature, China will continue to see its healthcare spending as a percentage of its GDP rise for the foreseeable future.

With all that money being spent on healthcare and medical systems for the elderly every year, there exists a very real potential for healthcare expenditures to crowd out spending in other sectors of the economy, likely to those sectors' detriment (Ishikawa 2019; Williams 2019). As the needs of a country's greying population continue to grow, that impact will be felt most acutely on the healthcare sector itself, necessitating further spending increases, which will take away money that could be spent, and in some cases may need to be spent, on sectors such as infrastructure. The effects of this will be compounded by the dwindling working age population, the process of which both contributes to and is in some ways a product of slowing or even negative GDP growth rates (Feng et al. 2014; Nie 2016). Relating to that, while China's GDP growth is projected to slow by mid century, it is expected that Japan will see negative GDP growth rates year over year by as early as 2030 (Yasutake 2012). The takeaway from all of this is that money will be spread more thinly than ever in recent memory as the related forces mentioned above combine to exert massive strain on the declining working age populations, and thus the financial backbones, of each country's economy, particularly in the case of Japan.

However, China may have more to worry about in the long run if the nation does not utilize its current time wisely. Otherwise, the country will be dealing with all the near future consequences described above that are at this point almost certain and unavoidable for Japan, except simultaneously on a vastly larger population scale and with much less developed healthcare infrastructure. If China does not learn from Japan's example, then, at the risk of sounding alarmist, the resulting crisis could prove catastrophic for the large East Asian nation. On top of the expected major increases in healthcare expenditures yearly, this could see the complete crumbling of the already buckling pension system, which would leave hundreds of millions of elderly Chinese without a financial safety net. Failure to rectify this, coupled with gaps in coverage, would lead to untimely deaths, especially in China's less developed, rural areas (Cheng 2019; Nie 2020). Urban areas would also struggle, as the population crisis continues to exacerbate the 4-2-1 phenomenon and place further economic burden upon China's younger cohorts (Jiang 2011). Luckily, the country does have time on its side, at least more so than Japan, but it still needs to act now.

Furthermore, it needs to do more than just its current three child policy, which, should it be successful, would help alleviate some of the strain placed on China's working age population, and as an extension its splintering pension system propped up by said cohorts, by supplementing it with more young people (Roser 2013). Even so, the three child policy alone would almost surely not be enough to act as a full course correction for China's artificially accelerated demographic transition, as population aging is just not a simple enough issue to be solved with a magic bullet type of policy (Feng et al. 2014). On top of that, if history should serve as any guide, said policy is unlikely to do much at all in the face of such a pervasive crisis (Jowett

1991). More fundamental change needs to occur at the societal level in both China and Japan if they truly wish to tackle population aging head on.

In the case of the latter, this would mean Japan loosening its notoriously strict immigration policies and submitting to the ideas of a future Japan that is not ethnically homogenous, a feat that may only occur in dire circumstances, at which time much of the preventable damage would have already been done (Milly 2020). Still, it is vital that they strive to do so regardless. The Japanese government is presently enacting some minor measures to combat population aging, such as campaigns encouraging young Japanese people to simply have more sex, given that the country has some of the lowest intimacy rates in the world, and even policies that pay women in certain prefectures per baby beared and provide them with free daycare services and subsidized preschool (“Tackling” 2020). However, experts agree that these efforts will not be nearly enough to address Japan’s continually worsening aging crisis, instead pointing to a complete reform of the nation’s immigration policies as its best bet (Milly 2020).

Long-term Impacts

Regardless of what happens with China and Japan’s respective population aging crises, given my new empirical data, we are more informed on the various potential outcomes than before. The results also grant enhanced validity and an understanding of the relationship between population aging and healthcare expenditures, and it reaches a similar conclusion on that relationship as seen in the Milena article on Italy that also found that healthcare expenditures are more closely correlated with population aging itself, rather than other similar metrics such as life expectancy or GDP per capita (Milena 2017). Similarly, this refutes the claims made by de

Meijer and Williams that healthcare expenditures are primarily tied to price changes and technological developments in the healthcare fields (de Meijer et al. 2013; Williams et al. 2019).

Though this study places special emphasis on population greying in China and Japan, the implications of my findings are more broadly applicable to the rest of the world's nations that are facing the same issue. This is true because, population aging is a natural demographic phenomenon that will eventually impact every country on Earth assuming they continue to develop and progress through their demographic transition stages in a similar manner to post-industrial nations such as the United States, much of Europe, and of course Japan (Roser 2013).

China offers a blueprint for larger scale population aging, which will be important for some of the world's most populous countries that are still seeing substantial population growth, such as India, Indonesia, Pakistan, Nigeria, etc., once they reach a higher level of development. With that said, the circumstances of both China and Japan act as cautionary tales for the rest of the world. And given that it is the single most extreme example of population aging in the world, Japan in particular offers a glimpse into uncharted waters. It would be of great benefit to the world to learn from their examples, both in terms of how they arrived at their current situation, what they have done wrong, and what they have done right. It is equally important to examine both of these elements in order to stave off and then mitigate the most drastic potential consequences of population aging. I say stave off and then mitigate because, in light of all the research done on population aging up until this point, there exists no evidence to suggest that population aging can be completely avoided (Roser 2013). The world must realize this and begin to develop strategies and enact plans now in order to be adequately prepared for the inevitable.

The hope is that this way countries can better manage the population aging phenomenon and lessen the severity of its impact on all facets of society.

As we know from connecting the extant literature with my quantitative analysis, this means heavily bolstering healthcare infrastructure, not just in scope of access to coverage, but also in specialized areas of medical care as well (Ishikawa 2019). In addressing the most pressing among them, healthcare systems need to focus their efforts on developing and acquiring the resources for more robust long-term care treatment and facilities, as well as looking at ways to most efficiently and effectively manage cases of multimorbidity and chronic illness that are so common in elderly populations (Lehnert 2011). As seen in the Marengoni study in Germany and others, an increase in the proportion of elderly persons that make up a population is very closely associated with multimorbidity, and the authors conclude that it leads to increased personal healthcare costs as well as health service consumption (Marengoni et al. 2011). This supports my empirical findings because it further shows that countries are not spending more on healthcare due to their higher GDP per capita measures. Rather, they are spending more on healthcare because their populations are getting older and require more advanced and comprehensive treatment. This also gives us a causal link between healthcare expenditures and multimorbidity.

On that note, chronic illness is another trend that emerged from the extant literature, and it too supports the conclusion that population aging is driving an increase in healthcare expenditures both around the world and in China and Japan specifically, in part because the literature heavily suggests that an increased prevalence of chronic illness itself is a main component of population greying. This was noted most clearly in the Graves and Zheng studies that looked at the relationship between chronic illness and direct healthcare costs in Australia, another aging society. Graves notes, “As the elderly population grows, costs are likely to rise

unless cost-effective intervention strategies are implemented as a matter of routine” (Graves 2014). This ties together with the need for long-term care resources, since chronic illnesses are by definition not something that can be as easily treated and permanently dealt with like a simple cut or a scrape. Instead, they are much more complex issues that persist for long periods of time, necessitating massive investment in both cost reduction strategies in addition to long-term care facilities that are better equipped to treat and manage chronic conditions (Chen 2018; Marengoni et al. 2011).

Next I want to address the red herring effect that popped up in the extant literature. This is a hypothesis that describes a perceived overstated emphasis on population aging as a driver for increased medical costs. However, the validity of said argument is contested among scholars. Though authors such as Hyun point to aging not being as important as some make it out to be when discussing rising healthcare expenditures, my study provides a different perspective (Hyun et al. 2016). The literature in conjunction with my findings makes it abundantly clear that population aging is a significant driver of total healthcare expenditures. And more specifically, it reveals the various facets of the population aging phenomenon itself that contribute most to that impact of healthcare costs, being the aforementioned increase in chronic illnesses, multimorbidity, and the need for better long-term care. These health complications are, much more often than not, inherently *elderly* issues that just develop naturally with age. Thus, when viewed on a larger societal scale, it is clear to see that these issues that primarily exist in the oldest cohorts of any given population are causing healthcare expenditures to rise in tandem with an increase in prevalence of said health complications. This points to the red herring effect being a false hypothesis, and in general the findings of this study support the idea that such a fixation on the questionable at best validity of the red herring effect obscures the need for meaningful

policy change to combat the intertwined and very real threats of population aging and rising healthcare costs, with Breyer claiming that the bulk of studies on the red herring effect are inconclusive at best anyway (Breyer 2020). Dealing with the causal mechanisms should be the main focus.

In terms of the human impact of those causal mechanisms, there are researchers out there looking to prevent or at the very least delay the onset of chronic illnesses and instances of multimorbidity, as those types of diseases, such as Alzheimer's and Parkinson's, often have severe complications and contribute to a significant erosion of a person's autonomy and quality of life (Takechi 2019). However, treatments for many of these chronic illnesses are still on the cutting edge of medical science and have not reached the point to where they can be implemented practically, which is why the pursuit of delayment methods is so vital to countries grappling with population greying (Takechi 2019). The extension of an elderly person's healthy years before they pass away is not only important for improving their quality of life, but it also has the added benefit of delaying the onset of expensive healthcare cost increases as well. The healthier countries' healthcare systems can make elderly people and the longer they can keep them that way, the less money countries will have to spend in the long run. All of this is to say that upstream prevention and delayment methods are just as important as downstream mitigation and management efforts.

Additionally, an important fact that countries need to realize is that a comparatively small increase in healthcare spending in the present can eliminate the need for a dramatic increase in the future because newly aging nations will be better prepared from the start. Otherwise there will be instances in which countries end up looking like present day Japan, which by comparison, had no pre-existing guide to look towards for help. With that said, they should also

be wary of making too radical of changes in short periods of time, lest they do as China did, overcorrecting for population growth and ending up thrusting themselves prematurely into being an aging society.

Chapter 6: Conclusion

This study set out to examine the population aging phenomenon and its impact on healthcare costs, as well as what aspects of population greying appear to be contributing to the trend of rising annual total healthcare expenditures. The most important finding is that population aging does indeed have a major impact on healthcare costs. However, the simplicity of the above statement belies the all-encompassing nature of this societal issue. It is impossible to overstate the gravity of the situation for both already advanced aging countries like Japan as well as countries in the beginning stages of population aging like China. In the latter's case, this is especially true given its unique situation as being comparatively underdeveloped for its current level of aging due to poor political planning (Kong 2019).

Furthermore, while this study puts China and Japan in the spotlight and uses them as least similar pairs, the primary purpose of undertaking this research task was to look at their results, extract major trends and observations, and apply those to test a broader theory on the relationship between the population aging phenomenon and healthcare expenditures. It was vital for these results to be generalizable to other places in the world because it not only allows for us to be more informed about the issue on a macro level, but it also functions as a blueprint from which other countries can learn. After all, population aging will impact all nations at some point in their futures, regardless of how far along they currently are in terms of demographic transition and level of overall development (Roser 2013).

In terms of the most important findings and takeaways from this study, there are multiple. First and foremost, the qualitative analysis showed definitively that population aging is a major contributor to increasing healthcare expenditures in both statistical significance and order of magnitude. Even when controlling for GDP per capita in the linear regression analyses, this relationship held true and showed that GDP per capita does in fact not possess a statistically significant influence on annual total healthcare expenditures. This was the case when looking at both all countries in the world as well as China and Japan specifically.

What is more, the quantitative findings lend credence to the major trends found in the theoretical framework derived from the extant literature regarding potential causal mechanisms driving population aging. In light of the empirical evidence of this study in conjunction with the work done by other researchers on the subject, we can reasonably conclude that the following specific, interrelated aspects of population aging are contributing most to its effect on healthcare expenditures: increased prevalence of multimorbidity, chronic illnesses, and the need for long-term care infrastructure and programs. These three side effects of population aging are responsible for the majority of aging's impact on medical costs (Graves 2014; Jin et al. 2020; Lehnert 2011; Marengoni et al. 2011). This also disproves the red herring effect theory seen in the extant literature, with my findings instead providing much evidence to support not just the association between the study's two main variables, but more importantly the causal relationship that links them.

With that said, one limitation of this study is that, no matter how heavily suggested it may be, it is very difficult to declare the existence of a complete causal relationship due to the complex nature of the issue being studied. Population aging and healthcare expenditures are both intertwined with so many other factors that it is impossible to completely rule out the possibility

that there is some other variable out there that is resulting in spuriousness. That is simply the nature of research like this and is a limitation that should always be mentioned, despite how miniscule and improbable of a chance it may be. However, I do want to stress that the results of my study make it very, very unlikely that such a spurious correlation exists, and I want to re-emphasize the high level of validity present in my findings. I am given no reason to believe that there are any outlying spurious variables accounting for the strong correlation between population aging and total annual healthcare expenditures.

One last thing that warrants discussion is the impact of the COVID-19 pandemic on healthcare expenditures. While this study used data collected prior to the onset of the pandemic, COVID-19 could have a short-term impact on current and near-future healthcare spending globally. There are multiple reasons to suspect this. First and most obviously, more people have required urgent medical care over the past year and a half, with hospitals worldwide facing issues of overcrowding, particularly before the creation and distribution of the vaccine. This points to a potential spike in healthcare expenditures. However, another side of this situation is that the virus is most deadly when it affects elderly people, who often pass away relatively quickly following infection, which could mean that healthcare spending might not increase as much as expected.

The last unknown factor is the prevalence of long COVID and how the increased medical needs of those afflicted with it may impact spending on long-term care. This will likely look different depending on how well a country has weathered the pandemic, with places like Japan and China having fared relatively well, while countries such as France and Italy have experienced a large number of deaths related to COVID-19, mostly in the elder cohorts (Coronavirus 2021). Except for China, all the countries just mentioned have world-class healthcare systems, but their levels of population aging likely made it difficult to mitigate deaths

during the pandemic, particularly in Italy, which experienced one of the earliest and most severe outbreaks (Coronavirus 2021). It is then reasonable to assume that Japan, a nation similarly advanced in its level of population aging, would have experienced comparable misfortune. In fact, the Japanese government was very worried at the onset of the pandemic about the potential strain their aging population would place on the country's healthcare system, and yet Japan has navigated the pandemic quite well overall, even pulling off the Olympics without much issue (Coronavirus 2021). Aside from the strict measures the Japanese government took to control the spread of the virus early on, this could also be related to the simple but overlooked fact that, unlike people here in America for example, Japanese people have for decades been wearing masks in public whenever they get sick. As a result, it has become a normalized part of their society, which is also known for prioritizing the wellbeing of the community over that of the individual. This is in contrast to the hyper-individualism seen in the United States and certain other countries that can often result in the prioritization of peoples' personal rights at the expense of the broader population's well being, which is to say that there is likely a cultural aspect at play here as well. Regardless, all of this is purely speculative, but it is worth keeping in mind for future research in the areas of population aging and healthcare spending.

In summation, population aging is one of the most serious issues facing more developed nations today, and it will become a similar threat to currently less developed nations in the future. Chief among these potential impacts is a drastic increase in healthcare expenditures. There exists a debate within the extant literature on the subject of to what extent aging impacts medical spendings and in what ways that relationship manifests. This study adds to the existing body of work on population aging by showing that there is a clear, strong, and statistically significant relationship between the two variables. And when viewed together with the main theoretical

trends found in the literature, the results support established, prevailing notions as to what exactly about population aging makes it such a large contributor to increased healthcare costs.

Zooming out a bit, the high level of generalizability of the least similar pair of China and Japan make their situations quite useful from a learning perspective for other nations around the world that are either already grappling with population aging or still have it looming in the distance. In either case, steps based on what is happening in China and Japan can be taken now in other nations to alleviate the worst impacts of population aging and the logistical and economic strains it places on a given country's healthcare system. The results of this study illuminate intricacies of the relationship between population aging and total healthcare expenditures, test and support conclusions seen in the extant literature regarding the causal nature of said relationship, serve as a guide for other aging countries, and allow us to be more informed about the issue going forward, all of which are beneficial in combating this major societal issue. Population aging is inevitable, but with the right actions taken and preparations put in place, its worst consequences are certainly able to be avoided and the rest of its impact managed.

Bibliography

- Aaron, Henry J. 2009. "What Drives Health Care Spending? Can We Know Whether Population Aging Is A 'Red Herring'?" No. wp2009-18. Center for Retirement Research, 2009.
- Arai, H., Ouchi, Y., Toba, K., Endo, T., Shimokado, K., Tsubota, K., Matsuo, S., Mori, H., Yumura, W., Yokode, M., Rakugi, H., & Ohshima, S. 2015. "Japan as the front-runner of super-aged societies: Perspectives from medicine and medical care in Japan." *Geriatrics & Gerontology International*, 15(6), 673–687.
<https://doi-org.umiss.idm.oclc.org/10.1111/ggi.12450>.
- Breyer, Friedrich, and Normann Lorenz. 2020. "The 'red herring' after 20 years: ageing and health care expenditures." 1-7.
- Chen Feinian, Yang Yang, and Liu Guangya. 2010. "Social Change and Socioeconomic Disparities in Health over the Life Course in China: A Cohort Analysis." *American Sociological Review* 75 (1): 126–50. [doi:10.1177/0003122409359165](https://doi.org/10.1177/0003122409359165).
- Chen, He, Yao Chen, and Bin Cui. 2018. "The Association Of Multimorbidity with Healthcare Expenditure among the Elderly Patients in Beijing, China." *Archives of Gerontology and Geriatrics* 79: 32–38. <https://doi.org/10.1016/j.archger.2018.07.008>.

Cheng, Y., Gao, S., Li, S., Zhang, Y., Rosenberg, M. 2019. Understanding the spatial disparities and vulnerability of population aging in China. *Asia & the Pacific Policy Studies*, 6(1):73-89. [doi:10.1002/app5.267](https://doi.org/10.1002/app5.267).

“Coronavirus Cases.” Worldometer, 2021. <https://www.worldometers.info/coronavirus/>.

Feng, X., Poston Jr., DL., Xiao-Tao, W. 2014. China’s One-child Policy and the Changing Family. *Journal of Comparative Family Studies*, 45(1):17-29. [doi:10.3138/jcfs.45.1.17](https://doi.org/10.3138/jcfs.45.1.17).

Global Burden of Disease Health Financing Collaborator Network. Global Health Spending 1995-2016. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2019.

Graves, Nicholas, and Henry Zheng. 2014. “Modelling the Direct Health Care Costs of Chronic Wounds in Australia.” *Wound Practice & Research: Journal of the Australian Wound Management Association* 22(1).

<https://search.informit.org/doi/10.3316/informit.272218893716909>.

Hinton, L, Chen, H. 2016. Introduction to the Special Section: Eldercare in Asia: A Call for Policy Development Beyond Traditional Family Care. *Ageing International*, 41(4):331-334. [doi:10.1007/s12126-016-9273-3](https://doi.org/10.1007/s12126-016-9273-3).

Hyun, Kyung-Rae, Sungwook Kang, and Sunmi Lee. 2016. "Population aging and healthcare expenditure in Korea." *Health economics* 25, no. 10: 1239-1251.

Inoue, J. 2013. Healthcare: The case of Japan. *Migration Letters*, 10(2), 191–209.

<https://doi-org.umiss.idm.oclc.org/10.33182/ml.v10i2.143>.

International Comparison Program, World Bank | World Development Indicators database,
World Bank | Eurostat-OECD PPP Programme 2018.

Ishikawa, T., Nakao, Y., Fujiwara, K., Suzuki, T., Tsuji, S., & Ogasawara, K. 2019. "Forecasting maldistribution of human resources for healthcare and patients in Japan: a utilization-based approach." *BMC Health Services Research*, 19(1), N.PAG.

<https://doi-org.umiss.idm.oclc.org/10.1186/s12913-019-4470-x>.

Jiang, Q, Sánchez-Barricarte, JJ. 2011. "The 4-2-1 family structure in China: a survival analysis based on life tables." *Eur J Ageing*, 8(2):119. [doi:10.1007/s10433-011-0189-1](https://doi.org/10.1007/s10433-011-0189-1).

Jiang, Q, Yang, S, Sánchez-Barricarte, J. 2016. "Can China afford rapid aging?" *SpringerPlus*, 5(1):1-8. [doi:10.1186/s40064-016-2778-0](https://doi.org/10.1186/s40064-016-2778-0).

- Jin, Xueying, Takahiro Mori, Mikiya Sato, Taeko Watanabe, Haruko Noguchi, and Nanako Tamiya. 2020. "Individual and Regional Determinants of Long-Term Care Expenditure in Japan: Evidence from National Long-Term Care Claims." *European Journal of Public Health* 30, no. 5: 873–78. <https://doi.org/10.1093/eurpub/ckaa065>.
- Jing, S., Yutao, G., Xiaoning, W., Qiang, Z. 2016. "mHealth For Aging China: Opportunities and Challenges." *Aging & Disease*, 7(1):1-15. [doi:10.14336/AD.2015.1011](https://doi.org/10.14336/AD.2015.1011).
- Jowett, AJ. 1991. "China: The one, two, three, four and more child policy." *Focus*, 41(2):32.
- Komatsu, H., Yagasaki, K., Kida, H., Eguchi, Y., & Niimura, H. 2018. "Preparing for a paradigm shift in aging populations: listen to the oldest old." *International Journal of Qualitative Studies on Health & Well-Being*, 13(1), 1. <https://doi-org.umiss.idm.oclc.org/10.1080/17482631.2018.1511768>.
- Kong, T., Yang, P. 2019. "Finding the vulnerable among China's elderly: identifying measures for effective policy targeting." *Journal of Aging & Social Policy*, 31(3):271-290. [doi:10.1080/08959420.2018.1485391](https://doi.org/10.1080/08959420.2018.1485391).
- LaFave, Daniel. 2017. "Family Support and Elderly Well-Being in China: Evidence from the China Health and Retirement Longitudinal Study." *Ageing International* 42 (2): 142–158. [doi:10.1007/s12126-016-9268-0](https://doi.org/10.1007/s12126-016-9268-0).

Lehnert, Thomas, et al. 2011. "Review: Health Care Utilization and Costs of Elderly Persons With Multiple Chronic Conditions." *Medical Care Research and Review*, vol. 68 (4): 387–420. [doi:10.1177/1077558711399580](https://doi.org/10.1177/1077558711399580).

Marengoni, A., Angleman, S., Melis, R. Mangialasche, F., Karp, A., Garmen, A., Meinow, B., & Fratiglioni, L. 2011. "Aging with multimorbidity: A systematic review of the literature." *Ageing Research Reviews*, 10(4): 430-439. <https://doi.org/10.1016/j.arr.2011.03.003>.

de Meijer, C., Wouterse, B., Polder, J. et al. 2013. "The effect of population aging on health expenditure growth: a critical review." *Eur J Ageing* 10, 353–361. <https://doi.org/10.1007/s10433-013-0280-x>

Milena Lopreite, Marianna Mauro. 2017. "The effects of population ageing on health care expenditure: A Bayesian VAR analysis using data from Italy". *Health Policy*, Volume 121, Issue 6, p. 663-674, ISSN 0168-8510. <https://doi.org/10.1016/j.healthpol.2017.03.015>.

Milly, Deborah J. 2020. "Japan's Labor Migration Reforms: Breaking With the Past?" [migrationpolicy.org](https://www.migrationpolicy.org). <https://www.migrationpolicy.org/article/japan-labor-migration-reforms-breaking-past>.

Mori, Takahiro, Shota Hamada, Satoru Yoshie, Boyoung Jeon, Xueying Jin, Hideto Takahashi, Katsuya Iijima, Tatsuro Ishizaki, and Nanako Tamiya. 2019. “The Associations of Multimorbidity with the Sum of Annual Medical and Long-Term Care Expenditures in Japan.” *BMC Geriatrics* 19, no. 1.

<https://doi.org/10.1186/s12877-019-1057-7>.

Nagl, A., Witte, J., Hodek, J. et al. 2012. “Relationship between multimorbidity and direct healthcare costs in an advanced elderly population. *Z Gerontol Geriat* 45, 146–154.

<https://doi.org/10.1007/s00391-011-0266-2>

Nargund, G. 2009. “Declining birth rate in Developed Countries: A radical policy re-think is required.” *Facts, views & vision in ObGyn* vol. 1,3: 191-3.

Nie, J.-B. 2016. “Erosion of Eldercare in China: a Socio-Ethical Inquiry in Aging, Elderly Suicide and the Government’s Responsibilities in the Context of the One-Child Policy.” *Ageing International*, 41(4), 350–365.

<https://doi-org.umiss.idm.oclc.org/10.1007/s12126-016-9261-7>

Nishi, Nobuo, Nayu Ikeda, Takehiro Sugiyama, Kayo Kurotani, and Motohiko Miyachi. 2020. “Simulating the Impact of Long-Term Care Prevention among Older Japanese People on Healthcare Costs from 2020 to 2040 Using System Dynamics Modeling.” *Frontiers in Public Health* 8: 926.

<https://doi.org/10.3389/fpubh.2020.592471>.

OECD (2021), Health spending (indicator). [doi: 10.1787/8643de7e-en](https://doi.org/10.1787/8643de7e-en)

Padmadas, SS. 2017. "Two-child policy in China: Rhetoric versus reality." *Annals of Human Biology*, 44(2):97-98. [doi:10.1080/03014460.2016.1177113](https://doi.org/10.1080/03014460.2016.1177113).

Rong, C., Ping, X., Fen, L., Peipei, S. 2018. "Internal migration and regional differences of population aging: An empirical study of 287 cities in China." *BioScience Trends*, 12(2):132-141. [doi:10.5582/bst.2017.01246](https://doi.org/10.5582/bst.2017.01246).

Roser, Max, Hannah Ritchie, and Esteban Ortiz-Ospina. 2013. "World Population Growth." *Our World in Data*. <https://ourworldindata.org/world-population-growth>.

Shi, L. 2018. "Preparing for an 'Insured' Old Age: Insurance Purchase and Self-Support in Old Age in Rural China." *Journal of Cross-Cultural Gerontology*, 33(2):183-195. [doi:10.1007/s10823-018-9348-6](https://doi.org/10.1007/s10823-018-9348-6).

Shimizutani, S. 2014. "The Future of Long-term Care in Japan." *Asia-Pacific Review*, 21(1), 88–119. <https://doi-org.umiss.idm.oclc.org/10.1080/13439006.2014.925199>.

Statistical Handbook of Japan 2017. Statistics Bureau, Ministry of Internal Affairs and Communications, Japan.

Steslicke, W. 1984. "Medical Care for Japan's Aging Population: An Introduction." *Pacific Affairs* 57(1), 45-52. [doi:10.2307/2758384](https://doi.org/10.2307/2758384).

Sun, X., Zhou, M., Huang, L., and Nuse, B. 2020. "Depressive Costs: Medical Expenditures on Depression and Depressive Symptoms Among Rural Elderly in China." *Public Health (Elsevier)*, 181, 141–150. <https://doi-org.umiss.idm.oclc.org/10.1016/j.puhe.2019.12.011>

"Tackling the Declining Birth Rate in Japan." 2020. Centre For Public Impact (CPI).
<https://www.centreforpublicimpact.org/case-study/tackling-declining-birth-rate-japan>.

Takechi, H., Kokuryu, A., Kuzuya, A., & Matsunaga, S. 2019. "Increase in direct social care costs of Alzheimer's disease in Japan depending on dementia severity." *Geriatrics & Gerontology International*, 19(10), 1023–1029.
<https://doi-org.umiss.idm.oclc.org/10.1111/ggi.13764>.

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019 - Special Aggregates, Online Edition. Rev. 1.

Vlandas, Tim. 2018. "Grey Power and the Economy: Aging and Inflation Across Advanced Economies." *Comparative Political Studies* 51, no. 4: 514–52.

<https://doi.org/10.1177/0010414017710261>.

Wang, Harry HX, Jia Ji Wang, Samuel YS Wong, Martin CS Wong, Fang Jian Li, Pei Xi Wang, Zhi Heng Zhou, Chun Yan Zhu, Sian M Griffiths, and Stewart W Mercer. 2014.

"Epidemiology of Multimorbidity in China and Implications for the Healthcare System: Cross-Sectional Survey among 162,464 Community Household Residents in Southern China." *BMC Medicine* 12, no. 1. <https://doi.org/10.1186/s12916-014-0188-0>.

Williams, Gemma, Jonathan Cylus, Tomáš Roubal, Paul Ong, Sarah Barber, and World Health Organization. 2019. "Sustainable health financing with an ageing population: will population ageing lead to uncontrolled health expenditure growth?"

World Bank staff estimates based on age/sex distributions of United Nations Population Division's World Population Prospects: 2019 Revision.

Wu, P., Wu, C., Wu, Y. 2018. "Reforming Path of China's Fertility Policy in Stabilizing Demographic Dividends Perspective." *Social Indicators Research*, 137(3):1225-1243.

[doi:10.1007/s11205-017-1642-0](https://doi.org/10.1007/s11205-017-1642-0).

Yasutake, T. 2012. "Global Japan: 2050 simulations and strategies."

<https://www.nippon.com/en/features/h00011/>.

Zhang, Q-E., Ng, CH., Ungvari, GS., Van, I-K., Wang, G., Xiang, Y-T. 2019. "Mental Health-Care Delivery for Older People in China: An Update of Challenges and Recent Clinical Research." *Journal of Geriatric Psychiatry & Neurology*, 32(6):287-290.

[doi:10.1177/0891988719865345](https://doi.org/10.1177/0891988719865345).

Zhao, Yang, Puhong Zhang, Brian Oldenburg, Teresa Hall, Shurong Lu, Tilahun Nigatu Haregu, and Li He. 2020. "The Impact of Mental and Physical Multimorbidity on Healthcare Utilization and Health Spending in China: A Nationwide Longitudinal Population-Based Study." *International Journal of Geriatric Psychiatry* 36, no. 4: 500–510.

<https://doi.org/10.1002/gps.5445>.

Zhao, Yaohui, John Strauss, Xinxin Chen, Yafeng Wang, Jinquan Gong, Qin-qin Meng, Gewei

Wang, Huali Wang. 2020. China Health and Retirement Longitudinal Study Wave 4

User's Guide, National School of Development, Peking University.

Zou, X., Nie, J., and Fitzgerald, R. 2020. "Wei-qu, Structural Injustice and Caring for Sick Older People in Rural Chinese Families: An Empirical Ethical Study." *Bioethics*, 34(6), 593–

601. <https://doi-org.umiss.idm.oclc.org/10.1111/bioe.12753>.

国家卫生健康委. 2021. 《全国第六次卫生服务统计调查报告》 [The Sixth National Health Service Statistical Survey released]. https://www.sohu.com/a/447402635_100167061.

信夫 池田. 2010. “失われた30年”に向かう日本” [Japan heading for the “lost 30 years”].

ニューズウィーク日本版.

<https://www.newsweekjapan.jp/column/ikeda/2010/12/20-3.php>.

厚生労働省. 2014. 「平成24年国民健康・栄養調査報告」. [The National Health and Nutrition Survey in Japan, 2012]. 健康局がん対策・健康増進課 栄養指導室.

<https://www.mhlw.go.jp/bunya/kenkou/eiyuu/h24-houkoku.html>.