How Much Will Health Coverage Cost? Future Health Spending Scenarios in Brazil, Chile, and Mexico

Amanda Glassman and Juan Ignacio Zoloa

Abstract

As Latin American countries seek to expand the coverage and benefits provided by their health systems under a global drive for universal health coverage (UHC), decisions taken today –whether by government or individuals- will have an impact tomorrow on public spending requirements. To understand the implications of these decisions and define needed policy reforms, this paper calculates long-term projections for public spending on health in three countries, analyzing different scenarios related to population, risk factors, labor market participation, and technological growth. In addition, the paper simulates the effects of different policy options and their potential knock-on effects on health expenditure.

Without reforms aimed at expanding policies and programs to prevent disease and enhancing the efficiency of health systems, we find that health spending will likely grow considerably in the not-distant future. These projected increases in health spending may not be a critical situation if revenues and productivity of other areas of the economy maintain their historical trends. However, if revenues do not continue to grow, keeping the share of GDP spent on health constant despite growing demand will certainly affect the quality of and access to health services.

Long-term fiscal projections are an essential component of planning for sustainable expansions of health coverage in Latin America.

JEL Codes: O23, I15, I180

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Introduction

In the last few decades, public spending in the social sectors in Latin American countries (LAC) has grown significantly. According to ECLAC (2012), the region spent $461 per capita (2005 dollars) on average around 1990 compared to $1,026 per capita by 2010. Public spending on health, education, and social protection increased from 11.2% of GDP in 1990 to 18.6% of GDP in 2010.

This growth can be explained by several factors. Some are structural—such as the aging of the population, urbanization, and the increasing availability of advanced medical technologies and new drugs—which are independent of public policy, while others are policy-related such as decisions relating to eligible populations, interventions and products to be covered by public subsidy.

Most LAC will have a rapidly aging population over the next half century. This should be a source of concern for policymakers for two main reasons: first, revenue growth may be more difficult to achieve in countries with older populations, and second, satisfying the needs of a large number of elderly can be difficult, particularly in low- and middle-income countries. In addition, middle and lower-income countries have invested less in prevention and provide suboptimal quality of care, and as a result, chronic diseases will generate more disability at earlier ages than in high-income countries, aggravating the problem. Aging –in combination with successful reduction of infectious disease incidence- has also driven a concentration of disease burden in non-communicable diseases, which require long and costly treatments.

Another part of the increased public expenditure can be attributed to the adoption of new technologies. Some medical technology advances can lead to increased productivity, shorter hospital stays, or delay in onset of symptoms. However, medical innovations that expand benefits to the consumer ultimately increase health spending because they are more expensive, in order to justify high research and development costs.

These factors, along with others, will cause health care costs to take up a growing share of GDP. The exact share of GDP will depend on the rate at which the economy grows as well as decisions made about taxation, borrowing, and public spending priorities. To understand the impact of these trends on spending and the economy, it is important to dimension and analyze the consequences of a continuous increase in spending and the options available to meet those requirements.

The goal of this paper is to develop projections of fiscal trends for health systems in Latin America. The paper focuses on three countries[1] for which there is health information available at the individual country level: Brazil, Chile, and Mexico, and includes trends in expenditure as a result of changes to population, risk factors, socioeconomic characteristics[2], and technological growth. In addition, the paper explores the effects of policy options and their potential knock-on effects on health expenditure. With this focus, the paper can contribute to a public debate on critical issues that will affect all citizens.

Much of the work done on long-term projections in Latin America has focused on pensions, such as the impact of demography on the sustainability of pension systems and the possibility of a universal flat pension that guarantees a minimum standard of living. This same concept can be extended to other social issues, such as achieving universal health coverage. Several countries are experiencing or moving towards a health financing transition, from a system in which health spending is low and predominantly out-of-pocket to one characterized by much higher, mostly pooled spending on health (Savedoff et al., 2012). Yet the success of these initiatives and their impact on health will depend on anticipating and managing the fiscal requirements.

The paper is organized as follows. First, we introduce the importance of long-term fiscal projections and discuss the different available methods to project health spending in section two. The third section reviews the literature on long-term projections in Latin American countries. The fourth section explores the drivers of health spending. In the fifth section, we present the methodology used, and section six describes the results of our analyses. Finally, sections seven and eight discuss the policy implications and recommendations and conclusions, respectively.

1. Importance of using long-term fiscal projections

Although the use of the long-term fiscal projections is not yet pervasive in public policy, these projections are useful tools to identify future challenges and inter-temporal inconsistencies in public finance. Long-term analyses are useful for modeling future expenditure on a number of explicit factors such as demographics, health, education, as well as macroeconomic factors. They are also valuable for governments to respond to current fiscal pressures and risks in a gradual manner, and to contribute to future

[1] While tempting to make comparisons across the considered countries, these estimates are not completely comparable because of differences in data quality and availability. Household surveys phrase questions differently, and the disaggregated data available by disease, cost and public expenditure are also different in each country.

[2] As smoking, alcohol use, sedentarism, access to education and health insurance and formal labor participation.

governments to understand and manage future fiscal pressures. Projections also serve as a baseline to compare the sustainability of current policies over time.

While these projections are considered best practice for social policy, government budgets, and fiscal transparency, their use has been limited to a small number of industrialized countries. In Latin America, analysis has been limited to ad hoc studies of pension systems. However, there is a growing literature examining population issues from a broader perspective and including some work in developing countries (Cotlear, 2011; IMF, 2012; OECD, 2013).

Growth of health spending and its long-term sustainability have become important issues on the political agenda of Latin American countries, since continuous growth of public spending puts pressure on the budget, provision of health care, and household spending. Without additional resources, options include accepting a decline in the quality of services, a decline in the number of interventions or diseases covered, or a change in the balance between what is funded through the national budget and what people pay out-of-pocket.

The solution to this problem depends on the role that society assigns to the state and how this balance is maintained over time. Are people willing to continue paying the current level of taxes or a greater one in order to adequately fund medical services? Will the government be able to increase borrowing to ensure the sustainability of valuable services? Some countries have succeeded in providing universal health coverage in response to widespread and persistent social pressures. However, in other countries, policymakers anticipate a backlash against the role of the state, since some believe that individuals should take more fiscal responsibility for services currently funded with public funds. These are difficult but inescapable questions.

To contribute to the public debate, policy options should include quantification of both the upside and downside of each scenario; consider the magnitude of impact on taxes and debt; and analyze the impact on equity in access to health.

2. Methods for projecting future spending

There are several modeling approaches to project health expenditure. Approaches differ by the type of data used, such as household data versus macroeconomic aggregate data. Some work uses cross-sectional techniques, while others use time series techniques. The OECD (2012) conducted a review of approaches for planning and forecasting health expenditures and identified three basic projection methods, and this section explores each:

- Macro level models
- Component based models
- Microsimulation models

2.1 Macro level models

Macro models focus mainly on aggregate data, analyzed based on the econometric estimation of historical trends in spending which is extrapolated for the coming years. These projections can be reasonably accurate in the short term but much less so in the long term.

Computed General Equilibrium (CGE) models are a type of macro model that adopt a global perspective. They estimate the global impact (and interactions) of changes in spending on health and social care by modeling the entire economy. The CMS Dynamic CGE Model, for example, represents the US economy as being composed of two markets, health and non-health products, for which aggregate supply and demand are modeled. From the demand side point of view, individuals are assumed to maximize their welfare through the consumption of both types of products, subject to their income and savings. From the supply side point of view, this CGE model assumes that both medical and non-medical firms maximize profits and that their profits depend on capital and labor costs and tax rates. The model allows for feedback from consumers and producers to rising levels of medical care expenditures, and therefore respond to levels of expenditure that negatively affect consumer welfare. CGE models depend on assumptions of equilibrium that may not account for observed trends and rely on assumptions that simplify the behavior of individuals, firms, and governments.

2.2 Component based models

Component based models include a large variety of forecasting models that analyze expenditure in terms of financing agents, providers, goods, and services consumed by groups of individuals or by a combination of these groups.

An important subclass of component-based models are cohort-based models. In cohort-based models, individuals are grouped into cells according to several key attributes. Typically, age and gender are the principal criteria used to stratify the population of interest.

These models have been very common over the years due to a number of advantages. First, implementation and maintenance of the model is usually simple and relatively inexpensive, because they can be developed in an interactive spreadsheet, requiring a limited amount of data that generally includes only a few parameters. Many of these parameters can be found in the literature, rather than be estimated. Secondly, the impact of policy changes can be assessed easily by simply modifying the policy parameters (Ringel et al., 2010). These models tend to be less demanding on data than micro-simulation models.

A simple version of component-based models typically use health expenditure estimates broken down into major spending categories and age classes. The data is generally available and often cover a relatively long time span. For example, demographic projections are often regularly produced and updated. However, the development of more sophisticated versions of the component-based models could require additional information, such as health spending broken down by gender and disease categories, by descendent and survivor status or by end-of-life costs. When national data is not available, researchers use partial information or information from another country, assuming that the same trends apply. For example, Wanless (2002) uses Scottish data that link records of hospitals with death records and assumes the results would be representative of all of the UK.

2.3 Microsimulation models

In microsimulation models, the unit of analysis is the individual and the models take into account several characteristics, such as age, gender, and geographic location. Behaviors are simulated to reflect events, such as the aging process. These models can be used to project total health spending but are often also used to model the process and outcome of various policy options in health care.

For example, the Population Health Model (POHEM), a dynamic microsimulation model developed by Statistics Canada, projects the potential future health, health care utilization, and health expenditure outcomes of leading chronic diseases[3]. It has been used to evaluate the possible impact on acute-care and home-care costs of an outpatient and early discharge strategy for breast cancer surgery patients, as well as the prospective impacts of new drugs and cancer screening.

Microsimulation models reproduce the characteristics and behavior of a population of interest from a large sample. The simulations can incorporate events such as pregnancy and birth; risk factors such as hypertension, cholesterol, smoking status, and changes in weight; and the burden and progression of diseases such as cancer, diabetes, and heart

[3] Statistics Canada (2014). Health Models. www.statcan.gc.ca/microsimulation/health-sante/health-sante-eng.htm (accessed April, 2014).

disease. In micro-dynamic models, certain characteristics and behaviors can evolve over time. Events compete to occur in each simulated life and a random component in the model ensures that not all individuals with the probability of experiencing an event actually will. Individual life trajectories are simulated until death. Costs can be assigned to interventions associated with the life events that have been simulated to project a future trend in health spending.

Microsimulation models require large amounts of data to effectively assemble a representative sample, must include all relevant features, and be based on sophisticated understanding and quantification of individuals' behavior and reactions to the policy variables analyzed.

Micro-dynamics simulation requires the design of realistic behaviors for all of the individuals. Degrees of responses that individuals may have to changes in an external variable (elasticities) may be estimated through econometric regressions based on the individual's past experiences and choices or may be taken from a review of the health and economic literature (Ringel et al., 2010).

This section presented several classes of models—macro models, component based models, and microsimulation models—that can be used for health spending projections. Each class is best suited to respond to a different set of questions. For example, if the policy question concerns the impact of health spending in the very short term, macro models are the best option. However, if a medium-term forecast of health expenditures is needed, models that take the influence of demographic variables may be most suitable. Nevertheless, if the policy question that arises is a long-term strategic issue, where there is a strong need to understand the interactions among individuals to assess a dynamic risk or to evaluate the epidemiological transition of the population, then the micro-simulation models are the best methods to be used (Anderson et al., 2007).

3. Review of the literature on health spending projections for Latin America

Although most previously published literature on health spending projections involves developed and OECD countries, some work has included middle income countries such as Brazil, China, India, Indonesia, Russia, and South Africa(OECD 2013). A small literature analyzing future health spending in LAC is also emerging. However, most of the work involving Latin America is based on macro models, which are not the best method to understand the interactions among individuals and to evaluate the population's epidemiological transition.

This section reviews two relevant papers on expenditure projections in LAC: Cotlear (2011) and IMF (2012).

Miller et al in Cotlear (2011) analyzes the fiscal impact of demographic change on public expenditure on education, health, and pensions in 10 LAC. Health spending is expressed as the product of cost of benefits per participant, the participation rate, and the dependency ratio represented by the following formula:

$$\frac{Expenditure}{GDP} = \text{benefits cost per participant} * \text{Participation rate} * \text{Demographic dependency ratio}$$

More specifically, expenditure as a proportion of GDP can be expressed as:

$$\frac{HE}{Y} = \left[\left(\frac{E}{Y}\right)\Big/\left(\frac{Y}{W}\right)\right] * \left[\frac{P}{B}\right] * \left[\frac{B}{W}\right]$$

Where E = aggregate expenditures, Y = GDP,P= participants (e.g., cancer patients), W = working age population (20-64 years), and B = population at risk of disease (e.g., population at risk of cancer).The dependency ratio is defined by the number of people close to death divided by the working age population.

The authors generate a measure of the contribution of political economy considerations called the benefit generosity ratio (BGR), which is the product of two policy variables—the participation rate and benefits per participant. In other words, it is the relative cost of benefits per person at risk. BGR measures the generosity of the health care benefits in each country relative to the average productivity of the working-age population. The BGR can be thought of as the fraction of the average worker's income that is consumed by the average person who is in the appropriate age range for consuming health care.

In Miller et al. (2011), aggregated public health spending is derived from the National Transfer Accounts (NTA 2009) of each respective country.[4]Health sector dependency ratios are calculated based on the CELADE (2009) population estimates. In order to estimate the number of people close to death in the population, the number of annual deaths is multiplied by 10, the number of years of projection.

[4] The paper uses internationally comparable estimates of the receipt of age-specific public benefits in health care for five of the countries; data were collected as part of the National Transfers Account project for Brazil, Chile, Costa Rica, Mexico and Uruguay. The age-specific benefits for the other five countries (Argentina, Colombia, Cuba, Nicaragua, and Peru) are illustrative and based on patterns present in the NTA countries.

Finally, health spending projections are made through estimates of demographic dependency ratio, assuming different rates of participation and earnings per participant.

The results of the study show that if there are no changes in the levels of generosity of benefits, in 2050 the aging population will bring a moderate increase—1.5% of GDP—in health expenditures in all the countries of the region. The richer societies become, the more they spend on health. In such a scenario, health expenditure would increase by 4.3% of GDP in 2050. In Brazil, demographic changes will generate an increase in spending of 1.5% of GDP, while for Mexico this Figure is 1.1% of GDP and Chile is less than one percent. In contrast, in a scenario where there are changes in the age structure, the results show an expenditure increase of 4.1% of GDP in Brazil, 3.2%inMexico, and 2.7% in Chile.

The weakness of the methodology described above is that several factors remain constant, such as the benefits per participant, and second, it omits several important drivers of health spending. In addition, neither the cost of treatment of each disease nor the epidemiological pattern is explicitly taken into account. The model assumes no change either in the cost of treatment of each disease or in the technological progress which literature highlighted as one of the most important causes in the increase of health expenditure in the last few decades (Xu et al., 2011; CBO, 2008; OECD, 2006; OECD 2013).

The IMF (2012) uses the Excess Cost Growth (ECG) approach to project health spending. The authors define ECG as the excess growth in health spending in real per capita terms over the real GDP per capita growth after controlling for the effect of demographic changes. ECG is an indication of a sector that is increasing its size in relation to the rest of the economy. By definition, a sector whose growth rate is higher than GDP increases its participation in the whole country's economy.

The determinants considered relevant to health spending are: income, demographic composition, technology, and other factors that may vary across countries, such as climate and diet. Each country's health system determines how these factors are transferred to public spending.

The model is expressed formally as follows:

$$Log\left(\frac{h_{i,t+1}}{h_{i,t}}\right) = \beta_0 + \beta_1 log\left(\frac{g_{i,t+1}}{g_{i,t}}\right) + \beta_2 \log\left(\frac{x_{i,t+1}}{x_{i,t}}\right) + \beta_{3,i}\mu_{i+}\varepsilon_{i,t}$$

Where $h_{i,t}$ is the real per capita health public expenditure for country *i* in the year *t*, $g_{i,t}$ is the real per capita GDP, $x_{i,t}$ defines the demographic composition, μ_i is a country fixed effect, and $\varepsilon_{i,t}$ is the error term of country in period *t*.

The model assumes that per capita growth of public expenditure(in logs) is a function of a growth rate (in logs) that is common to all countries, changes in the demographic composition (in logs) and a specific rate of growth of each country.

The results show a moderate increase in health-related costs as a proportion of GDP over the next 20 years—by 1.1 percentage points in 2030—in all emerging countries. By analyzing individual cases, it can be observed that in Brazil and Mexico the health-related costs will increase by around 1.6% of GDP while in Chile the rise will be of 1.1%.

The main limitation of this work is that the data for emerging countries is available only for the most recent years. As a consequence, the projections based on this data are not robust. To substitute the missing data the Excess Cost Growth in developed countries is extrapolated to emerging countries. In addition, the experience of emerging countries is very diverse: some countries have recently completed economic and political transitions, while others are still in the process. Similarly, some countries have achieved universal coverage, while others have not.

The identification of factors that determine health spending in each country and the knowledge of their future evolution is extremely important to elaborate good long-term fiscal projections. Therefore, it is also relevant to know which factors influence health spending and which will be their future behavior to determine the potential impact on health care costs.

4. Drivers of health expenditure

This section details the most important determinants of health expenditure and how each source affects health spending. Major sources of expenditure growth include demographic and epidemiological transitions; technological progress; risk factors such as smoking, unhealthy eating, alcohol consumption, and lack of physical activity; income; treatment practices; and prices and health productivity. There are other factors affecting health expenditure, however, they have received little attention mostly due to the lack of available information.

4.1 Demographic and epidemiological transition

Two processes are central to existing demography-related literature. The first is demographic transition, which is a process by which a population moves from a state characterized by a large proportion of young people to one where the population is predominantly old. The second is epidemiological transition, where the demographic transition affects health statuses and health care demand. In populations undergoing a demographic and epidemiological transition, more children survive and become adults, and as a result they are increasingly exposed to risk factors associated with non-communicable diseases, thus increasing their potential contribution to health spending increases.

Both the demographic and epidemiological transitions will have an influence on projected spending, although there is some controversy about the specific mechanism. The 2009 Aging Report from the European Commission shows that average health expenditures increase with age. Thus, an aging population could be expected a priori to be associated with an increase in the public health expenditure per capita. In other words, the fact that the share of older people in the population is growing faster than that of any other age group, both as a result of longer lives and a lower birth rate, should generate an automatic increase in the average health spending. However, this European Commission finds little support in the data, and assessing the effect of an aging population on health has proved to be far from straightforward (Breyer et al., 2011). Others claim that what matters in health spending is not aging but rather the proximity to death (Felder et al., 2000; Seshamani and Gray, 2004; Breyer and Felder, 2006; Werblow et al., 2007; OECD, 2013). This argument is consistent with the observations where health expenditure tends to increase in a disproportionate way when individuals are close to death, and mortality rates are higher for older people.

4.1.1. Demographic transition

Demographic transition is the process whereby a population initially characterized by high fertility, high mortality, and high proportion of a young population, becomes characterized by low fertility, low mortality, and a high proportion of an old population (Omran, 1971; Chesnais, 1992 and Cotlear, 2011). Most demographic transitions have been initiated by decreasing mortality of young children, leading to an increase in life expectancy. During the initial stage which usually last several decades, fertility rates remain high, and population grows rapidly.

In Latin America, the demographic transition occurred partly as a result of the decline in infant mortality rates through better control of infectious, parasitic, and respiratory diseases. According to World Health Organization (WHO), infant mortality–measured as the probability of death between birth and age one–in LAC decreased on average by 60% from 1990 to 2010, from 41 to 16 deaths per 1,000 live births, although significant differences can be observed between countries. During the same period, a similar decrease occurred in the under-5 mortality rate, where the number of deaths before age 5 dropped from 52.1 to 20.6 per 1,000 live births. In addition, the maternal mortality rate decreased by 44% from 1990 to 2010, from 133.2 to 74.9 deaths per 100,000 births.

A decline in fertility has also been a driving force in the demographics of LAC. According to the World Development Indicators (WDI), the fertility rate in Latin America decreased markedly from 1960 to 2010, from an average of 6.26to 2.41 children per woman.

Nearly all LAC countries are in a period of transition[5]characterized by low child and old age dependency ratios with respect to working age adults. Given heterogeneity in the demographic transition, for some countries, this window of opportunity is starting to close, while for others it is beginning to open (Saad in Cotlear, 2011).

4.1.2 Epidemiological transition in Latin America

There is a parallel process to the demographic transition known as the epidemiological or health transition. With rising average age from the demographic transition, people are increasingly exposed to the risk factors associated with chronic diseases. As a result, the burden of death and disease shifts from maternal and perinatal conditions to chronic and degenerative diseases (Kinsella and He 2009). In addition, after being exposed at an early age to malnutrition, infectious diseases, and environmental hazards, children in LAC are more likely to experience poor health during adulthood. The demographic transition changes the state of health of the population and impacts the demand for medical care.

Two decades ago, the WHO noted a distinction in prominent causes of disability between developed and developing countries. In the latter, disability stemmed primarily from malnutrition, communicable diseases, accidents, and congenital conditions. In industrialized countries, disability resulted largely from the chronic diseases — cardiovascular diseases (CVDs), arthritis, mental illness, and metabolic disorders— as well as accidents and the consequences of drug and alcohol abuse. As economies in developing countries expand and the demographic and epidemiological situation changes, the nature and prevalence of various disabilities may also change. In the Latin American region, NCD accounted for 77% and 84% of the burden of disease in 2000

[5]A high proportion of economically dependent population (children and elderly) generally limit economic growth, since a significant portion of resources are allocated to attend their needs. By contrast, a large proportion of working age people can boost economic growth because a larger proportion of workers and a lower level of spending on dependents tend to accelerate capital accumulation.

and 2011, respectively. The transition towards non-communicable diseases such as chronic and degenerative diseases will require longer and likely more expensive treatments.

4.2 Technological progress

Growth in health care spending is driven by new technologies and services coming to market, their adoption, and widespread diffusion. Although some technological advancement may generate cost savings, [6]on the whole, advances in health care are likely to be cost-increasing[7] due to the high costs of research and development, in addition to the expansion of available treatments and ongoing treatment possibilities (Banks, 2008).

The Productivity Commission of Australia (2005) estimates that the impact of new technologies across four leading disease types –diabetes, cardiovascular, cancer, and neurology– generates an increase in expenditure greater than cost savings anywhere else in the health system. Similarly, forecasts by the Ministry of Social Affairs in Sweden point to a larger impact of new technologies and treatments on expenditure, compared with the impact of even the most pessimistic assumptions about the health status of future populations (Ministry of Health and Social Affairs, 2010).The increase in demand can also explain the recent upward trend health care costs. Dormont and Huber (2005) found that in France, the price of certain surgical treatments, such as cataracts, decreased while the frequency of the number of treatment prescriptions significantly increased.

4.3 Risk Factors

An additional variable that affects spending is exposure to risk factors, such as tobacco smoking, unhealthy eating, alcohol consumption, and lack of physical activity. These risk factors are associated with increases in chronic diseases such as diabetes, cancer, and cardiovascular conditions. The changes in disease prevalence have a direct relationship with the amount and types of health services that are in demand, and therefore with health spending. Social norms and preferences about health care may also influence behavior and consequent demand for health services, and therefore affect health expenditures.

According to the WHO, non-fatal but debilitating health problems associated with obesity include respiratory difficulties, chronic musculoskeletal problems, skin problems,

[6]Prices for diagnostic tests, surgeries, and drugs have declined over time, including antiretroviral drugs (Nunn et al., 2007).

[7] These cost increases may also reflect improvements in service quality, for example, diffusion of angioplasty and the use of MRIs instead of X-ray (IMF, 2012).

and infertility.[8]The likelihood of developing type-2 diabetes and hypertension rises steeply with increasing levels of body fat. Although the prevalence of obesity was limited to older adults for most of the 20th century, it now affects children, even before puberty. About 85% of people with diabetes are type-2, and of these, 90% are obese or overweight. The 2002 World Health Report reported that about 58% of diabetes, 21% of ischemic heart disease, and 8-42% of certain cancers globally were attributable to a Body Mass Index[9] above 21.

A rise in the prevalence of obesity is a likely contributor to the growth of health care spending. The US Congressional Budget Office found that obese people incur greater health care costs. In 2001, spending for health care per person of normal weight was $2,783, compared to$3,737 per obese person and $4,725 per morbidly obese person. If health care spending per capita remained at 1987 levels for each category of body weight, but the prevalence of obesity changed to reflect the 2001 distribution, health care spending would have risen about 4% of all spending growth from 1987 to 2001. Another way to examine the effect of obesity on spending is to ask how much would be saved if the prevalence of obesity returned to that of 1987, given the 2001 levels of spending for each respective category of body weight. That approach implies that changes in the prevalence of obesity account for around 12% of the spending growth between 1987 and 2001.

The rising disability rates among the future elderly due to obesity could displace improvements made in the past, such as reduced exposure to disease, better medical care, and reduced smoking. Although these are studies on American citizens, the trend appears global in nature, and there is no compelling reason why the trend in other countries should diverge. Obesity may, in the near future, erode the achievements of healthy aging of the current elderly and impose an additional burden on the health system costs (OECD, 2006).

From a policy point of view, investments in public health interventions, and treatments designed to reduce population exposure to risk factors could curb spending levels. For example, increases in taxes on tobacco and alcohol, control measures of smoking in

[8]More life threatening problems fall into four main areas: cardiovascular diseases; conditions associated with insulin resistance such as type-2 diabetes; certain types of cancer, especially hormone-related and large bowel cancer; and gallbladder disease.

[9] BMI is a person's weight in kilograms divided by height in meters squared. Because BMI does not distinguish body fat from bone and muscle mass, the index can misclassify some people. The standard BMI categories are as follows: underweight (BMI less than 18.5), normal (18.5 to 24.9), overweight (25 to 29.9) and obese (30 or more). These definitions are based on evidence that suggests health risks are greater at or above a BMI of 25. The risk of death, although modest until a BMI of 30 is reached, increases with an increasing Body Mass Index (US Department of Health and Human Services, 2001).

public places, and salt reduction have proven effective in improving health (WHO, 2010).

4.4 Income

Household income has been identified as an important factor that explains differences in health spending and its growth across countries (Newhouse, 1992). Variations in per capita income are closely correlated with variations in per capita health spending, and higher levels of GDP contribute to higher levels of spending.

Fogel (2008) argues that as individuals in a nation become richer, they place a higher value on health and are willing to spend a larger share of their income on improving health.[10]Income elasticity varies greatly in empirical results and whether health care is a luxury good or a necessity is still debated. The effect of real income growth on public health expenditures has been the subject of debate, but the precise value of the income elasticity is still uncertain. Empirical estimates tend to increase with the degree of income aggregation, implying that health care could be "an individual necessity and a national luxury" (Getzen, 2000). However, a high aggregate income elasticity (above unity), often found in macro studies, may result from biases in estimates originating from a number of sources, such as failure to control appropriately quality effects and account for the peculiar statistical properties of some of the variables. Most recent findings from this literature (Acemoglu et al., 2009; Holly et al., 2011; OECD, 2013 and Fan & Savedoff 2014), found a real income elasticity below unity, indicating that health spending does not grow faster than GDP. Indeed, Costa-Font et al. (2011) use meta-regression analysis of 48 published studies to produce bias-corrected estimates of the relationship between income and health expenditures and find that this income elasticity ranges from 0.4 to 0.8. The remaining differences between these estimates probably reflect differences in the share of health spending growth that is implicitly or explicitly attributed to other factors such as technological change or unbalanced growth.

An important factor that determines income is size of the labor force. In Latin America, not everyone in the working age is economically active, especially among the female population despite recent increases. Similarly, as professional training becomes longer, a growing number of young adults remain in the education system and out of the labor market. These observations suggest that countries with low labor participation rates have an opportunity to expand their workforce and disposable income. Currently, according to Socioeconomic Database for Latin America and the Caribbean (SEDLAC) data for

[10]The inverse causality, where GDP is a function of the cost of care, has also a theoretical basis (Erdil and Yetkiner 2009).

2010, the economically active population represents 63.4% of people in working age (25-64 years), and the Labor force participation among men is around 93.2% while for women, 61%.

4.5 Treatment practices

Health expenditure is determined by the costs associated with treating diseases and the number of individuals who are treated for each disease. Therefore, an important factor in health spending is the intensity of care received by individuals.

In developing countries, only part of health needs are demanded due to several factors, such as lack of information about how to obtain health services, local availability, and family budget constraints. Health utilization is strongly related to perceived health needs. Given that health utilization is voluntary, an individual in a population tends to use health services when he or she perceives some dysfunction that could affect his or her present or future health. However, as mentioned before, part of the population—particularly the poor— experience problems accessing health services. For example, in Mexico, 30% of obese people in the poorest quintile received treatment while in the richest quintile 49.7% receive the treatment. On average 89.7 percent of people with diabetes receive treatment, 46.9% of patients suffering from heart disease receive treatment, and 60.3% of people with high blood pressure receive treatment. The treatment rate is similar in Chile, where 88.1% of diabetics, 61.3% of people with high blood pressure, and 48.8% of heart disease patients receive treatment. These indicators are lower for poorer population groups.

The probability of receiving treatment depends on whether individuals have health insurance or have access to subsidized care, among other things. However, what matters beyond access to health insurance is the quality and timeliness of health services. In the future, access to health services will play a large role in health expenditure, so it should be taken into account in future projections.

4.6 Prices and health productivity

The price of health care relative to the general price level is a significant driver of health spending growth (Huber, 1999; Leung, 2007).Unbalanced growth theory[11] states that

11 A well-known explanation of why health care costs have increased inexorably over time was proposed by Baumol and Bowen (1966), and elaborated on in Baumol et al.(2012). They noted that in Beethoven's time, it took four musicians to play a piece of music written for a string quartet, and that it still takes only four musicians to do this. However, the real pay of those musicians is now considerably higher than it was previously. The productivity of string quartets inevitably falls over time: they suffer from a 'cost disease' – a situation in which they find that they are able to command higher wages as employers compete for musicians

productivity in the health sector is low relative to other sectors, due to health services are highly personalized and intensive in labor (Baumol, 1967). Therefore, the prices of health services tend to rise relative to other prices and wages. Low productivity sectors must keep up with wages in high-productivity sectors (Baltagi, 2010).

Other authors argue that health care is in fact characterized by rapid increases in productivity that are poorly measured, and this leads to an overestimation of inflation in health (Cutler and McClellan, 2001; Chernew and Newhouse, 2012). The view that prices are going up is probably related to the relevance of newer and more expensive treatments, which leads people to avoid other forms of care that have become routine and less expensive.

How health systems are organized and financed also explains differences in health spending across countries. Studies of OECD countries find that systems based on public funding with more centralized services and a fixed budget tend to have stronger levels of control over total funding (Mosca 2007; Wagstaff 2009) than systems based on insurance or those which reward the production and/or the number of procedures without explicit controls (Tyson et al. 2012).

5. Methodology

This section describes the methodology for the overall long-term projections and for each determinant of health expenditure. A micro-simulation approach is used because it most effectively takes into consideration the interactions among individuals to assess dynamic risk and the population's epidemiological transition. It incorporates not only population trends but also risk factors, socioeconomic characteristics, and technological growth. These topics have received little attention in the literature, mainly due to lack of available information.

We define health spending as the sum of health-related expenditures for the individuals in a population, taking into account the probabilities of each individual to develop and be treated for a disease.

Formally, the projection can be expressed as follows:

$$Spending_t^e = \sum_{f=1}^{F} \sum_{i}^{N} P_i^f \left(X_t^e \beta_{t0}^f \right) * P_i^{T,f} \left(T_t^e \gamma_{t0}^f \right) * CE_{t0}^f * W_{i,t}$$

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who would otherwise take jobs in higher paid industries. These industries are able to pay more because of their ability to improve labor productivity.

$Spending_t^e$ is health spending in period *t* under the scenario *e*, defined as the sum of expenditures on *F* diseases for *N* individuals.

P_i^f is the probability of individual *i* to develop disease *f*.X_t^e are the characteristics of individual *i* in period *t* under the scenario *e*, and β_{t0}^f are the coefficients of the probit model for the disease *f* in the survey year(t_0).

$P_i^{T,f}$ is the probability of treating disease *f* by the individual *i*, T_t^e are individual characteristics related to treatment in period *t* under scenario *e*, γ_{t0}^f are the coefficients of the treatment probit model for disease *f* in the survey year(t_0).

CE is the average cost of treating disease *f* in the survey year (t_0) and $W_{i,t}$ is the weighting of individual *i* in period *t*.

The spending calculations represent only a part of total health expenditure. The components of health spending analyzed in this research do not cover all diseases and expenses. There are expenses of some diseases that are not captured in surveys or are not attributable to any particular disease; this spending has not been included in our estimates, and therefore our estimates are relatively conservative.

In an effort to measure as close to total health expenditure as possible, the calculated health spending is extrapolated under the assumption that the participation of analyzed expenditure components is constant throughout the period analyzed. This methodology allows us to disaggregate expenditure trends in every variable present in the survey, for example, age group, gender, and region.

The extrapolation is formally written as:

$$Total\ Health\ Spending_t^e = Spending_t^e * \frac{Total\ Health\ Spending_{t0}}{Spending_{t0}^e}$$

Where $Total\ Health\ Spending_{t0}$ is the total health spending expressed in the national accounts for the initial period and $Spending_{t0}^e$ is the health spending for each of the components considered. Calculating this value for each year enables projection of the level of spending.

5.1 Demographic and health status

The changes in demographics with respect to age and gender are simulated from household surveys and population projections made by the national institutes of demographics of each country: IBGE in Brazil, INE in Chile, and INEGI in Mexico.

Disease projections are based on data from health modules of household surveys. The surveys included details on the magnitude and distribution of the following diseases: asthma, cancer, cirrhosis, cholesterol, depression, diabetes, spinal pain, kidney disease, heart disease, hypertension, rheumatism, tendonitis, and tuberculosis. The surveys also include details on coverage and characteristics of health plans. It is important to notice that the surveys used are different and not all diseases and risk factor are reported in the surveys.

Probit models are used to estimate the probability of an individual getting certain disease, based on individual characteristics such as age, gender, educational level, ethnicity, risk factors, and socioeconomic factors as explanatory variables.[12]

The statistics for several risk factors—smoking, alcohol consumption, and obesity—are worth discussion in countries where the information is available. According to the 2013 OECD Factbook, the percentage of the 15 and older age group who are daily smokers is 21% in OECD countries, about 13.3% in Mexico, 15.1 in Brazil and almost 30% in Chile. The alcohol consumption of those ages 15 and older is 9.5 liters per capita per year in OECD countries, 7.1 liters in Brazil, 8.6 liters in Chile and 5.9 in Mexico. Although alcohol consumption rates in Brazil and Chile are lower than that of OECD countries, they are expected to increase in the future. The overweight and obese population aged 15 and above rate is 52.7% across all OECD countries, in Brazil is around 48.1%, 64.5% in Chile and near 70% in Mexico. Brazil has better indicators than a number of OECD countries, such as Portugal (53%), Spain (53%), Hungary (54%), Czech Republic (54%), Australia (55%), Slovenia (55%), Greece (58%), Iceland (59%), and the US (62%).

Older populations are more likely to develop chronic diseases. In Mexico, the probability of a male at age 80 of having heart disease is 15.8 times greater than a male at age 25 and 7.68 times greater than a male at age 60. Similarly, the probability of a male at age 80 of having diabetes, cancer, and hypertension, is 33, 30, and 18 times greater, respectively, than a male at age 25. The probability of a male at age 60 of having the same three diseases is 27, 13, and 14 times great than a male at age 25. The results are similar for

[12] Smoking and alcohol use, sedentary lifestyle, access to health insurance, and participation in the formal labor market.

females. In Brazil, the likelihood of developing hypertension is 9.25 times greater for a male at age 80 than at age 25, and 6 times greater than a male at age 60. Similarly, the probability of a male at age 80 of having diabetes, cancer, and hypertension, is 20, 14, and 18 times greater, respectively, than a male at age 25. The probability of a male at age 60 of having the same three diseases is 23, 5, and 6 times greater than a male at age 25. For females, the trends are similar but the values are on average 35% lower.

The exposure to risk factors increases the probability of individuals developing chronic diseases. In Mexico, a male at age 25 who smokes is 2.3 times more likely to have cancer than one who does not, and a 25 year-old female who smokes is 2.4 times more likely to get cancer than one who does not. Similarly, the likelihood of a man having heart disease is 7.34 times greater if he smokes than if he does not. Finally, the probability of developing diabetes is 6.4 times greater in a male at age 25 and 11.5 times greater in a female at age 25 who is obese than someone who is not. In Brazil, a smoker at age 25 is 5.3 times more likely to have a heart attack than one who does not. A person with a sedentary lifestyle increases his or her chances of having a heart attack by 7.29 times.

5.2 Technological progress

Technological innovation influences health spending, but the literature on this topic is less developed and there is little empirical evidence.

One way to examine how a specific technological development and the associated changes to clinical practice effect spending on specific types of patients is through a case-study approach. However, it does not allow for a comprehensive analysis of how total health spending changes with advances in technology.

Another way to approximate the effect of technological innovation on health spending is indirectly through the “residual” method. First, one can estimate how changes in certain demographic and economic factors—such as aging and rising personal income—contributes to spending, assuming no changes in medical technology. After taking into account as many measurable factors as possible, the unexplained portion of spending growth, or the residual, can be attributed to technological change and the associated changes in clinical practice.

The residual approach yields findings that can be sensitive to the assumptions of various factors. Studies using this approach generally do not account for dynamic interactions between growth of personal income, health insurance coverage, and technology development. Nonetheless, the residual method can yield a reasonable approximation of how technological change relates to long-term growth in total health care spending.

In OECD (2013), residual growth was estimated on a sample of OECD countries over the period 1995-2009. The authors find a 4.3% average per capita growth of public spending on health for the 1995-2009 period, which can be broken down into 0.5% product of demographic change, 1.8% product of income effect, and 2% product of residual or technological change. This means that about half of the growth is due to "technological progress"[13].

Total health spending that includes technological progress THS_t^{TP} is estimated through the following formula:

$$THS_t^{TP} = THS_t^e * \frac{\text{Average annual \% } growth\ in\ public\ health\ spending\ (1995-2009)}{\text{Average annual \% } Residual \text{ contribution to change in spending}}$$

While these values may be useful as a reference point, technological growth will not realistically keep increasing the health spending without limit. In this study's model, two alternative scenarios are constructed in addition to the scenario where the residual effect continues to increase health spending at historical rates. In the first alternative, the growth rate decreases with time due to some cost containment policy. In the second alternative, the rate at which expenditure grows because of technology is reduced to rates similar to that of OECD (2006). In this case, after 10 years the residual is reduced from 35% to 28%, a2.3% annual decline.

The way in which this residual is estimated includes not only technological change but also inflation, so it is possible that the effect of technology is overestimated.

5.3 Risk Factors

Different levels of alcohol consumption, smoking, sedentary lifestyle, income, and participation in the labor market are simulated to capture the impact of changes in the risk factor prevalence of the population.

When designing alternative scenarios, one of the most important methodological decisions is simulating changes in behavior, including smoking status, alcohol consumption, and sedentary lifestyle. The assignment of these changes was based on the following methodology. We first estimated a probit model, and then estimated the probability that an individual had a given characteristic; for example, in the case of tobacco consumption, we ran a model to determine the probability of being a smoker.

[13] In OECD (2013), the residual expenditure growth is computed by subtracting the effect of aging and the increase in income (using an elasticity of 0.8) from the increase in real health spending.

As a result, individuals were ordered as follows: first those with the aforementioned feature (smokers) then those without that feature (non-smokers) in descending order according to the estimated probability. The modifications were made following the previously formed ranking to reach the desired ratio in the simulation.

5.4 Income

Several income scenarios were calculated in this paper. In the first one the earnings of the populations are assumed to remain constant in real terms. Income projections are calculated by multiplying the GDP per worker in the survey year by the projected economically active population, maintaining the same rate of labor market participation. This is a conservative estimate, because revenue increase due to future productivity increase is expected. We also assume some scenarios more optimistic where real income growth at 1% and 3% rate per year.

5.5 Treatment practices

One of the simulated scenarios involves changes in the decision to carry out treatments prescribed for each disease. Where information on treatment is available, the methodology for assigning treatment decisions is the same as that of risk factors.

The model to determine the probability that an individual will be treated established a rank order according to the estimated probability and changes in treatment probability were simulated, following the modeled ranking until the new, simulated probabilities of treatment have been assigned to the entire population.

5.6 Prices and health productivity

The projections assume that the relationship between medical prices and general price levels are constant. As a result, the estimated technological progress residual may only partly capture increases in medical prices given that medical prices may increase more quickly than general prices, as has been observed in other countries.

A further limitation of the analysis is the assumption that the supply of health care services will increase to meet demand, for example, that there are no restrictions in hospital infrastructure and there are enough medical specialists and resources to finance expansions. This paper does not assume any policy changes that may affect demand, such as the subsidy of certain practices, and there are not general equilibrium effects.

6. Projection results

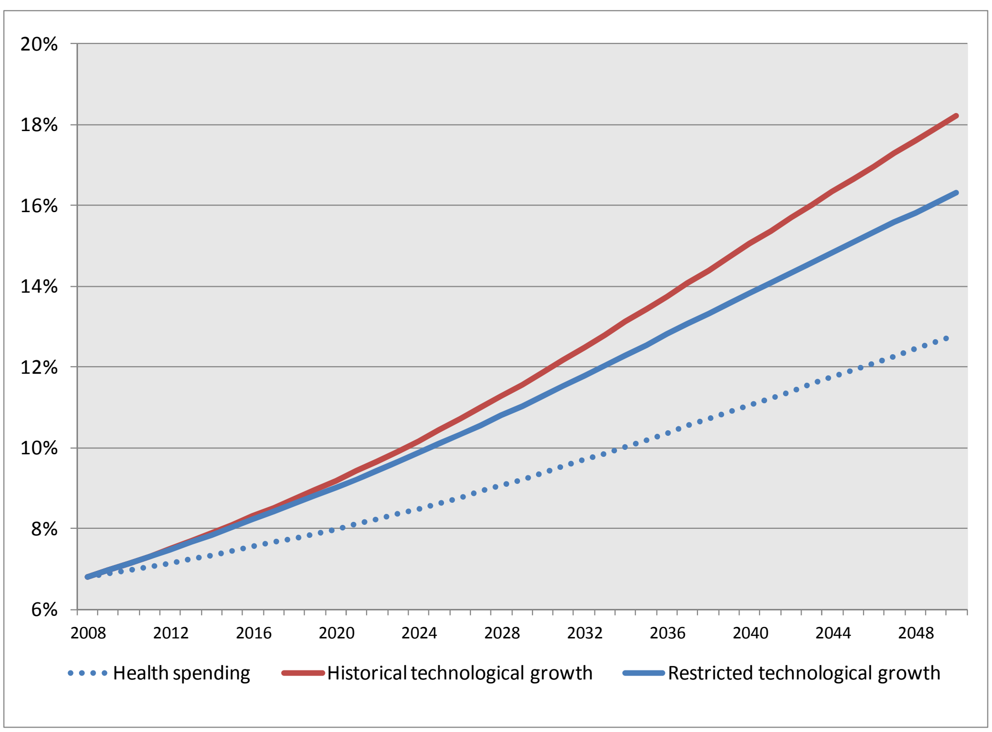
This section summarizes the most important projection and simulation results. Full details of results can be found in the annexes. The projections clearly illustrate the magnitude of future fiscal challenges and intertemporal inconsistencies that policy makers will have to cope with in the future.

6.1 Brazil

In Brazil, according to demographic trends health expenditure will shift towards the over 65 year-old population as the proportion of young people decrease. In future years Brazil will see an increase in the prevalence of heart disease, cancer, rheumatism, diabetes, and hypertension. As such, health expenditure shifts accordingly.

The public health expenditure forecast through 2050 is shown in Figure 1. Without income growth expenditure will increase from 6.8% of GDP in 2008 to 18.2% of GDP in 2050, assuming that the spending increase related to technology keeps pace with its historical growth. These figures reach 12% as income grows at 1%, but come down if income growth rate is assumed at 3% to 5.3% of GDP as shown in Figure 2.

Figure 1.Forecasts of public health expenditure growth (% GDP), Brazil.

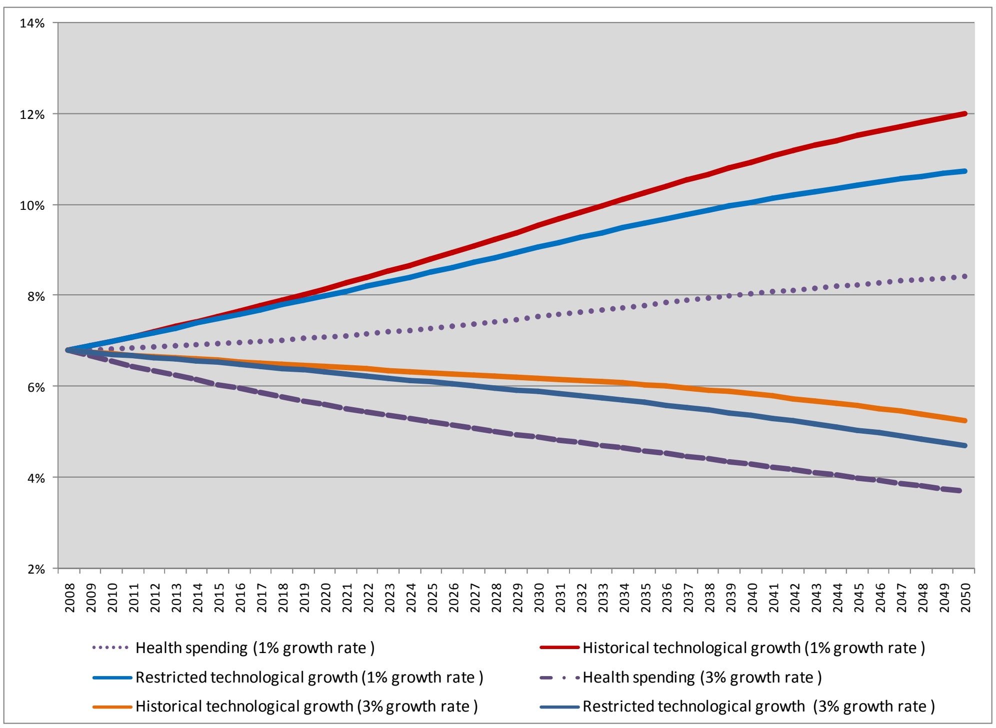


Source: Own calculations based on IBGE projections and PNAD 2008.

In absolute terms, this means that health spending will have increase by 452,847 million reais in the analyzed time period. These figures reach 12% as income growth at 1% and when the income growth rate is 3% the expenditure decrease until 5.3% of GDP.

If Brazil implements cost containment policies that reduce the growth rate of technology-related costs, health-related expenditure will beabout16% of GDP in 2050 instead of 18.2%. The difference between the two scenarios represents a saving of 1,107 million reais. As income growth at 1% the share of GDP needed is around 10.7 % instead of 16, and when the income growth rate is 3% it decrease until 4.7% of GDP.

Figure 2.Forecasts of public health expenditure growth (% GDP) with income growth, Brazil.

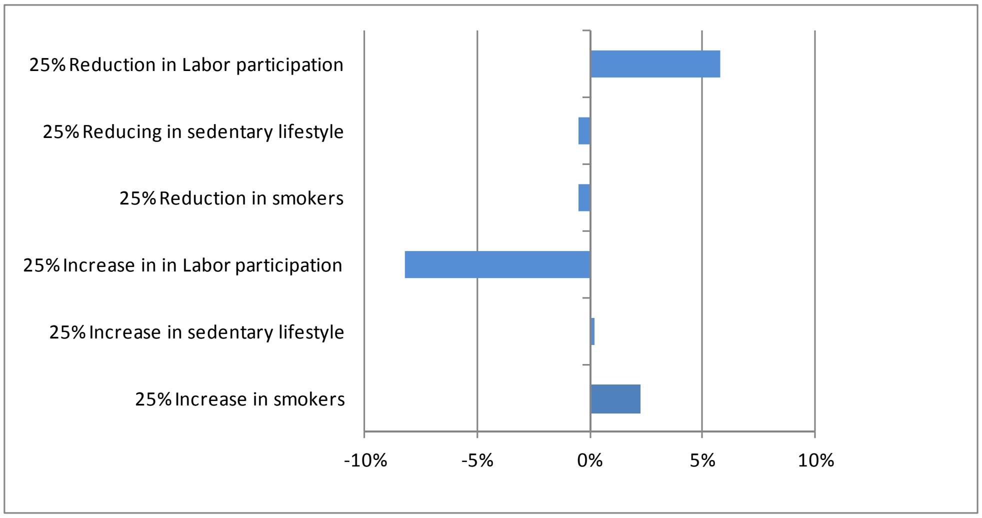


Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 3 shows the results under several scenarios. If the increase in the proportion of smokers increases by 25%, from 30% to 38%, health spending will increase by approximately 2% each year. In 2050, spending increases from 15.6% to 15.9% of GDP, where technology costs continue to grow at historical rates. The increase in people living a sedentary lifestyle does not generate major changes in health spending, but the 25% increase in labor participation, from 68% to 85%, reduces health spending by nearly 7% of GDP.

The reverse results are found in the scenarios in which risk factors are reduced. If the proportion of smokers decreases by 25%, from 30% to 23%, health spending will decrease by approximately 0.75% in each simulated year. Furthermore, the reduction in people with sedentary lifestyles does not generate major changes in the level of health spending, whereas the 25% reduction in labor participation, from 68% to 51%, results in an increase of more than 5% in health spending in 2050.

Figure 3.Health spending under different scenarios (% GDP), Brazil 2050.



Source: Own calculations based on IBGE projections and PNAD 2008.

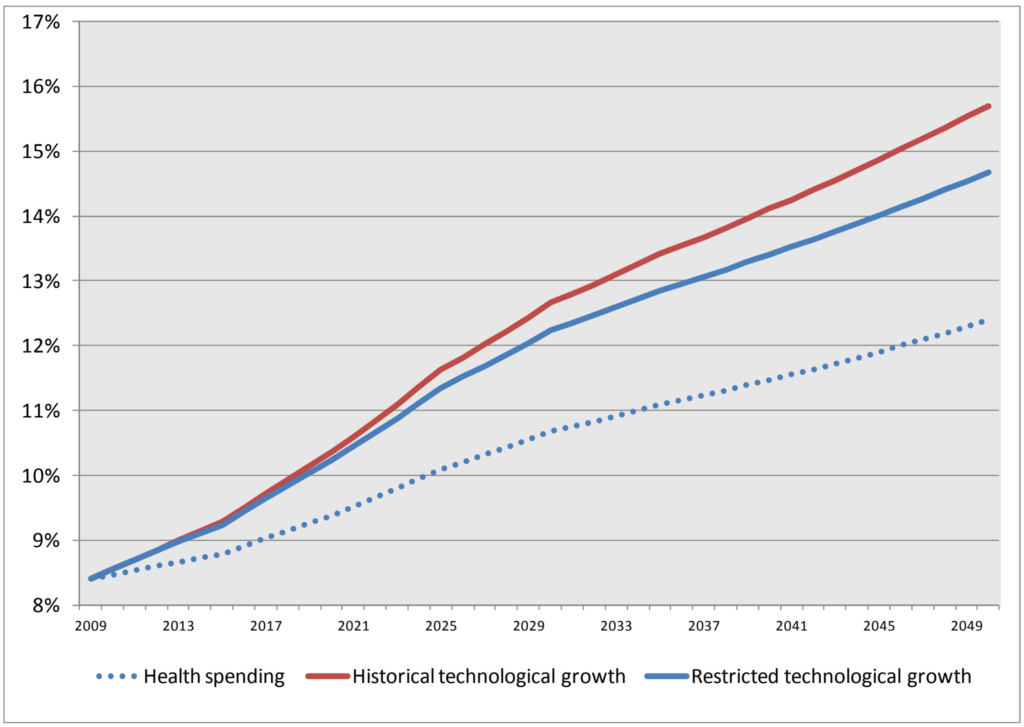
6.2 Chile

Health expenditure in Chile will shift sharply towards the over 65 year-old population as the proportion of young people decreases. The projections show a significant decrease in the share of treatments prescribed for depression and obesity and an increase for hypertension, strokes, heart attacks, and diabetes. Similarly, there will be an increase in health spending for heart disease, diabetes and stroke, and a reduction in spending on depression, HIV and kidney disease.

Under a scenario where the cost of technological growth maintains the current trajectory and the income growth rate remains constant, health spending will increase from 8.4% of GDP in 2009 to 15.7% of GDP in 2050 (Figure 4). The absolute increase in spending in this scenario will be 9,745,249 million Chilean pesos in the analyzed period. By contrast, if Chile implements cost containment policies that reduce the growth rate of technology-related costs, health-related expenditure will be around 14.7% of GDP in 2050, which represents a savings of 20,469 billion Chilean pesos during the analyzed period. Figure 5 reflects the sensitivity of the model to projections of and assumptions about economic growth; health spending would reach 10.4% of GDP if income grows at 1% per annum on average, but if income growth is 3%, expenditure decreases to about 4.7% of GDP in 2050 (Figure 5).

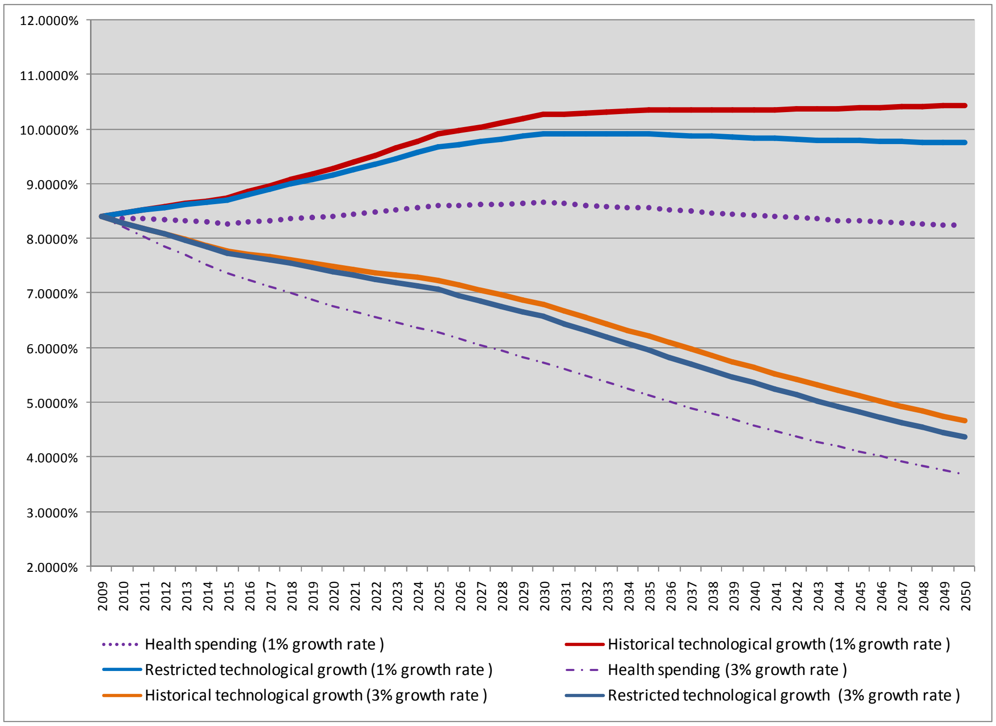
In a scenario where all individuals that develop a disease are treated, health spending in 2050 will increase by 47% of GDP. This scenario implies not only an extension of the medical procedures covered by the AUGE program, but also that all individuals have access to treatment.

Figure 4.Forecasts of growth in public health expenditure (% GDP), Chile.



Source: Own calculations based on INE projections and ENS 2009.

Figure 5.Forecasts of growth in public health expenditure with income growth (% GDP), Chile.



Source: Own calculations based on INE projections and ENS 2009.

6.3 México

In Mexico, health expenditure will shift substantially towards the over 65 year-old population as the proportion of young people is cut in half. During the analyzed period, the proportion of people suffering from diabetes, hypertension, heart diseases and cancer increases, whereas depression obesity and kidney disease decrease. The new disease distribution modifies the structure of health expenditure, with increases in spending for hypertension, diabetes, heart disease, and cancer and decreases in spending for kidney disease, obesity, and depression. As such, health expenditure shifts accordingly.

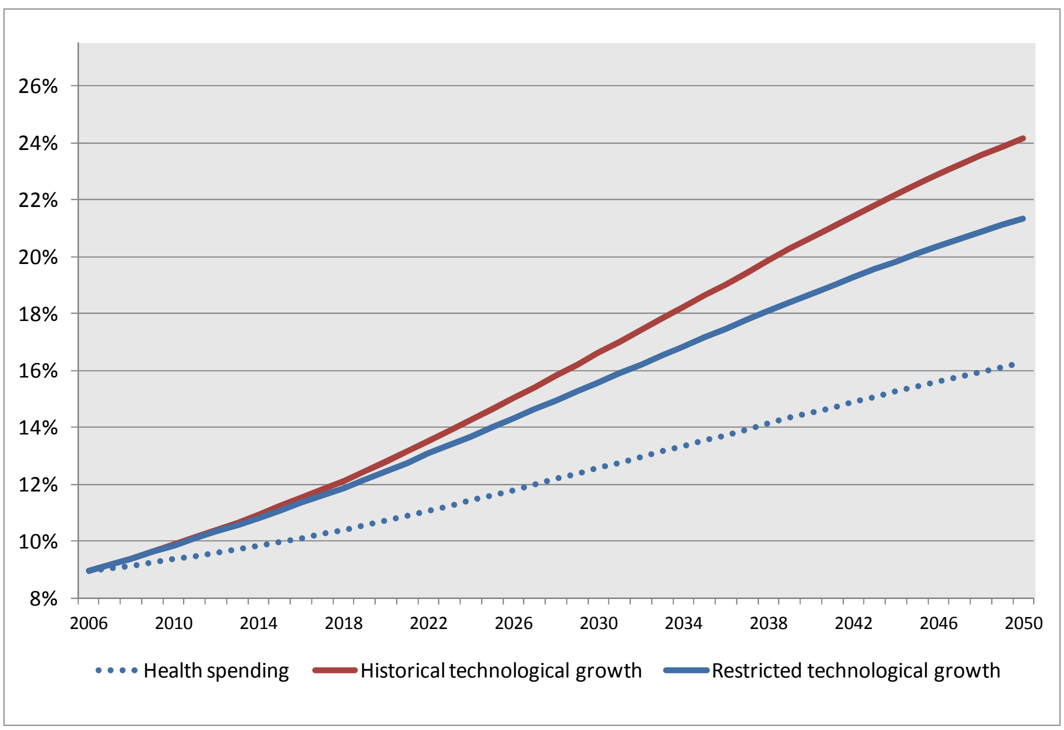
Figure 6 shows that if the current technology-related spending growth is maintained and without income growth, spending will increase from 8.9% of GDP in 2006 to 24.2% of GDP in 2050. These figures reach 15.5% if income grows at 1% or 6.6% of GDP if the income growth rate is 3%. In absolute terms, spending will increase by 2,336 billion pesos in the analyzed period.

In the scenario where cost containment policies are implemented, health spending will decrease by nearly 12.4% of GDP by 2050, which represents a savings of around 6,607 billion pesos during the analyzed period. As income grows at 1%, the share of GDP needed is around 13.7 % instead of 12.4%, and when the income growth rate is 3% health spending decreases to 5.8% of GDP as shown in Figure 7.

Figure 5 shows the results under several other scenarios. If the proportion of smokers increases by 25% (30% to 38%), health spending will increase by approximately 1% of GDP each year. A 25% increase in people living a sedentary lifestyle does not generate major changes in the level of health spending. A 25% increase in labor participation (from 58% to 73%) results in a reduction of nearly 4.5% in health spending.

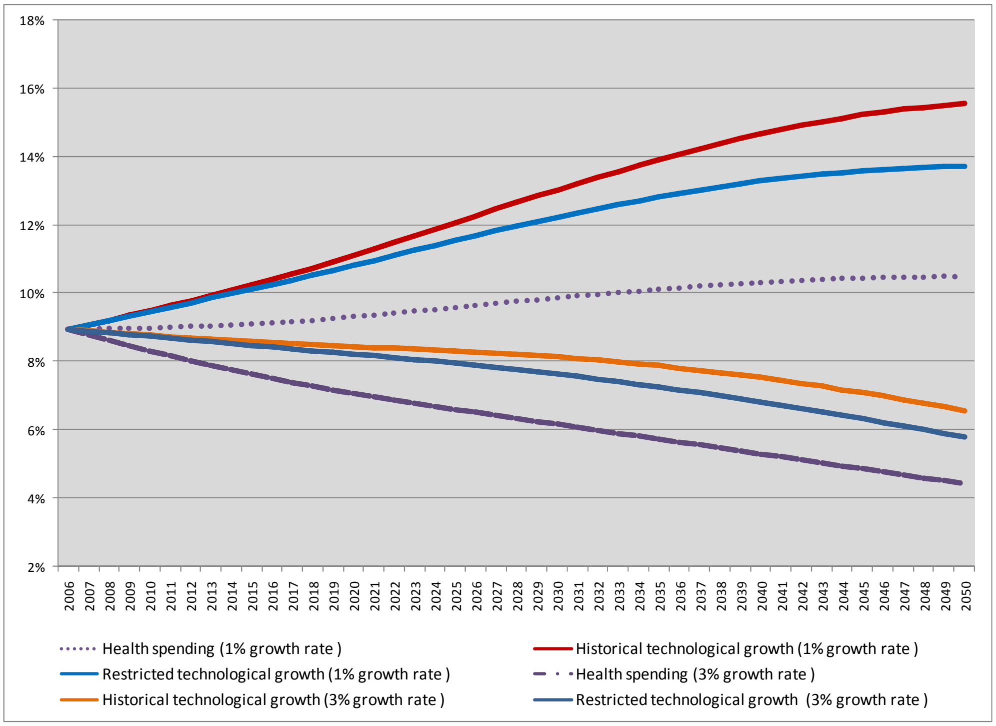
The reverse results are found in the scenarios in which risk factors are reduced. If number of smokers decreases by 25% (from 30% to 22.5%), health spending will decrease by approximately 1%. A decrease in the proportion of people living a sedentary lifestyle does not generate major changes in the level of health spending, whereas the 25% decrease in labor participation, from 58% to 44%, results in an increase of nearly 4% in health spending.

Figure 6.Forecasts of growth in public health expenditure (% GDP), México.



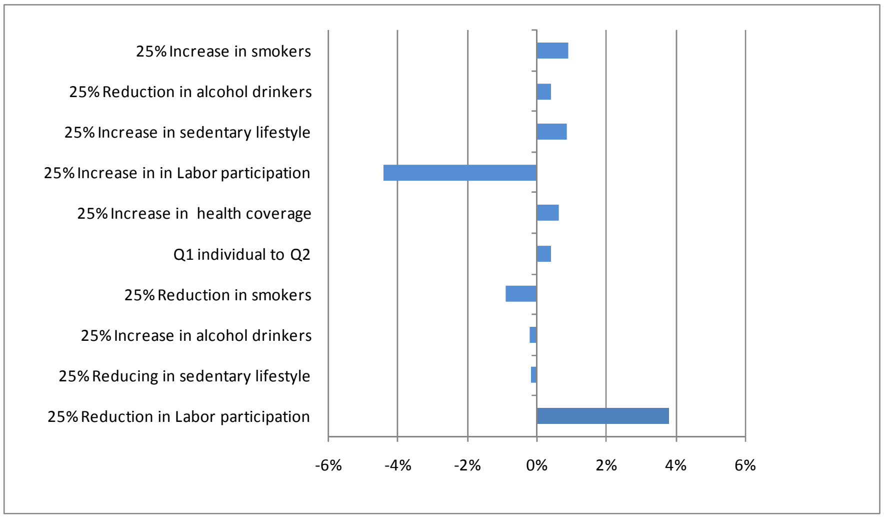
Source: Own calculations based on CONAPO INE projections and ENSANUT 2006.

Figure 7.Forecasts of growth in public health expenditure (% GDP) with income growth, México.



Source: Own calculations based on CONAPO INE projections and ENSANUT 2006.

Figure 8.Health spending under different scenarios, Mexico 2050 (x axis = percent GDP)



Source: Own calculations based on CONAPO INE projections and ENSANUT 2006.

7. Policy recommendations and implications

The current magnitude of health spending and the estimated future trends show that health spending will likely grow rapidly in the future. The increase in health spending may not be an obstacle to universal health coverage if revenues and productivity of other areas of the economy maintain their historical trends.

However, if revenues do not continue to grow or if significant volatility is experienced, even at current trends in utilization, expenditure requirements will generate serious fiscal pressures. The alternative, keeping the share of GDP spent on health constant despite growing demand, would affect the quality and access to health services, leading to greater levels of implicit rationing of care and associated inequalities.

By emphasizing risk factor prevention, improving productivity and eliminating inefficiencies, countries could assist more people with the same level of spending.

Many successful public health interventions to reduce risks are based on relatively low-cost regulation, for example, safety belt regulation, drunk driving penalties, salt and transfat reduction in foods, school feeding reforms, smoking bans in workplaces, addition of fluoride to water, and removal of carbon monoxide from domestic gas supply.[14] Implemented together, the World Bank estimates that over 50 percent of the NCD burden in developing countries could be averted. Latin American countries have made progress on this agenda, but it remains far from complete.

Technical and allocative inefficiencies in health spending are also very large (IMF 2012) (Garber and Skinner, 2008), and represent an opportunity to improve outcomes while controlling cost escalation. WHO estimates that between 20 to 40 percent of the resources for health are misused (WHO, 2010b). A study by the OECD suggests that by halving the inefficiencies in health systems, life expectancy at birth would increase more than a year on average. Achieving the same result through an increase in spending would require a 30% increase in health spending per capita (Joumard et al., 2010).

However, in order to reduce inefficiencies, countries need to understand how they spend currently and what may happen with spending in the future.

As the simulations have shown, greater labor market participation could lead to increased income and an associated reduction in the likelihood of getting a disease, and consequently a reduction in health spending. The development of labor market policies

[14]Suicide by gas accounted for 40% of British suicides in 1963 and none by 1975. Substitution to other forms of suicide was low, with total suicides falling by around 2000 people per year (Clarke and Mayhew 1988).

encouraging greater labor participation of both women and men is vital to achieve a better quality of life, a lower level of public spending, and more resources to finance expensive health care.

The results of this study also show that technological change will likely be an important component of the future health care costs. An effective strategy for sustainable expansion of universal health coverage and as an extension long-term cost control must seriously address issues related to the incorporation of new technologies to the health care system, assuring that public subsidy goes mainly to value for money interventions and products. Health systems need to put fair and evidence-based systems in place to set cost-effective priorities for public spending in health (Glassman and Chalkidou 2012).

In health markets, consumers are willing to pay for insurance (through taxes or premiums) to avoid catastrophic risks. It is important to find the right level of insurance and co-payment that will support efficiency goals. Co-payments can play a valuable role in constraining inappropriate demand and, by private financing, relieving some of the fiscal strains for the government from burgeoning health care costs; however, fees and co-payments should never be used to restrict access to genuinely needed and cost-effective care.

Better informing and empowering patients to act on the availability and quality of medical services can also contribute to better value for money. For example, in the USA and UK, data has long been available on the individual performance of cardiac surgeons. Recent changes to the National Health System in the UK have enabled patients to choose public treatment among competing hospitals, with information about their relative performance, and feedback from patients, both available on the web (UK NHS, 2008).This type of information, along with funding premiums for high-performing hospitals and health staff can improve quality of services and empower consumers. In addition, better preventive care practices by individuals and families can also contribute to improved efficiency and outcomes.

In developing countries, many factors limit access to health, such as lack of information, lack of services, distance to services, or household budget constraints. For this reason, it is necessary to develop policies to achieve universal access to prevention and early treatment of non-communicable diseases, especially among the poor. The challenge is to expand the basic coverage to most of the population in a fiscally sustainable way.

In countries with direct public provision, such as Brazil, the progressive extension of coverage often has more to do with the physical location of facilities and wage policies, because eligibility for care is not subject to insurance enrollment. In these cases, urban areas are privileged in terms of access to health care, and supply expansion in rural areas and most vulnerable communities may be necessary. Further, out-of-pocket spending is still significant in the Brazilian system, and still significant among the poor, suggesting that subsidized services are not having the desired effect on financial protection from impoverishing out of pocket spending on health.

Chile has near achieved universal coverage on health through a compulsory social security system with explicit guarantees access to health care, but funding and supply are mixed, so that the system is de facto segmented (private and public) and includes relatively high administrative costs. One of the main challenges of this system is the lack of equity in the quality of medical care.

In Mexico, universal health care coverage has not yet been achieved. The health care system is segmented between many suppliers both public and private insurers. As a result, there is a high degree of fragmentation, inequality of access and high administrative costs. On the other hand, half of total health expenditure is paid out-of-pocket. The social protection system should try to reduce fragmentation and achieve universal coverage.

There are several important limitations to this analysis. In the analysis, it is likely that there is some endogeneity between labor participation and the possibility of getting a disease, mainly because individuals that are not working are actually sick or disabled. That situation would not be solved (although could be improved) by getting a job. As a consequence, the results obtained in this paper should be taken with care and as an illustration of the possible future trends. There are also some interactions that are not considered in the model and are beyond the scope of this type of approach, for example: alcohol consumption is a risk factor for liver cirrhosis and many other negative outcomes such as violence, depression, among others, that may not been adequately captured in the model.

Finally, due to limited household-level data, long term care and disability issues were not included in the model. This is a relevant topic, as many elderly in LAC currently rely on family structures for care and have on average 4-5 children to provide this care. However, future elderly cohorts are likely to rely more on public services because they will have on average 2 children and more disabilities (obesity, mental and physical illness). This is an important subject left to future research.

8. Concluding remarks

A rapidly aging population requires a new health agenda targeting both supply and demand. On the supply side, the biggest challenge is to manage the fiscal impact of aging populations and related technology changes. On the demand side, the challenge is to implement policy measures to promote healthy behavior, preventive measures among the elderly, and achieve affordable costs for health insurance, drugs, and medical procedures.

The high rate of mortality in adults (15-59 years) in Latin America reflects high rate of smoking, alcohol consumption, and sedentary lifestyle, but also reflects the lack of access of the population to early treatment and prevention of non-communicable diseases. For both welfare and fiscal reasons, it is imperative that governments invest in surveillance of chronic diseases and disabilities.

Despite these challenges, health problems and growing fiscal pressures are not an inevitable consequence of the demographic transition. Many successful policies of disease and disability prevention in developed countries result in better coverage and quality of health care.

The use of effective preventive measures, such as stronger incentives to maximize productivity and quality, can make healthy aging a reality and curb rising health care costs. In part, higher productivity may be achieved by simply adopting better processes, such as avoiding wasteful cost shifting between parts of the health system funded by different parties, or the application of evidence-based treatment protocols to reduce adverse events and clinical variation. Structural changes, such as reorganizing the system to realize economies of scale and scope may also offer gains.

In addition, the evaluation of new technologies must consider all the benefits of new treatments, including reductions in work absences or reduced side effects. Once in use, new technologies need to be subject to greater systematic review of their efficacy and cost effectiveness.

Over the last years, most LAC increased health rights, not only through the extension of coverage or creating universal health systems, but also through the progressive incorporation of new procedures in the basic health packages. As such, it is even more important that governments incorporate the impact of demographics, risk factors, and adoption of new technologies in the analysis of long-term fiscal requirements.

Given the current magnitude of health spending and the pressure to spend more in the future, regular projections of the long-term fiscal outlook and sustainability of the health system are required. A capacity to monitor trends of potentially high-cost programs, such as long-term care services and costly medical procedures, also needs to be developed.

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10. Annex 1.Brazil

This section develops the methodology and presents outcomes for long-term health expenditure projections for Brazil. The analysis is based on the 2008 Pesquisa Nacional por Amostra de Domicílios (PNAD), which contains a module about access to health services. Furthermore, the source for population projections for 1980-2050 is IBGE (2008 revision)[15] and that of the administrative data on health spending is Health Information Department (DATASUS).

PNAD 2008 covered 150,591 homes and 391,868 household members, which represents 190 million people. This data is representative at a national and regional level (urban and rural).

10.1 Demographic projections

The IBGE[16]projects the Brazilian population by gender and age from 1980 to 2050, and changes in age structure are simulated by generating new weights from PNAD 2008.[17]. Figure 9 and Figure 7 show the simulated population projections by age group and gender, respectively.

Changes in the population structure between 2008 and 2050 is noted by a sharp drop in the proportion of young people. In the under-11 age group the proportion of individuals decreases from 20.1% to 9.4%, in the 11-17 age group, 10.5% to 5.6%, and in the 17-25 age group, from 14.5% to 8.1%. The 25-35 age group decreases from 15.3% to 10.9%, although the 45-55 age group does not present major changes. The older groups increase, where the 55-65 age group doubles (from 12.2% to 22.3%) and the over-65 age group almost triples (from 6.9% to 23.3%).

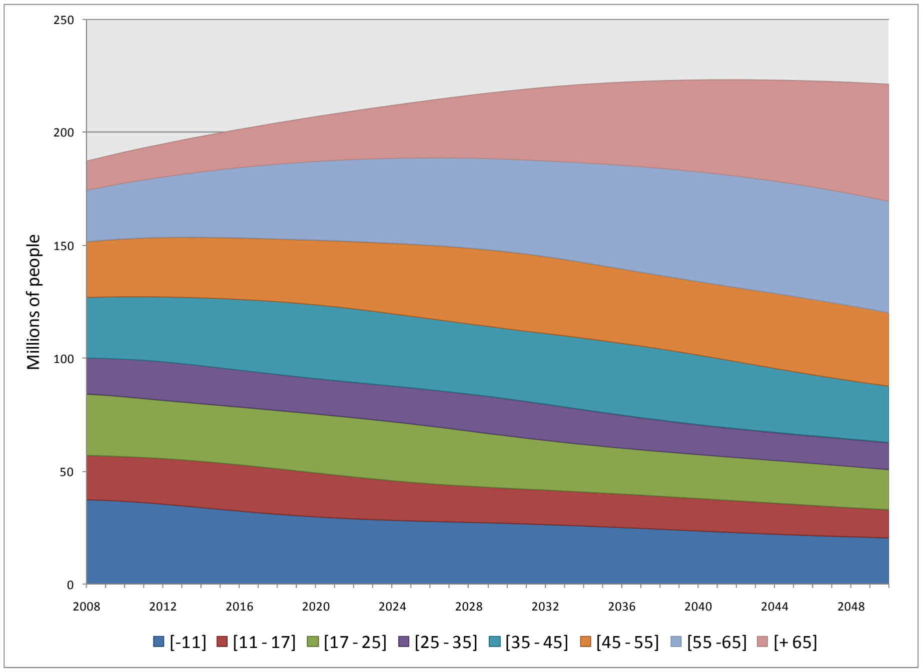
There are no major changes to the composition of males to females in the analyzed time period. In the population projections by gender, intertemporal variations are not significant, indicating that the proportion of women will change substantially in the coming years. The projections show that the proportion of women will be 51.4% in 2008 and 52.3% in 2050.

[15] Instituto Brasileiro de Geografia e Estadísticas – IBGE. Dirección de Investigación, Coordinación de Población e Indicadores Sociales, Estudios e Investigaciones. Información demográfica y socioeconómica number 24.

[16] Proyección de la población de Brasil por edad y género 1980-2050, Revisión 2008. Instituto Brasileiro de Geografía y Estadísticas – IBGE. Dirección de Investigación, Coordinación de Población e Indicadores Sociales, Estudios e Investigaciones. Información demográfica y socioeconómica number 24.

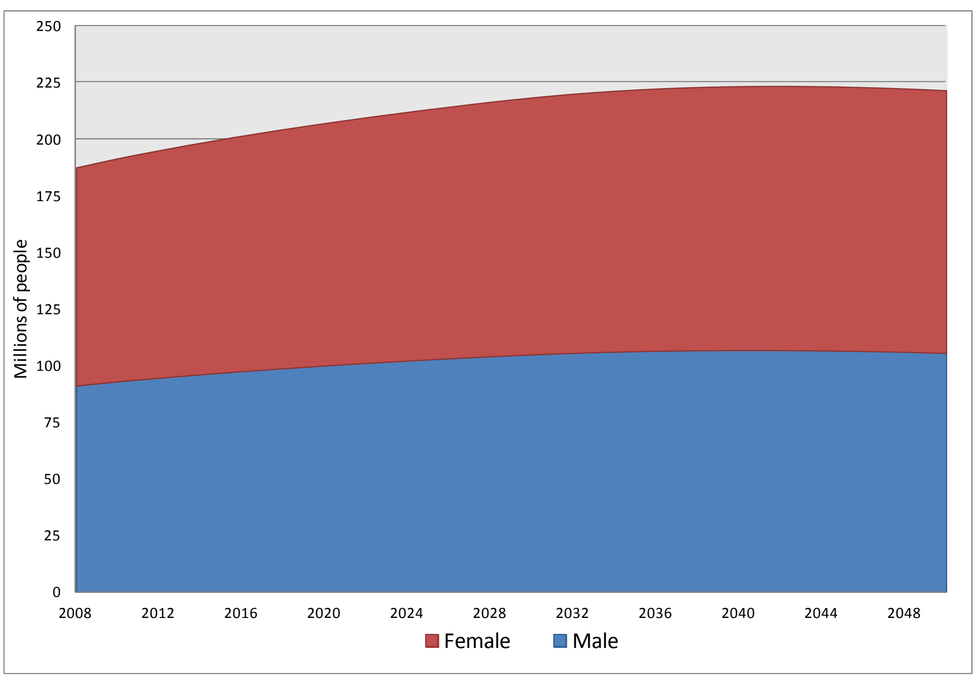
[17] For more details see Bussolo, et al. (2007).

Figure 9.Population trends according to age group.



Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 10. Population trends according to gender



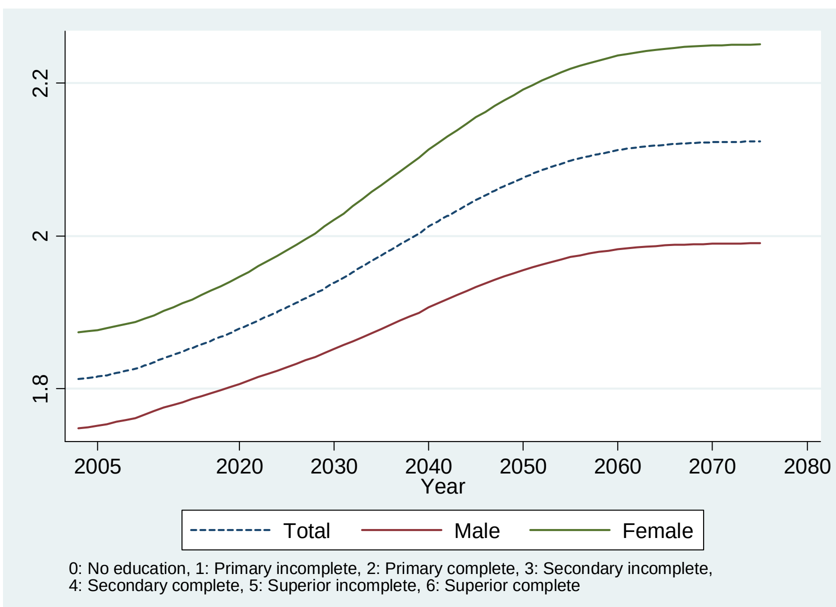
Source: Own calculations based on IBGE projections and PNAD 2008.

Some assumptions are required to generate projections for the population's educational levels. In PNAD 2008 individuals at age 28had the highest education level, and the same is assumed for future projections. For example: in the simulation of 2030, individuals between 28 and 50 will have the same educational structure that 28-year-old-individuals in 2008, whereas those over 50 years will have the same educational level they had in 2008. The projections assume that individuals at ages under 25 also kept the same educational structure as in2008.

In order to simulate the educational structure, the population is divided into groups according to age and gender. Within each group, individuals are grouped according to the number of years of education, and individuals are randomly ranked within the groups.

In order to modify the educational structure of each simulated group, we first assign the highest level of education 28-year-old had to individuals with higher rankings within the higher education level and then to the individuals with the higher ranking in the next education level and so on, until we reach the desired proportion. We performed this procedure for all educational levels in all groups. Figure 11 shows the simulated educational structure. Over time, a significant increase in the education level is expected, where by the year 2070, the structure begins to stay steady when all individuals reach the educational level of 28-year-old-individuals in PNAD 2008.

Figure 11.Evolution of educational levels.



Source: Own calculations based on IBGE projections and PNAD 2008.

10.2 Epidemiological projections

PNAD 2008 provides data related to the morbidity, access to health services, use of health services, and coverage and scope of health plans. It allows for the analysis on the magnitude and distribution of several diseases: asthma, cancer, cirrhosis, depression, diabetes, spinal pain, kidney disease, heart disease, hypertension, rheumatism, tendinitis, and tuberculosis.

It provides data on access to preventive health services (clinical exams, mammograms, and cancer preventive exams) for females above age 25 and physical mobility conditions for people over age 14. PNAD 2008 also contains data on tobacco consumption.

Table 1shows the distribution of diseases by age group. Diseases prevalence increases with age, except in asthma which has a U-shaped distribution.

A probit model estimates the probability of an individual to contract a certain disease by gender. The independent variables used in the model are: age, age squared, gender, years of education, whether or not the person is indigenous, smoking status, and area of residence (urban or rural). Participation in the labor market and the geographical region of residence are also included. Table presents the results.

Generally, there is a positive and nonlinear relationship between age and the likelihood a disease, with the exception of asthma and tuberculosis. For asthma and tuberculosis, the probability of contracting an illness increases with age but at decreasing rates.

The probit model indicates that higher educational levels will reduce the probability of developing the analyzed diseases, with the exception of cancer, which has no relationship with education. Ethnicity does not present a uniform impact across diseases. Sedentary lifestyle and urban area residence generally increase the chances of developing disease. Smoking increases the probability to develop all diseases. Participation in the labor market decreases the probability of developing a disease. Diabetes increases the probability of developing kidney disease, and hypertension increases the probability of developing cancer as well as kidney disease.

Table 1.Percentage of sick people according to disease and age group.

Age Groups	Asthma	Cancer	Cirrhosis	Heart disease	Depression	Diabetes	Spinal pain	Hypertension	Kidney diseases	Rheumatism	Tendinitis	Tuberculosis
[-11]	8.21%	0.04%	0.02%	0.61%	0.12%	0.12%	0.40%	0.12%	0.15%	0.17%	0.05%	0.02%
[11 - 17]	5.28%	0.05%	0.02%	0.83%	0.70%	0.28%	2.51%	0.48%	0.27%	0.64%	0.33%	0.02%
[17 - 25]	4.03%	0.09%	0.05%	0.92%	1.78%	0.41%	5.58%	2.11%	0.60%	1.08%	1.26%	0.08%
[25 - 35]	3.87%	0.20%	0.08%	1.15%	3.25%	0.75%	8.80%	4.71%	0.93%	1.56%	2.13%	0.09%
[35 - 45]	3.40%	0.33%	0.14%	2.04%	4.93%	1.56%	14.12%	9.63%	1.38%	3.18%	3.24%	0.15%
[45 - 55]	3.31%	0.65%	0.22%	4.30%	7.33%	4.36%	22.84%	20.96%	1.92%	6.93%	4.85%	0.20%
[55 -65]	4.31%	1.45%	0.35%	10.14%	9.24%	11.25%	31.75%	40.41%	2.69%	16.05%	6.23%	0.28%
[+ 65]	6.40%	2.91%	0.33%	19.71%	9.28%	16.81%	35.46%	55.75%	3.36%	26.61%	4.69%	0.27%

Source: Own calculations based on PNAD 2008.

Table 2. Disease probability estimates.

Variables	Asthma		Cancer		Cirrhosis		Heart Disease		Depression		Diabetes		Spinal pain		Hypertension		Kidney diseases		Rheumatism		Tendinitis		Tuberculosis	
	Enfermedad																							
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Age	-0.014***	-0.033***	0.045***	0.035***	0.021***	0.055***	0.035***	0.033***	0.056***	0.056***	0.075***	0.092***	0.062***	0.068***	0.092***	0.088***	0.016***	0.033***	0.064***	0.046***	0.057***	0.052***	0.022***	0.038***
Square age	0.000***	0.000***	-0.000***	-0.000***	-0.000***	-0.001***	-0.000***	-0.000***	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***	-0.001***	-0.001***	-0.001***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Years of educatio	-0.005***	0.000	0.012***	0.013***	-0.013***	-0.019***	-0.020***	-0.005***	-0.012***	-0.008***	-0.028***	0.006***	-0.015***	-0.025***	-0.030***	-0.004***	-0.019***	-0.019***	-0.016***	-0.019***	0.018***	0.015***	0.000	-0.016***
Indigenous	0.023***	-0.008***	-0.167***	-0.105***	0.110***	0.097***	0.042***	-0.012***	-0.067***	-0.069***	-0.004***	-0.014***	-0.016***	0.009***	0.113***	0.011***	0.020***	(0.002)	0.018***	0.042***	-0.035***	-0.029***	0.007***	0.160***
Sedentary	0.106***	0.146***	-0.030***	0.071***	-0.270***	-0.294***	0.056***	0.053***	-0.072***	0.152***	0.019***	0.080***	0.022***	0.059***	-0.025***	0.120***	0.004	0.030***	-0.004**	0.029***	0.086***	0.116***	0.110***	-0.054***
Smoke	0.218***	0.113***	0.091***	0.121***	0.100***	0.274***	0.092***	0.096***	0.198***	0.158***	0.015***	0.033***	0.127***	0.093***	0.003***	0.061***	0.103***	0.025***	0.081***	0.057***	0.154***	0.118***	0.143***	0.224***
Urban	0.081***	0.043***	-0.022***	0.022***	-0.132***	0.140***	0.063***	0.082***	0.086***	0.103***	0.098***	0.232***	0.084***	-0.011***	0.034***	0.093***	0.023***	-0.089***	0.045***	-0.038***	0.268***	0.089***	(0.003)	0.184***
Active	-0.006***	-0.117***	-0.142***	-0.290***	-0.052***	-0.404***	-0.116***	-0.315***	-0.121***	-0.520***	-0.148***	-0.276***	-0.006***	-0.069***	-0.087***	-0.196***	0.043***	-0.147***	-0.048***	-0.213***	0.089***	-0.142***	-0.024***	-0.235***
Region 1 (North)	0.083***	0.016***	-0.011***	0.041***	-0.160***	-0.110***	0.073***	0.086***	-0.151***	-0.179***	0.070***	0.041***	-0.003***	0.049***	-0.099***	-0.071***	0.113***	0.070***	0.268***	0.266***	-0.278***	-0.095***	-0.009**	-0.051***
Region 3 (Southe:	0.245***	0.246***	0.087***	0.083***	0.083***	-0.013***	0.166***	0.147***	0.234***	0.182***	0.107***	0.147***	-0.052***	0.015***	0.061***	0.094***	0.134***	0.077***	-0.071***	-0.079***	0.393***	0.352***	-0.103***	0.016***
Region 4 (South)	0.326***	0.349***	0.163***	0.282***	0.067***	0.011***	0.333***	0.253***	0.448***	0.303***	0.097***	0.070***	0.028***	0.070***	0.081***	0.082***	0.250***	0.199***	0.074***	0.074***	0.417***	0.403***	-0.075***	0.041***
Region 5 (Midwe:	0.190***	0.202***	0.091***	0.016***	0.041***	-0.035***	0.286***	0.210***	0.242***	0.092***	0.099***	0.098***	0.070***	0.071***	0.043***	0.065***	0.337***	0.207***	0.092***	0.030***	0.116***	0.132***	-0.152***	-0.208***
Diabetes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.849***	0.752***	0.363***	0.267***	-	-	-	-	-	-
Hypertension	-	-	0.044***	0.139***	-	-	-	-	-	-	-	-	-	-	-	-	0.387***	0.338***	-	-	-	-	-	-
Constant	-1.723***	-1.387***	-3.920***	-3.948***	-3.652***	-3.964***	-3.087***	-3.055***	-2.997***	-3.040***	-3.968***	-4.692***	-2.643***	-2.693***	-3.641***	-3.782***	-2.777***	-2.937***	-3.461***	-3.063***	-3.910***	-3.743***	-3.555***	-3.935***
Observations	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	120,163	111,073	28,969
Pseudo R2	0.02	0.02	0.09	0.17	0.04	0.08	0.15	0.17	0.07	0.08	0.17	0.18	0.10	0.10	0.27	0.23	0.07	0.08	0.18	0.16	0.08	0.06	0.02	0.06
Wald Test (rho = (	331920	408724	399501	583972	29070	165798	3045100	2671643	2005890	1110859	2554994	1837826	5086552	4007313	11213045	7787537	736532	682520	4881215	2570617	1456938	584577	23755	70271
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in brackets

** significant at 10%; ** significant at 5%; *** significant at 1%*

Source: Own calculations based on PNAD 2008.

10.3 Health expenditures

Brazil's Health Information Department (DATASUS) provides information about admissions and outpatient procedures that are performed through the Unified Health System (SUS).[18]

DATASUS provides the number of hospitalizations approved for payment by the Health Departments, the payout for each practice approved, the total amount paid, and number of inpatient days. For hospital procedures, the data is available for total procedures approved for payment, the value approved for payment by the Health Departments, and the final amount paid.

Spending on hospital care (hospitalization and outpatient procedures) is calculated using available information in 2008 through DATASUS. Where possible, spending on admissions and outpatient procedures is associated with the specific diseases analyzed. In order to obtain a measure of hospital care spending per patient for each disease—or average expenditure per patient—total expenditure is divided by the number of patients with the disease in the 2008 PNAD. Spending that could not be assigned to a specific disease was divided by the total patients in each federal unit and added to the disease average expenditure. This average disease expenditure by federation unit is used as a reference for calculating the health spending projections. Table 3shows the average cost of hospitalization by disease.

The estimate of hospital care spending in 2007—22.344million reais—represents 10% of total Brazilian health spending (Table 4). This proportion is assumed to be constant throughout the analyzed period.

[18] The Unified Health System (SUS) was created by the 1988 Constitution for the entire Brazilian population to have access to public health care. Previously, health care was the responsibility of the National Health Care Institute of Social Security (INAMPS), and was restricted to those who contributed to social security, and others were treated in philanthropic services. According to IBGE (2003), slightly more than 42 million Brazilians had private health insurance (24% of the population), while the remainder of the population (76%) relied solely on ITS for medical treatment.

Table 3. Average hospitalization expenditure according to disease.

Disease	Patients (*)	%	Spending on hospitalization (**)	%	Spending on outpatient procedures (**)	%	Spending on hospital care (**)	%	Average expenditure on hospitalization (***)	Average expenditure on outpatient procedures (***)	Average expenditure on hospital care (***)
	i		ii		iii		iv = ii + iii		v = ii / i	vi = iii / i	vii = iv / i
Asthma	9.44	9.6%	184.0	2.2%	26.4	0.2%	210.4	1.0%	19.5	2.8	22.3
Cancer	1.07	1.1%	618.3	7.5%	1,249.6	10.5%	1,867.9	9.2%	576.2	1,164.5	1,740.7
Cirrhosis	0.26	0.3%	65.5	0.8%	20.4	0.2%	85.9	0.4%	253.8	79.3	333.1
Heart disease	7.54	7.7%	1,092.1	13.2%	90.1	0.8%	1,182.2	5.8%	144.9	12.0	156.8
Depression	7.84	8.0%	-	0.0%	11.1	0.1%	11.1	0.1%	0.0	1.4	1.4
Diabetes	6.81	6.9%	65.5	0.8%	83.7	0.7%	149.2	0.7%	9.6	12.3	21.9
Spinal pain	25.55	26.0%	-	-	22.1	0.2%	22.1	0.1%	0.0	0.9	0.9
Hypertension	26.53	27.0%	109.0	1.3%	4.6	0.0%	113.6	0.6%	4.1	0.2	4.3
Obesity	-	-	17.2	0.2%	-	-	17.2	0.1%	-	-	-
Other	-	-	5,887.1	71.0%	8,882.6	74.4%	14,769.7	73.1%	-	-	-
Kidney diseases	2.38	2.4%	172.6	2.1%	1,528.8	12.8%	1,701.4	8.4%	72.6	642.9	715.4
Rheumatism	10.77	10.9%	51.6	0.6%	5.9	0.0%	57.5	0.3%	4.8	0.5	5.3
Tuberculosis	0.24	0.2%	23.2	0.3%	7.0	0.1%	30.2	0.1%	95.5	28.8	124.3
Total	98.43	100%	8,286.1	100%	11,932.3	100%	20,218.4	100%	84.2	121.2	205.4

(*) Note: in millions, (**) Note: in millions of reais, (***) Note: reais

Source: Own calculations based on DATASUS data.

Table 4. Final consumption according to institutional sector - Brazil - 2005-2007.

Products	Final consumption, by institutional sector (Million of reais at current prices)			
	2005	2006	2007	%
Families	**103,223**	**115,064**	**128,865**	**100**
Medicines for human use	36,407	40,667	44,783	34.8
Medicines for veterinary use	169	208	229	0.2
Materials for medical, hospital and dental uses	218	240	249	0.2
Devices and instruments for medical, hospital and dental use	2,009	2,320	2,567	2.0
Health plans - including health insurance	8,632	9,933	11,686	9.1
Hospital care services	19,992	19,348	22,344	17.3
Other services related to health care	35,152	41,550	46,102	35.8
Private social services	644	798	905	0.7
Public administration	**70,417**	**83,801**	**93,383**	**100**
Medicines for human use	3,819	4,302	4,728	5.1
Public Health	56,529	66,528	76,471	81.9
Hospital care services	8,851	11,551	10,815	11.6
Other services related to health care	1,193	1,395	1,348	1.4
Private social services	25	25	21	0.0
Nonprofit institutions or families services	**1,783**	**2,126**	**2,292**	**100**

Source: IBGE, Surveys department, National Accounts Coordination.

10.4 Projections outcomes

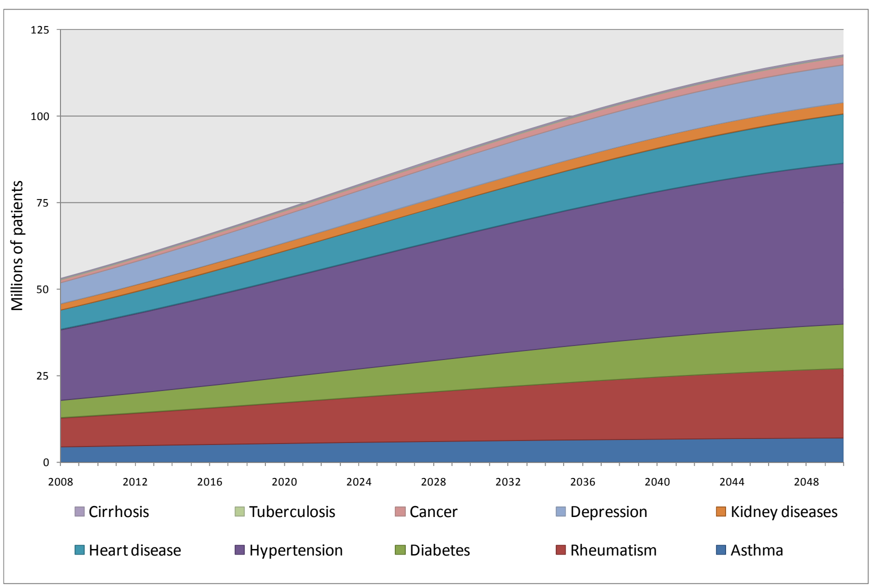
This section presents the health expenditure projection results according to disease and gender, under baseline and alternative scenarios.

10.4.1 Base line scenario

Simply put, health spending is the sum of health-related expenditures for the individuals in a population, taking into account the probabilities of each individual to develop and be treated for a disease. The ratio of hospital care spending to total health spending remains constant throughout the period analyzed. The methodology allows for the disaggregation of expenditure trends to every variable available in the survey, such as age group, gender, and region.

Figure 12 shows the projected number of patients by disease. Over time, there will be an increase in the people suffering from heart disease, cancer, rheumatism, diabetes and hypertension, and a decrease in asthma and kidney disease.

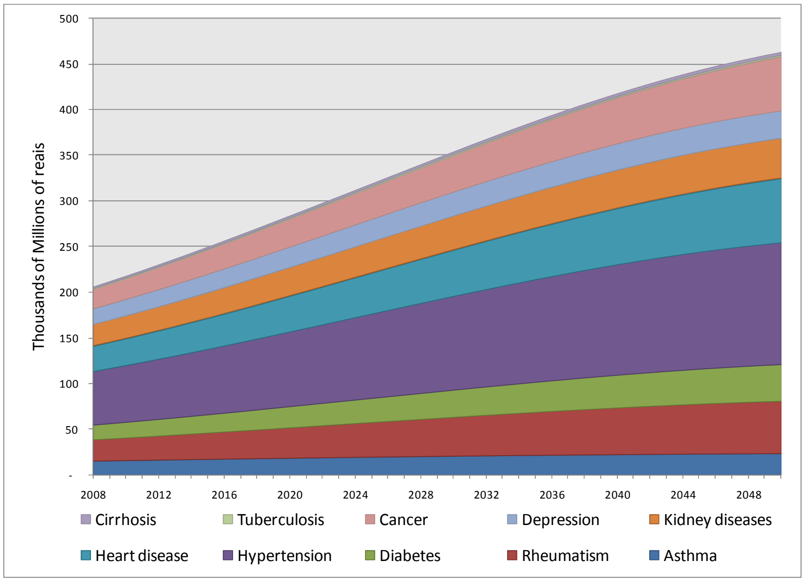
Figure 12. Patient trends according to disease.



Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 13 shows the projected hospital care expenditure by disease. The projections estimate an increase in spending for heart disease and cancer and a reduction in spending for asthma, kidney disease, and depression. For the other diseases analyzed, there are no major changes in spending.

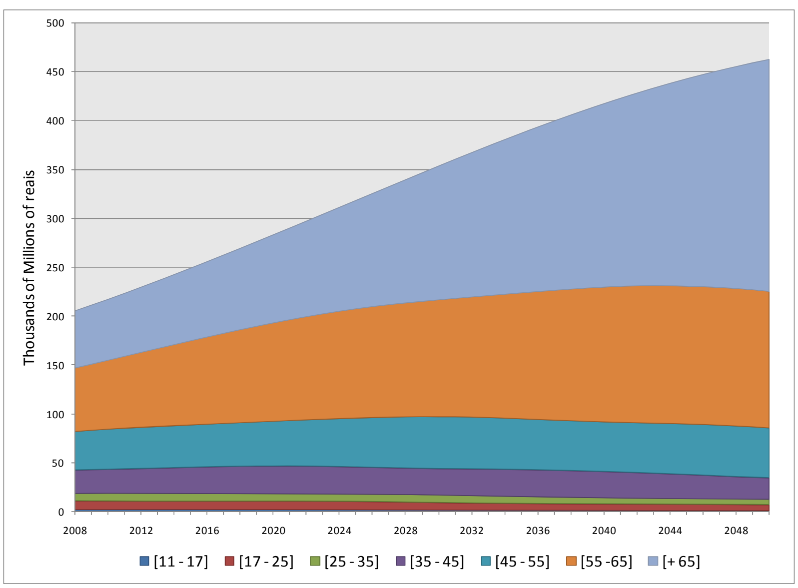
Figure 13. Health expenditure trends, according to disease.



Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 14 shows the projected health expenditure by age group. The share of total expenditure of the under-25 age group decreases by 5.1%, and that of the adult age group decreases by 14.3%. On the other hand, the share of expenditure of the 55-65 age group increases by 2.8% and that of the over-65 age group increases by 21%.

Figure 14. Health expenditure trends according to age group.

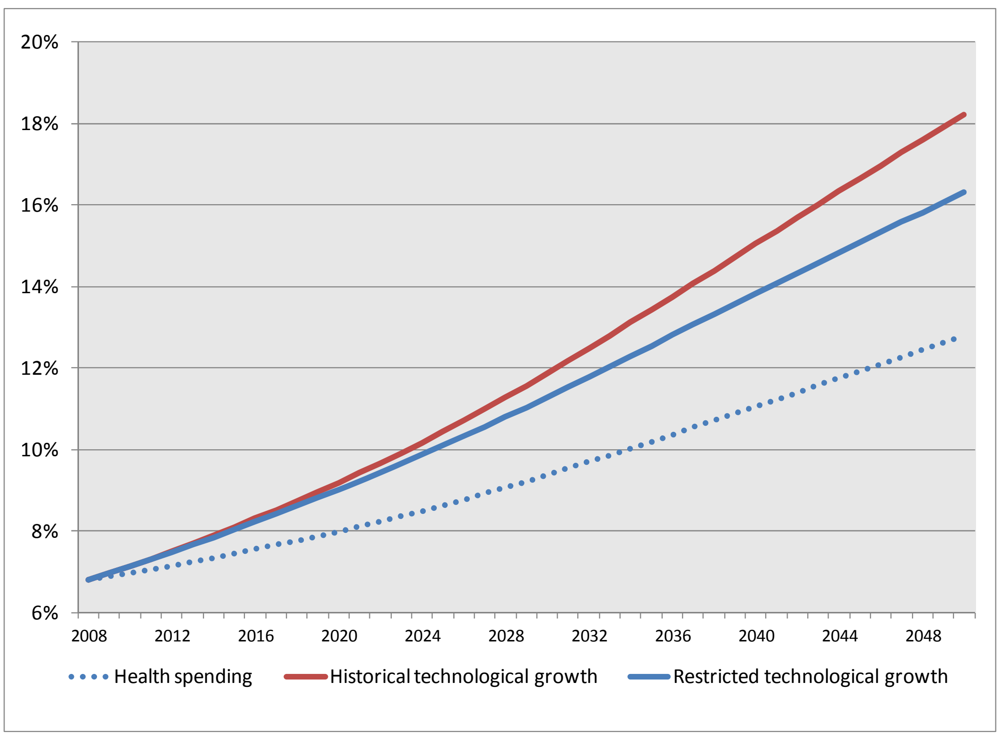


Source: Own calculations based on IBGE projections and PNAD 2008.

In the projection without income growth (Figure 15), which shows health spending as a proportion of GDP, real per capita income is constant without changing labor participation. Health expenditure as a proportion of GDP will increase from 6.8% in 2008 to 18.2% in 2050. These figures reach 12% as income growth at 1% and when the income growth rate is 3% the expenditure decrease until 5.3% of GDP. Assuming that current technology-related spending growth is maintained. In absolute terms, this means that health spending increases by 452,847 million reais within 42 years.

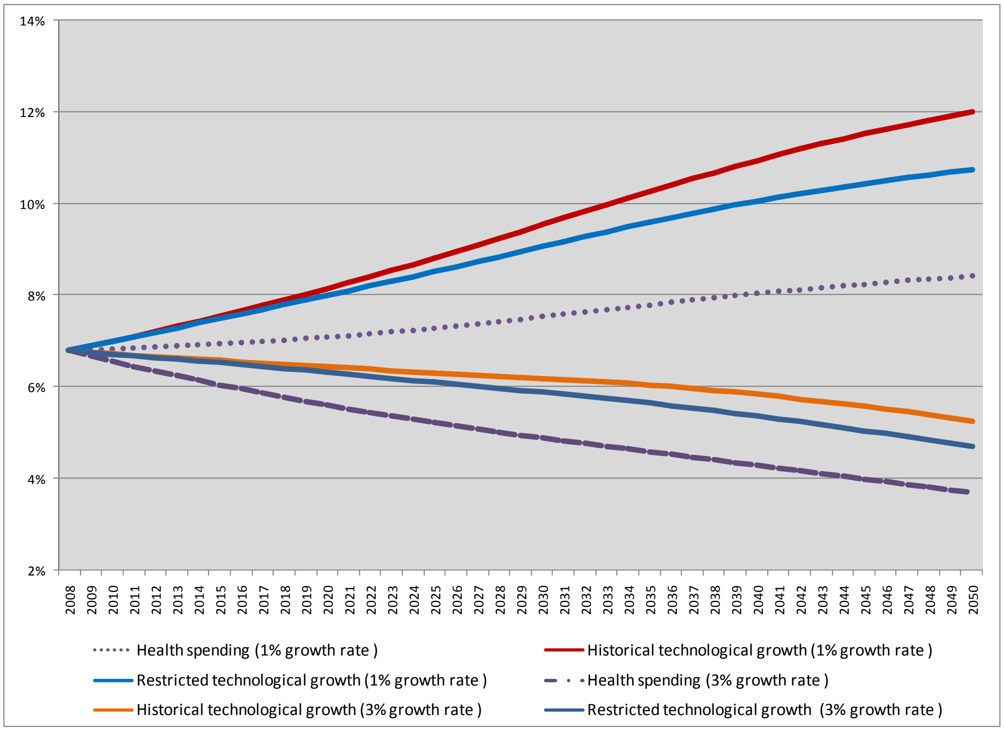
Figure 15 shows that if cost containment policies are implemented (restricted technological growth scenario), health expenditure as a proportion of GDP will increase by 9.5 percentage points instead of 11.4% between 2008 and 2050. This would be a saving of 1,107 million reais during the analyzed period. . As income growth at 1% the share of GDP needed is around 10.7 % instead of 16, and when the income growth rate is 3% it decrease until 4.7% of GDP (Figure 16).

Figure 15. Health expenditure trends (% GDP)



Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 16. Forecasts of public health expenditure growth (% GDP) with income growth, Brazil.



Source: Own calculations based on IBGE projections and PNAD 2008.

10.4.2 Alternative scenarios

This section estimates the impact of the changes in risk factors and socioeconomic characteristics on health spending. We simulated increases and decreases of 25% in the proportion of smokers, sedentary behavior and participants in the labor marker.

One of the most important methodological challenges in the simulation is the choice of the individuals which their behavioral characteristics will be modified. Table 5 shows the risk factors in Brazil.

Smokers are defined as individuals who have smoked at least 100 cigarettes during their lifetime. An individual is considered an alcohol drinker[19]if they currently consume alcohol. Sedentary behavior is defined as sitting for more than 8 hours a day without any vigorous physical activity or exercising less than once a week.

[19] The most sensible thing would be to consider individuals who consume more than a certain amount of alcohol. Unfortunately, individuals who answered about how often they drink and how many drinks are 'not too many' do not allow us to perform robust estimates. Therefore, care must be taken in using the results of this variable.

The methodology used is as follows: we used a probit model to estimate the probability of having a risk factor, for example in the case of smoking, we determine the probability of an individual to smoke. Then we generate a ranking ordered according to the estimated probability. As a result individuals were ordered as follows: first those individuals with the aforementioned feature in descending order according to the estimated probability and then those without that characteristic ordered by the estimated probability, also in descending order. The changes in the characteristic were made following the ranking until we reach the desired ratio. Table 6 shows the risk factor estimations.

Table 7 shows the results under different scenarios. The estimation under the scenario in which the we assume an increase in the proportion of smokers from 30% to 38% (25% increase) shows an increase in health spending around 2%, from an 18.2% of GDP in 2050 under the scenario with technology keeps pace with the historical growth to an 18.6% of GDP. This increase in health expenditure is different by disease. Asthma, heart disease, depression, cancer, tuberculosis, and cirrhosis result in the greatest spending increases.

Table 5. Risk factors in Brazil.

Gender	Smokers	Sedentarism	Labor participation
Female	23.8%	4.4%	57.2%
Male	37.7%	3.7%	80.3%
Total	30.5%	4.1%	68.3%

Source: Own calculations based PNAD 2008.

The increase in proportion of people living a sedentary lifestyle does not generate major changes in the level of health spending. A possible explanation is the low level of people currently living a sedentary lifestyle. The proportion of people living a sedentary lifestyle increases from 4.1% to 5.1% in the simulation.

A 25% increase in labor participation, from 68% to 85%, results in a reduction of nearly 7% in health spending. The diseases most positively affected are diabetes, depression, cancer, tuberculosis and cirrhosis.

In the reverse scenarios, the effects are the opposite. If the proportion of smokers decreases from 30% to 23% (25% decrease), health spending will be reduced by approximately 0.75% of GDP per year. Furthermore, the reduction in sedentarism does not generate major changes in the health spending. The 25% reduction in labor participation from 68% to 51% of the population results in an increase of more than 5% in health spending, while the diseases that most increase the spending are diabetes, heart disease, depression, cancer, tuberculosis, and cirrhosis.

Table 6.Riskfactorestimations[20].

Variables	Smokers		Sedentary		Labor participation	
	Female	Male	Female	Male	Female	Male
Age	0.090***	0.080***	-0.052***	-0.015***	0.104***	0.162***
Square age	-0.001***	-0.001***	0.000***	0.000***	-0.001***	-0.002***
Years of education	-0.033***	-0.047***	0.083***	0.083***	0.062***	0.042***
Indigenous	0.085***	0.073***	-0.139***	-0.090***	0.076***	0.053***
Sedentary	0.103***	0.095***			-0.087***	-0.318***
Smoke		-	0.105***	0.077***	0.059***	0.028***
Urban	0.106***	0.053***	0.482***	0.458***	-0.276***	-0.570***
Active	0.084***	0.087***	-0.123***	-0.314***	-	-
Region 1 (North)	0.063***	0.002***	0.170***	0.177***	0.139***	-0.028***
Region 3 (Southeast)	0.145***	0.106***	-0.066***	-0.005***	0.279***	0.040***
Region 4 (South)	0.056***	0.012***	0.126***	0.141***	0.173***	0.095***
Region 5 (Midwest)	0.038***	-0.129***	0.003*	0.063***	0.085***	-0.037***
Constant	-2.846***	-2.171***	-1.634***	-2.306***	-1.876***	-1.596***
Observation	120,163	111,073	120,163	111,073	120,163	111,073
Pseudo R2	0.08	0.13	0.14	0.11	0.14	0.23
Wald Test (rho = 0)	5286062	9739429	2904708	1849016	11220467	12245114
Prob > chi2	0	0	0	0	488	2564

Source: Own calculations based on IBGE projections and PNAD 2008.

The maps in section 10.5 show expenditure changes by geographic distribution in 2008 under different scenarios. These maps show that health spending is concentrated in certain areas such as Minas Gerais, Rio de Janeiro, and Sao Paulo which account for almost 40% of the population, where a large proportion of low-income individuals reside.

As labor participation increases, areas where health spending will decrease are Sao Paulo (-6.4%), Pernambuco (-6.5%), Rio De Janeiro (-6.9%), and Alagoas (-7.5%).

[20] Estimates used for simulations.

Changes in smoking decisions and in sedentary behavior does not generate regional effect. The spending growth is similar in all areas.

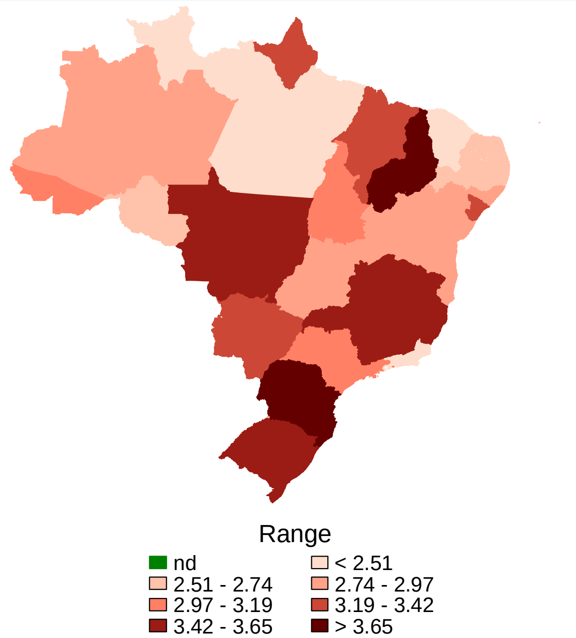
Table 7. Health expenditure changes assessed against the baseline scenario.

Year	25% increase in smokers	25% increase in sedentary lifestyle	25% increase in labor participation	25% reduction in smokers	25% reduction in sedentary lifestyle	25% reduction in labor participation
2008	1.97%	0.05%	-6.68%	-0.75%	-0.06%	5.21%
2009	1.98%	0.05%	-6.68%	-0.74%	-0.06%	5.20%
2010	2.00%	0.04%	-6.68%	-0.73%	-0.06%	5.19%
2011	2.01%	0.04%	-6.69%	-0.72%	-0.06%	5.20%
2012	2.02%	0.04%	-6.70%	-0.71%	-0.06%	5.21%
2013	2.03%	0.04%	-6.71%	-0.70%	-0.06%	5.22%
2014	2.04%	0.04%	-6.72%	-0.69%	-0.05%	5.24%
2015	2.05%	0.04%	-6.74%	-0.68%	-0.05%	5.27%
2016	2.06%	0.04%	-6.76%	-0.67%	-0.05%	5.30%
2017	2.07%	0.04%	-6.78%	-0.66%	-0.05%	5.33%
2018	2.07%	0.04%	-6.80%	-0.65%	-0.05%	5.37%
2019	2.08%	0.04%	-6.83%	-0.64%	-0.05%	5.40%
2020	2.08%	0.04%	-6.85%	-0.63%	-0.05%	5.44%
2021	2.09%	0.03%	-6.88%	-0.62%	-0.05%	5.47%
2022	2.09%	0.03%	-6.91%	-0.61%	-0.05%	5.50%
2023	2.10%	0.03%	-6.94%	-0.60%	-0.05%	5.53%
2024	2.10%	0.03%	-6.98%	-0.59%	-0.05%	5.55%
2025	2.10%	0.03%	-7.02%	-0.58%	-0.05%	5.56%
2026	2.10%	0.03%	-7.05%	-0.58%	-0.05%	5.57%
2027	2.11%	0.03%	-7.10%	-0.57%	-0.05%	5.57%
2028	2.11%	0.03%	-7.14%	-0.56%	-0.05%	5.57%
2029	2.11%	0.03%	-7.18%	-0.56%	-0.05%	5.57%
2030	2.11%	0.03%	-7.23%	-0.55%	-0.05%	5.56%
2031	2.11%	0.03%	-7.27%	-0.55%	-0.05%	5.56%
2032	2.12%	0.02%	-7.32%	-0.54%	-0.05%	5.55%
2033	2.12%	0.02%	-7.37%	-0.54%	-0.05%	5.55%
2034	2.12%	0.02%	-7.42%	-0.53%	-0.05%	5.55%
2035	2.13%	0.02%	-7.47%	-0.53%	-0.05%	5.56%
2036	2.13%	0.02%	-7.52%	-0.52%	-0.05%	5.57%
2037	2.13%	0.02%	-7.57%	-0.52%	-0.05%	5.59%
2038	2.14%	0.02%	-7.62%	-0.52%	-0.05%	5.61%
2039	2.14%	0.02%	-7.67%	-0.52%	-0.05%	5.63%
2040	2.14%	0.02%	-7.72%	-0.51%	-0.05%	5.66%
2041	2.14%	0.02%	-7.77%	-0.51%	-0.05%	5.69%
2042	2.15%	0.02%	-7.82%	-0.51%	-0.05%	5.72%
2043	2.15%	0.02%	-7.87%	-0.51%	-0.05%	5.74%
2044	2.15%	0.02%	-7.92%	-0.51%	-0.05%	5.77%
2045	2.15%	0.02%	-7.97%	-0.51%	-0.05%	5.78%
2046	2.15%	0.02%	-8.03%	-0.51%	-0.05%	5.80%
2047	2.15%	0.02%	-8.08%	-0.51%	-0.05%	5.81%
2048	2.15%	0.02%	-8.14%	-0.51%	-0.05%	5.81%
2049	2.15%	0.02%	-8.20%	-0.51%	-0.05%	5.81%
2050	2.15%	0.02%	-8.25%	-0.51%	-0.05%	5.81%

Source: Own calculations based on IBGE projections and PNAD 2008.

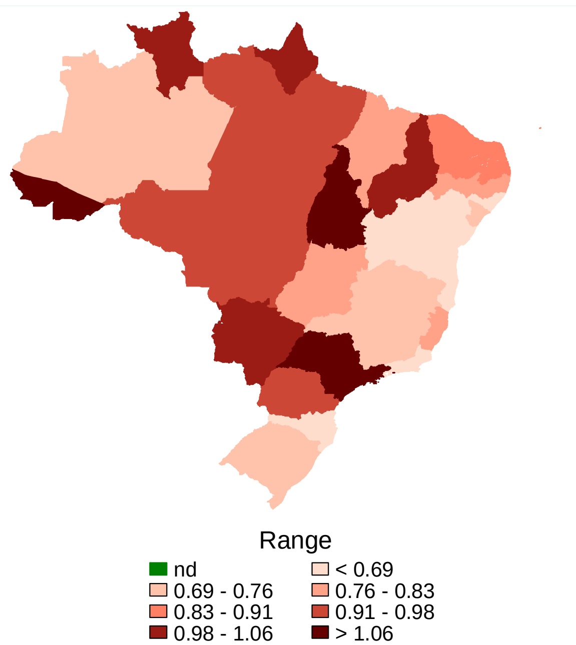
10.5 Maps

Figure 17. Geographic variations in health spending (%).25% increase in smokers.



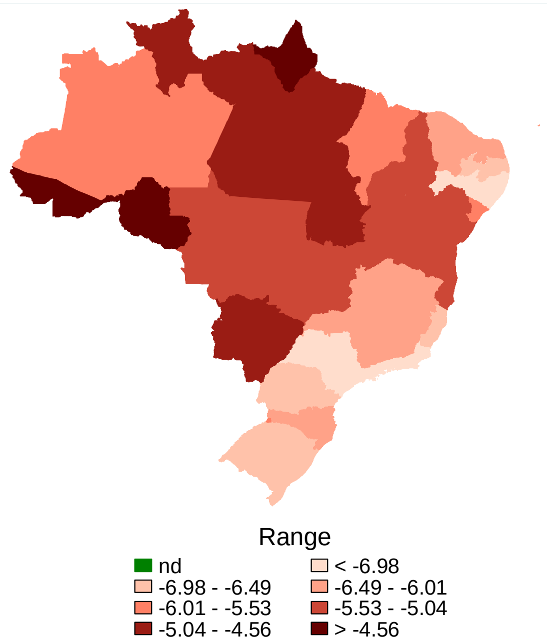
Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 18. Geographic variations in health spending (%).25% increase in sedentary lifestyle.



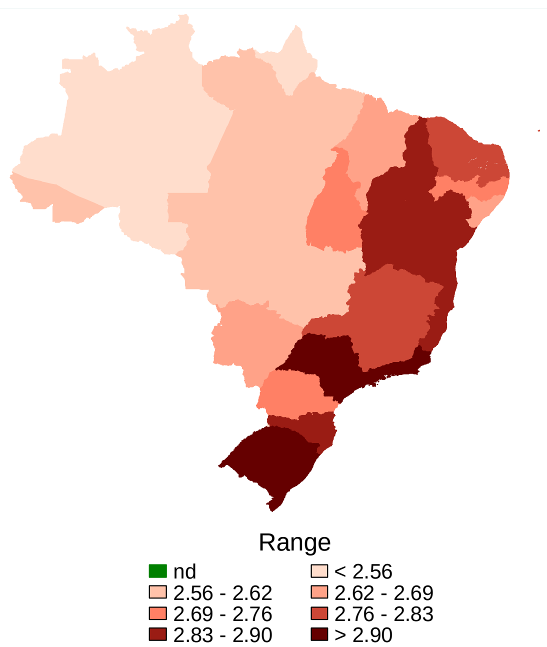
Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 19. Geographic variations in health spending (%).25% increase in labor participation.



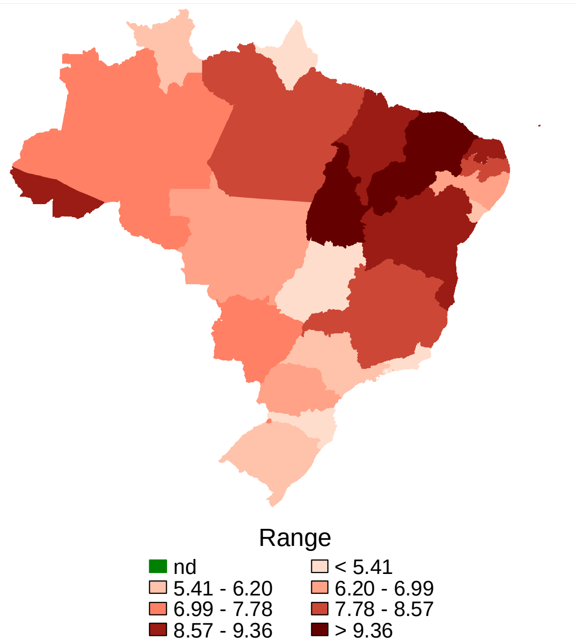
Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 20. Geographic variations in health spending (%).25% reduction in smokers.



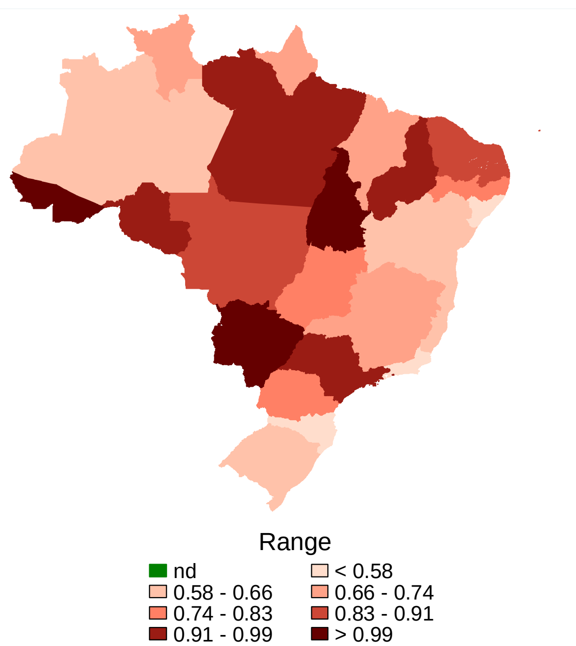
Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 21. Geographic variations in health spending (%).25% reduction in sedentary lifestyle.



Source: Own calculations based on IBGE projections and PNAD 2008.

Figure 22. Geographic variations in health spending (%).25% reduction in labor participation.



Source: Own calculations based on IBGE projections and PNAD 2008.

11. Annex 2.Chile

This section develops the methodology and presents outcomes for long-term health expenditure projections for Chile. The study is based on the 2009 National Health Survey (ENS 2009), and the source for population projections for1990-2050 is the National Institute of Statistics (INE). The 2007health spending data comes from the Ministry of Health of Chile.[21]

ENS 2009 interviewed 5,434 people. A nurse performed clinical measurements and tests on 5,043 participants and 4,956 further laboratory examinations (blood and urine tests). This data is representative at a national and regional level (urban and rural). The survey includes those over age 15.

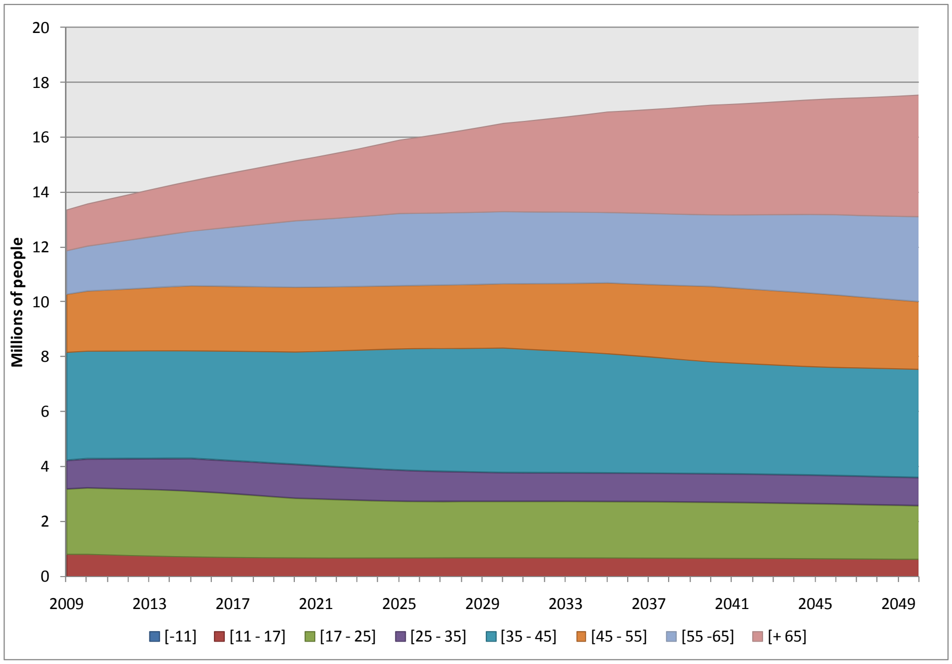
11.1 Demographic projections

The INE projects the Chilean population by gender and age from 1990-2050, and changes in age structure are simulated using new weights. Figure 23 and Figure 24show the simulated population projects by age group and gender, respectively.

Changes in the population structure is noted by a significant decrease in the proportion of young people. In the under-11 age group, the decrease is from 17% to 12%, in the 11-17 age group, 10% to 6%, and in the 17-25 age group, from 14% to 9%. The proportion of individuals in the 25-35 age group decreases from 7% to 5%, although the 45-55 age group does not present major changes. The proportion of individuals in the older groups increase, where the proportion of individuals in the 55-65 age group increases by 5.5% of the total population, and the proportion of individuals in the over-65 age group more than doubles. The projections predict an increase in the proportion of women (from 56% to 63%) during the analyzed period.

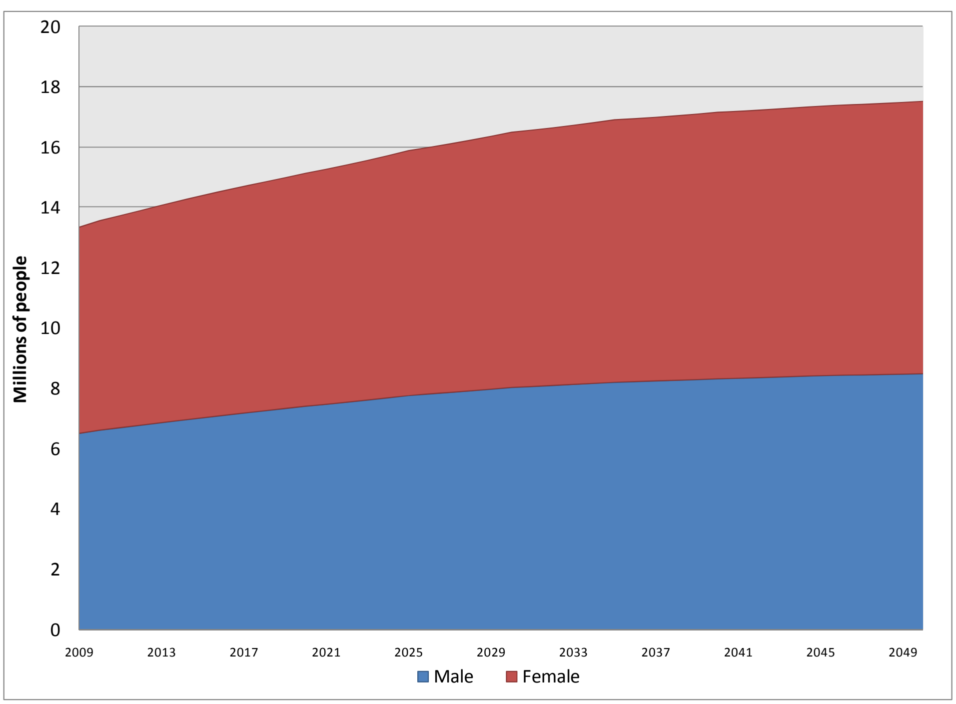
[21] For more details see "Verificación del costo esperado por beneficiario del conjunto priorizado de problemas de salud con garantías explícitas," Ministerio de salud de Chile, 2007.

Figure 23. Evolution of the population according to age group.



Source: Own calculations based on INE projections and CASEN 2009.

Figure 24. Population trends according to gender.



Source: Own calculations based on INE projections and CASEN 2009.

11.2 Epidemiological projections

ENS 2009 contains information on the prevalence of some chronic and infectious diseases and the utilization, quality, and responsiveness of health services. It provides data related to the magnitude and distribution of diseases such as high blood pressure, dyslipidemia, nutritional status, diabetes mellitus, metabolic syndrome, cardiovascular risk, musculoskeletal symptoms, renal function, chronic respiratory symptoms, cognitive impairment of the elderly, and hepatitis B and C, as well as risk factors such as alcohol, sedentary lifestyle, and smoking.

Table 8. Percentage of people according to disease and age group.

Age groups	Heart disease	Stroke	Depression	Asthma	Hypertension	Diabetes	Cholesterol	HIV	Kidney Diseases	Epilepsy	Cirrhosis	Gastric illness
[11 - 17]	0.0%	0.0%	11.0%	7.2%	58.4%	1.7%	40.9%	0.0%	1.3%	0.6%	0.0%	0.5%
[17 - 25]	0.2%	0.0%	16.1%	8.4%	74.6%	0.1%	70.2%	0.0%	0.3%	1.6%	0.9%	1.8%
[25 - 35]	1.2%	1.0%	19.9%	6.2%	65.7%	1.2%	64.4%	0.0%	0.0%	1.8%	3.0%	4.4%
[35 - 45]	1.3%	0.9%	23.4%	3.1%	36.3%	5.6%	60.0%	0.5%	1.0%	3.7%	3.5%	6.0%
[45 - 55]	5.0%	2.5%	24.2%	6.9%	31.5%	9.6%	52.3%	0.0%	1.7%	2.3%	3.3%	9.6%
[55 -65]	7.0%	4.4%	27.2%	6.8%	25.6%	19.6%	44.3%	0.1%	3.4%	1.5%	4.8%	11.9%
[+ 65]	9.8%	8.4%	23.5%	8.0%	26.1%	20.1%	48.0%	0.2%	4.4%	1.7%	2.8%	11.5%
Total	3.2%	2.2%	21.7%	6.1%	33.2%	7.9%	53.0%	0.2%	1.6%	2.3%	2.8%	6.6%

Source: Own calculations based on CASEN 2009.

Table 8 shows the distribution of diseases by age group. Table 9 shows the proportion of individuals treated which shows that in most diseases, prevalence and treatment rate increase with age. Unlike the other health surveys used in this research, the data from the ENS 2009 does not provide robust estimates of diseases probabilities. Therefore, there are no disease projections based on the individual characteristics, and only demographic changes are considered.

Table 9. Percentage of treated people according to disease and age group

Age groups	Heart disease	Stroke	Depression	Asthma	Hypertension	Diabetes	Cholesterol	HIV	Kidney Diseases	Epilepsy	Cirrhosis	Gastric illness
[11 - 17]	.	.	86%	12%	21%	77%	100%	.	100%	62%	.	100%
[17 - 25]	29%	.	87%	23%	17%	1%	41%	.	100%	99%	24%	86%
[25 - 35]	84%	0%	88%	12%	31%	88%	45%	.	.	97%	27%	69%
[35 - 45]	8%	89%	94%	17%	21%	59%	52%	100%	82%	98%	80%	83%
[45 - 55]	54%	99%	81%	41%	43%	58%	58%	.	54%	87%	42%	87%
[55 -65]	69%	96%	79%	30%	49%	79%	50%	100%	79%	79%	50%	96%
[+ 65]	81%	99%	85%	60%	48%	79%	70%	100%	44%	73%	35%	93%
Total	67.4%	93.8%	85.2%	31.6%	38.9%	72.4%	55.2%	100.0%	68.5%	90.5%	51.3%	89.1%

Source: Own calculations based on CASEN 2009.

11.3 Health expenditures

The Ministry of Health of Chile conducted a study that estimated the cost for 56[22] health problems in 2007, and where possible, the costs are linked with disease-specific data from ENS 2009. Total cost per treated patient is calculated by dividing total expenditure by the number of patients treated for each disease. Table 10 shows the cost per patient treated by disease.

Public expenditures represents only a part of the health spending. Table 11 shows that the estimated expenditure for 2009 is 6% of health final consumption. Projections are extrapolated assuming that the share of public expenditure as a proportion of total health spending remains constant.

[22] ESRD; operable congenital heart disease in children under 15 years, cervical cancer, cancer pain relief and palliative care advanced, acute myocardial infarction AMI Diabetes mellitus type 1 Diabetes mellitus type 2 breast cancer, spinal Disrrafias; Scoliosis, Niagara, total hip prosthesis, Cleft lip, cancer in children under 15 years Schizophrenia, testicular Cancer, lymphomas in persons 15 years and older; AIDS; Ira <5 years; pneumonia in people 65 years Hypertension , Epilepsy, oral Health, Premature, conduction disorders: pacemaker; cholecystectomy gallbladder cancer preventive, gastric cancer, prostate cancer, Vices of refraction, strabismus, diabetic retinopathy, rhegmatogenous retinal detachment nontraumatic, Hemophilia, mild and moderate depression outpatient treatment, benign prostatic hyperplasia, Orthotics, ischemic stroke, obstructive lung disease outpatient conical; Asthma bronchial respiratory distress syndrome in the newborn; leukemia in persons 15 years and older; severe ocular trauma; Fibrosis; Great severe burn; alcohol and drug dependence in adolescents; Analgesia delivery; hearing loss secondary rheumatoid arthritis, Osteoarthritis Hip Mild and Moderate in over 60 years of Knee Osteoarthritis Mild and Moderate in over 55 years; Break Aneurysms and Rupture of intracranial Vascular Malformations;

Table 10. Average expenditure according to disease

Disease	Expected Cost	Sick people	Patients treated	Cost per patient treated
Alcoholism	11,676,723	138,602	128,058	91,183
Asthma	7,739,819	812,812	257,036	30,112
Goiter		681,245	582,800	
Cancer	61,890,924	36,576	89,275	693,262
Cirrhosis		344,972	210,167	
Cholesterol		1,327,076	732,941	
Depression	51,324,831	2,877,725	2,452,011	20,932
Stroke	56,153,565	289,056	270,352	207,705
Diabetes	49,670,559	1,045,143	756,750	65,637
Gastric diseases	12,313,182	801,084	791,601	15,555
Kidney diseases	66,069,503	192,638	128,915	512,504
Epilepsy	358,289	277,182	270,329	1,325
Hypertension	49,892,451	1,243,229	481,739	103,567
HIV	21,947,864	22,075	22,075	994,241
Infarct	14,496,003	424,946	272,828	53,132
Obesity	3,913	4,549,685	523,219	234,802
Diseases not considered	276,798,673			
Total	680,336,301	15,064,046	7,970,096	85,361

Source: Own calculations based on Chilean Ministry of Health

(*) Note: Chilean pesos

Table 11. Health final consumption expenditure, Chile 2009. (In thousands Chilean pesos)

Specification	Total	Hospital activity	Activity ambulatory primary	Other activities related to human health	Activity regulation of public health and health activities	Activities plans compulsory social security
Final Consumption Expenditure	**2,566,088,283**	**1,651,268,657**	**611,115,458**	**22,862,604**	**154,053,773**	**126,787,791**
Individual Consumption Expenditure	**2,438,932,362**	**1,651,250,318**	**611,115,458**	**22,862,604**	**62,372,936**	**91,331,046**
Health Hospitality	2,138,668,214	1,535,894,810	610,358,144	22,862,188		
Chemicals and pharmaceuticals	668,453				662,160	6,293
Placement, education, rehabilitation, prevention and other	5,711,985	1,502,941	1,920		4,207,124	
Placing high-risk pregnant	106,402	106,402				
Family placement of children and non-hospital	1,271,841	1,271,237	604			
Expense Risk MAP	19,647	19,647				
Indigenous Program	106,971	105,655	1,316			
Support Programme newborn	4,207,124				4,207,124	
Purchase additional medical services to the system	205,933,130	113,852,567	755,394	416		91,324,753
Purchase surgery	19,621,362	19,621,362				
Purchase hemodialysis services	79,628,819	1,378,836				78,249,983
Purchase medical services urgent care	22,332,924	22,332,924				
Purchase of other medical services nes (a)	84,350,025	70,519,445	755,394	416		13,074,770
Feeding programs	57,503,652				57,503,652	
Feeding program for the elderly (PACAM)	17,583,906				17,583,906	
Complementary national food program (PNAC)	39,919,746				39,919,746	
Collective Consumption Expenditure	**127,155,921**	**18,339**			**91,680,837**	**35,456,745**
Program winter campaign	18,339	18,339				
n.e.p.	127,137,582				91,680,837	35,456,745

Source: Health Satellite Account 2003 - 2009, Ministry of Health of Chile

11.4 Projection outcomes

This section presents the health expenditure projections by disease and gender, as well as the simulations outcomes under different scenarios.

11.4.1 Base line scenario

Simply put, health spending is the sum of health-related expenditures for the individuals in a population, taking into account the probabilities of each individual to develop and be treated for a disease. The ratio of hospital care spending to total health spending remains constant throughout the period analyzed. The methodology allows for the disaggregation of expenditure trends to every variable available in the survey, such as age group, gender, and region.

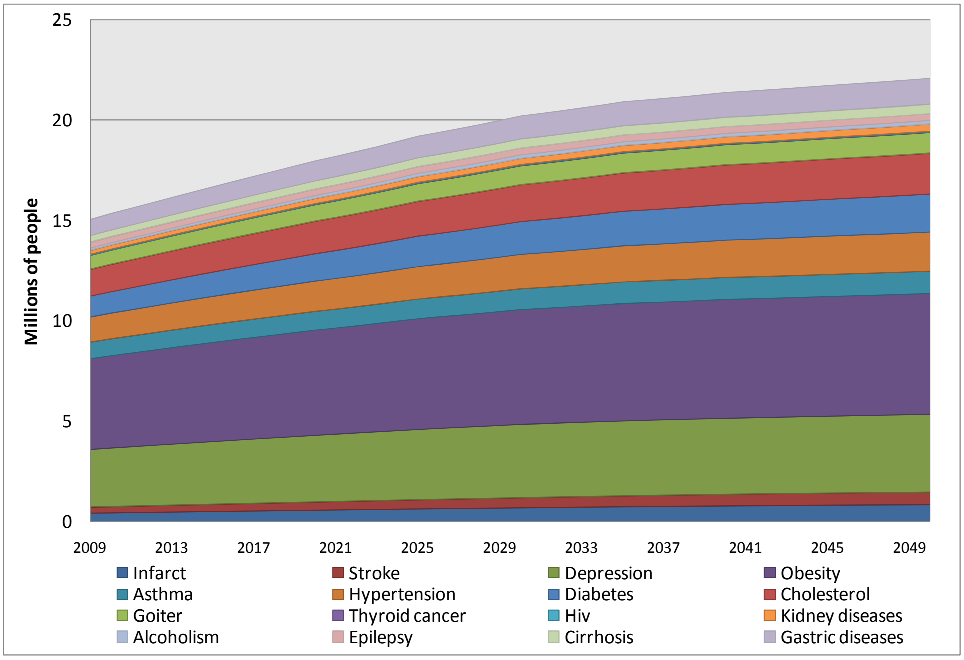
Figure 21 shows the projection of the number of people with each disease. Hypertension(0.6%), high cholesterol (0.4%), infarctions (1%), cerebrovascular accidents or stroke (0.8%),and diabetes (1.7%) have the greatest increase in number of people, and depression (-1.5%), obesity (-2.9%), and asthma (-0.4%) have the greatest decrease in number of people.

Figure 22 shows the projection of the number of treated patients by disease. The greatest decrease in number of people treated are in depression (-4.4%) and obesity (-1.12%), and the greatest increase in number of people treated are in hypertension (0.8%), strokes (1.33%), infarctions (1.62%), and diabetes (2.17%).

The projections estimate an increase in the spending for heart disease (1.3%), diabetes (1.4%), and cerebrovascular accidents (4.0%), and a reduction in spending for depression (-3.5%), HIV (-2.2%), and kidney diseases (-0.6%). For other diseases analyzed, there are not major changes in spending.

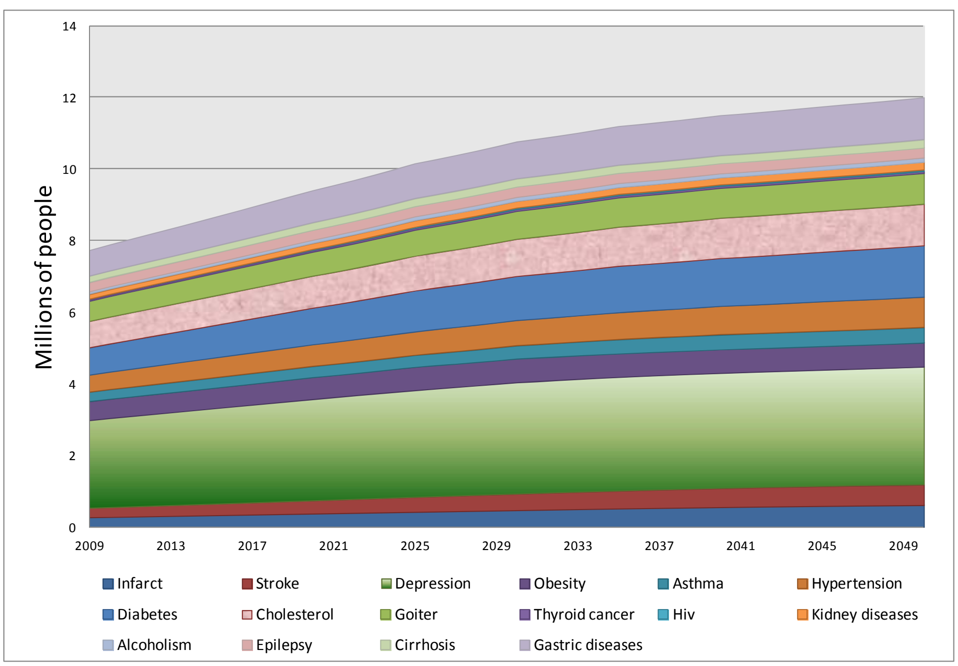
Figure 23 shows the projected health expenditure by age group. The share of total expenditure of the under-25 age group decreases by 7% of total population, and that of the adult age group decreases by 15% of total population. The share of expenditure on the 55-65 age group increases by 3.7% of total population and that of the over-65 age group increases by 18% of total population.

Figure 25. Patient trends according to disease



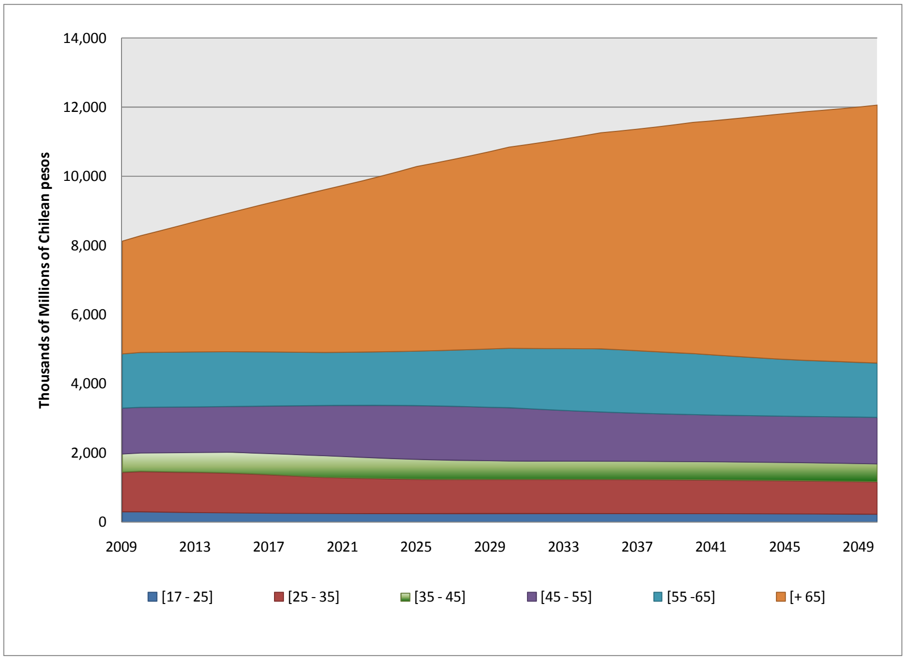
Source: Own calculations based on INE projections and ENS 2009.

Figure 26. Patients treatment trends, according to disease.



Source: Own calculations based on INE projections and ENS 2009.

Figure 27. Forecasts of growth in public health expenditure[23]



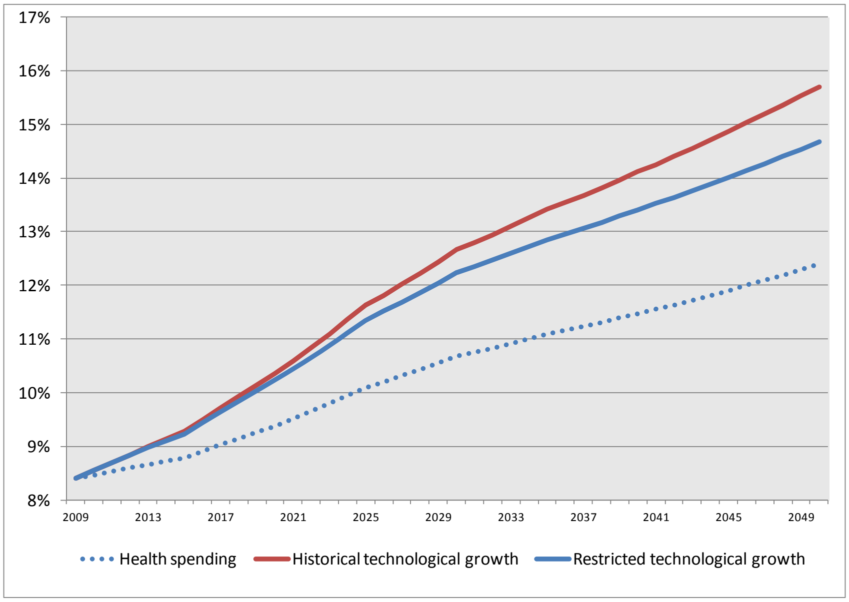
Source: Own calculations based on INE projections and ENS 2009.

Figure 24 shows that health spending will increase by 7.3% of GDP, from 8.4% in 2009 to 15.7% in 2050, assuming that current technology-related spending growth is maintained. These figures reach 10.4% as income growth at 1% and when the income growth rate is 3% the expenditure decrease until 4.7% of GDP in 2050. In absolute terms, this means that health spending will increase by 9,745,249 million Chilean pesos in 41 years.

Where cost containment policies are implemented (restricted technological growth scenario), health expenditure as a proportion of GDP will increase by 6.3% of GDP by 2050. This would be a saving about20,469 billion Chilean pesos during the analyzed period. . As income growth at 1% the share of GDP needed is near 9.8 % and when the income growth rate is 3% it decrease until 4.7% of GDP in 2050.

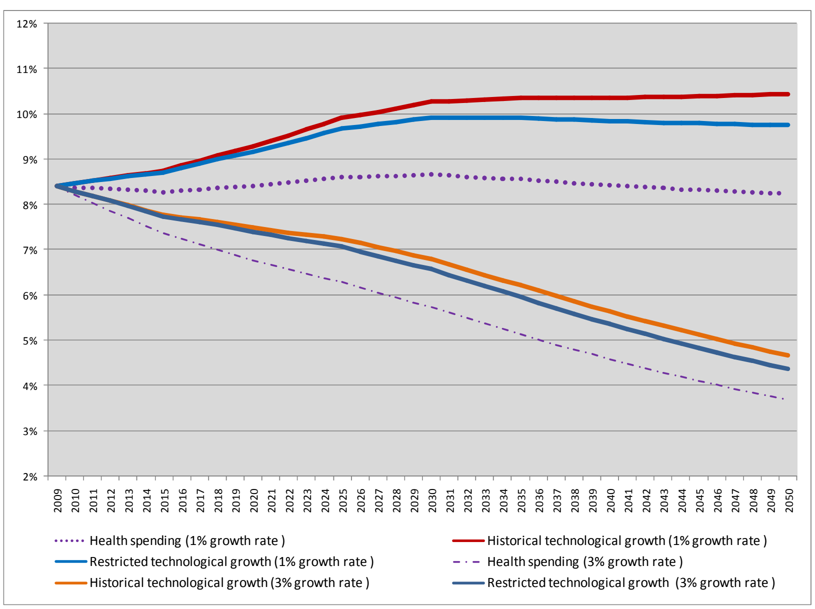
[23] Only diseases with information on treatment cost are analyzed.

Figure 28. Health spending projections(% GDP).



Source: Own calculations based on INE projections and ENS 2009.

Figure 29. Forecasts of growth in public health expenditure with income growth (% GDP), Chile.



Source: Own calculations based on INE projections and ENS 2009.

11.4.2 Alternative scenarios

A scenario where all diagnosed patients receive treatment is a good approximation of an expansion of the AUGE program. In this scenario, there are no barriers to health, such as lack of information, distance problems, and household budget.

In this scenario, health spending in 2050 will increase by 47% in nominal terms. Disease with the highest health expenditure increases are asthma (158.6%), hypertension (132.6%), kidney disease (63%), heart disease (32.3%),and diabetes (32.3%)(Table 12).

Regionally, the areas with the largest increases in expenditure are those where a relatively higher proportion of low-income individuals reside such Los Lagos and O'Higgins whereas spending increases less in the poorest areas such as Tarapaca, Arica, and Parinacota.

The maps in section 11.5 show expenditure changes by geographic distribution in 2009 under different scenarios. These maps show that health spending is concentrated in metropolitan areas (41% of total spending), including 14% in the Bíobío area and 12% in Valparaiso.

Table 12.Health expenditure changes assessed against the baseline scenario.

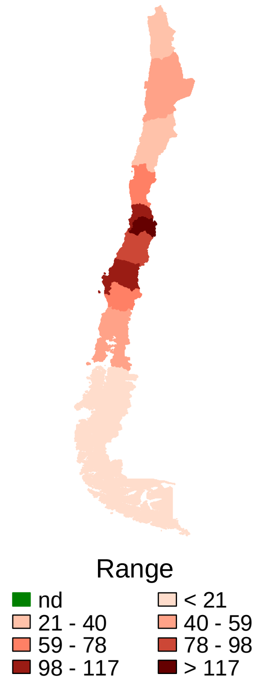
Year	Infarct	Stroke	Depression	Asthma	Hypertension	Diabetes	Hiv	Kidney diseases	Epilepsy	Gastric diseases	Total
2009	56%	7%	17%	216%	158%	38%	0%	49%	10%	13%	52%
2010	56%	7%	17%	215%	157%	38%	0%	50%	11%	13%	52%
2011	55%	7%	17%	213%	156%	37%	0%	50%	11%	12%	52%
2012	55%	7%	18%	212%	155%	37%	0%	51%	11%	12%	52%
2013	54%	7%	18%	211%	154%	36%	0%	51%	11%	12%	51%
2014	54%	7%	18%	210%	153%	36%	0%	52%	11%	12%	51%
2015	54%	7%	18%	208%	152%	36%	0%	52%	11%	12%	51%
2016	53%	7%	18%	207%	151%	35%	0%	53%	11%	12%	51%
2017	53%	7%	18%	205%	151%	35%	0%	53%	11%	12%	51%
2018	52%	6%	18%	204%	150%	35%	0%	54%	11%	12%	51%
2019	51%	6%	18%	202%	150%	35%	0%	54%	11%	12%	51%
2020	51%	6%	18%	200%	149%	34%	0%	55%	11%	12%	50%
2021	50%	6%	18%	199%	149%	34%	0%	55%	11%	11%	50%
2022	50%	6%	18%	198%	148%	34%	0%	56%	11%	11%	50%
2023	50%	6%	18%	196%	147%	34%	0%	57%	11%	11%	50%
2024	49%	6%	18%	195%	147%	34%	0%	57%	11%	11%	50%
2025	49%	5%	18%	194%	146%	34%	0%	58%	11%	11%	49%
2026	48%	5%	18%	191%	146%	34%	0%	59%	12%	11%	49%
2027	48%	5%	18%	189%	145%	34%	0%	59%	12%	11%	49%
2028	47%	5%	18%	186%	145%	34%	0%	60%	12%	11%	49%
2029	46%	5%	18%	184%	145%	34%	0%	61%	12%	11%	49%
2030	46%	5%	18%	182%	144%	34%	0%	61%	12%	11%	49%
2031	45%	5%	18%	179%	143%	34%	0%	62%	12%	11%	49%
2032	45%	5%	18%	177%	143%	34%	0%	62%	12%	11%	49%
203	44%	5%	18%	175%	142%	34%	0	63%	12%	11%	49

3							%				%
2034	43%	5%	18%	172%	141%	34%	0%	63%	12%	11%	49%
2035	43%	5%	18%	170%	141%	34%	0%	63%	12%	11%	49%
2036	42%	5%	18%	168%	140%	34%	0%	64%	12%	11%	49%
2037	42%	5%	18%	167%	140%	34%	0%	64%	12%	10%	49%
2038	41%	5%	18%	165%	139%	34%	0%	64%	12%	10%	49%
2039	40%	5%	18%	164%	138%	34%	0%	64%	12%	10%	49%
2040	40%	5%	18%	162%	138%	34%	0%	64%	12%	10%	49%
2041	40%	5%	19%	161%	137%	34%	0%	63%	12%	10%	48%
2042	39%	5%	19%	161%	136%	33%	0%	63%	12%	10%	48%
2043	39%	5%	19%	160%	136%	33%	0%	63%	12%	10%	48%
2044	39%	5%	19%	159%	135%	33%	0%	62%	12%	10%	48%
2045	38%	5%	19%	158%	135%	33%	0%	62%	12%	10%	48%
2046	38%	5%	19%	158%	134%	33%	0%	62%	12%	10%	48%
2047	38%	5%	19%	158%	134%	33%	0%	62%	12%	10%	48%
2048	38%	4%	19%	158%	133%	33%	0%	62%	12%	10%	47%
2049	37%	4%	19%	158%	133%	32%	0%	63%	12%	10%	47%
2050	37%	4%	19%	159%	133%	32%	0%	63%	12%	10%	47%

Source: Own calculations based on INE projections and ENS 2009.

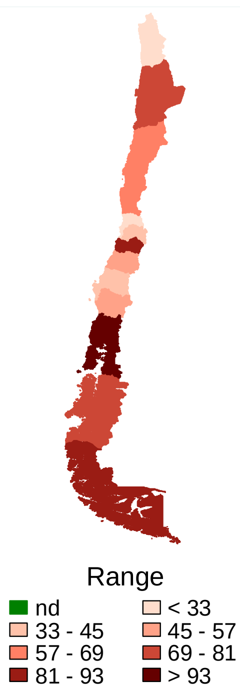
11.5 Maps

Figure 30. Geographic variations in health spending (%). Base line scenario.



Source: Own calculations based on INE projections and ENS 2009.

Figure 31. Geographic variations in health spending (%). 100% treatment.



Source: Own calculations based on INE projections and ENS 2009.

12. Annex 3. México

This section develops the methodology and presents outcomes for long-term health expenditure projections for Mexico. The study is based on the 2006 National Survey of Health and Nutrition (ENSANUT 2006), which contains disease, treatment, and health spending information. The source for population projections for 2005-2050 is the Mexican Population Council.

ENSANUT 2006 covers 48,304 homes, 206,700 household members, 24,098 children, 25,166 adolescents and 45,446 adults. It also contains50,027 micronutrients serology samples and 90,267 anthropometric measurements. This survey represents 103 million people, and this data is representative at a national and regional level (urban and rural).[24]

12.1 Demographic projections

The National Population Council[25] (CONAPO) projects the Mexican population by gender and age[26] from 2005 to 2050, and changes in age structure are simulated by generating new weights for ENSANUT (2006). Figure 27 shows the simulated population projections by age group, respectively.[27]

Changes in the population structure is noted by a significant decrease in the proportion of young people. In the under-11 age group, the decrease is from 17% to 8%, in the 11-17 age group, from 15% to 8%, and in the 17-25 age group, from 15% to 8.4%. The proportion of individuals in the 25-35 age group decreases from 15% to 11%, although the 45-55 age group does not present major changes. The proportion of individuals in the older groups increase, where the proportion of individuals in the 55-65 age group doubles, and the proportion of individuals in the over-65 age group triples.

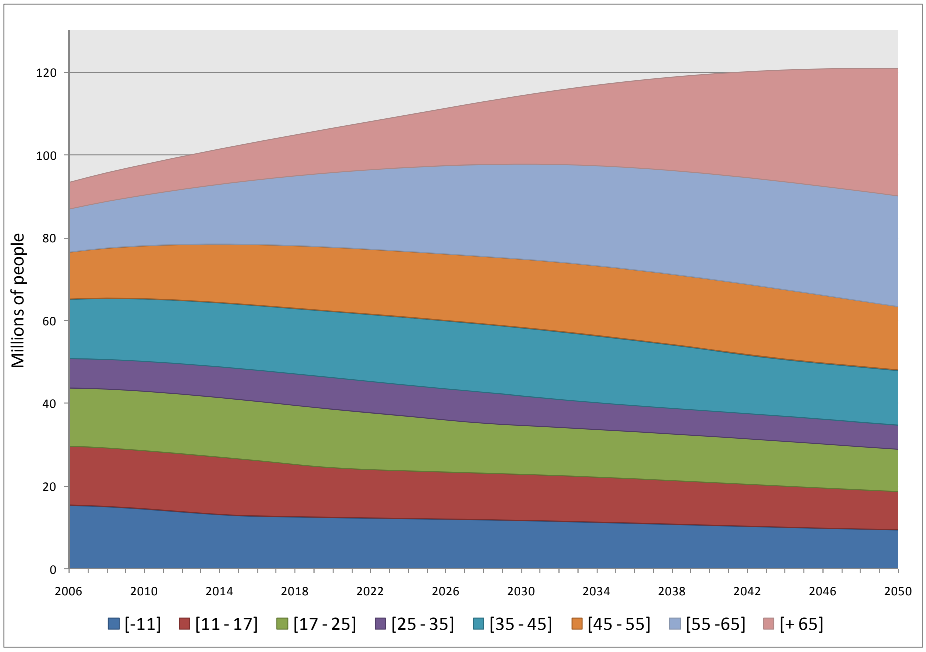
[24] It should be noted that the sample size allocation between strata was in proportion to the size of the same except in those states in which the sample size expanded, where the expansion was distributed among the strata which included households incorporated to Oportunidades. This implies that the design of the survey sample is not self-weighted.

[25] www.conapo.gob.mx

[26] Even performed by municipality and geographical entity.

[27] For a more detailed analysis see Bussolo, et al. (2007).

Figure 32. Population trends according to age group.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Some assumptions are required to generate projections for the population's educational[28] levels. In 2006 ENSANUT individuals 25 old years had the highest educational level, and the same is assumed for future projections. For example: in the simulation of the year 2031, individuals between 25 and 50 will have the same educational structure as 25 years old individuals in 2006, whereas those over 50 will have the same educational level as they had in 2006. This procedure was performed until we completed the entire time period. The projections assume that individuals at ages under 25 also kept the same educational structure as in2006.

In order to simulate the educational structure, the population is divided into groups according to age and gender. Within each group, individuals are grouped according to the number of years of education, and individuals are randomly ranked within the groups.

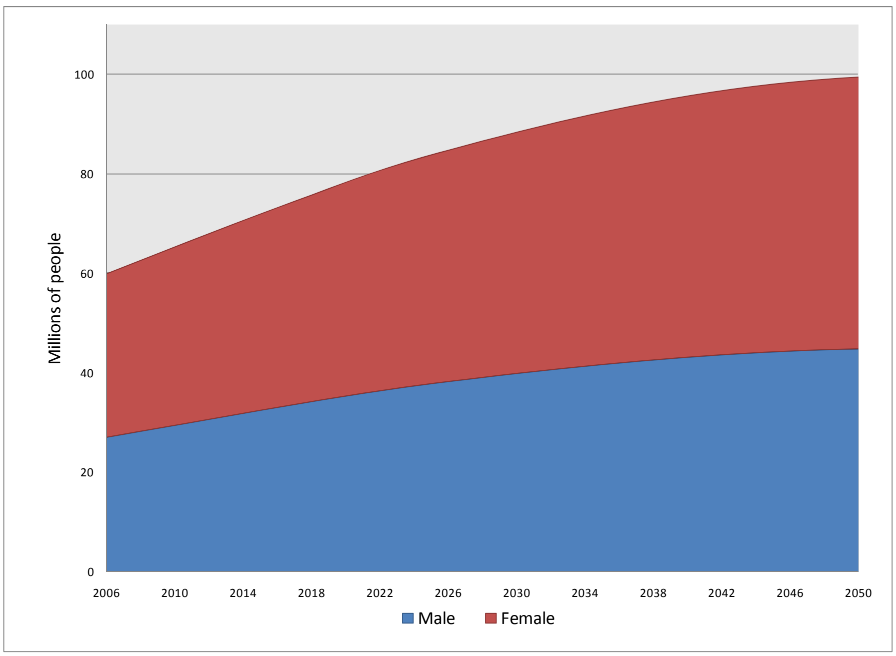
In order to modify the educational structure of each simulated group, we first assign the highest level of education 25-year-olds had to individuals with higher rankings within the higher education level and then to the individuals with the higher ranking in the next

[28] For educational structure we mean the population divided into age and gender groups and the proportions of each grade in each of these groups.

education level and so on, until we reach the desired proportion. We performed this procedure for all educational levels in all groups.

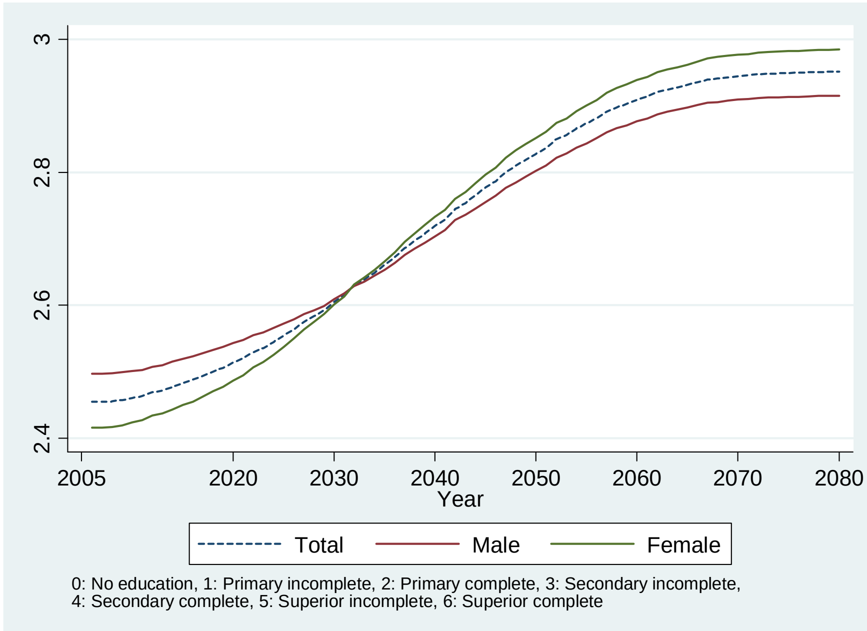
Figure 29 shows the simulated educational structure. Over time, a significant increase in the education level is expected, where by the year 2075, the structure begins to stay steady when all individuals reach the educational level of 25-year-old individuals. Near 2032 female educational levels stars to be higher than that of males, due to an increase in completion of primary and secondary studies rates.

Figure 33. Evolution of educational levels according to gender.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 34. Evolution of average educational levels.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

12.2 Epidemiological projections

ENSANUT 2006 provides data on the prevalence and treatment of chronic and infectious diseases, the quality and responsiveness of health services, and the health spending of Mexican households. Diseases such as cancer, cholesterol, depression, diabetes, kidney disease, heart disease, hypertension, high triglycerides, and obesity and risk factors such as alcohol and tobacco consumption are included.

Table 13. Percentage of sick people according to disease and age group.

Grupo de edad	High triglycerides	Cholesterol	Depression	Obesity	Diabetes	Hypertension	Kidney disease	Heart disease	Cancer
[17 - 25]	0.76%	2.18%	11.65%	4.91%	0.39%	4.70%	10.74%	0.29%	0.14%
[25 - 35]	2.03%	3.30%	13.46%	7.88%	1.42%	7.33%	14.77%	0.30%	0.44%
[35 - 45]	3.38%	6.14%	15.31%	10.12%	3.17%	9.63%	16.78%	0.48%	0.55%
[45 - 55]	6.44%	11.28%	17.44%	9.66%	7.98%	16.18%	16.24%	1.02%	1.09%
[55 - 65]	8.36%	15.60%	18.38%	11.45%	15.25%	25.41%	15.10%	1.83%	1.26%
[+ 65]	6.27%	14.25%	25.88%	6.92%	17.14%	36.10%	15.59%	4.14%	1.42%
Total	4.54%	8.64%	16.56%	8.79%	7.03%	15.39%	15.02%	1.16%	0.79%

Source: Own calculations based on ENSANUT 2006.

Table 13 shows the distribution of diseases by age group. Table 14 shows the proportion of individuals treated. Table 13 and Table 14 show that in most diseases, prevalence and treatment rate increase with age.

Table 14. Percentage of people treated according to disease and age group

Grupo de edad	High triglycerides	Cholesterol	Depression	Obesity	Diabetes	Hypertension	Kidney disease	Heart disease	Cancer
[17 - 25]	45.92%	52.05%	45.51%	36.80%	64.46%	10.97%	7.67%	23.14%	100.00%
[25 - 35]	60.68%	61.83%	44.71%	35.92%	76.97%	21.35%	9.81%	6.66%	74.24%
[35 - 45]	76.40%	69.41%	56.04%	41.62%	82.13%	31.40%	9.40%	22.49%	95.73%
[45 - 55]	80.10%	76.49%	56.55%	43.87%	87.83%	55.82%	10.23%	40.55%	93.55%
[55 - 65]	85.14%	78.14%	52.20%	41.81%	91.39%	72.91%	10.40%	47.34%	89.64%
[+ 65]	83.07%	83.26%	62.50%	42.51%	94.73%	83.96%	10.71%	66.02%	89.30%
Total	79.49%	75.29%	54.28%	41.14%	89.89%	61.34%	9.74%	48.78%	90.86%

Source: Own calculations based on ENSANUT 2006.

We employ a probit model by gender to determine the probability of an individual to contract a disease. The independent variables used were: age, squared age, gender, years of education, ethnicity, smoking condition, alcohol drinker status, obesity, cholesterol, diabetes and hypertension. We also include the urban situation (urban or rural), the participation in the labor market and the geographical region the person lives in. Table 15 shows the estimation results.

Generally, there is a positive and nonlinear relationship between age and the likelihood of contracting a disease, with the exception of depression. The probability of developing depression increases with age but at decreasing rates.

The model indicates that a greater number of years of education will reduce the probability of getting sick, with the exception of obesity, cancer, and high cholesterol. Being a member of an indigenous ethnic group and consuming alcohol does not uniformly impact the probability of developing an illness across diseases. Sedentary behavior generally increases the likelihood of developing a disease. Smoking increases the risk of developing all diseases analyzed. In addition, labor market participation decreases the likelihood of developing a disease.

Obesity increases risk of developing all diseases analyzed. Having diabetes increases the risk of depression, obesity, hypertension, kidney disease, and heart disease. Furthermore, having high blood pressure increases the risk of cancer, depression, kidney and heart disease, and high cholesterol increases the risk of having heart disease.

Table 16 shows that generally, there is a positive and nonlinear relationship between age and the likelihood of being treated. A greater number of years of education increases the chances of being treated in almost all diseases. A similar effect is found for health insurance and income.

Table 15. Estimation of disease probabilities.

Variables	Disease															
	Depression		Obesity		Diabetes		Hypertension		Kidney disease		Heart disease		Cancer		Cholesterol	
	Female	males	Female	males	Female	males	Female	males	Female	males	Female	males	Female	males	Female	males
Age	-0.006***	-0.004***	0.033***	0.033***	0.102***	0.108***	0.040***	0.047***	0.003***	0.022***	0.007***	0.010***	0.050***	0.010***	0.084***	0.083**
Square age	0.000***	0.000***	-0.000***	-0.000***	-0.001***	-0.001***	-0.000***	-0.000***	-0.000***	-0.000***	0.000***	0.000***	-0.000***	0.000***	-0.001***	-0.001**
Years of education	-0.052***	-0.040***	0.020***	0.002***	-0.033***	-0.001***	-0.021***	0.018***	-0.003***	-0.000***	-0.026***	0.021***	0.011***	0.011***	0.006***	0.034**
Married	-0.017***	-0.096***	0.047***	-0.014***	0.034***	0.047***	0.022***	0.082***	0.202***	0.128***	-0.192***	0.109***	-0.127***	-0.036***	0.019***	0.190**
Indigenous	0.061***	0.022***	0.160***	0.065***	0.075***	0.098***	0.032***	-0.136***	-0.003***	-0.032***	-0.211***	0.190***	-0.041***	-0.519***	0.020***	-0.026**
Sedentary	0.188***	0.155***	0.067***	0.237***	0.056***	0.236***	0.042***	0.160***	0.112***	0.136***	0.206***	0.214***	0.056***	0.085***	0.017***	0.165**
Drink alcohol	0.146***	0.054***	0.002	-0.068***	-0.116***	-0.175***	0.058***	-0.049***	0.296***	-0.028***	-0.053***	0.006***	-0.094***	-0.172***	0.079***	-0.029**
Smoke	0.187***	0.080***	0.106***	-0.129***	0.013***	0.146***	0.057***	0.062***	0.119***	0.159***	0.249***	0.073***	0.162***	0.078***	0.157***	0.119**
Urban	-0.114***	-0.001	-0.265***	-0.313***	-0.242***	-0.348***	-0.100***	-0.187***	-0.050***	-0.139***	-0.068***	-0.194***	-0.079***	0.057***	-0.325***	-0.192**
North	0.025***	0.034***	-0.223***	-0.573***	-0.063***	0.039***	-0.199***	-0.210***	-0.138***	-0.115***	-0.057***	-0.248***	0.036***	-0.118***	-0.380***	-0.306**
Northeast	-0.206***	-0.160***	-0.189***	-0.042***	0.076***	0.096***	-0.204***	-0.134***	-0.184***	-0.119***	0.005	-0.224***	-0.133***	0.094***	-0.251***	-0.202**
West Central	0.109***	0.137***	-0.147***	-0.197***	-0.131***	0.049***	-0.139***	-0.024***	-0.097***	-0.136***	0.194***	-0.069***	-0.026***	0.069***	-0.227***	-0.268**
Central-East	-0.007***	-0.020***	-0.092***	-0.211***	-0.041***	0.166***	-0.169***	-0.154***	-0.012***	-0.028***	-0.062***	-0.241***	0.025***	0.082***	-0.194***	-0.139**
South	0.115***	0.160***	-0.307***	-0.299***	-0.325***	0.046***	-0.388***	-0.126***	-0.112***	-0.036***	-0.022***	-0.328***	0.127***	-0.130***	-0.229***	-0.201**
East	-0.040***	0.038***	-0.239***	-0.217***	0.134***	0.129***	-0.269***	-0.200***	-0.106***	0.079***	-0.082***	-0.410***	-0.262***	-0.776***	-0.010***	0.016**
Yucatan Peninsula	-0.301***	-0.189***	-0.438***	-0.397***	-0.083***	-0.083***	-0.204***	-0.080***	-0.197***	-0.034***	0.075***	-0.199***	-0.085***	0.107***	-0.027***	-0.007**
Obesity	0.214***	0.240***	-	-	0.226***	0.134***	0.400***	0.368***	0.219***	0.210***	-0.506***	0.252***	-0.272***	-	0.274***	0.573**
Diabetes	0.160***	0.165***	0.195***	0.083***	-	-	0.424***	0.586***	0.316***	0.050***	0.220***	0.234***	-	-	-	-
Hypertension	0.275***	0.351***	-	-	-	-	-	-	0.346***	0.465***	0.433***	0.521***	0.221***	0.251***	-	-
Cholesterol	-	-	-	-	-	-	-	-	-	-	0.556***	0.608***	-	-	-	-
Constante	-0.412***	-1.159***	-2.644***	-2.579***	-4.246***	-4.720***	-2.019***	-2.993***	-1.050***	-2.065***	-2.682***	-3.415***	-3.649***	-3.414***	-3.552***	-3.990**
Observations	21,564	17,467	21,644	17,523	21,644	17,523	21,644	17,523	21,644	17,523	21,443	17,378	21,539	17,174	21,443	17,378
Pseudo R2	0.05	0.05	0.03	0.03	0.15	0.13	0.11	0.13	0.03	0.04	0.16	0.21	0.05	0.1	0.09	0.09
Wald Test (rho = 0)	1472008	743009	202010	119183	1551008	988652	2615596	2040089	886630	680601	592454	652682	175669	133983	1183098	938987
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own calculations based on ENSANUT 2006.

Table 16. Estimation of treatment probabilities.

Variables	Treated disease													
	Depression		Obesity		Diabetes		Hypertension		Kidney disease		Heart disease		Cancer	
	Female	males	Female	males	Female	males	Female	males	Female	males	Female	males	Female	males
Age	0.021***	0.017***	0.024***	0.008***	0.120***	0.015***	0.129***	0.049***	0.030***	0.010***	-0.035***	0.072***	0.115***	-0.348***
Square age	-0.000***	-0.000***	-0.000***	0.000***	-0.001***	0.000***	-0.001***	-0.000***	-0.000***	-0.000***	0.001***	-0.000***	-0.001***	0.003***
Years of education	0.001***	0.011***	0.034***	0.015***	-0.013***	0.007***	0.015***	0.018***	0.021***	-0.014***	0.033***	-0.010***	0.038***	-0.007***
Health Insurance	0.033***	0.032***	-0.066***	-0.030***	0.094***	0.103***	0.321***	0.205***	-0.067***	0.293***	-0.069***	0.236***	0.312***	1.044***
Quintile of income per adult equivalent	0.022***	0.031***	0.115***	0.098***	-0.095***	-0.023***	-0.010***	-0.014***	0.013***	0.130***	0.024***	0.104***	-0.151***	-0.005
Constant	-0.551***	-0.737***	-1.472***	-1.156***	-2.259***	0.287***	-4.192***	-2.280***	-2.169***	-2.099***	-0.413***	-2.847***	-1.522***	10.121***
Observations	0	3088	801	2096	1038	1550	990	3687	1876	4405	1743	206	182	265
Pseudo R2	0.01	0.01	0.03	0.02	0.12	0.04	0.20	0.15	0.01	0.03	0.10	0.06	0.15	0.24
Wald chi2	46108	12149	101365	45425	175187	40552	920515	469792	30530	57136	33261	26349	37356	4519
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own calculations based on ENSANUT 2006.

12.3 Health expenditures

ENSANUT 2006 provides data on ambulatory (curative and preventive) and inpatient service utilization and the costs incurred by households. It also includes data on expenses incurred to reach the health care center, health services, drugs, lab tests, and others. Table 17 presents the average costs incurred by kind of expenditure and disease.[29]

ENSANUT 2006 only provides data on out-of-pocket expenditure. Public health spending is available at state level. Therefore, public expenditure per capita is calculated by dividing the total expenditure by the number of treated patients for each state, and the total treatment cost for each disease is the sum of out-of-pocket spending and the average public spending per treated patient.

The total treatment cost is 201,826 million Mexican pesos, and Table 18 shows that this only represents 22% of total utilization of the health sector—985,282 million Mexican pesos—in 2008. The spending projections are extrapolated assuming that the proportion of treatment costs out of total utilization remains constant throughout the analyzed period.

[29] In the survey there was neither information about the cost of treatment for high triglycerides nor cholesterol.

Table 17.Average out of pocket expenditure by disease.

Disease	Transport	Doctor's visits	Medicines	Clinical studies	Other medical expenditures	Total
Cancer	39	5,494	366	908	574	2,461
Heart disease	53	986	594	766	732	823
Depression	29	187	364	332	494	408
Diabetes	25	171	428	288	714	237
Cerebral embolism	203	2,514	1,687	1,791	.	3,679
Stress	63	370	447	412	500	504
Hypertension	11	417	371	300	526	252
Obesity	4	443	276	900	.	697
Lung diseases	6	234	483	500	217	294
Kidney diseases	55	327	770	663	1,449	742
Respiratory diseases	16	144	284	245	331	210
Total	23	437	402	436	593	368

Source: Own calculations based ENSANUT 2006, (*) Note: in Mexican pesos

Table 18. Supply and utilization of the health sector in México

Concept	2008	2009	2010
Total supply			
Production at market prices	874,737,966	936,165,554	1,002,789,418
Imports of goods and services CIF	46,104,302	53,766,447	56,695,347
Margin trading and distribution	64,440,606	67,305,735	81,539,557
Total supply = total utilization	**985,282,874**	**1,057,237,736**	**1,141,024,321**
total utilization			
Intermediate demand at purchasers' prices	162,896,220	179,253,287	191,459,184
Final demand at purchasers' prices	822,386,654	877,984,449	949,565,137
Final consumption	798,709,237	854,368,037	922,140,433
Private Consumption	473,629,682	497,667,389	538,188,028
Government consumption	325,079,554	356,700,648	383,952,405
Gross fixed capital formation	5,274,520	4,977,127	4,976,706
Changes in inventories	2,367,024	1,527,909	2,119,630
Exports of goods and services FOB	16,035,874	17,111,376	20,328,368

Source: Mexico National Accounts. Health Sector Satellite Accounts of Mexico, 2008-2010. INEGI

12.4 Projections outcomes

This section presents the health expenditure projections according to disease and gender, as well as the simulations outcomes under different scenarios.

12.4.1 Base line scenario

Simply put, health spending is the sum of health-related expenditures for the individuals in a population, taking into account the probabilities of each individual to develop and be treated for a disease. The ratio of public spending to out-of-pocket spending remains constant throughout the period analyzed. The methodology allows for the disaggregation of expenditure trends to every variable available in the survey, such as age group, gender, and region.

Figure 30 shows the projected number of patients by disease. The projections estimate a decrease in the number of people suffering from depression, obesity, and kidney disease and an increase in the number of people suffering from heart disease, diabetes, and hypertension.

Figure 31 shows the projected number of treated patient by disease. The projections estimate an increase in the number of people being treated for heart disease, diabetes, and hypertension and a decrease in the number of people being treated for depression, obesity, and kidney disease.

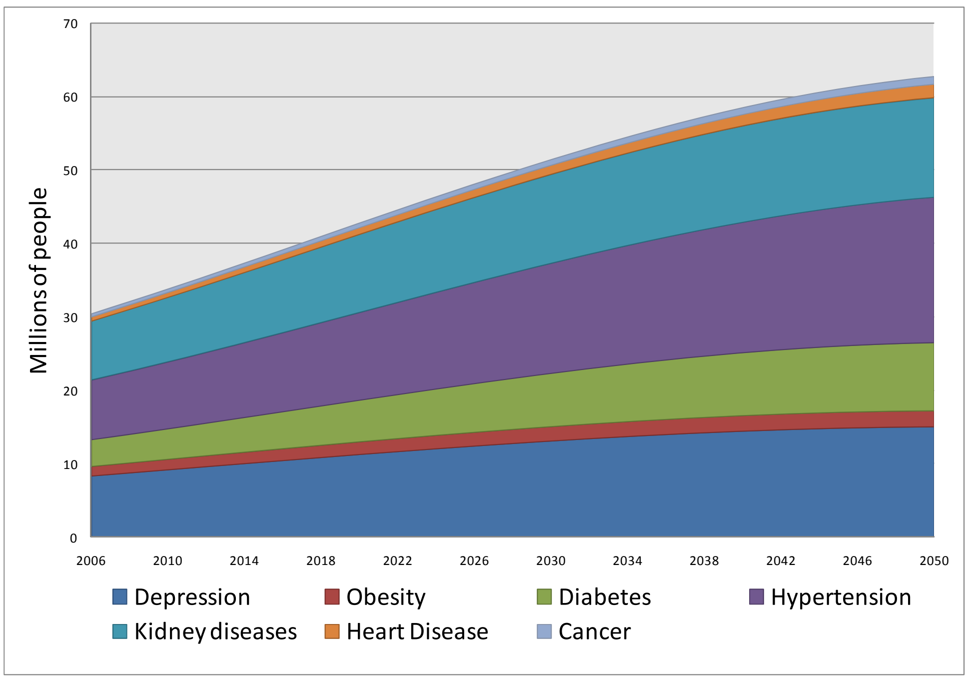
Figure 32 shows the projected health expenditure by disease. The projections estimate an increase in the proportion spent on diabetes (1.4%) and hypertension (7.3%) and a reduction in the proportion spent on kidney disease (-1.5%) and depression (-7.4%). For the other diseases analyzed, there are no major changes in spending.

Figure 33 shows the projected health expenditure by age group. The share of total expenditure of the under-25 age group decreases by 3.6% of the population, and that of the adult age group decreases by 21.6% of the population. On the other hand, the share of expenditure of the 55-65 age group increases by 1.3% of the population, and that of the over-65 age group increases by nearly 24% of the population.

Figure 34 shows that if current technology-related spending growth is maintained and there is no income growth, health expenditure as a proportion of GDP will increase 15.2%, from 8.9% in 2006 to 24.2% in 2050. These figures reach 15.5% as income growth at 1% and when the income growth rate is 3% the expenditure decrease until 6.6% of GDP. In absolute terms, this means that health spending will increase by 2,336 billion pesos within 44 years.

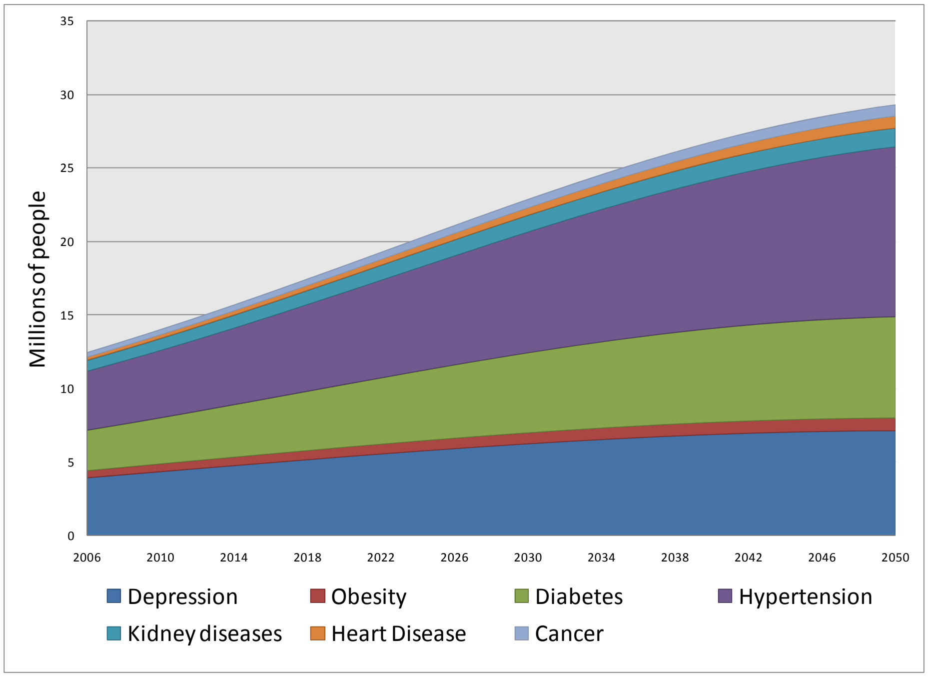
When the cost containment policies are implemented (restricted technological growth scenario), health expenditure as a proportion of GDP will increase 12.4% of GDP instead of 15.2% of GDP. As income growth at 1% the share of GDP needed is around 13.7 % instead of 12.4%, and when the income growth rate is 3% it decrease until 5.8% of GDP as it shown in Figure 40. This represents a savings of around 6,607 billion pesos during the analyzed period.

Figure 35. Patient trends according to disease.



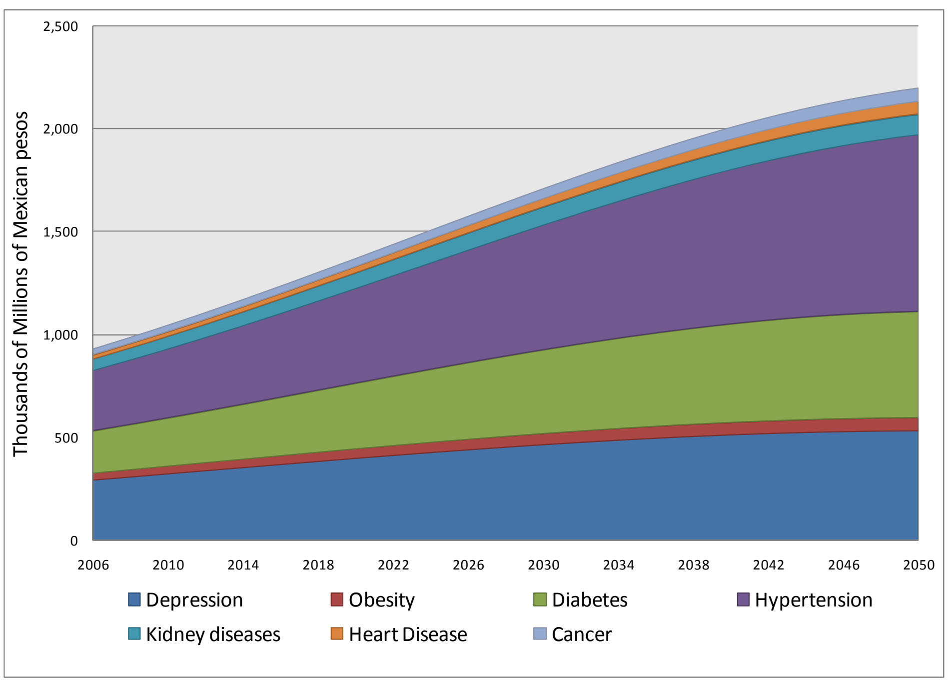
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 36. Treated patients trends according to disease.



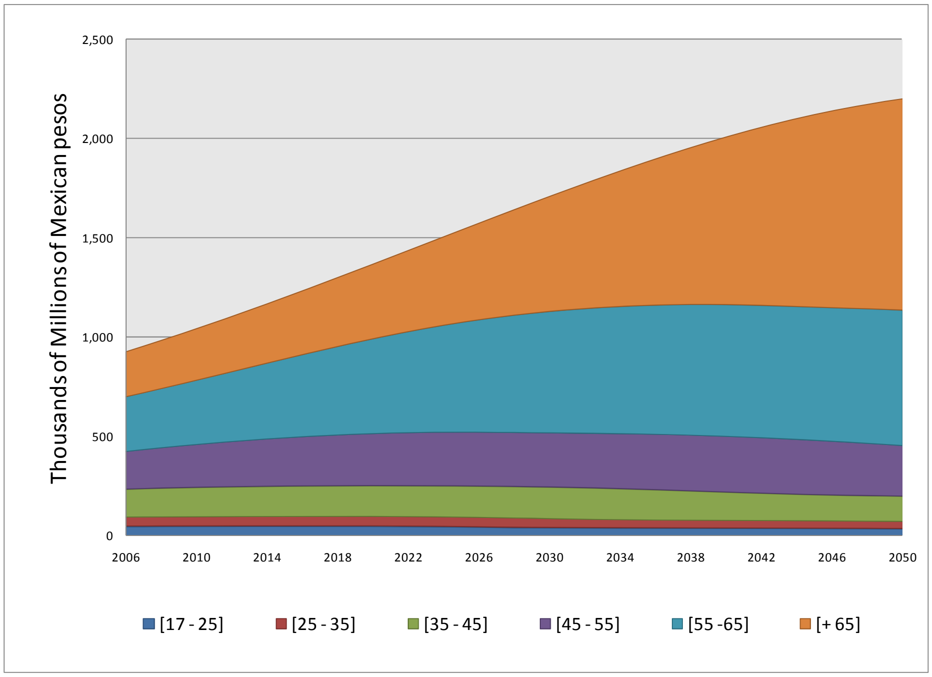
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 37. Health expenditure trends according to disease.



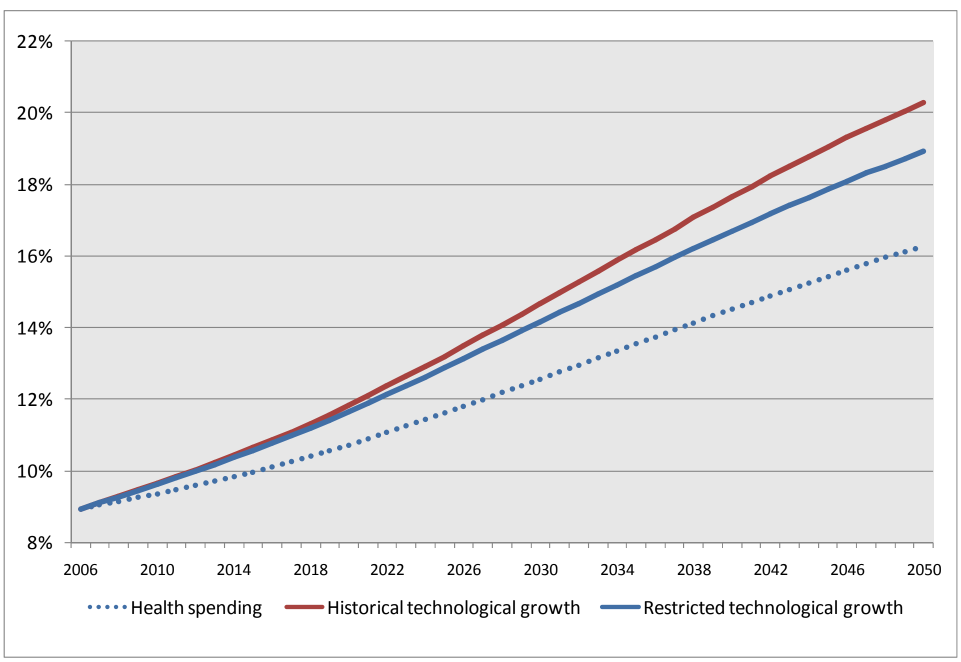
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 38. Health expenditure trends according to age group.



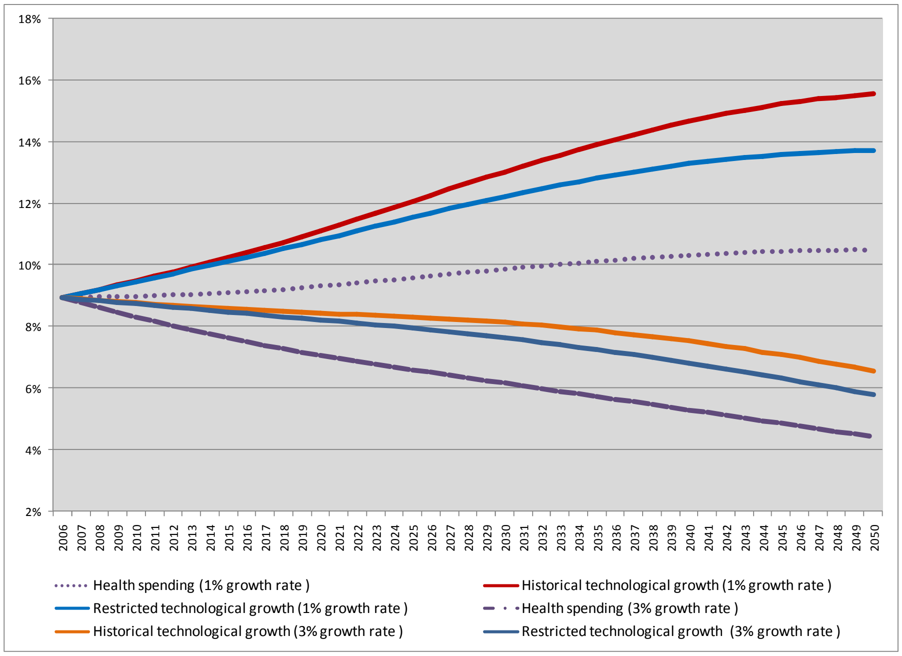
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 39. Health expenditure trends (% GDP).



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 40. Forecasts of growth in public health expenditure (% GDP) with income growth, México.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

12.4.2 Alternative scenarios

This section estimates the impact of the changes in risk factors and socioeconomic characteristics on health spending. We simulated increases and decreases of 25% in the proportion of smokers, sedentary behavior, and participants in the labor marker. Change in the income distribution, where individuals currently in the lowest income quintile become part of the second quintile, is assumed.

One of the most important methodological challenges in the simulation is the choice of the individuals which their characteristics will be modified (smoker, sedentarism, etc.). This choice was not done random we modified each feature to individuals most likely to have that feature. Table 19 shows the risk factors in Mexico.

Smokers are defined as individuals who have smoked at least 100 cigarettes during their lifetime. An individual is considered an alcohol drinker[30]if they report current alcohol

[30] The most sensible thing would be to consider individuals who consume more than a certain amount of alcohol. Unfortunately, individuals who answered about how often they drink and how many drinks are 'not too many' do not allow us to perform robust estimates. Therefore, care must be taken in using the results of this variable.

consumption above XX. Sedentary behavior is defined as sitting for more than 8 hours a day without any vigorous physical activity or exercising less than once a week.

The methodology used is as follows: we estimated a probit model to estimate the probability of having that feature, for example in the case of smoking it was considered a model to determine the probability of an individual to smoke. Then we generate a ranking ordered according to the estimated probability. As a result individuals were ordered as follows: first those individuals with the aforementioned feature in descending order according to the estimated probability and then those without that characteristic ordered by the estimated probability, also in descending order. The changes in the characteristic were made following the ranking until we reach the desired ratio. Table 20 shows the estimates results related to risk factors.

Table 21 shows the results under different scenarios. An increase in the proportion of smokers from 30% to 38% (25% increase) shows an increase in health spending around 1%, although the outcomes differ by disease. Spending increases are greatest for cancer, heart disease, and kidney disease.

With a25% increase in labor participation, from 58% to 72%, health spending will increase by 2.7%. The diseases with higher health expenditure are cancer, heart disease, and kidney disease. Likewise, an increase in the health coverage reduces health spending by 0.7%, whereas the changes in income distribution do not generate major changes. The increase in alcohol drinkers and sedentary behavior does not generate major changes in the level of health spending.

Under the scenario where exposure to risk factors decreases, the results are the opposite. The decrease of 25% on smoking reduces health spending by nearly 1%, whereas reducing sedentary lifestyle does not generate major changes. Lower labor participation will increase health spending around 2.8%.

The maps in section 12.5 show expenditure by geographic distribution in 2006 under different scenarios. These maps show that health spending is concentrated in certain areas like Federal District, Mexico, Jalisco and Veracruz, which account for almost 40% of the population where a large proportion of low-income individuals reside.

As labor participation increases, areas where health spending will decrease are Nuevo Leon (-4.01%), Sinaloa (-3.86%), Durango (-3.62%), and Chiapas (- 3.58%), areas mostly inhabited by low-income individuals. On the other hand, changes in smoking rate generate a different effect in each region. The areas where health spending will increase most are Federal District (1.70%), Queretaro (1.82%), Hidalgo (1.88%), and Morelos (1.91%).

The changes in alcohol consumption and sedentary behavior does not generate a regional effect. The spending growth is similar in all areas.

Implementation of a policy aiming at increasing health insurance coverage will improve access to treatment and in turn will generate an increase in expenditures. Such increases will have a different effect in each region. Spending will increase the most in Oaxaca (1.00%), Coahuila (1.03%), Guerrero (1.07%), Hidalgo (1.10%), and Michoacan (1.16%)

Table 19.Risk factors in Mexicans.

Gender	Smokers	Alcohol Drinkers	Sedentary	Labor participation
Female	15.60%	18.50%	3.40%	37.60%
males	46.80%	53.10%	4.70%	82.40%
Total	29.70%	34.10%	4.00%	57.90%

Source: Own calculations based on ENSANUT 2006.

Table 20.Risk factor estimations[31].

Variables	Smokers		Alcohol Drinkers		Sedentary		Labor participation	
	Female	males	Female	males	Female	males	Female	males
Age	0.016***	0.008***	0.004***	0.013***	-0.057***	-0.027***	0.104***	0.097***
Square age	-0.000***	-0.000***	-0.000***	-0.000***	0.001***	0.000***	-0.001***	-0.001***
Years of education	0.021***	-0.023***	0.024***	0.005***	0.012***	0.016***	0.046***	-0.003***
Married	-0.103***	0.047***	-0.093***	0.067***	-0.193***	0.192***	-0.772***	0.605***
Indigenous	-0.097***	-0.073***	-0.003***	0.033***	0.027***	-0.021***	0.146***	0.055***
Sedentary	0.158***	0.260***	0.144***	-0.017***	-	-	0.225***	-0.124***
Drink alcohol	-	-	0.833***	0.574***	0.136***	0.190***	0.057***	-0.017***
Smoke	0.818***	0.575***	-	-	0.144***	0.002*	0.149***	0.118***
Urban	-0.464***	-0.297***	-0.197***	0.133***	-0.169***	-0.328***	-0.318***	-0.005***
Active	0.067***	-0.016***	0.145***	0.141***	0.196***	-0.112***	-	-
North	-0.002*	-0.052***	-0.262***	-0.074***	-0.100***	-0.087***	-0.217***	-0.059***
Northeast	-0.016***	-0.011***	-0.077***	0.059***	-0.249***	0.072***	-0.048***	0.007***
West central	-0.048***	0.014***	0.012***	-0.214***	-0.102***	0.123***	0.009***	0.034***
Central-east	0.068***	0.121***	0.001	-0.130***	-0.019***	0.119***	-0.122***	0.041***
South	-0.501***	-0.321***	-0.066***	-0.253***	-0.203***	0.005**	-0.092***	0.042***
East	-0.428***	-0.253***	-0.055***	-0.172***	0.020***	0.121***	-0.179***	0.018***
Yucatan peninsula	-0.467***	-0.268***	0.169***	0.007***	-0.181***	0.042***	-0.172***	0.240***
Constant	-1.641***	-0.404***	-1.083***	-0.336***	-0.886***	-1.451***	-1.935***	-0.819***
Observations	21,760	17,580	21,760	17,580	21,760	17,580	21,760	17,580
Pseudo R2	0.12	0.06	0.10	0.06	0.08	0.03	0.15	0.21
Wald Test (rho = 0)	2,937,902	1,971,483	2,839,599	1,941,651	647,347	252,903	5,547,073	4,770,429
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own calculations based on ENSANUT 2006.

[31] Estimations used in the simulations.

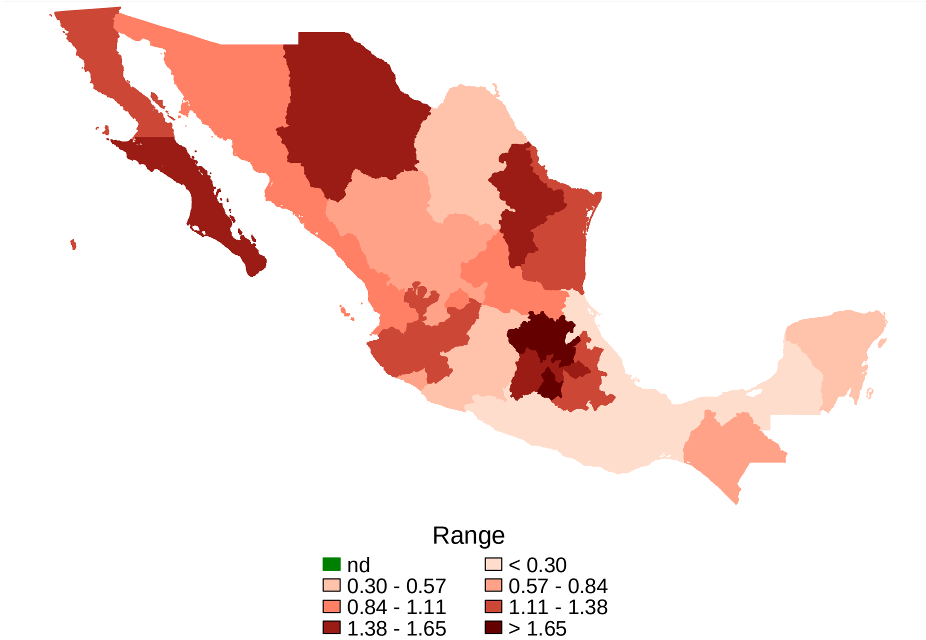
Table 21.Health expenditure changes assessed against the baseline scenario.

Year	25% Increase in smokers	25% Increase in alcohol drinkers	25% Increase in sedentary lifestyle	25% Increase in health coverage	Q1 individual to Q2	25% Increase in Labor participation	25% Reduction in smokers	25% Reduction in alcohol drinkers	25% Reducing in sedentary lifestyle	25% Reduction in Labor participation
2006	1.08%	-0.14%	0.37%	-2.70%	0.72%	0.24%	-0.97%	0.24%	-0.20%	2.82%
2007	1.08%	-0.14%	0.37%	-2.71%	0.71%	0.25%	-0.97%	0.25%	-0.20%	2.83%
2008	1.08%	-0.15%	0.37%	-2.73%	0.71%	0.25%	-0.97%	0.25%	-0.20%	2.84%
2009	1.07%	-0.15%	0.37%	-2.75%	0.71%	0.25%	-0.97%	0.25%	-0.20%	2.85%
2010	1.07%	-0.16%	0.37%	-2.76%	0.71%	0.26%	-0.97%	0.26%	-0.20%	2.86%
2011	1.07%	-0.16%	0.37%	-2.78%	0.71%	0.26%	-0.96%	0.26%	-0.20%	2.88%
2012	1.07%	-0.17%	0.37%	-2.80%	0.70%	0.26%	-0.96%	0.26%	-0.20%	2.90%
2013	1.06%	-0.17%	0.37%	-2.82%	0.70%	0.27%	-0.96%	0.27%	-0.20%	2.92%
2014	1.06%	-0.18%	0.38%	-2.84%	0.70%	0.27%	-0.96%	0.27%	-0.20%	2.94%
2015	1.06%	-0.18%	0.38%	-2.87%	0.70%	0.27%	-0.96%	0.27%	-0.20%	2.97%
2016	1.06%	-0.18%	0.38%	-2.90%	0.69%	0.28%	-0.95%	0.28%	-0.20%	3.00%
2017	1.05%	-0.19%	0.39%	-2.93%	0.69%	0.28%	-0.95%	0.28%	-0.20%	3.03%
2018	1.05%	-0.19%	0.39%	-2.96%	0.69%	0.29%	-0.95%	0.29%	-0.20%	3.06%
2019	1.04%	-0.20%	0.40%	-2.99%	0.69%	0.29%	-0.95%	0.29%	-0.20%	3.10%
2020	1.04%	-0.20%	0.40%	-3.02%	0.68%	0.29%	-0.95%	0.29%	-0.20%	3.13%
2021	1.04%	-0.20%	0.41%	-3.06%	0.68%	0.30%	-0.94%	0.30%	-0.20%	3.17%
2022	1.03%	-0.20%	0.41%	-3.09%	0.68%	0.30%	-0.94%	0.30%	-0.20%	3.20%
2023	1.03%	-0.21%	0.42%	-3.13%	0.68%	0.31%	-0.94%	0.31%	-0.20%	3.24%
2024	1.02%	-0.21%	0.43%	-3.17%	0.67%	0.31%	-0.94%	0.31%	-0.20%	3.27%
2025	1.02%	-0.21%	0.44%	-3.22%	0.67%	0.31%	-0.93%	0.31%	-0.20%	3.31%
2026	1.01%	-0.22%	0.45%	-3.26%	0.67%	0.32%	-0.93%	0.32%	-0.19%	3.34%
2027	1.01%	-0.22%	0.46%	-3.31%	0.66%	0.32%	-0.93%	0.32%	-0.19%	3.37%
2028	1.00%	-0.22%	0.47%	-3.35%	0.66%	0.33%	-0.93%	0.33%	-0.19%	3.40%
2029	1.00%	-0.22%	0.48%	-3.40%	0.66%	0.33%	-0.92%	0.33%	-0.19%	3.43%
2030	0.99%	-0.22%	0.49%	-3.45%	0.66%	0.33%	-0.92%	0.33%	-0.19%	3.46%
2031	0.99%	-0.22%	0.50%	-3.50%	0.65%	0.34%	-0.92%	0.34%	-0.19%	3.49%
2032	0.98%	-0.22%	0.51%	-3.55%	0.65%	0.34%	-0.92%	0.34%	-0.19%	3.52%
2033	0.98%	-0.22%	0.53%	-3.60%	0.65%	0.35%	-0.92%	0.35%	-0.19%	3.54%
2034	0.97%	-0.22%	0.54%	-3.64%	0.65%	0.35%	-0.92%	0.35%	-0.19%	3.57%
2035	0.97%	-0.22%	0.56%	-3.69%	0.64%	0.36%	-0.91%	0.36%	-0.18%	3.58%
2036	0.96%	-0.23%	0.57%	-3.74%	0.64%	0.36%	-0.91%	0.36%	-0.18%	3.60%
2037	0.96%	-0.23%	0.59%	-3.79%	0.64%	0.36%	-0.91%	0.36%	-0.18%	3.62%
2038	0.95%	-0.23%	0.61%	-3.84%	0.64%	0.37%	-0.91%	0.37%	-0.18%	3.63%
2039	0.95%	-0.23%	0.63%	-3.89%	0.63%	0.37%	-0.91%	0.37%	-0.18%	3.64%
2040	0.94%	-0.23%	0.65%	-3.93%	0.63%	0.38%	-0.91%	0.38%	-0.18%	3.65%
2041	0.94%	-0.23%	0.67%	-3.98%	0.63%	0.38%	-0.91%	0.38%	-0.18%	3.67%
2042	0.94%	-0.23%	0.69%	-4.03%	0.63%	0.38%	-0.91%	0.38%	-0.18%	3.68%
2043	0.93%	-0.23%	0.71%	-4.08%	0.63%	0.39%	-0.90%	0.39%	-0.17%	3.70%
2044	0.93%	-0.23%	0.73%	-4.12%	0.62%	0.39%	-0.90%	0.39%	-0.17%	3.72%
2045	0.92%	-0.23%	0.75%	-4.17%	0.62%	0.39%	-0.90%	0.39%	-0.17%	3.73%
2046	0.92%	-0.23%	0.78%	-4.21%	0.62%	0.40%	-0.90%	0.40%	-0.17%	3.75%
2047	0.92%	-0.23%	0.80%	-4.26%	0.62%	0.40%	-0.90%	0.40%	-0.17%	3.77%
2048	0.91%	-0.23%	0.83%	-4.31%	0.62%	0.40%	-0.90%	0.40%	-0.17%	3.79%
2049	0.91%	-0.22%	0.85%	-4.36%	0.62%	0.40%	-0.90%	0.40%	-0.17%	3.81%
2050	0.91%	-0.22%	0.88%	-4.41%	0.62%	0.41%	-0.90%	0.41%	-0.17%	3.82%

Source: Own calculations based on CONAPO projections and ENSANUT 2006.

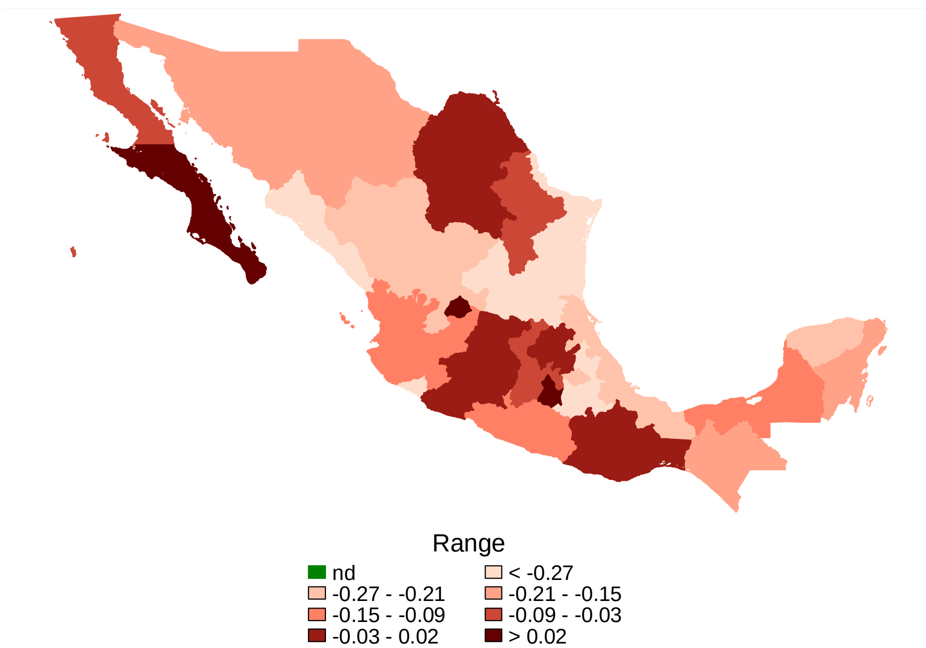
12.5 Maps

Figure 41.Geographic variations in health spending (%). 25% increase in smokers.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 42.Geographic variations in health spending (%). 25% increase in alcohol drinkers.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 43.Geographic variations in health spending (%). 25% increase in sedentary lifestyle.

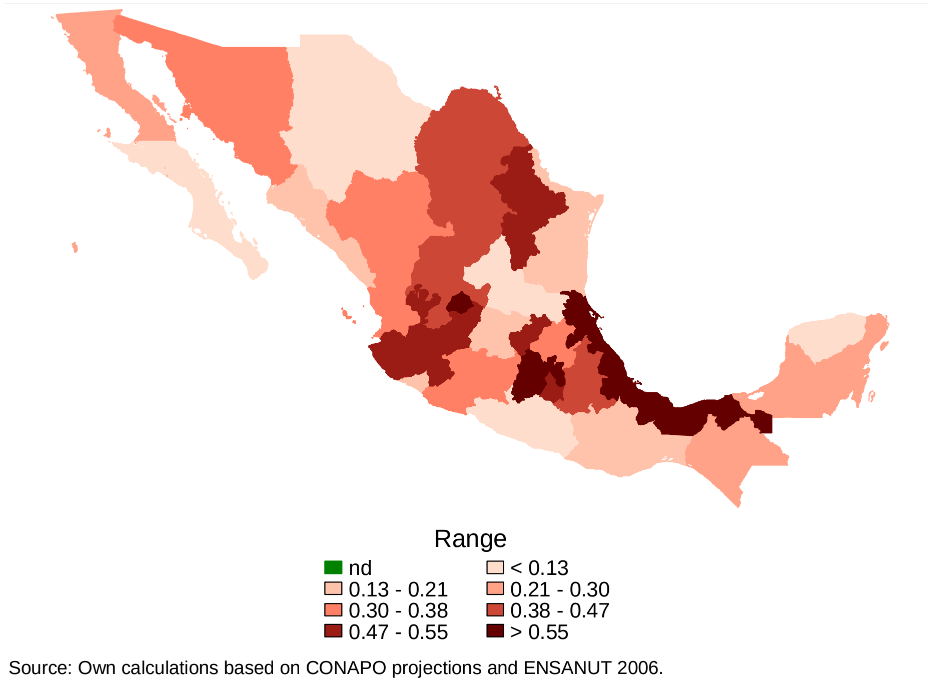


Figure 44.Geographic variations in health spending (%). 25% increase in labor participation.

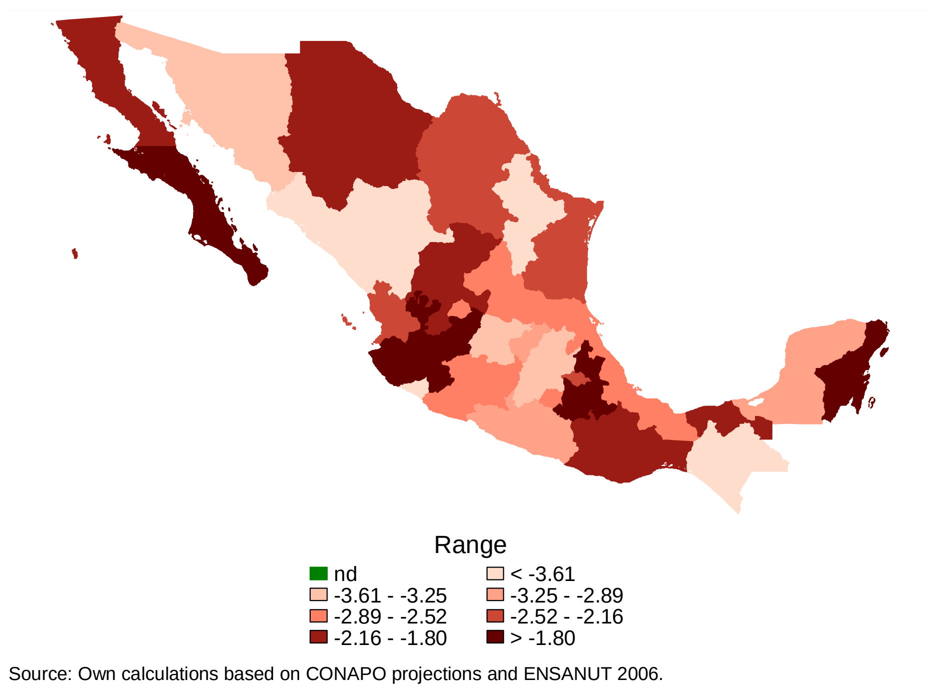
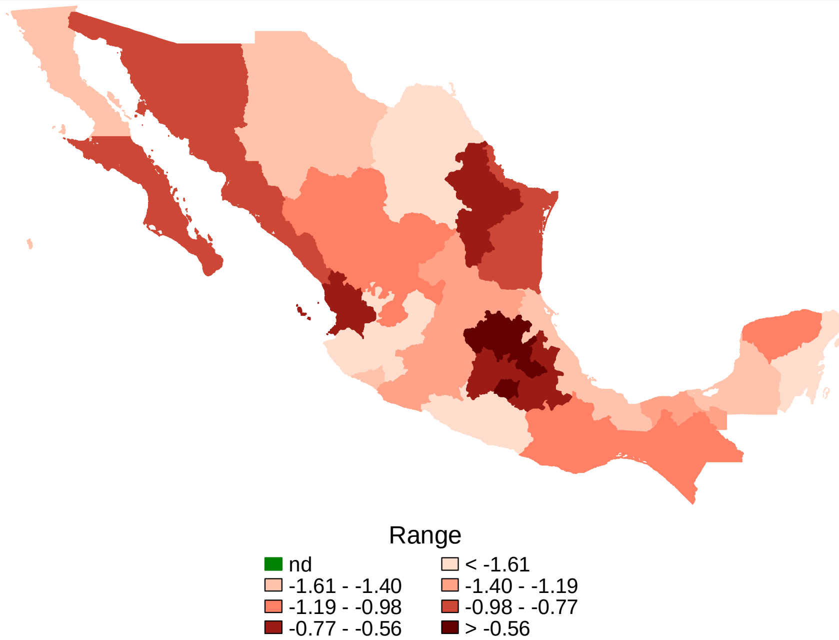
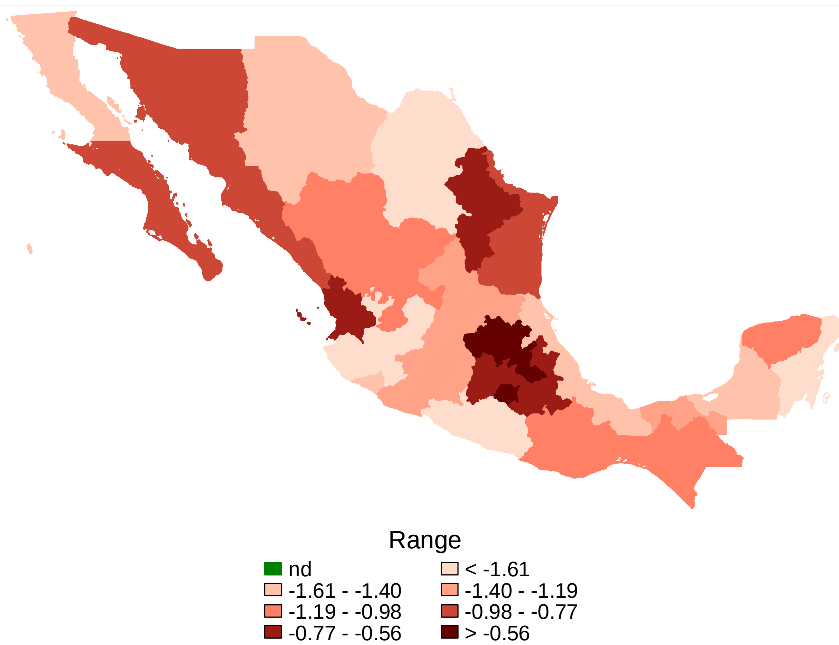


Figure 45.Geographic variations in health spending (%). 25% reduction in smokers.



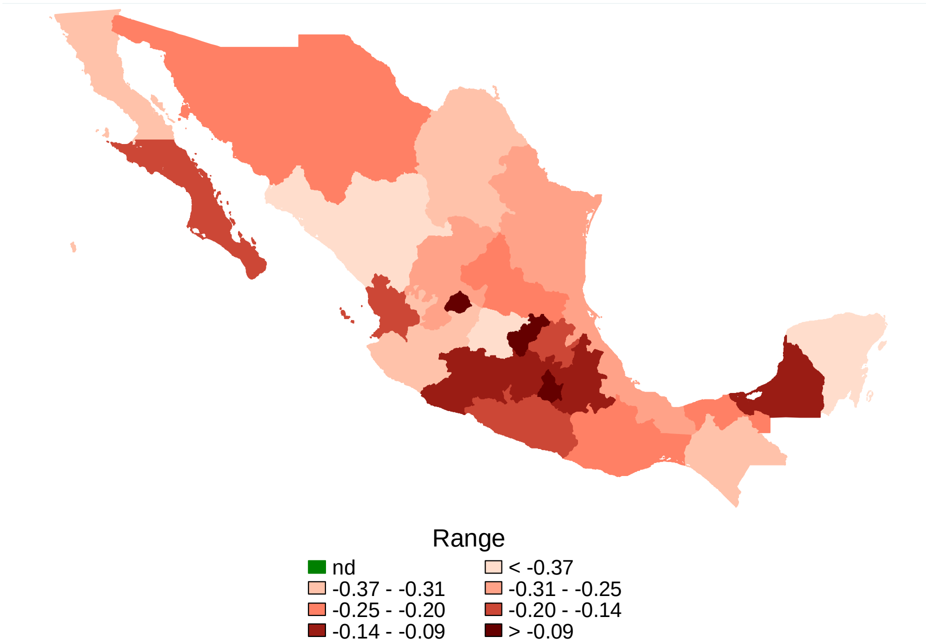
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 46.Geographic variations in health spending (%). 25% reduction in alcohol drinkers.



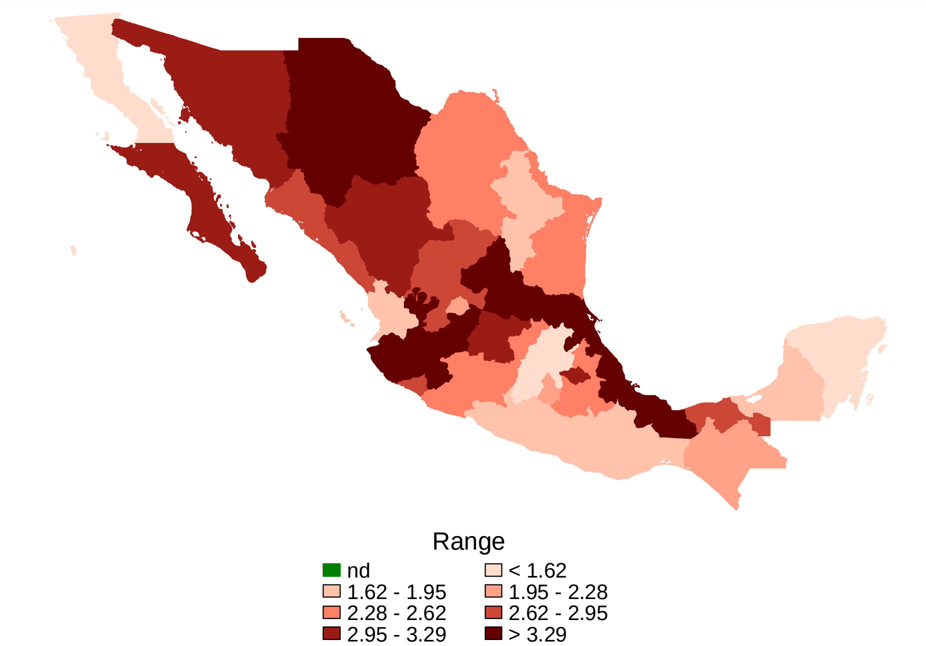
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 47.Geographic variations in health spending (%). 25% reduction in sedentary lifestyle.



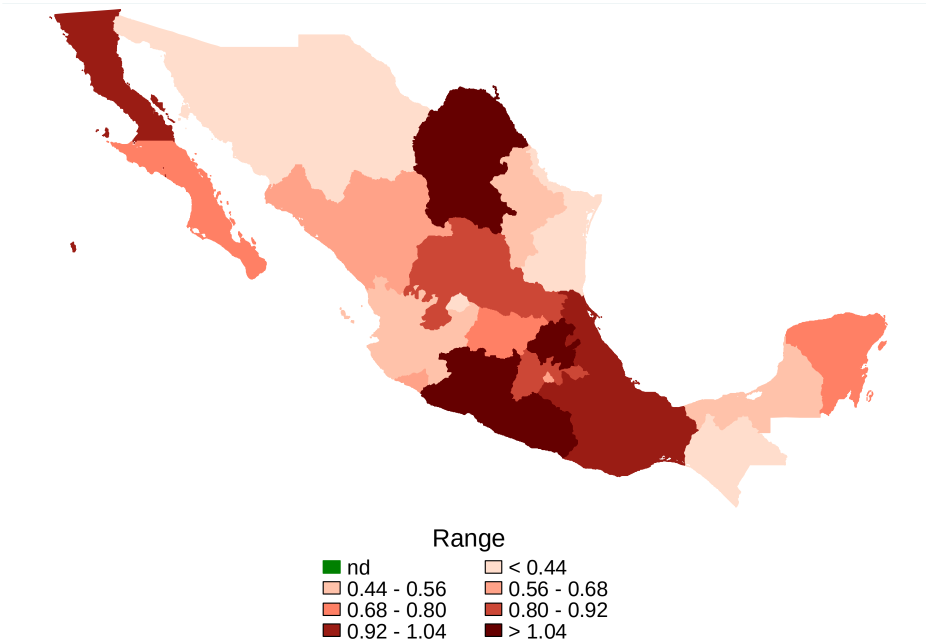
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 48.Geographic variations in health spending (%). 25% reduction in labor participation



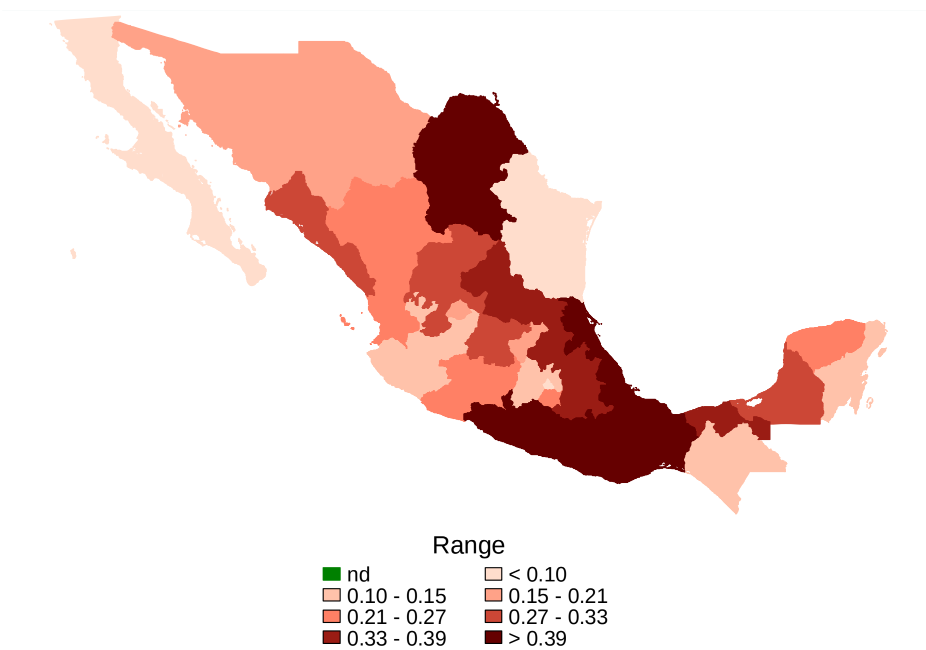
Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 49. Geographic variations in health spending (%). 25% increase in healthinsurance.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.

Figure 50. Geographic variations in health spending (%). individuals in the lowest income quintile become part of the second quintile.



Source: Own calculations based on CONAPO projections and ENSANUT 2006.