



Swiss Re
Centre for Global Dialogue

Risk Dialogue Series

Health Risk Factors in Rapidly Changing Economies



In collaboration with



HARVARD
SCHOOL OF PUBLIC HEALTH

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Preface

Dear reader

We are very pleased to welcome you to this edition of the Risk Dialogue Series on Health Risk Factors in Rapidly Changing Economies.

This compendium features articles that analyse time trends and developments of key risk factors associated with the increasing prevalence of chronic, non-communicable diseases (NCDs) seen in major emerging markets around the world. The health profile of these countries is changing swiftly and significantly. As economies grow, as infectious diseases decrease, and as lifespan increases, there is an increase in NCDs. The incidence of cardiovascular diseases, stroke, diabetes, cancer, accidents, and mental health issues are rising rapidly, providing a major challenge for providers and funders of health care. The prevalence and costs to the health care system is a concern to insurers and public health officials alike.

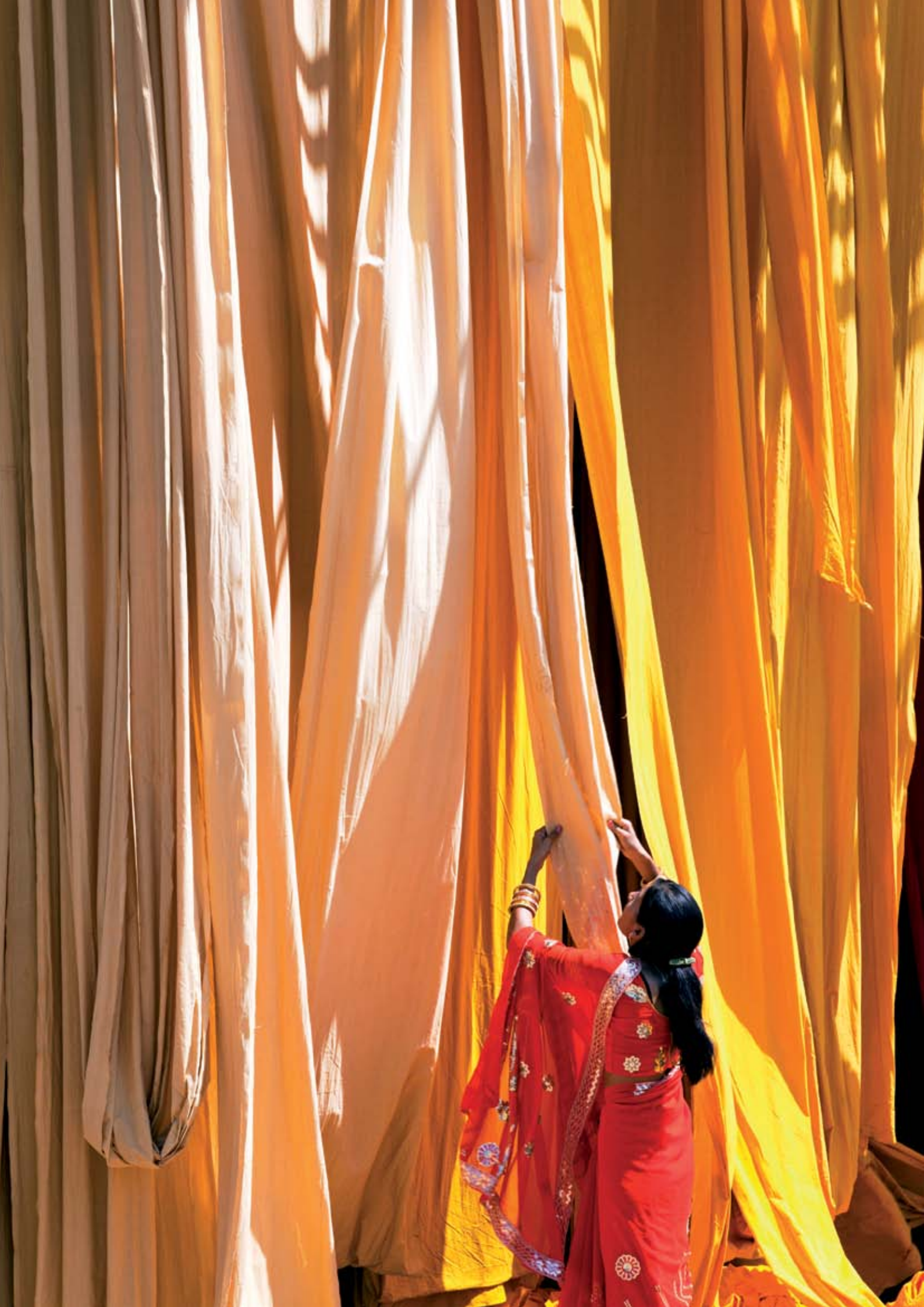
The SEARCH – Systematic Explanatory Analyses of Risk factors affecting Cardiovascular Health – collaboration is a joint undertaking between the Harvard School of Public Health (HSPH) and Swiss Re. The articles presented in this compilation are by HSPH faculty members, their research fellows and Swiss Re colleagues. The extensive research conducted and summarised in the articles were conducted primarily during the 100th anniversary of HSPH and the 150th anniversary of Swiss Re.

We hope these papers provide insightful data and analyses into the major health trends confronting some of the most populous nations on the planet; we intend that these articles will inspire both private and public sectors to seek ways in which we can most effectively manage the NCD pandemic.

With best regards

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SEARCH – The search for health data and insights from rapidly changing economies

Christoph Nabholz, Simon Woodward

Emerging markets have undergone a dramatic transformation over recent decades. They have typically developed from largely rural, agricultural societies to manufacturing and service providing urban powerhouses. Less publicised, but equally significant has been the shift in their health profiles. Emerging markets have been largely successful in ridding themselves of communicable diseases; only to be confronted by a pandemic of chronic, non-communicable diseases (NCDs) putting significant strain on health care systems. Public and private health care providers both need to develop effective responses to this pandemic.

Shift in health profiles

There has been a dramatic shift in lifestyles in emerging markets and the drivers which influence health.

Pre-industrial societies typically experience conditions of under- or malnourishment. What food is available consists of staple cereal or vegetable crops. Diets are most likely low in animal products, processed foods and sugar. Providing both for food and family needs requires intense physical effort. Health provisions and medicines are likely to be basic. Doctors are few and far between. Many early deaths are likely to occur from preventable conditions, particularly around childbirth. Sanitation may be sparse or minimal, living close to livestock, with no guarantee of clean water. In these conditions, communicable diseases can flourish. These include influenza, tuberculosis, hepatitis, measles and Ebola among others.

Health drivers have shifted as countries have industrialised and urbanised.

Health drivers have shifted as countries have industrialised and urbanised. Many of the conditions that allow communicable diseases to flourish have been corrected or eradicated in emerging markets. Water supplies and sanitation have improved. There has been a significant reduction in the number of people living close to livestock. Health services have developed significantly in large cities where citizens have access to doctors and hospitals. Childbirth has become safer.

In a short space of time, emerging markets have gone from conditions of hard physical work and scarcity to conditions of sedentary work and plenty.

Food – and a large choice of food – has become readily available. Diseases of malnourishment – which frequently weaken immune systems and leave individuals vulnerable to other conditions – have been consigned to the past. However, societies are moving from the challenge of under- to over nourishment. The nature of that nourishment has shifted from high fibre staples to more processed foods, more animal produce and a significantly higher intake of sugar. Supplementing food, populations have greater access to tobacco and alcohol, both with serious effects on health. Work has frequently become more sedentary, in the form of computer, clerical or light manufacturing work. Lifestyle has also become more sedentary with convenience goods and cars reducing the need for physical exertion.

Cardiovascular disease is on the rise in emerging markets.

The net result has been a pandemic of NCDs in emerging markets. Most common amongst these is cardiovascular disease; hence the concentration in the SEARCH project - Systematic Explanatory Analyses of Risk factors affecting Cardiovascular Health - on the drivers of cardiovascular conditions. However, those drivers affect a wide, and often related, range of other NCDs, including cancer, respiratory diseases and diabetes.

As a result, there has been a rapid change in emerging health profiles, from infectious diseases to a predominance of non-communicable diseases.

These very different diseases have common qualities. Infectious conditions, while frequently severe, tend to be acute. NCDs are generally chronic conditions, often managed for many years, and in many cases requiring high levels of medical care. Moreover, while the very young and very old are more vulnerable to most communicable diseases, NCDs are concentrated among older age groups. One of the consequences of urbanisation and industrialisation has in most countries been a decline – a sometimes dramatic decline – in the birth rate. Because there has also been a drop in the death rate, as communicable diseases become less common, all emerging markets are beginning to age – some quite rapidly.

SEARCH – The search for health data and insights from rapidly changing economies

The four countries studied in the SEARCH research project - Brazil, China, India, Mexico – account for nearly three billion people, or 42% of the world's population.

In China, Type 2 diabetes was very uncommon in the 1980s. The obesity rate in Mexico has surpassed that in the US.

Emerging markets are rapidly moving towards patterns of deaths more reminiscent of developed markets.

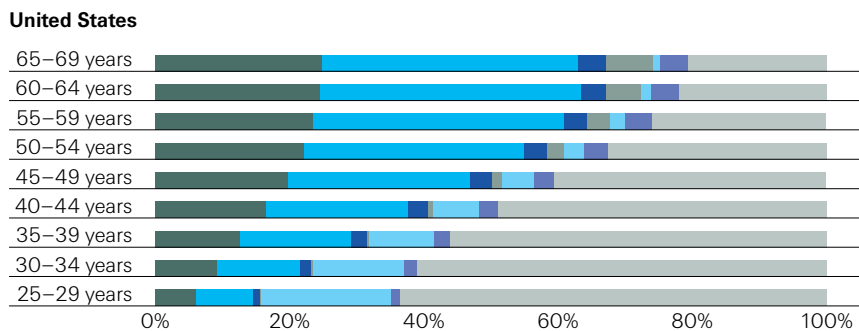
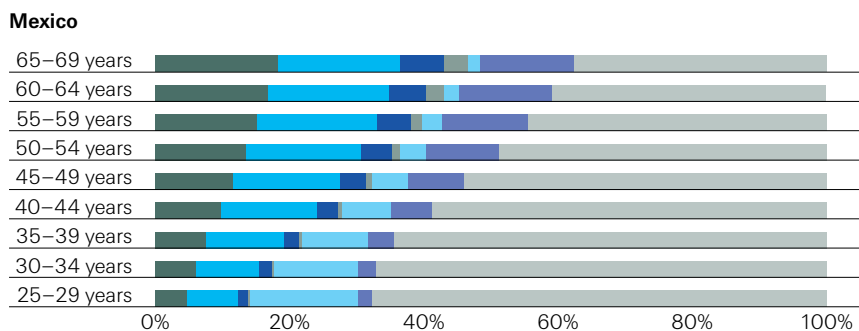
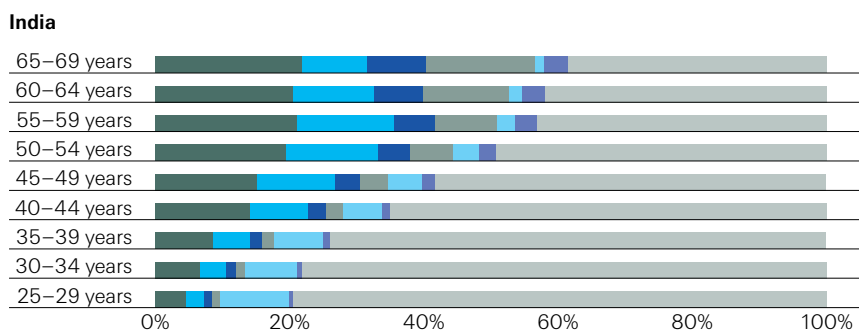
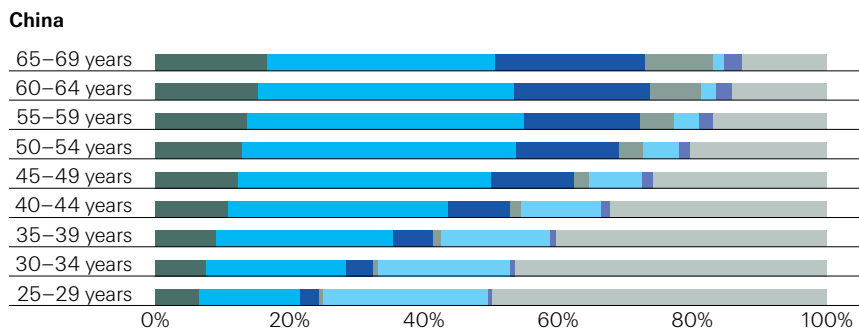
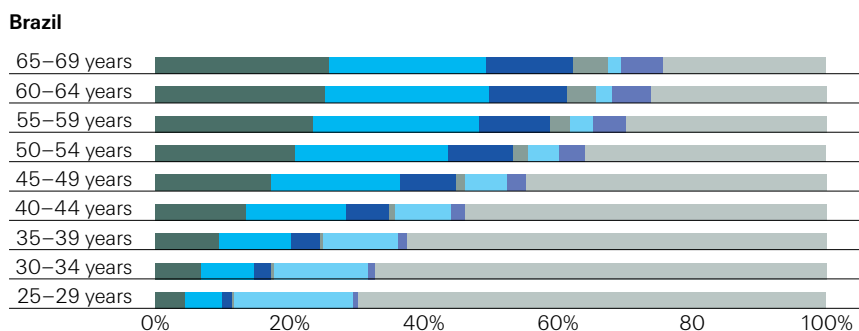
All of these trends are occurring in the most populous nations in the world. The four countries studied in the SEARCH research project – Brazil, China, India, Mexico – account for nearly three billion people, or 42% of the world's population. Within the broad trends of the NCD epidemic, there is considerable geographic variation. No two countries are exactly alike.

In China, Type 2 diabetes was very uncommon in the 1980s, almost unknown in much of the country; it now has a prevalence of 11.6%¹ in the adult population, narrowly overtaking the prevalence rate of the US in just twenty years. In 2013, the United Nations Food and Agricultural Organisation estimated that Mexico surpassed the US in its obesity rate at 32.6% of the population.

As a result, these markets are rapidly moving towards patterns of deaths more reminiscent of developed markets. This can be seen most clearly in China, with cancer and heart disease deaths comparable to the US (see Figure 1). There are proportionally more stroke deaths in China than the US; however, these can be expected to fall with medical progress. Other countries such as Brazil and Mexico are transitioning towards the US death patterns, but more slowly; notable in this context is the high incidence of diabetes in Mexico (see Figure 1). India is furthest from the US; communicable infectious diseases are more prevalent in India. NCDs – such as cancer, stroke and heart diseases – are typically more costly for insurers and public health authorities. As demonstrated in Figure 1, NCDs increase significantly as people become older. When looking at the four country profiles, cardiovascular diseases and stroke stand out.

Figure 1:
Causes of death in 2010 in age intervals
25–69 years in selected countries
(% total mortality by age band)

- Heart disease
- Cancer
- Stroke
- COPD
- Transport injuries
- Diabetes
- Other



Notes: In the younger age bands, transport injuries are the leading cause of death; but then quickly declines in the older age bands. The key differences observed in the country profiles compared to the USA are: Brazil has a higher stroke death rate (13% vs 4%; age band 50–69); India has a high death rate due to communicable diseases (30% communicable diseases, 10% injuries; 60% non-communicable diseases; across all age groups) and has high lung disease or COPD (chronic obstructive pulmonary diseases) death rate (16% vs 7%; age band 50–69); China has a heart disease mortality rate which is lower than in the USA (15% vs 24%; age band 50–69), while death due to stroke is significantly higher in China (19% vs 4%; age band 50–69); Mexico stands out with a high diabetes death rate (14% vs 4%; age band 50–69).

Source: Global Burden of Disease 2010

The SEARCH study aims to provide an overview of the drivers of NCDs within these countries, together with the responses of public health authorities.

In this publication is a selection of articles reflecting the breath of different risk factors addressed by SEARCH in four countries.

As China faces rapid population ageing, medical treatment costs of CVD – both acute hospital expenses and long term healthcare expenditures – are likely to rise significantly.

China in recent years has seen unprecedented levels of air particulate pollution in some cities.

Brazil was one of the foremost countries in anti-smoking legislation. Efforts are underway to encourage healthier eating and more exercise.

Even though smoking prevalence has decreased significantly since 1989, a core group of young people continues to take up smoking.

Country health profiles

A large number of articles have been contributed by the researchers from HSPH and Swiss Re, which will all be featured in four country specific publications. In this compendium publication, we have picked a selection of articles reflecting the breath of different risk factors addressed by SEARCH in the four countries. The following articles have been included:

China

The leading cause of death in China is currently cardiovascular disease (CVD). As Wang, Lu and Chen report, it accounts for 41% of all deaths every year, which in a country as vast as China, accounts for one death every ten seconds. As China faces rapid population ageing, medical treatment costs of CVD – both acute hospital expenses and long term healthcare expenditures – are likely to rise significantly. Non-medical costs associated with CVD events, such as loss of income, also contribute to the significant financial distress of patients. This will stretch provision of health care services, which officially became universal in 2009, despite significant regional differences. While the reform of the essential medicines system has reduced high out-of-pocket medicine spending, a significant gap still exists for which private insurers can offer financial protection.

Rapid urbanisation in China has had detrimental effects on air quality, not least because modern pollutants, such as car exhaust fumes, frequently mix with smoke from heavy industry, domestic coal burning and power production. China in recent years has seen unprecedented levels of air particulate pollution in some cities, as described by Dockery and Pope. Air pollution in China is estimated to have contributed to 1.2 million premature deaths. Lifetime exposure to air pollution in Beijing, for example, is estimated to reduce life expectancy by around three years.

Brazil

Public health authorities can have a considerable influence over health trends. In Brazil, according to researcher Marcia Castro, there were a number of successful campaigns against communicable diseases. The legacy of this success influences public policy towards NCDs. Brazil was one of the foremost countries in anti-smoking legislation. Efforts are underway to encourage healthier eating and more exercise; although confronted by an ageing population, the challenges of confronting the NCD epidemic are considerable.

One of the ironies of Brazil is that, while it is clamping down on domestic tobacco consumption, it is the leading global exporter of tobacco, according to researcher Hillel Alpert. The Brazilian authorities have succeeded in reducing smoking prevalence – through a mixture of price increases, advertising bans and graphic warnings – by 50% since 1989. However, given the size of Brazil, there are still some 25 million smokers. Moreover, a core group of young people – which includes more women than men – continues to take up smoking. The widening of social globalisation of young people may yet have a positive impact on tobacco prevalence among the young.

Diabetes has spread so rapidly that India, with an estimated 65 million sufferers, has been typecast as the 'diabetes capital of the world'.

India's population has moved from a diet of whole grains and vegetables to one rich in processed food, added fats and sugars.

The consumption of sugary drinks in Mexico has led to a rise in the prevalence of diabetes, leading the country to become the first in the world to implement a soda tax.

It is a major challenge for public health authorities in emerging markets to manage the spread of NCDs.

Brazil has already successfully demonstrated how to reduce smoking.

Campaigns to address the causes of NCDs, health care facilities to treat them and funding are needed.

Funding NCD treatment is a major issue, particularly as costs are currently concentrated on individuals.

India

Authors Reddy and Mohan highlight how India is on the cusp of health change. It has both extensive recent urbanisation; with continuing widespread near-subsistence agriculture in basic conditions. Infectious disease is still a serious public health concern; but the spread of NCDs is rapid. The number dying from CVD per year is estimated at 2.7 million, higher in absolute terms than China. Diabetes has spread so rapidly that India, with an estimated 65 million sufferers, has been typecast as the 'diabetes capital of the world'.

The spread of diabetes has mainly been related to changes in diet, as noted by researcher Shilpa Bupathiraju. India's population has moved from a diet of whole grains and vegetables to one rich in processed food, added fats and sugars. This nutritional change has occurred at a faster pace than in developed economies. The economic impact of this sudden transition is huge; and the public health authorities are struggling to respond to this preventable condition.

Mexico

India may have more diabetics than any other country, but Mexico, fuelled by a severe epidemic of obesity, is also facing significant challenges due to the prevalence of diabetes. In his article, Beltran-Sanchez shows that Mexico has undergone considerable dietary change over the past decade. Notable for Mexico is the high presence of sugary drinks in a country where drinking water quality can be poor. The authorities are taking steps to address dietary changes, notably being the first country in the world to implement a 'soda tax'. Nonetheless, the challenge is considerable; not least because Mexico has a young demographic and their rates of obesity are rising.

NCDs – moving towards health care solutions

From what we know of developed markets, there is no silver bullet for NCDs. No single measure can be taken to reverse their virulent spread. In some ways, NCDs are more insidious than infectious diseases. In order to stop an infectious disease, one has to neutralise the source of the infection; or to develop immunity. Both of these have been achieved with some measure of success in all countries studied. NCDs, however, are frequently lifestyle diseases. Their likelihood is substantially reduced by not smoking, eating healthier and increasing physical activity. The challenge is to persuade individuals to do these things; and to provide treatment for those already with NCDs.

These are massive challenges. They are not entirely insurmountable. Brazil has shown clearly how a multi-agency approach to a multi-faceted challenge can be achieved, eg by reducing cigarette consumption in the country. It is one piece to a large puzzle, but an important piece nonetheless.

The challenge for policy makers is threefold: public health campaigns to address the causes of NCDs; the optimal distribution of health care facilities to treat NCDs; and the funding in place to allow health campaigns and treatment. These are not all functions of the state; valuable contributions from private sector actors are also needed.

The costs of NCDs can be financially ruinous to those in emerging markets who suffer from them. Health or life insurance penetration in all four countries studied is low. If public health provision, as is often the case, proves insufficient, then treatment expenses must be met out of pocket. That may impact not only the sufferer, but the family members that support them. There are knock-on implications. Those with NCDs may avoid going to see a doctor when an earlier visit could have led to a more cost effective treatment. Potential health costs may also encourage a savings culture – which is not always a bad thing, but one that can be taken to extremes. Some Asian economies show macro-economic distortions with the amount of savings being drained away from everyday spending.

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Insurance can be a cost effective way of funding necessary health treatments.

Private insurance can be a cost effective way to provide protection to individuals in the face of ill health. Within an efficient regulatory system, insurers can be one means of helping control health care costs. Together with other public and private initiatives, it can be one of the pillars within a well-functioning health system – a system which can react and to a degree manage the NCD pandemic confronting emerging markets.

The starting point for both private and public actors in tackling the NCD epidemic is information.

SEARCH and NCDs

The starting point for both private and public actors in tackling the NCD pandemic is information. For public health authorities, it informs them where they can best distribute their preventative measures and budget; and points to the best allocation of public health care resources. SEARCH is a valuable tool in assessing both the epidemiological spread of NCDs based on new data and the latest literature reviews; and the effectiveness of some of the responses to NCDs.

The SEARCH publication is designed to provide the latest epidemiological research to support public health officials and actuaries in modelling health outcomes.

For insurers, data and information is a vital part of their business model. It allows them to create sustainable risk pools and set premiums that reflect the risk posed by individuals in the pool. Traditionally, such actuarial assumptions have been based on past data tables. This approach will not be thrown out; however, the speed and scale of the NCD epidemic in emerging markets will also cause actuaries to cast an eye forwards to the potential outcomes of current health trends. Here, SEARCH is a valuable tool in placing past data tables alongside the latest epidemiological research.

The joint SEARCH research project is designed to provide insights and tentative conclusions to one of the biggest challenges facing the most populous countries in the world.

The joint SEARCH research project, between Swiss Re and the Harvard School of Public Health is designed to provide insights and tentative conclusions to one of the biggest challenges facing the most populous countries in the world. Recent economic and societal changes have been profound in Brazil, China, India and Mexico. The effects of these changes on health should not be overlooked.

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About the authors

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Closing the financial gap for cardiovascular disease in China

Xiaojie Wang, David Lu, Hueyfang Chen

Cardiovascular Disease (CVD) is the leading cause of mortality and morbidity in China. The medical cost of CVD has been trending upwards at varying rates by geographic location over the past six years, and is projected to increase further in the future. Currently, over 90% of the population in China is covered by the social healthcare system that went through a recent reform in 2009. However, insurance coverage on CVD remains a major challenge and is putting the Chinese population at risk. It is expected to cause even more significant economic burden in the future.

Cardiovascular disease (CVD) is the leading cause of mortality and morbidity in China.

Introduction

Cardiovascular disease (CVD) has been the leading cause of mortality and morbidity in China in recent years. In 2010, 1.7 million people in China died from stroke and another 0.9 million died from ischemic heart disease¹. According to a 2012 report on cardiovascular diseases in China, around 41% of total deaths could be attributed to CVD every year. In China, it is estimated that there is one CVD death every 10 seconds².

CVD risk factors such as hypertension, tobacco smoking, alcohol use and an unhealthy westernised diet have been trending upwards over the last 20 to 30 years.

According to our findings during the Systematic Explanatory Analyses of Risk factors affecting Cardiovascular Health (SEARCH) project, CVD risk factors such as hypertension, tobacco smoking, alcohol use and an unhealthy westernised diet have been trending upwards over the last 20 to 30 years, when a rapid health transition occurred in China³. In Moran's model⁴, it was estimated that the projected number of annual cardiovascular events will increase by more than half from 2010 to 2030, even if we only account for ageing and population growth factors. In short, China is facing a fast growing financial burden due to CVD in the coming decades.

In this paper, the authors estimate the financial protection gap for CVD in China by analysing the medical expenses of CVD and financial protections provided by existing insurance.

China announced nationwide healthcare reform in 2009 in order to achieve universal access to healthcare services and reduce the economic burden of medical expenses for its citizens. Recently, more and more attention has been focused on evaluating the current social health insurance system in China. In this paper, we are going to estimate the financial protection gap for CVD in China by analysing the medical expenses of CVD and financial protections provided by existing insurance, mainly based on the data from the China Health Statistical Yearbooks (2008–2013) and topic-related research publications^{7–12,18}. The financial protection gap is defined as the excess amount of medical expense over the amount reimbursed by both social and commercial insurances. With this, we hope to trigger thoughts on how to better fill these financial gaps, as well as the role that private insurance providers can play to help combat this challenge.

The social health insurance system in China consists of three schemes.

Current health insurance coverage

The social health insurance system in China consists of three schemes: the new rural cooperative medical care system (NRCMS) for rural residents, the urban employee basic medical insurance (UEBMI) for urban residents employed by state-owned/private enterprises and urban resident basic medical insurance (URBMI) for the other urban residents (eg the urban unemployed, self-employed, elderly and students)^{5–8}. The coverage varies across the three schemes and regions, and it is seen as the government's attempt to narrow the financial gap by providing reimbursement for not just CVD-related costs, but also for general healthcare spending. On top of providing insurance to its citizens, the government also has established various programmes to control medical and drug costs in hospitals. China has set the goal to achieve universal health care coverage for all its citizens by 2020⁷.

The inequality in China’s health care system is due to the uneven development across regions.

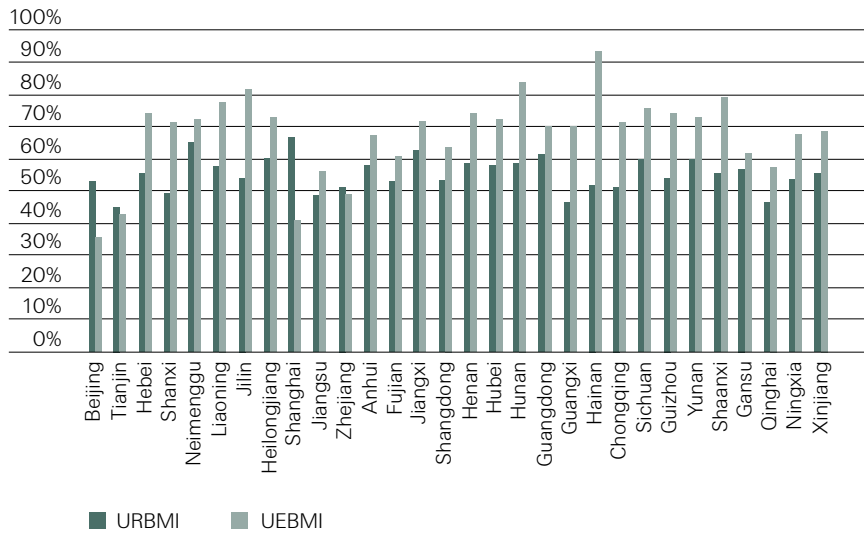
Reimbursement rates vary by health insurance scheme. It is assumed that patients with CVDs are reimbursed at rates that are below average due to the higher costs associated with CVDs.

Regional differences

The inequality in China’s health care system still exists due to the uneven development across regions. In general, UEBMI’s benefits are better than the other two schemes due to its stronger financial base derived from contributions by both employers and employees. In contrast, URBMI and NRCMS are more heavily dependent on government subsidies and hence, wealthier regions tend to have better coverage⁸. Since we did not find specific CVD-financial protection data, the publications for general diseases were used for discussion in this section. We believe that the coverage for general diseases should provide a good overview of what might be the financial protections available for CVDs under China’s healthcare system. At any rate, we believe using the general diseases coverage is optimistic as CVDs medical costs are higher than average medical costs, and there are new and innovative treatments for CVDs that are likely not covered by the current system.

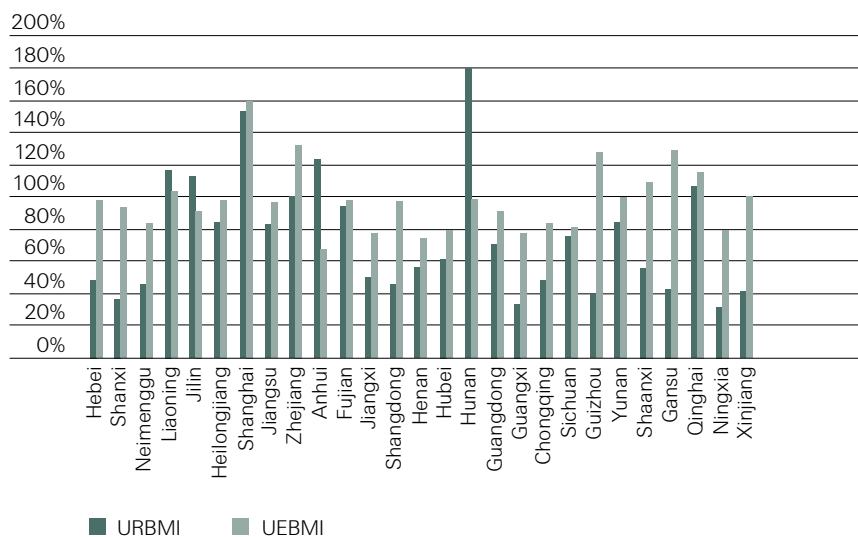
Huang⁸ summarised the inpatient and outpatient coverage under UEBMI and URBMI for each province in China based on a report from the Ministry of Human Resources and Social Insurance in 2010 (Figures 1,2). Employees in Beijing, Tianjin and Shanghai must cover 60–70% of the medical expenses out of pocket; this reflects the big gap between social insurance cover and the higher medical expenses in these big cities. The research⁵ suggests that the reimbursement rates under NRCMS are lower than URBMI. According to this study, the provincial average of inpatient reimbursement rates is around 70% for UEBMI and 55% for URBMI. The provincial average of outpatient reimbursement amount is around 100 RMB for UEBMI, one-third higher than for URBMI. It is reasonable to assume that reimbursement rates for patients with CVDs are lower than average due to more advanced and complicated treatments with costs that could reach the cap much faster. In addition, outpatient costs for CVDs would have less coverage compared to the average due to the expensive long-term medicine cost associated with CVDs.

Figure 1: Inpatient reimbursement rates of UEBMI and URBMI by province in 2010 as a percent of total expenses



Source: Huang (2010)⁸

Figure 2:
Outpatient reimbursement amount of UEBMI and URBMI by province in 2010 as a percent of total expenses

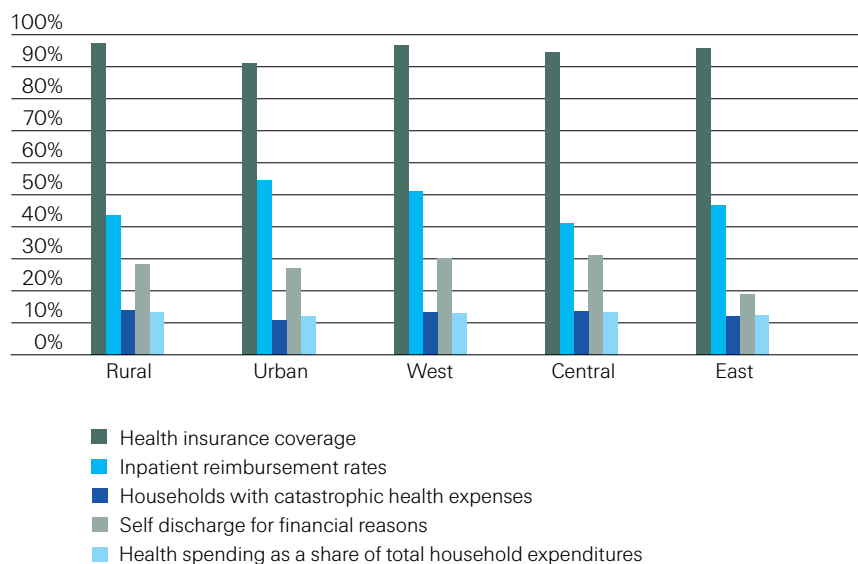


Source: Huang (2010)⁶

Compared to urban areas, rural areas cover a wider population but reimbursement rates are lower.

Meng et al⁷ conducted research on health service accessibility and financial protection for general diseases based on the 2011 National Health Service Survey (Figure 3). To study the regional differences, data were split into urban or rural areas and three geographic regions: east, central, and west (Figure 4). By 2011, health insurance coverage, including both social and commercial insurances, was provided to over 90% of the population nationwide. Compared to urban areas, rural areas cover a wider population but reimbursement rates are lower. The inpatient reimbursement rates range from 40%–55%; the difference is mainly due to different health schemes.

Figure 3:
Regional financial protection comparison



Source: Meng (2012)⁷

Figure 4:
Provinces, municipalities and autonomous regions by Eastern, Central and Western regions



Source: Swiss Re

Catastrophic health expense, defined as spending 40% or more of total income on healthcare, is a challenge for both urban and rural residents.

Catastrophic health expense was defined as spending 40% or more of total income on healthcare. Meng et al also indicated that little improvement was observed on the percentage of households having catastrophic health expenses during the period 2003–2011. Although reimbursement caps have increased almost twice as much on average since 2007, catastrophic health expenses still remain a concern. Inpatient self-discharge rates due to financial stress were on average 28.8% nationwide, and even in the richest region, the rate was still close to 20%. Some experts believe the percent of households experiencing catastrophic health expenses is expected to be much higher than the numbers in this paper, especially in rural areas. It is also interesting to note that the percentage of households with catastrophic health expenses does not vary much between urban and rural areas, which indicates that urban residents are subjected to similar catastrophic health expense risks as rural residents.

Although the findings from this study apply to general disease, we could reasonably infer that CVD trends are similar if not worse.

To reduce high out-of-pocket spending on medicines, China reformed the essential medicines system back in 2009.

Medicine coverage

Due to significant expenditure on medicine, China reformed the essential medicines system in 2009 to reduce high out-of-pocket spending on medicine^{9–11}. The latest essential drug list (EDL) was released in 2013, which includes 317 western medicines and 203 traditional Chinese medicines. The drugs on EDL have higher reimbursement rates than non-essential drugs and are categorised into two groups – List A and List B. List A comprises lower-priced and the most frequently used drugs (mostly generic) and are fully reimbursed. Drugs on List B are often higher priced and include patented and innovative drugs; the selection of drugs on List B can be adjusted by provinces and municipalities to suit their local economic situation and healthcare needs. The reimbursement level for List B drugs also varies across province governments. It was found that wealthier provinces added more drugs to their provincial EDLs⁵. The NRCMS covers significantly less drugs than the urban healthcare schemes⁵.

Medical expense of cardiovascular diseases

CVD medical expenses, including the various cost components, trends, and variances by regions, age and gender, were analysed.

In this section, we narrow our focus to concentrate on medical costs and components associated with CVD, and the financial protection gap that is still yet to be closed. Due to data availability, the focus is on coronary heart disease (heart attack and heart failure) and cerebrovascular disease (stroke). In 2011, the total inpatient expenses in China were about RMB 50 billion for acute myocardial infarction, RMB 140 billion for cerebral haemorrhage and RMB 270 billion for cerebral infarction². This translates to about USD 75 billion in aggregate. In this section, we studied the CVD medical expense, including the various cost components, trends, and variances by regions, age and gender.

The economic burden of CVD includes both short-term and long-term direct costs as well as indirect costs.

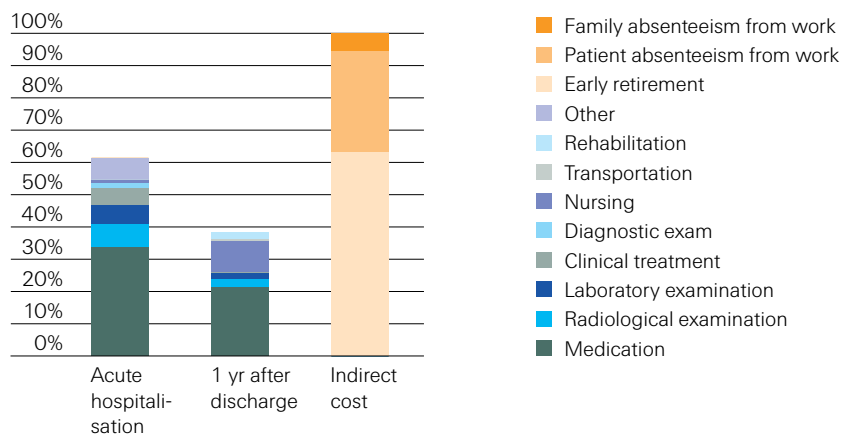
Components of CVD medical expenses

The economic burden of CVD includes both short-term and long-term direct costs as well as indirect costs. All inpatient costs, including drugs during that period, could be grouped into the short-term direct costs category, which contribute to the majority of the total CVD medical expenses. The long-term direct costs consist of medication after hospital discharge, follow-up outpatient service, nursing at home etc. Indirect costs are associated with the impairment of work and life activities, such as loss of income due to short term sick leave from work, or permanent leave such as early retirement.

Researchers found that about 60% of the cost incurred after a stroke was during the acute hospitalisation phase, and 40% was during the first year after discharge. Medicine was the biggest driver of costs.

Hu¹² analysed the direct cost components of atrial fibrillation (AF) related stroke in China (Figure 5). The average total direct cost of AF-related stroke was about USD 5000 per patient-year. About 60% of the cost was incurred during the acute hospitalisation phase, and 40% during the first year after discharge. This shows that the financial burden on medical costs continues to be significant, not just when the patients were first diagnosed with the disease and were hospitalised, but it remains for many months even after the patients are discharged from the hospital. Among all costs listed by Hu, the major cost driver is medicine. More than half of total direct costs in both the short-term and the long-term can be attributed to drug costs. The indirect cost was more than half of the direct cost, and 63% of the total indirect cost was associated with early retirement. This indicates that besides medicine costs, loss of income is another big component of total costs associated with CVD. Sun et al¹³ also did statistical analysis on inpatient CVD medical cost. They found that about 40% of inpatient costs come from medicines, which was consistent with Hu's research.

Figure 5:
Direct and indirect costs components of AF-related stroke



Source: Hu (2013)¹²

Closing the financial gap for cardiovascular disease in China

AF-related stroke patients are expected to pay more than 50% of their associated medical costs.

Geographic variances of CVD medical costs are mostly caused by the disparities in economic development and different social insurance coverage.

Limited accessibility to quality healthcare services in rural areas may be forcing patients to seek care beyond the local hospitals and results in additional costs.

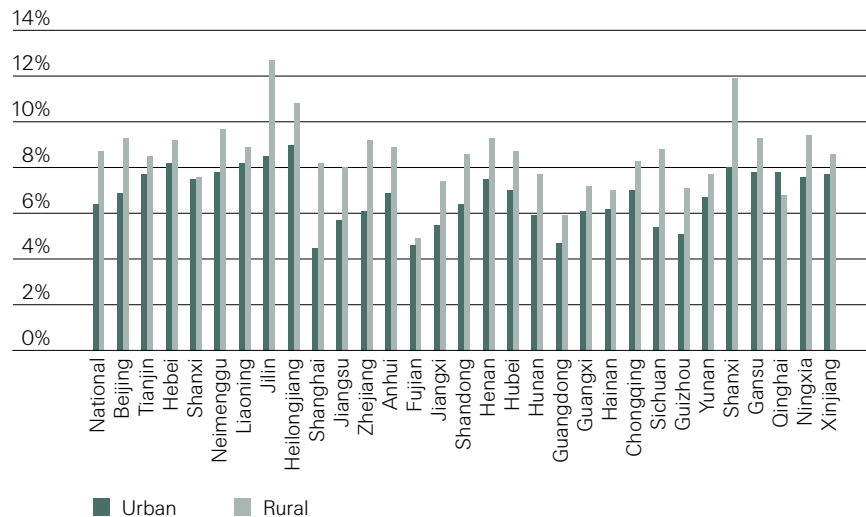
As discussed above, current public insurance schemes reimburse around 50% of inpatient costs, excluding drugs, which represent about 20% of the total direct costs of AF-related stroke. The coverage for medicine cost varies significantly between regions and schemes. With less coverage for the more recent, innovative, and imported Western drugs, the average reimbursement rate for CVD drug cost could be lower than 50%. Therefore, AF-related stroke patients are expected to pay more than 50% of their associated medical costs. In addition to that, there is currently no coverage for any of the indirect costs incurred due to sickness, which could be as high as 50% of total direct costs.

Geographic variances

Geographic variances of CVD medical costs are mostly caused by the disparities in economic development and different social insurance coverage. In this part of study, we analysed the ratio of health expenditure to the annual expenditure by region. Since there is no specific CVD-expenditure data in the China Health Statistical Yearbook, we used the data for overall medical expenses.

Figure 6 shows that the ratio of annual health expenditure to total expenditure per capita ranges from 4%–9% for urban areas and 5%–13% for rural areas. In general, people in rural areas spend relatively more on healthcare than people from urban areas. The less-developed provinces, such as Jilin and Shanxi, usually have above-average health expenditure percentages, especially in the rural areas. They also tend to exhibit higher disparity between urban and rural healthcare spending. This suggests that limited accessibility to quality healthcare services in rural areas forces patients to seek care beyond the local hospitals and results in additional costs (eg transportation, room and board etc). These costs need to be carefully accounted for when developing a viable solution for rural residents to close the financial gap on CVD medical expenses or even general medical expenses. Of all provinces, only Qinghai shows a reverse trend of higher health expenditure ratio in the urban versus rural area. One explanation could be that politics sometimes determines the level of social healthcare benefits. Provinces like Qinghai, with small populations and concentrated ethnic minorities, receive more subsidies from the central government to ensure they have better financial protection¹⁴.

Figure 6: Regional health expenditure comparison



Source: China Health Statistical Yearbook (2013)

Regional health expenditures were compared in several cities/provinces across China.

For the comparison, we focus on the biggest cities in China, where there is generally good healthcare access and plenty of opportunities for private insurance carriers. We chose four cities/provinces, one from each region (Table 1) to compare the variances between the North (Beijing), South (Guangdong), East (Shanghai) and West (Chongqing) of China. Chongqing, being the smallest city among the four, has the highest health expenditure/annual expenditure per capita in its urban area, even though its absolute amount of health expenditure is at the lower end.

Table 1:
Regional health expenditure versus average annual expenditure

| Regions | Urban | Rural |
|-----------|-------|-------|
| National | 6.4% | 8.7% |
| Beijing | 6.9% | 9.3% |
| Shanghai | 4.5% | 8.2% |
| Guangdong | 4.7% | 5.9% |
| Chongqing | 7.0% | 8.3% |

Source: China Health Statistical Yearbook (2013)

Even among the big cities, healthcare expenditure as a percentage of average annual expenditure differs.

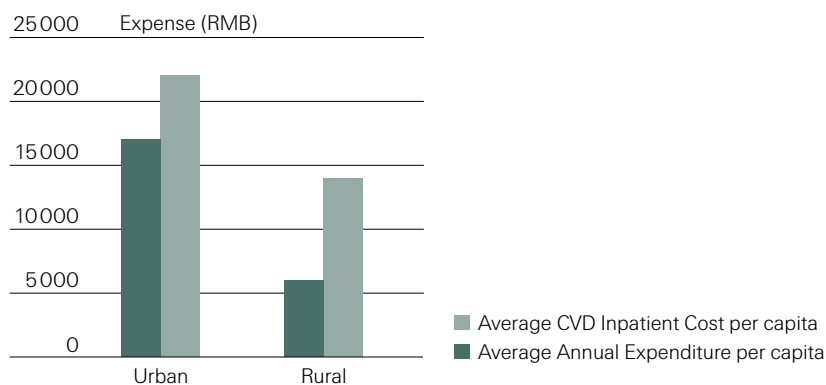
This suggests that even among the big cities, healthcare expenditure as a percentage of average annual expenditure differs and hence, there could be bigger financial gaps observed in such cities. Such areas could be a good market for private health insurance to step in and offer additional protection. Comparing the north and the south, people from Beijing spent more on healthcare compared to people from Guangdong. The figure for Guangdong could be attributable to the better insurance coverage in those areas¹⁵. This is consistent with the findings shown in Figure 1 – ie the inpatient reimbursement rates from social healthcare schemes for urban residents are higher in Guangzhou than Beijing. Although Chongqing has a similar inpatient reimbursement level for urban areas as Guangzhou, its residents spend much more on health care than Guangzhou residents. It is not clear why this is the case.

In urban areas, it is projected that the average CVD inpatient costs are around 130% of annual expenditure per capita, while in rural areas, the ratio increases to 230%.

Rural versus urban comparison

In Figure 7, we compared CVD inpatient medical costs and annual expenditure per capital for both urban and rural areas. According to the definition in the China Health Statistical Yearbook 2013, the urban areas include municipality districts and prefectural-level districts, while the rural areas include county-level cities, counties, towns and villages. CVD inpatient medical costs were significantly higher than annual expenditure per capital in both urban and rural areas. In urban areas, it is projected that the average CVD inpatient costs are around 130% of annual expenditure per capita, while in rural areas, the ratio increases to 230%. This creates a significant financial burden to people with CVD, even if we apply a 50% reimbursement rate under the current public health scheme. Although people in rural areas spend less in terms of annual expenditures and inpatient medical costs, they are more vulnerable after being hit by CVD due to the higher ratio of inpatient medical cost to annual expenditure.

Figure 7:
2012 Average CVD inpatient medical cost versus annual expenditure per capita



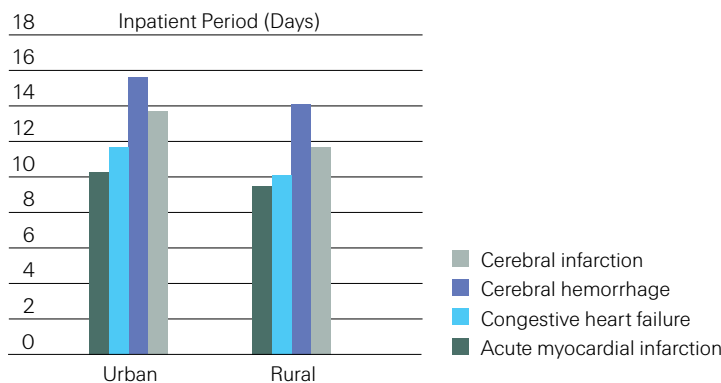
Source: China Health Statistical Yearbook (2013)

Closing the financial gap for cardiovascular disease in China

Hospital stays are longer among urban residents compared to rural residents.

Studies also find that hospital stays are longer among urban residents compared to rural residents (Figure 8), which suggests that rural residents could be receiving inadequate healthcare due to financial hardships. If this is the case, personal private insurance might not be the right solution as rural residents would not be able to afford it. However, government could pair up with large re/insurance companies to design additional affordable healthcare solutions for rural residents, while encouraging urban residents to purchase additional personal private insurance from local insurance providers in order to close the protection gap. This could save a significantly reduce government healthcare expenditures, while providing adequate medical financial protection to all citizens.

Figure 8:
2012 CVD-specific inpatient days between urban and rural areas



Source: China Health Statistical Yearbook (2013)

Annual inpatient medical cost data for five major cardiovascular diseases from the China Health Statistical Yearbook were analysed.

CVD medical cost trends

Six years of annual inpatient medical cost data for five major cardiovascular diseases from the China Health Statistical Yearbook were analysed. The total inpatient medical cost for those CVDs, except coronary artery bypass grafting (CABG), includes the expenses for examination, treatment, medicine and hospital stays. CABG includes the additional surgery expense. The compounded annual increase rates for each disease are shown in Table 2.

Table 2:
2012 CVD-specific inpatient medical cost between urban and rural areas (in RMB)

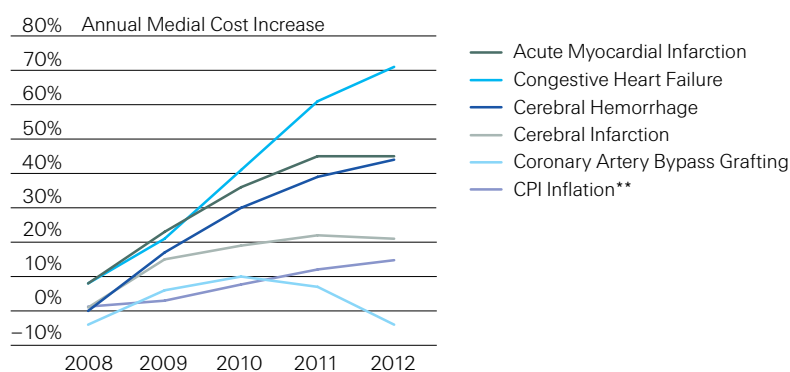
| Diseases | Urban | Rural | Urban/Rural Ratio |
|---------------------------------|-------------|-------------|-------------------|
| Acute myocardial infarction | 20000–30000 | 7000–12000 | 1.7–4.1 |
| Congestive heart failure | 10000–16000 | 5000–6000 | 1.6–3.2 |
| Coronary Artery Bypass Grafting | 35000–50000 | 35000–40000 | 0.9–1.4 |
| Cerebral hemorrhage | 16000–20000 | 10000–13000 | 1.3–2.1 |
| Cerebral infarction | 10000–15000 | 5000–7000 | 1.4–2.8 |

Source: China Health Statistical Yearbook (2013)

The average annual cost increases for acute myocardial infarction, congestive heart failure, and cerebral haemorrhage were around 8% to 11%, which were higher than the annual inflation rate.

The average annual cost increases for acute myocardial infarction, congestive heart failure, and cerebral haemorrhage were around 8% to 11%, which were higher than the annual inflation rate¹⁶ of 4%. Despite the average inflation rate of 4%, the inpatient medical cost for CABG remained stable over the past six years. One explanation for this is that such surgery becomes a more mature procedure and its cost is controlled by the government, which leads to higher efficiency and lower costs. After the 2009 healthcare reforms, the increase of CVD inpatient cost slowed which could be attributed to the cost-effective control by governments (Figure 9).

Figure 9:
Six year trend of annual CVD inpatient medical cost per capita in China



Note: Data for 2007 was used as the base in the accumulative increase rates

Source: China Health Statistical Yearbook (2013)

The inpatient cost for CVDs represented a significant portion of annual average disposable income.

Table 3 indicates that the inpatient cost for CVDs represented a significant portion of annual average disposable income, which further confirms the heavy financial burden incurred at the onset of CVD events. National healthcare reform helped to control cost increases. The medical costs for the listed CVDs are expected to gradually become more and more affordable as the ratio of those medical costs to disposable income decrease.

Table 3:
Six year trend of annual CVD inpatient medical cost per capita in China

| Year | Acute Myocardial Infarction | Congestive Heart Failure | Cerebral Hemorrhage | Cerebral Infarction | Coronary Artery Bypass Grafting | CPI Inflation** |
|------------------------------|-----------------------------|--------------------------|---------------------|---------------------|---------------------------------|-----------------|
| 2007 | 11 602 | 4 179 | 8 481 | 5 990 | 36 429 | 6.58% |
| 2008 | 12 566 | 4 512 | 8 489 | 6 047 | 34 819 | 1.26% |
| 2009 | 14 271 | 5 067 | 9 958 | 6 874 | 38 574 | 1.70% |
| 2010 | 15 774 | 5 896 | 11 020 | 7 143 | 40 071 | 4.57% |
| 2011 | 16 793 | 6 732 | 11 802 | 7 325 | 38 802 | 4.06% |
| 2012 | 16 802 | 7 148 | 12 207 | 7 241 | 34 836 | 2.41% |
| Average Annual Increase Rate | 8% | 11% | 8% | 4% | -1% | 4% |

<http://www.inflation.eu/inflation-rates/china/historic-inflation/cpi-inflation-china.aspx>. The CPI inflation rates in China from 2007–2012¹² were used to calculate the compound average inflation rate during this period, which was 4.11%.

Source: China Health Statistical Yearbook (2013)

For CVDs, the medical costs beyond the social insurance coverage represent the gap to be filled by medical reimbursement insurance.

According to the Swiss Re Asia Medical Survey 2014²⁰, the top two barriers to purchasing personal medical reimbursement insurance in China are lack of knowledge and affordability.

Table 4:
CVD expenditures and income effects among different income strata

Financial protection gap of cardiovascular diseases

Generally speaking, the medical expenses for CVDs include both short-term and long-term direct costs as well as indirect costs. The largest portion of short-term direct cost comes from inpatient costs, about half of which are paid out-of-pocket. Considering the high cost of CVDs, those medical costs beyond the social insurance coverage represent the gap to be filled by medical reimbursement insurance. The longitudinal study from CHARLS Research Team¹⁷ indicated that only 7% of the wealth of the older population (aged 45 and over) is held in liquid assets such as cash, while the majority of their wealth is in the form of property (73%). When facing large out-of-pocket expenses for CVDs, patients might be forced to sell their properties.

Huffman et al¹⁸ included participants aged 25–70 from Beijing and Henan Zhoukou City and collected data in 2008–2009 to assess the economic impact of CVD. They split the survey participants into three groups by income level using the national population income distribution: low (poorest 40%), middle (middle 40%) and high (top 20%). The low income group had the highest out-of-pocket proportion of annual household expenditure and the highest percentage of income loss, although in absolute terms, their income losses were the smallest. The financial gap was the biggest for the low income group, followed by the middle income group; the gap was the smallest for the high income group. The high saving rate in urban areas, an estimated 30% of disposable income¹⁹, indicates that middle and high income groups can use their savings to reduce the financial distress caused by CVD. According to the Swiss Re Asia Medical Survey 2014²⁰, the top two barriers to purchasing personal medical reimbursement insurance in China are lack of knowledge and affordability. Due to cost and limited knowledge about insurance, low income groups are less likely to purchase medical insurance compared to middle and high income groups. The latter are growing due to increasing urbanisation and are more willing to pay for the best healthcare treatment as well as the additional protection offered by commercial insurance.

| | Low | Middle | High |
|---|------|--------|-------|
| Expenditures | | | |
| Inpatient expenditures/Total CVD expenditures, % | 77.2 | 77.5 | 82.1 |
| 15-month out-of-pocket CVD expenditures as a proportion of annual total household expenditures, % | 40.1 | 30.5 | 15.0 |
| Income Effects | | | |
| Any decrease in individual income, % | 45.5 | 24.4 | 13.1 |
| Any decrease in household income, % | 40.9 | 25.6 | 14.3 |
| Decrease in individual monthly income since hospitalisation, INT\$* | 73.3 | 122.2 | 244.4 |
| Median decrease in household monthly income since hospitalisation, INT\$ | 85.6 | 122.2 | 342.2 |

*INT\$ is international dollars

Source: Huffman (2011)¹⁸

There is an increasing need to provide insurance for patients in China that covers cross-regional and overseas medical costs.

Another finding from the Swiss Re Asia Medical Survey 2014²⁰ is that the top two criteria for patients in China when selecting a hospital are quality of treatment and the reputation of the hospital. Compared with patients in other Asian countries, such as India and Thailand, Chinese patients put the most weight on reputation and have a higher propensity to purchase commercial reimbursement products. The hospitals with the highest reputation in China are mostly in metropolises like Beijing and Shanghai. Currently, cross-provincial reimbursement systems are lacking which enable patients from other provinces to seek better treatment in these cities. Moreover, some advanced medical treatments for CVDs are only available or have higher successful rates in developed countries, such as the US. However, the medical costs for these advanced overseas treatments are extremely high. For example, the average cost of a heart transplant in the US is about USD 787000 due to the complicated procedure and procurement of the organ²¹. If commercial

insurance could provide the coverage for these expensive overseas therapies as well as the living expenses during medical tours, it would ease the financial burden for the insured if they choose overseas treatments. Therefore, there is an increasing need to provide insurance for patients in China that covers cross-regional and overseas medical costs.

Commercial insurance could meet the needs of Chinese patients by providing coverage for non-essential drugs, especially patented and innovative drugs, and imported medical devices.

Current social medicine policies state that EDL drug revenues are required to reach 25%–40% of total revenues in medium-sized hospitals, where middle and high-income groups are most likely to seek healthcare service. Around 60–75% of drugs prescribed by those hospitals have high prices and low reimbursement rates. Moreover, the quality of imported medical devices for heart surgeries are usually higher than domestic devices and receive partial medical reimbursement, eg cardiac pacemakers, vascular stent, heart valves etc²³. One study²² indicated that only up to 25% of patients who need to use high priced treatments for diseases can afford those treatments. When it comes to CVDs, the percentage is expected to be no more than 25%. Therefore, commercial insurance could meet the needs of Chinese patients by providing coverage for non-essential drugs, especially patented and innovative drugs, and imported medical devices.

Care-seeking behaviours are strongly associated with insurance accessibility and affordability.

Patients' care-seeking behaviours are strongly associated with insurance accessibility and affordability. A study of hospitalisation expenses for patients undergoing cardiac interventional surgery in Guangzhou found that inpatient expenses for those with medical insurance were significantly higher than those without insurance²⁴. Fang et al²⁵ also found that the higher coverage of commercial insurance was associated with higher medical costs. One explanation could be that middle and high income groups are more likely to buy health insurance and are more willing to pay for the best treatments and medicines. The true medical cost of CVD in this study might be potentially underestimated if social/private insurances increase their coverage, including reimbursement rates and caps, which could encourage people to increase their use of healthcare services – both in terms of frequency and quality. Therefore, insurance providers should be careful in designing their products to prevent excessive use of the coverage, which could result in higher costs and waste.

Besides drug costs, the long-term costs include the significant cost of care after severe CVDs events.

Besides drug costs, the long-term costs include the significant cost of care after severe CVDs events, such as stroke. Social insurance schemes are more concentrated on the coverage of inpatient costs and less on the costs for care after a patient is discharged from hospital. More than one-third of stroke survivors have some degree of disability and need assistance for daily living²⁶. Because of the 4-2-1 family structure, more and more disabled elderly patients, after CVDs events, are seeking care services from caregivers instead of family members. The monthly cost of full-time caregivers could be around RMB 2000–5000 (USD 300–800) for big cities like Beijing and Shanghai. However, in 2014, the average retirement income in Beijing is only about RMB 3000 (USD 500)²⁷. As the demand and costs of caregiving service increases, patients and their families will face heavier financial burdens.

Disability income insurance and long term care (LTC) insurance could provide protection for patients and financial stability.

The indirect cost comes from the loss of income for both patients and their family members. Huffman et al¹⁸ found that there is a significant decrease in individual income after CVD hospitalisation for both individuals and households. Disability income insurance and long term care (LTC) insurance could provide protection for patients and financial stability.

Summary

The medical costs of cardiovascular diseases consist of both acute hospital expenses and long-term healthcare expenditures.

The medical costs of cardiovascular diseases consist of both acute hospital expenses and long-term healthcare expenditures. Among those, the cost associated with medicine is the major cost driver. The non-medical costs associated with CVD events, such as loss of income, also contribute to the financial distress of patients. The CVD inpatient medical cost represents a larger percentage of total annual expenditure for rural residents compared to urban residents. Health spending as a portion of total annual expenditure varies by geographic location due to the disparities in social insurance coverage, economic development and quality of healthcare.

Financial protection for CVD patients is insufficient in China.

Studies indicated that financial protection for CVD patients is insufficient in China. The lack of protection affects low income groups the most. Nearly half of the inpatient costs were paid out-of-pocket by low income groups. About one-fourth of patients self-discharged due to financial stress as a result of high medical costs and the lack of insurance protection. The reimbursement cap on inpatient costs may have contributed to the relatively high out-of-pocket expenditures for CVD. While the reform of the essential medicines system has reduced high out-of-pocket medicine spending, a gap still exists. Reimbursement rates vary across regions due to differentiated healthcare needs. Since the in-/out-patient medical costs are expected to continue increasing in the future, there is a growing need to fill the gap between medical cost and the financial protection available currently, particularly for households with chronic diseases like CVD.

CVD insurance policies could supplement the national insurance coverage.

CVD insurance policies could supplement the national insurance coverage to cover the out-of-pocket medical expenses such as deductible, co-payment and any amount exceeding the reimbursement caps. In addition, CVD insurance products in China could expand to include long-term care and non-medical costs such as physical therapy, nursing care, transportation & lodging and lost wages. As China is making progress to open its insurance markets to commercial insurers, more and more life and health insurance products are expected to be sold to individuals as additional protection to supplement the national social insurance system. Findings from this paper could support the design and pricing of CVD-related medical insurance in China.

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Lost life expectancy due to air pollution in China

Douglas W. Dockery, C. Arden Pope III

Smog in Beijing and other Chinese cities has caused pollution to reach unprecedented levels. It is impossible to measure the health costs or loss of life due to air pollution with absolute accuracy or certainty. Nonetheless, data suggests that poor air quality imposes a significant health burden on the urban population. When the Prime Minister quipped that living in Beijing would shorten his life by 5 years, he succinctly captured the risk air pollution poses to Chinese city dwellers. Chinese authorities are now looking at ways to address air pollution and other environmental concerns, both to manage public health costs and to lessen the impact on economic growth.

Introduction

Air quality in the US and Europe has improved in recent decades, but has deteriorated in much of the developing world.

Air quality in the United States and Europe has substantially improved over the last couple of decades, and cleaner air has contributed to increased life expectancy¹. However, in many countries in the developing world, air pollution control has been sacrificed in the name of economic development.

Poor air quality in Beijing is harming not only the health of its residents, but also its economy.

The severe and deteriorating air pollution situation in China is a case in point. The high particulate air pollution readings in Beijing have been documented and reported on the web by the US Embassy. The Chinese government has begun publishing real time measurements of air quality in most cities. There is increasing concern that poor air quality is not only harming the people, but may also be harming economic growth in China.

In October 2013, the city of Harbin reported that the air quality index had soared to 500, its highest possible level.

Winter air pollution events in the north of China are common, and the hazard is well recognised. "If I work in your Beijing, I would shorten my life by at least five years," Zhu Rongji told city officials when he was prime minister in 1999². However, the government is just beginning to try and control or at least mitigate these air pollution events. In October 2013, a particularly severe air pollution episode in the northern city of Harbin was reported around the world. In blogs, people reported not being able to see their hands in front of their faces or other people. The Harbin government reported an air quality index (AQI) score of 500, the highest possible reading, and concentrations of PM_{2.5} – ie fine particulate matter that are 2.5 microns or smaller in diameter and especially harmful to health – of 1 000 micrograms per cubic meter (mg/m³).

When London's smog level in 1952 reached that of the level recently recorded in Harbin, 4000 deaths occurred.

These anecdotal reports and quantitative measurements from Harbin (Figure 1) are remarkably similar to those from London during the 1952 Great Smog (Figure 2). Health data from Harbin have not been reported, but in London 4 000 excess deaths were attributed to this event. Recent analyses have suggested that the true number of excess deaths could be 12 000³.

Harbin's pollution levels are believed to be linked to the policy of providing free coal for heating.

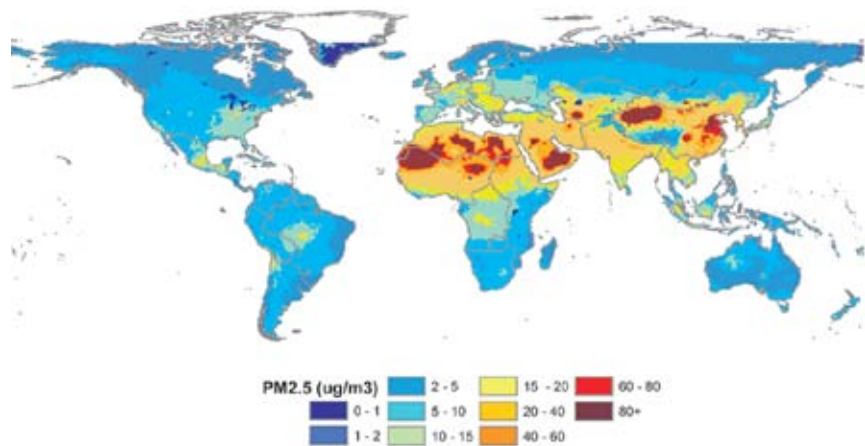
This Harbin episode coincided with the mandated start of heating of the homes and offices. The policy of providing free coal for heating in the north has been associated with persistently high winter particulate air pollution levels in northern cities. A recent analysis⁴ evaluated the effect of this policy. Outdoor ambient concentrations of particulate air pollution (Total Suspended Particulates) were found to be 55% higher and life expectancies 5½ years shorter in the north. Deaths due to cardiorespiratory causes were notably higher.

Lost life expectancy due to air pollution in China

Outdoor air pollution in China was estimated to contribute to 1.2 million premature deaths and 25 million healthy years of life lost.

In December 2012, the Global Burden of Disease analyses were published in The Lancet⁵. As part of that effort, average 2005 fine particle (PM_{2.5}) air pollution was estimated across the world (Refer to Figure 1)⁶. Outdoor air pollution in China was estimated to contribute to 1.2 million premature deaths and 25 million healthy years of life lost⁷. Outdoor air pollution was ranked as the fourth leading risk for loss of life expectancy in China; indoor air pollution from burning solid fuels for heating and cooking was the fifth leading cause.

Figure 1:
Estimated 2005 annual average PM_{2.5} concentrations (µg/m³)⁶.



Source: Brauer et al (2012)⁶

This paper seeks to provide estimates on loss of life expectancy due to exposure to air pollution.

These huge numbers of excess deaths and total years of lost life expectancy are compelling, but fail to communicate the risk to an individual of life-long exposure to extremely high air pollution, or the risk to visitors or temporary residents. The objective of this commentary is to provide useful, comparable effect estimates on loss of life expectancy under various exposure scenarios for exposure to air pollution and, for comparison, to cigarette smoke, a common, well studied risk.

Methods

For this study, the life expectancy for non-smokers is calculated by adjusting the rates of those aged 18 and older.

Our estimates of survival curves and life expectancy are derived using standard life-table techniques and are calculated using 2008 age-specific death rates for the total population of the United States⁹. The counterfactual, baseline, life expectancy for non-smokers is calculated adjusting the rates for ages 18 years and older to 80% of rates from the total population. This provides hypothetical population-based mortality rates and estimates of life expectancy for a contemporary, healthy, non-smoking population. We estimated life expectancy for various exposure scenarios by multiplying the baseline age-specific death rates by the relative risks for each of these scenarios.

Excess risk estimates for air pollution scenarios were based on literature reviews.

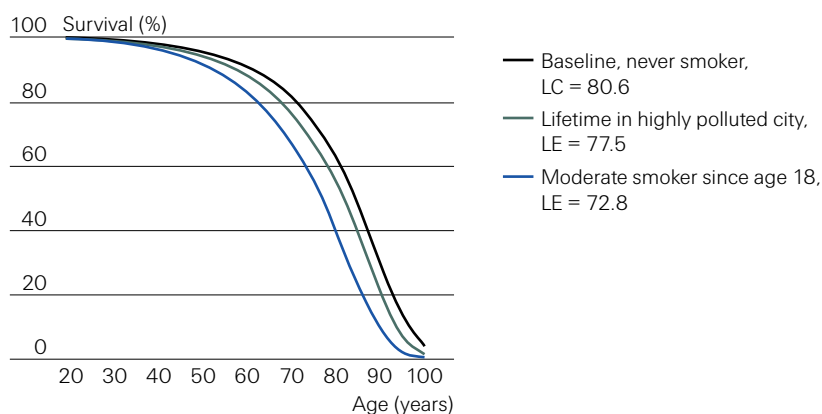
Excess risk estimates for the various air pollution exposure scenarios are based on recent literature reviews^{9, 10}. Specifically, excess risk from exposure to air pollution in a mildly polluted city (15 $\mu\text{g}/\text{m}^3$ mean $\text{PM}_{2.5}$), a moderately polluted city (25 $\mu\text{g}/\text{m}^3$ mean $\text{PM}_{2.5}$), and a highly polluted city (55 $\mu\text{g}/\text{m}^3$ mean $\text{PM}_{2.5}$) relative to a very clean city (5 $\mu\text{g}/\text{m}^3$ mean $\text{PM}_{2.5}$) are estimated to be 7%, 14%, and 30%, respectively. The excess risk estimates for a highly polluted city may somewhat underestimate the effects of air pollution of Beijing for two reasons. First, average $\text{PM}_{2.5}$ concentrations in Beijing are reported to be 58 $\mu\text{g}/\text{m}^3$ in 2005⁶ and have been getting worse. Second, we are using more conservative risk estimates than would be obtained by linear extrapolations from US cohort studies because of recent evidence that the exposure-response function flattens out at higher levels of exposure¹¹.

Results and discussion

Cigarette smoking, to a large extent, and exposure to ambient air pollution to a less extent both adversely alter survival curves.

Figure 2 illustrates differences in the life-table derived survival curves and life expectancy for the different exposure stylised scenarios. Cigarette smoking significantly adversely alters the survival curves. A lifetime of exposure to ambient air pollution in a highly polluted city has a similar, but less dramatic impact on the survival curves. Lifetime exposure to second-hand smoke (SHS) has a somewhat smaller, but similar effect (not shown in Figure 2).

Figure 2:
Survival curves 18–100 years and estimated life expectancy (LE) for alternative excess risk assumptions



Source: author

Lost life expectancy due to air pollution in China

Long-term smoking can reduce life expectancy by 4.5 to 12.5 years.

Table 1 presents the estimated years of life expectancy and the estimated reduction in estimated life expectancy, relative to the baseline. Long-term active smoking clearly has a substantial impact on life expectancy ranging from 4½ to 12½ years lost, depending on the level of smoking. The loss of life expectancy is substantially reduced for smokers that quit smoking. How much loss of life expectancy will occur depends on various factors including, level of smoking, the age when an individual began and stopped smoking, and the lagged or residual excess risk from the smoking upon cessation. For an ex-smoker who smoked from age 18–40, life expectancy would be almost two years less than if he/she had never smoked, but nearly 6 years longer than if he/she had continued smoking.

Table 1:
Life-table derived estimates of reduced life expectancy from different exposures to cigarette smoke and ambient fine particulate matter air pollution

| Baseline life expectancy (LE) | Years LE | Reduced years LE | Reduced days LE |
|--|----------|------------------|-----------------|
| Baseline LE for never smoker at birth | 80.6 | – | – |
| Long-term exposures to active cigarette smoking | | | |
| Smoker, heavy, since age 18 (add 200% excess risk since age 18) | 68.1 | 12.5 | 4,571 |
| Smoker, moderate, since age 18 (add 100% excess risk since age 18) | 72.8 | 7.8 | 2,851 |
| Smoker, light, since age 18 (add 50% excess risk since age 18) | 76.1 | 4.5 | 1,653 |
| Ex-smoker, moderate smoker from age 18-40 (add 100% excess risk from age 18-40, 50% at age 41, 25% age 42, 10% thereafter) | 78.7 | 1.9 | 701 |
| Long-term exposure to second hand cigarette smoke | | | |
| Live/Work with smoker 18+ (add 25% excess risk from age 18) | 78.1 | 2.5 | 903 |
| Live/Work with smoker 18–65 (add 25% excess risk from age 18–65) | 79.6 | 1.0 | 352 |
| Live with smoker as child with no lagged/residual risk (add 25% excess risk from age 0–18) | 80.4 | 0.2 | 74 |
| Long-term exposures to air pollution | | | |
| Lifetime in mildly polluted city (add 7% excess risk from birth) | 79.8 | 0.8 | 292 |
| Lifetime in moderately polluted city (add 14% excess risk from birth) | 79.0 | 1.6 | 569 |

Source: author

Living with a smoker throughout adult life could reduce life expectancy by 2.5 years.

As can be seen in Table 1, living with a smoker throughout adult life could reduce life expectancy by up to 2½ years. On the other hand, working with a smoker between 18 and 65 years was estimated to reduce life expectancy by only 1 year, assuming the increased risk does not persist once exposure stops. Because of the relatively low baseline risks of mortality for children, exposure to SHS as a child results in a reduction in life expectancy of only about 74 days. If, however, the increased risks of childhood exposure to SHS persist, the reduction in life expectancy may be substantially higher.

Life-time exposure to ambient air pollution, comparable to that found in Beijing, may reduce life expectancy by approximately three years.

The estimated reduction in life expectancy from a lifetime of exposure to ambient air pollution clearly depends on the level of pollution (Table 1). For example, lifetime exposure to air pollution in a mildly polluted city (15 µg/m³ mean PM_{2.5}) or a moderately polluted city (25 µg/m³ mean PM_{2.5}) relative to a clean city (5 µg/m³ mean PM_{2.5}) results in an estimate of 0.8 and 1.6 years reduction in life expectancy. Life-time exposure to ambient air pollution, in a highly polluted city (comparable to Beijing, China) may result in an estimated loss of life expectancy of approximately 3 years.

The net effect on a population from being exposed to ambient air pollution is significant in terms of total loss of years of life.

Thus a lifetime of exposure to air pollution either from outdoor air pollution, indoor air pollution from SHS, or personal smoking can lead to years of lost life expectancy. Living in a highly polluted city has estimated effects comparable to or even greater than that from living with a smoker. Smoking, however, is a personal choice and only a fraction of the population engages in this voluntary exposure. On the other hand, breathing is not. The entire population is exposed to ambient air pollution. The net effect on population of a 3.1 year reduction in life expectancy across everyone breathing ambient air pollution is much larger than a 7.8 year reduction only among those smoking.

One can compare the risks of pollution and smoking in terms of the incremental effect of each year of exposure.

It is useful to compare these risks in terms of the incremental effect of each year of exposure. This helps us appreciate the effect of potential changes in exposures or behaviours. It also provides insights into the comparative risk for a worker or student who temporarily moves to such an environment.

One year of living in an elevated air pollution environment could result in as much as a few days to a few weeks of shorter life expectancy per year, depending on the levels of pollution and age at time of exposure.

To illustrate, Table 2 presents the estimated reduction in life expectancy for a 50-year old non-smoker who spends one year in various modelled cities with mild, moderate and high PM_{2.5} air pollution. Because the incremental reductions in estimated life expectancy for each year of exposure are small, we report these as days lost per year. One year of living in an elevated air pollution environment could result in as much as a few days to a few weeks of shorter life expectancy per year, depending on the levels of pollution and age at time of exposure. If the increased risks from a one year exposure were to persist, even only in part, the reduction in life expectancy would be larger. Because the baseline risk goes up with age, the impact of each year of exposure to high pollution on life expectancy is much larger at age 65 (21 days lost life expectancy) than it is at age 50. Likewise, the impact on lost life expectancy is less at age 35 years (5 days).

Table 2:
Estimates of reduced life expectancy for 1 year exposures to cigarette smoke and ambient fine particulate matter air pollution at 50 years of age

| One-year exposure at age 50 with various PM _{2.5} pollution levels | Reduced years LE | Reduced days LE |
|---|------------------|-----------------|
| Living in mildly polluted city (add 7% excess risk) | .008 | 3 |
| Living in moderately polluted city (add 14% excess risk) | .015 | 6 |
| Living in highly polluted city (add 30% excess risk) | 0.032 | 12 |
| One-year exposure at age 50 with various smoking exposures | Reduced years LE | Reduced days LE |
| Smoker, heavy (add 200% excess risk) | .216 | 79 |
| Smoker, moderate (add 100% excess risk) | .108 | 39 |
| Smoker, light (add 50% excess risk) | .054 | 20 |
| Live/Work with smoker (add 25% excess risk) | .027 | 10 |

Source: author

What does this mean for the individual?

The estimates provided are for the population life expectancy and do not refer to how much any individual's life is shortened by one year of exposure to pollution.

These estimates are for the population life expectancy and do not provide specific estimates how much any individual's life is shortened by one year of exposure in a polluted city. In fact, in this modelling exercise, we assume that if the person survives this experience, they would go on with the normal expectation of death with no increased residual risk. Evidence from smoking cessation studies suggests that risk of fatal cardiovascular events (ischemic heart or cerebrovascular), the primary cause of death from these exposures, begins returning to near normal within a few weeks/ months of cessation of smoking and is only somewhat elevated after a few years. For respiratory conditions, air pollution exposure can contribute to accelerated, irreversible loss of lung capacity. It may take months to years to return to normal risk, and indeed there may be permanent but small elevated risk.

Lost life expectancy due to air pollution in China

For an individual, the implication of these results is not that their life is measurably shortened. Rather these estimates reflect the increased probability of death each year.

Once the air pollution exposure is removed – eg by moving to a cleaner city – the excess risk of dying returns to normal.

Living/working in a moderately polluted city has comparable effects on life expectancy as living with a smoker or working in an environment with substantial second-hand smoke.

Air pollution affects those with pre-existing chronic cardiovascular conditions the most.

Masks are not very effective in preventing individuals from breathing in or limiting exposure to ambient particles.

Air pollution does impact life expectancy in developing countries.

Comparing air pollution and smoking has certain limitations.

It is not possible to measure health costs or loss of life from air pollution accurately.

Failure to address air pollution and other environmental concerns is now being recognised as a significant public health burden and could adversely impact economic growth.

For an individual, the implication of these results is not that their life is measurably shortened. Rather these estimates reflect the increased probability of death in each year. Again to illustrate, among one thousand (1000) non-smoking 50 year olds, we would expect 3½ to die within a year. If all of them smoked, we would expect an additional 3½ to die (ie only a fraction of them would be expected to take up this behaviour). Alternatively, if the non-smokers experience PM_{2.5} air pollution of approximately 55 mg/m³ for a year, we would expect one additional death (ie in this case everyone is at risk).

These individuals would most likely die from acute events such as a myocardial infarction, stroke, asthma attack or traffic accident. It is assumed that once the air pollution exposure is removed – eg by moving to a cleaner city – the excess risk of dying returns to normal.

While these estimates of loss life expectancy for a 50 year old are simplistic, they provide a basis for comparing risks. Thus living/working in a moderately polluted city has comparable effects on life expectancy as living with a smoker or working in an environment with substantial second-hand smoke.

Can individuals take actions to protect themselves, other than leaving?

The most effective strategy is to reduce your own baseline risk of cardiorespiratory death¹². Air pollution affects those with pre-existing chronic cardiovascular conditions. Long-term strategies to reduce risk of cardiorespiratory disease have the added benefit of reducing the likelihood of death due to air pollution.

Masks and other breathing protection are not very effective in preventing individuals from breathing in or limiting exposure to ambient particles¹². Office and home air conditioning has some limited benefit in reducing exposures to ambient outdoor air pollution. Indeed gaseous pollutants (eg sulfur dioxide, ozone, nitrogen oxides and other water soluble gases) are readily removed by air conditioning. However, the normal filters in air conditioners are only modestly helpful in removing inhalable, airborne particles. Office and home filters can be helpful if specifically designed for removal of small particles, eg HEPA filters. However, targeted filtering of inhalable particles is difficult, expensive and requires regular cleaning and maintenance. Thus, the preferred approach is cleaning up the ambient outdoor air.

Summary and conclusions

From these calculations, it becomes apparent that outdoor particulate air pollution is having a substantial effect on life expectancy in much of the developing world.

As George Box reminded us “All models are wrong, but some are useful¹³.” This model of life expectancy valuing the effects of air pollution and cigarette smoking in the currency of days of lost life expectancy is simplistic, ignores many nuances in the actuarial data, and in that sense is clearly wrong. However, this approach helps us understand the comparative impact of air pollution relative to other known risk factors.

It is impossible to measure the total health costs or loss of life due to air pollution in China, or elsewhere with absolute accuracy or certainty. However, when the Prime Minister quipped that living in Beijing would shorten his life by 5 years, he succinctly captured the reality that air pollution imposes a substantial health burden on the population in China.

Most countries have seen a dramatic improvement in life expectancy over the past 50 years that appears to be at least correlated with economic development. Failure to address air pollution and other environmental concerns, however, is now being recognised as a significant public health burden and a potential impediment to economic growth.

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Overview of health risk factors in Brazil

Marcia C. Castro

Brazil has made significant progress in reducing infectious diseases, although problems still persist. Currently non-communicable diseases (NCDs) represent the largest mortality and morbidity burden in the country. This situation may become more critical as the population ages and the prevalence for being overweight and obese increases. Brazil has a historically good record of facing health challenges through large scale campaigns. It most recently became the global leader in tobacco control, despite being among the top 5 producers of tobacco in the world. This article discusses historical and current pattern of mortality, morbidity and associated risk factors in Brazil, particularly when faced with structural demographic change. It also discusses government programmes, such as the Family Health Strategy and the Strategic Action Plan to tackle NCDs.

Health campaigns in Brazil: A brief history

A series of historical events including a 1916 speech by Miguel Pereira, a leading physician, shaped the discourse on public health in Brazil.

Several historical events related to public health in Brazil since the Republic era, ranging from discovery of new diseases, to novel control methods of malaria, to large scale campaigns, played an important role in the past and to some extent set the context for what we observe now in the country. An important event in creating a momentum for change was a speech delivered by a physician named Miguel Pereira in 1916 at the Medical School in Rio de Janeiro. While referring to expeditions that assessed the health conditions of rural areas in the North and Northeast regions¹⁻⁶, he stated that rural Brazil was an enormous hospital⁷.

At one time, poor health conditions were seen as an obstacle to economic development.

Poor health conditions of the poor and rural populations were seen as an obstacle to economic development. Sanitation movements, which brought together physicians, scientists, intellectuals and politicians, resulted in major reforms of the sanitary services in the country. Important milestones included the start of the Pro-Sanitation Movement in 1916, as well as the creation of the National Department of Public Health in 1920 and the Ministry of Education and Public Health Affairs in 1930⁸.

Campaigns were launched to combat specific diseases such as yellow fever, bubonic plague, smallpox and malaria.

Large scale (and mostly vertical) campaigns were launched to address specific diseases such as yellow fever, bubonic plague, smallpox and malaria. This model of intervention gained momentum, and many of these campaigns received support from the Rockefeller Foundation. There are campaigns still present in Brazil, such as the National Immunization Day against Poliomyelitis⁹.

Demographic transition

Demographic changes in Brazil have had an impact on current health risk factors.

Crucial to the understanding of current health risk factors in Brazil is the demographic transition that brought about major changes to the structure of the population, coupled with patterns of economic growth and social changes that have been observed since the mid-20th century.

Brazil's population grew rapidly between 1940 and 1970. However, the total fertility rate from dropped from 6.3 in 1960 to 1.9 in 2010.

Brazil experienced high population growth between 1940 and 1960, an average of 2.8% per year. After a similar growth between 1960 and 1970, the growth started to decline in the 1970s (2.5%), reaching an average of 1.64% per year during 1991 and 2000⁹, and 1.17% between 2000–2010. The total fertility rate (TFR) remained at high and relatively constant levels between 1940 and 1960¹⁰. A modest and slow decline since the early 1900s and small oscillations in fertility in the 1950s and 1960s have been reported^{9,11}. Nevertheless, important demographic transformations started in the mid-1960s. In four decades, the TFR experienced a dramatic decline: from 6.3 in 1960 to 2.3 in 2000^{9,10,12}, and the 2010 Population Census indicated a TFR of 1.9. This decline occurred in all regions and across different socioeconomic groups.

Overview of health risk factors in Brazil

Life expectancy has steadily increased since 1940 and by 2012 was 74.6 for males and 78.3 for females.

Regarding mortality, in the 1940s life expectancy in Brazil was below 50 years¹³. By 2012, the number increased to 74.6 (71 for males and 78.3 for females)¹⁴. Most of the gains in life expectancy were a direct result of the decline in infant mortality (IMR)¹⁵. Brazil had an IMR of 162 per 1000 live births in 1930; between 1930 and 1970, IMR declined by 29.2%, and between 1970 and 2005, it fell 79.7%¹⁶. According to the 2010 Population Census, IMR was 15.6.

Due to changes in mortality and fertility, the median age of the population has increased.

As a result of these changes in mortality and fertility, the age structure of the population became older. In 1950, the median age of the population was 18, with 41.8% of the population concentrated in ages younger than 15, and 4.3% aged 60 or older. In 2010, the median age increased to 27, with 24.1% of the population younger than 15, and 10.8% aged 60 or older. In the wealthiest regions of the country (Southeast and South), the median age of the population is even higher at 32¹⁷.

Brazil's population has become more urbanised since 1950 and now has better access to infrastructure.

In addition, it is worth highlighting that: (i) the population became more urbanised: from 36.2% in 1950 to 84.4% in 2010; and (ii) the population had better access to infrastructure. Access to electricity increased from 68.5% in 1980 to 99.5% in 2012; 25.8% of the population had access to sanitation in 1980 and 97.4% had access in 2012. In 1980, 47.5% had access to piped water, while in 2012 this figure increased to 84.3%.

National income has risen since the 1960s; however, economic inequality also increased.

National income increased between the 1960s and 1990s more than 3 times, accompanied by an augmentation of social disparities¹⁸. Brazil became one of the most unequal countries worldwide – it ranked 2nd in income concentration in 1998¹⁹, and in 1999, it was the country with the highest ratio between the average income of the 20% richest and the 20% poorest, above 30²⁰.

Since 2001, economic inequality has improved.

Since 2001, a steady decline in inequality has been observed, with the Gini Index decreasing from 57.1 in 2001 to 50.5 in 2012^{21,22}. This decline was observed in 80% of Brazilian municipalities.

Epidemiological transition

Disease burden has changed. By 2007, nearly 75% of deaths were attributable to non-communicable diseases.

The pattern of disease burden in Brazil has also been changing, particularly since the 1950s. The proportion of total deaths due to infectious diseases decreased from almost 50% in 1930 to about 5% in 2007^{23,24}. In contrast, in 2007 approximately 72% of all deaths were attributable to non-communicable diseases (NCDs) including cardiovascular diseases (the main cause of death), chronic respiratory diseases, diabetes, cancer, and others, including renal diseases²⁵.

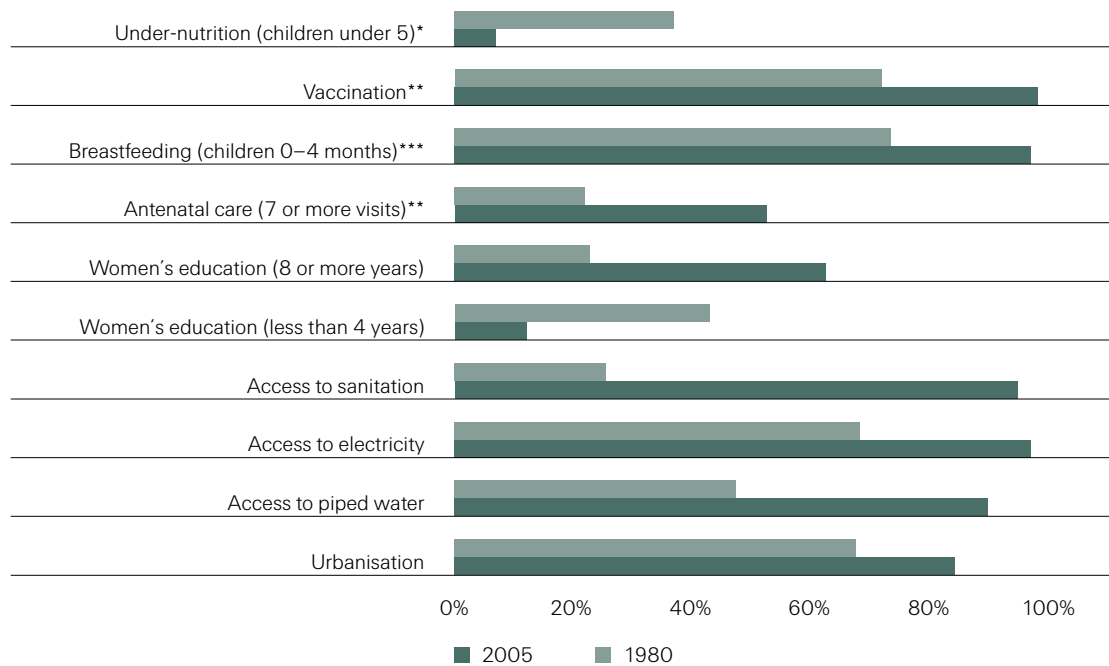
Infectious diseases are in decline, although the control of dengue and visceral leishmaniasis is still a challenge.

Regarding infectious diseases, Brazil observed important successes/partial successes, and some failures. Among the successes are: the control of vaccine-preventable diseases, the reduction in mortality by diarrhea, and the control of Chagas disease. Partial successes include the control of leprosy, schistosomiasis, malaria, hepatitis, HIV/AIDS and tuberculosis. Among the failures are the control of dengue and visceral leishmaniasis²³.

Mortality due to cardiovascular and chronic respiratory diseases is on the decline, but diabetes and hypertension have increased.

Mortality and morbidity for NCDs are greatest among the poor. Age-standardised mortality due to NCDs registered a 20% decline between 1996 and 2007, mostly for cardiovascular and chronic respiratory diseases²⁶. The decline was associated with reductions in smoking and expansion of primary health care. Indeed, standardised mortality rates for cardiovascular disease decreased from 287.3 per 100 000 people in 1980 to 161.9 in 2003 (the disease with the largest decline in the same period was stroke: from 95.2 to 52.6 per 100 000 people²⁶). However, diabetes and hypertension are increasing, as is the prevalence of overweight and obesity in the population²⁵.

Figure 1:
Temporal trends of some factors



Source: Castro MC, Simões CCS. Spatio-temporal trends in infant mortality in Brazil. Population Association of America, 2010 Annual Meeting, Dallas, TX. 2010:248

Current situation regarding risk factors

Since 2006, the Brazilian Ministry of Health has conducted telephone based surveys to monitor risk factors of non-communicable diseases.

In 2006, the Brazilian Ministry of Health established the annual Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases' (VIGITEL), comprising state capitals and the Federal District (about 54 000 interviews a year). It allows the analysis of risk and protective factors of NCDs found in the adult population (aged 18 years or older)²⁷.

Smoking has decreased significantly among the population due to preventative legal actions.

Brazil has made important progress towards reducing smoking: the prevalence of smoking in 2011 was 14.8%, a major decline from 34.8% in 1989 (as reported by the National Survey on Health and Nutrition (PNSN))^{25,28,29}. This was achieved through several preventative legal actions began in 1996 (eg tax increases, use of picture warnings on cigarette packs, and bans/restrictions on advertising)³⁰.

About 15% of adults in Brazil engage in at least 30 minutes of physical activity five times per week.

While a long time series on physical activity in Brazil is not available, data from VIGITEL shows that about 15% of the adult population engaged in at least 30 minutes of some type of physical activity for at least five days a week in 2010, with the most active being young and well educated males. About 14% were inactive, and 28.2% reported watching three hours or more of television a day³¹.

In recent years, more and more Brazilians have become overweight or obese.

The nutritional transition in Brazil is of crucial importance and one of the greatest challenges ahead¹⁸: while the prevalence of child stunting declined, the prevalence of overweight and obesity has significantly and steadily increased in the recent past^{32,33}. In 2011, the overweight incidence among adults was 48.5% (52% among men and 45% among women); in 1974-75, the overweight incidence was 18.6% among males^{34,35}. The prevalence of obesity has increased from 11.4% in 2006 to 15.8% in 2011. This is also a concern among children aged 5-9: in 2008-9, 33.5% and 14.3% of these children were overweight and obese, respectively³⁶.

Overview of health risk factors in Brazil

The distribution of risk factors differs by social group; smoking, consumption of high fat meat and obesity are more common among the less educated.

The distribution of risk and protective factors is not equal among social groups. Smoking, consumption of meat with visible fat, and obesity are more common among the less-educated, while physical activity during leisure time and the recommended consumption of fruits and vegetables (five portions a day, five or more times a week) are higher among the population with 12 or more years of schooling. In addition, the highest increase in the prevalence of being overweight was observed in the North and Northeast regions (the poorest), while the increase in the prevalence of obesity was higher in the South and Southeast (the wealthiest)²⁹.

Although major achievements in health have been observed, some challenges remain.

Discussion

Brazil has gone through major demographic, economic and social changes, and the epidemiological transition is still ongoing. While major achievements on the health arena have been observed, important challenges remain. Regarding NCDs, for example, the number of deaths due to cardiovascular disease has increased since 1980, mainly a result of the changes in the age structure of the population that is becoming older (and thus more elderly are exposed to the risk of chronic diseases)²⁶. The standardised mortality rates, however, have been declining, mainly a reflection of declines in smoking and improved access to basic health care²⁵.

Brazil implemented the Family Health Program in 1994 to improve access to primary health care.

Regarding access to health care, the Family Health Program, implemented in 1994, aims to improve access to primary health care, utilising a community-based approach for local care provision. Health care services are provided by a team comprised of at least one physician, one nurse, one nurse assistant, and up to six community health workers; some teams may also include a dentist and two assistants. Each team is responsible to provide care for up to 1000 families (or approximately 4500 people) in a determined geographical area³⁷. As of December 2013, 64.7% of the population was reached by community health agents, and 56.4% covered by family health teams (with marked regional differences).

To address the steady increase in the number of overweight and obese individuals and to cope with the rise in non-communicable diseases, the Ministry of Health launched the Strategic Action Plan.

Currently, one of the most pressing challenges regarding NCDs is the significant and steady increase in the overweight and obese population (children, adolescents and adults). To address that challenge and others, in 2011 the Brazilian Ministry of Health launched the Strategic Action Plan to tackle NCDs in the country. The Plan aims at preparing Brazil to cope with and restrain NCDs in the next 10 years. It addresses four main groups of diseases (cardiovascular, cancer, chronic respiratory, and diabetes) and their shared modifiable risk factors (smoking, alcohol abuse, physical inactivity, unhealthy diet, and obesity). It describes guidelines and measures to be taken concerning: a) surveillance, information, evaluation, and monitoring; b) health promotion; and c) comprehensive care²⁹.

The programme also stresses the importance of physical activity and increased fruit and vegetable consumption.

The suggested national goals of the programme are to: reduce premature mortality rate (< 70 years old) caused by NCDs at 2% a year; reduce prevalence of obesity among children; reduce prevalence of obesity among adolescents; restrain obesity among adults; reduce prevalence of alcohol abuse; increase leisure time physical activity levels; increase fruit and vegetable consumption; reduce the average salt consumption; reduce prevalence of smoking; increase coverage for mammograms exams among 50 to 69-year-old women; increase coverage for cervical cancer preventive exams among 25 to 64-year-old women; and treat 100% of women diagnosed with precursory lesions of cancer.

Brazil continues to make significant progress in reducing infectious diseases, but is still looking to reduce non-communicable diseases.

In summary, Brazil has made significant progress in reducing infectious diseases, although problems still persist. NCDs currently represent the largest mortality and morbidity burden in the country, which can become more critical considering the ageing population and the increasing number of overweight and obese individuals. The successful implementation of the Strategic Action Plan to tackle NCDs (described above) will be crucial in the years to come. Historically, Brazil has shown a good record of facing health challenges, and most recently became the world leader in tobacco control, despite being among the top 5 producers of tobacco in the world^{30,38}. The future is yet to be written.

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Understanding the global risk of the tobacco epidemic and its trajectory in an emerging market nation

Hillel R. Alpert

The tobacco epidemic is a “chronic global risk” and may be the single most important risk to determine longevity and mortality in the 21st century. This report closely examines how Brazil has been confronting its tobacco problem and provides insight into the societal characteristics and external and internal influences that will determine the course of the epidemic in Brazil and other emerging market nations.

Brazil is the world’s second largest producer and leading exporter of tobacco.

Introduction

Brazil is both the second largest producer and leading exporter of tobacco, and the second country to fully sign the Framework Convention on Tobacco Control, which sets forth multi-sectorial and trans-frontier actions to combat the epidemic worldwide. Brazil’s tobacco control efforts to date have decreased male and female smoking prevalence by 50%; however, the early age of smoking initiation and relatively high prevalence of smoking among women are still of major concern. Brazil’s recent ban on the use of menthol and other flavors in tobacco products may spearhead how product regulation decreases tobacco use by reducing product addictiveness, attractiveness and abuse potential. Future trends will depend on tobacco marketing and promotion on one hand, and public health policies on the other, and their influences on the societal acceptability versus denormalisation of smoking.

Tobacco was responsible for an estimated 110 million deaths worldwide during the twentieth century and USD 500 billion in yearly losses due to illnesses, decreased productivity and premature deaths.

The global risk of smoking

The tobacco epidemic is clearly a “global risk” of catastrophic proportions with large-scale implications for mortality and longevity in nations. Meeting the World Economic Forum’s definition of a global risk, the tobacco problem is global in scope, has economic impact, cross-industry relevance, requires a multi-stakeholder approach, and is associated with uncertainty¹. Tobacco was responsible for an estimated 110 million deaths worldwide during the twentieth century and 500 billion dollars in yearly losses due to illnesses, decreased productivity, and premature deaths². Its future trajectory depends on many competing variables and thus entails considerable uncertainty. Because the harms of tobacco use and the benefits of cessation are well-established, it is the single most preventable cause of death worldwide. However, if current trends continue, tobacco use will grow and result in approximately one billion deaths from diseases during the 21st century². In contrast to acute or “event-driven” global risks, tobacco use is a “chronic” risk¹ whose future course will be determined by private and public sector activities and developments at the global, national and local community levels. Uncertainties regarding its future course may be diminished with insightful analyses based on a clear understanding of its nature, knowledge of the factors that either promote or mitigate tobacco use in nations, and the wisdom of experience.

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An estimated 1.2 billion persons in the world currently smoke, while nearly 80% of tobacco-attributable deaths occur in low and middle-income countries.

Interventions, such as clean indoor air laws, advertising restrictions and counter-marketing, are far more successful in decreasing smoking prevalence than are individual level interventions.

The WHO Framework Convention on Tobacco Control sets forth multi-sectorial and trans-frontier actions to combat the epidemic worldwide.

Smoking prevalence has decreased, but the tobacco industry continues to market and promote smoking.

The nature of the tobacco epidemic

An estimated 1.2 billion persons in the world currently smoke, while nearly 80% of tobacco-attributable deaths occur in low and middle-income countries³. In order to anticipate or predict the course of the epidemic in nations or globally, tobacco use must be understood as a societal phenomenon, with the key influences on individual smoker's behaviour occurring at the social, community and population levels. The tobacco industry has long known this and set maintaining the social acceptability of smoking as a strategic goal⁴ and formed a working party in the 1970s to "improve the climate of social acceptability"⁵. The result has been the creation of social norms that treat smoking behaviour as acceptable, desirable and sometimes even expected for a member of society.

Similarly, research in California and Massachusetts has demonstrated that population interventions, such as clean indoor air laws, advertising restrictions and counter-marketing, have been far more successful in decreasing smoking prevalence than are individual level interventions⁶⁻⁸. Public health experts have noted that notwithstanding the significant role of cessation therapies, the use medications or cognition to fight a larger group behaviour does not appear to be effective in bringing about large-scale changes, whereas changing social norms is⁸. This report closely examines how Brazil as an emerging market nation has been confronting its tobacco problem in order to illustrate and provide insight into the societal characteristics as well external and internal influences that may determine the course of the epidemic in similar nations and globally.

Risk mitigation

Collective experience from local, state and national efforts to curb the tobacco epidemic led to the first international public health treaty, the WHO Framework Convention on Tobacco Control (FCTC)⁹, which was negotiated under the auspices of the WHO in 192 countries. The FCTC sets forth multi-sectorial and trans-frontier actions to combat the epidemic worldwide. It obliges parties to implement a variety of tobacco control measures, which include both tobacco product supply and demand reduction strategies. Each of the strategies is intended to have a direct effect on reducing tobacco use. For example, increasing cigarette pricing through taxation has been a highly effective intervention in many places for reducing the demand for cigarettes, especially among young people and persons from lower income brackets. Studies by the World Bank and others have showed that increases in taxes and prices have reduced per capita cigarette consumption in Brazil and other nations¹⁰. Further effective measures include protecting the public from exposure to tobacco smoke; requiring tobacco product disclosures; regulating tobacco product packaging and labelling; restricting tobacco advertising, promotion and sponsorship; regulating the contents of tobacco products; and advancing public education, communication, training and awareness programmes. Over and beyond the effects of the individual policies, these measures have a collective, synergistic effect to socially denormalise smoking.

Smoking prevalence has decreased in nations that have adopted and successfully implemented the FCTC tobacco control policies. Yet, declines in prevalence have been limited as a result of continued tobacco industry marketing and promotion activities, the addictive nature of the product, and enduring social acceptance, even in nations where substantial progress has been made. Of the strategies available, tobacco product regulation has been used relatively little to date, but could potentially have far-reaching effects on smoking. Although some nations have set limits on tar levels and banned the use of misleading "lights" descriptors on packaging and in advertising, not much evidence exists to show significant effects on smoking prevalence as a result of these measures. Possible reasons are that low-tar cigarettes are no less harmful or addictive than other cigarettes, and "lights" descriptor bans appear to have been circumvented by substitution of alternative, color-coded descriptors that are recognised by consumers. The design and characteristics of tobacco products could be regulated in numerous ways, at least some of which could have significant effects on use by reducing product addictiveness and abuse potential.

The U.S. Food and Drug Administration (FDA) has been authorised by the Family Smoking Prevention and Tobacco Control Act (FSPTCA) in 2009 to set standards for tobacco product design, contents, and constituents.

The U.S. Food and Drug Administration (FDA) has been authorised by the Family Smoking Prevention and Tobacco Control Act (FSPTCA) in 2009 to set standards for tobacco product design, contents and constituents; including banning the use of menthol and other flavors and additives that affect the appeal, attractiveness, and abuse potential of products particularly to youth, women and other potentially susceptible persons; as well as to set other product regulations¹¹. The FSPTCA provides a population-based set of criteria for the FDA to use in determining whether a tobacco product or design feature is “appropriate for the protection of the public health”. These include an assessment of the “increased or decreased likelihood that existing users of tobacco products will stop using such products; and the increased or decreased likelihood that those who do not use tobacco products will start using such products.” Once the FDA enacts its authority, the US experience with product regulation should be instructive to other nations in the future. In the meantime, Brazil has already recently implemented some tobacco product regulations whose results will be of interest to other emerging market nations.

Tobacco control in an emerging market nation

Brazil has one of the strictest tobacco control legislations in the world.

Brazil is ironically the second largest producer and leading exporter of tobacco, as well as the second country to fully sign the FCTC. It now has one of the strictest tobacco control legislations in the world. Brazil has implemented a societal, population-oriented approach to tobacco control since the Ministry of Health established the National Tobacco Control Program (NTCP) in 1989 through the Instituto Nacional de Câncer¹². The programme’s initial dissemination approach was motivated by the need to reach opinion makers and form a critical mass with the aim of changing social acceptance of smoking¹². Smoking was seen at that time as a lifestyle choice and it had broad social acceptance in an environmental context of extensive advertising¹². The programme prioritised reaching three major community channels: schools, work environments and health units¹². The local media was included in this network as an important vehicle for increasing the population’s knowledge about the harms of smoking in order to reduce the social acceptance of smoking and motivate smokers to quit¹².

To discourage smoking, tobacco prices were sharply increased, smoke-free air laws were introduced and tobacco advertising was banned.

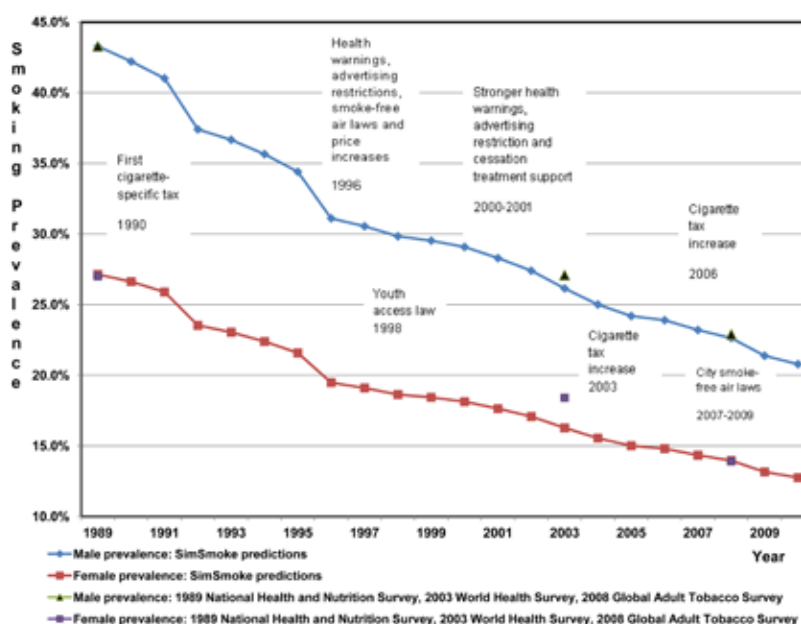
Tobacco control efforts began with large price increases followed by strong advertising restrictions and health warnings, and later by partial smoke-free air laws and increased availability of cessation programmes¹². Tobacco advertising is now banned, including mass media, internet and any other electronic means, as well as sponsorship at cultural or sporting events. The country has compulsory graphic warnings and insertions in packaging and advertising. Brazil’s states and municipalities have also widely adopted local laws banning smoking in closed public environments, including bars, restaurants, and public and private organisations. Strong public health campaigns continue to be conducted promoting adoption of healthy behaviours and lifestyles.

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Since 1989, smoking prevalence among men and women has decreased nearly 50%.

Major accomplishments of Brazil's tobacco control efforts include an almost 50% decrease among both male and female smoking prevalence since 1989^{13, 14}. A policy simulation model called "SimSmoke", which is designed to isolate the effect of tobacco policies from previous trends in smoking prevalence, estimated a 46% relative reduction in smoking prevalence from 1989 to 2010 associated with the policies implemented (Refer to Figure 1)¹⁴. Evidence suggests that the tobacco control efforts have also been effective in changing the social acceptability of smoking. Eighty-eight percent of both smokers and non-smokers reported to be against smoking in enclosed public places, and a similar percentage of the population is extremely supportive of even stronger than existing regulations for tobacco products¹⁵.

Figure 1:
Brazil smoking prevalence for individuals aged 18 years and above, 1989–2010: SimSmoke predictions and various surveys



Source: Levy D et al ¹⁴

Flavor additives have also been banned from cigarettes.

Brazil's most recent tobacco product regulations may be groundbreaking. The ANVISA (Health Surveillance Agency) banned flavour additives to cigarettes, such as menthol, mint, clove, cinnamon, cocoa, vanilla, and others by March 2014¹⁶. Ingredients such as these, when added to cigarettes, can make them more attractive to young people as well as mask the strong smell and flavour typical of the tobacco leaf^{15, 17}. ANVISA also prohibited commercialisation, importation, and advertisement of any electronic smoking devices (ie e-cigarettes), while the sales and popularity of these devices have been growing rapidly in other countries¹⁵.

Mexico, like Brazil, has strong anti-tobacco control policies in place.

The effectiveness of Brazil's tobacco product regulations could be evaluated by comparing progress with a similar emerging market country such as Mexico, which does not have these regulations and could serve as a control. Aside from product regulation, Mexico's tobacco control policies are comparable to those in Brazil with only a few differences. In Brazil, 100% smoke-free indoor air policies cover more areas than those of Mexico, more forms of advertising are banned, and larger, graphic, and more informational package warnings are required. Mexico, on the other hand, has: (1) some outdoor smoke-free policies, (2) penalties for not posting smoke-free signs, (3) prescribes steps for owners to take in order to stop persons from smoking, (4) bans cigarette sales through vending machines, and (5) explicitly bans false, misleading, or deceptive advertising, including the printing of tar, nicotine, and carbon monoxide levels on packages¹⁸. The most prominent difference between the two countries' tobacco control policies is the presence or absence of tobacco product regulations.

Current and future of risk for smoking in Brazil

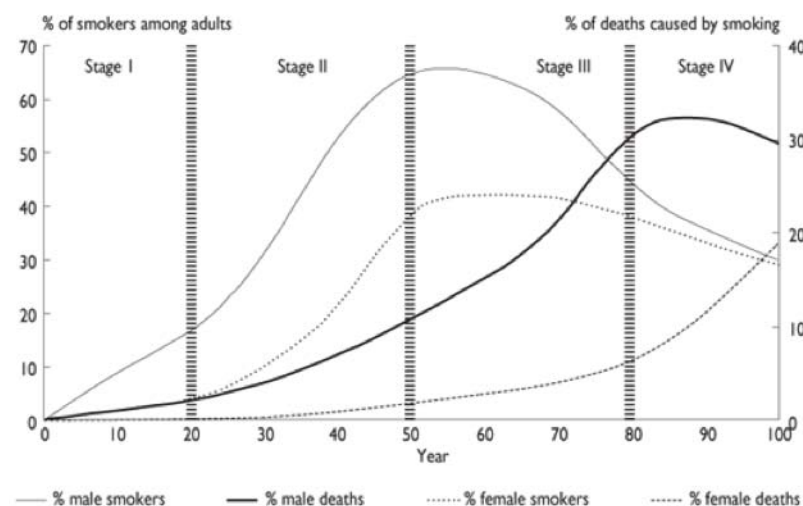
While tobacco consumption has decreased, more than 25 million people in Brazil still smoke.

Despite the nation's policy advances, Brazil continues to have a serious tobacco problem. While tobacco consumption has decreased over the last decades, the absolute number of tobacco users in the country is still very high (around 25 million among persons 15 years of age or older)¹². Of continued and major concern are the early age of smoking initiation and the relatively high prevalence of smoking among women. Nine percent of boys and seven percent of girls between ages 14 and 18 are using tobacco¹⁵, and smoking is becoming increasingly popular among women.

Smoking among women is becoming increasingly popular, with women accounting for the majority of new smokers.

Females now account for the majority (54%) of new smokers in the country¹⁵. As shown by Lopez et al, increases in female smoking prevalence in a country typically lags behind increases in male prevalence¹⁹ (Refer to Figure 2). Female smoking is often driven by: (1) "peer pressure", (2) an association of smoking with being stronger and more mature, (3) images in relation to equal rights with men, (4) a view of smoking as an aid to weight loss (instead of eating) or weight gain often associated with quitting, and (5) increasing numbers of brands for female smokers¹⁵. Targeted marketing plays a significant role. Following the development and marketing of menthol brands to young women, Japan experienced an upsurge in smoking among high school aged girls, particularly of menthol brands²⁰.

Figure 2:
Spread of smoking and smoking-related mortality within a country, over time



Source: Reproduced from Tobacco Control, Lopez, AD, Collishaw NE, Piha T (1994). A descriptive model of the cigarette epidemic in developed countries. 3: 242-247 with permission from BMJ Publishing Group Ltd.

Advertising bans are not in place in Brazil.

Brazil still lacks an advertising ban on posters and panels, on the packaging itself, and at points-of-sale¹⁵. ANVISA proposed regulating advertising at retail points-of-sale and increasing visible warnings on packages, although these policies have not yet been adopted¹⁵. Brazil's smoke-free laws are ignored in many establishments. Many people continue to smoke in stairwells of public places, such as theatres, hospitals, libraries and cinemas. Enforcement of the Brazilian Federal Tobacco Legislation forbidding the sale to children under 18 years of age remains lax¹⁵. Increased application of 100% smoke-free policies combined with enforcement, visits by authorities and large fines to increase compliance, could further decrease the country's smoking rate¹⁵.

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Spending on cigarettes ranges from 4.8% to 7% of family expenditures.

Cigarette spending in Brazil ranges from 4.8% to 7.0% of family expenditures, suggesting that existing price and tax policies are not optimal and that more could be done to make cigarette purchase less affordable¹². While monthly income or per capita income is an important indicator of overall purchasing power, a better indicator for the poorest sectors of society is the minimum wage divided by the average price of a cigarette package, which indicates the number of cigarette packages that can be purchased on a minimum wage¹². As of September 2008, a low-income smoker could buy 150 packages of cigarettes a month, while he or she could buy 83 in January 1996¹². The Ministry of Health is reportedly planning to implement a tax increase by 2015 to increase the price of cigarettes by 55%¹⁵. These pricing policies could be significant as the purchasing power of the Brazilian population increases if the policies obtain an acceptable margin for the minimum wage/cigarette price ratio¹².

The future of smoking in Brazil will depend on the balance between efforts that promote versus mitigate the social acceptability of tobacco.

The future of smoking in Brazil will depend on the balance between countervailing forces promoting versus mitigating the social acceptability and desirability of tobacco use for individuals. The Simsmoke model was also used to consider the potential effect of policies that had not yet been implemented. The model estimated that if tobacco control policies are strengthened in Brazil to be fully consistent with FCTC, the effect would be to decrease smoking prevalence by the year 2050 by up to 39%¹⁴. The model does not consider directly the effect of income and purchasing power on smoking rates or feedback through social norms and attitudes, and peer and family behaviours¹⁴. Brazil's experience with its new tobacco product regulations may provide new empirical data to further refine the model's predictions.

Globalisation and the potential use of "big data"

The use of "big data" may reveal key factors that are associated with a change in smoking prevalence.

The "big data" approach may be another opportunity to gain insight into trends in smoking in emerging market nations. For example, analyses of a longitudinal, time-series global database of nations' societal, human and economic development characteristics as well other data could reveal key factors that are associated with changing smoking prevalence. Such data are available from a number of comprehensive, global, country-specific sources, including: (a) the KOF Index of Globalization, which was developed at the KOF Swiss Economic Institute and measures three main dimensions of globalisation: economic, social, and political, annually for 207 countries over the period 1970–2011^{21,22}; (b) detailed annual data pertaining to the politics, economy, risk, regulation and business environment of countries worldwide, which are available from the Economic Intelligence Unit²³; and (c) the WHO's MPOWER reports, which include country level data pertaining to six evidence-based tobacco control measures for reducing tobacco use corresponding to the acronym²⁴. The measures are: (M) monitoring tobacco use and prevention policies; (P) protecting people from tobacco smoke; (O) offering help to quit tobacco use; (W) warning people about the dangers of tobacco; (E) enforcing bans on tobacco advertising, promotion and sponsorship; and (R) raising taxes on tobacco.

Predictors of a nation's three year change in smoking prevalence differ by gender.

Preliminary analysis of these data found that predictors of a nation's three year change in smoking prevalence differ for males and females²⁵. Changing male smoking prevalence was predicted by a nation's wealth, governance, education and economic globalisation; whereas changing female smoking prevalence was predicted by the single variable, social globalisation, as seen for example by an inverse relationship between change in smoking prevalence and internet use²⁵. Mexico's social globalisation index was 33% higher than Brazil's, while Mexico experienced an average 1.2% 3-year decline in female smoking prevalence during 1998–2012 compared to an average of 0.2% in Brazil²⁵. Possibly, the more that women in society use internet for telecommunications, social media and non-face-to-face interactions, the less time they might spend with others in-person and the

less exposure they may have to the social, physical, and psychological cues for smoking that encourage and reinforce tobacco use. The definitions and boundaries of communities may be changing in this era of globalisation, which may have important implications for the most common types of social influences on smoking behaviour. Models that are based on “big data” may be further refined by incorporating further data such as measures of promotional, or supply-side, influences. In addition, the path of the tobacco epidemic may be affected by factors having cross-border effects, including trade liberalisation, direct foreign investment, global marketing, transnational tobacco advertising, promotion and sponsorship, and the international movement of contraband and counterfeit cigarettes. Trade liberalisation may increase market competition, which may in turn lead to lower prices and other practices, such as increased marketing to stimulate demand²⁶.

Country-specific data is being collected to analyse attitudes about tobacco use, marketing, policies and behaviours.

Relevant country-specific data is also being collected through the Global Tobacco Surveillance System (GTSS) organised by the WHO and the U.S. Centers for Disease Control and can be used to describe and analyse attitudes toward tobacco use, marketing and policies, in addition to smoking behaviours among youth and adults²⁷. A Global Youth Tobacco Survey (GYTS) analysis of youth aged 13 to 15 years in 115 countries, primarily in the developing world, examined relationships between youth support for smoke-free-policies and smoking status, and exposure to secondhand smoke, controlling for demographic and environmental factors and country-level policy factors³⁰. The majority of youth worldwide were found to support smoke-free policies in public places, many of whom are still living in areas still lacking these rules²⁸. Youth attitudes data such as these provide a useful window into a society’s present and potentially changing social norms pertaining to smoking and might also reflect important future policy directions.

Conclusions

The risk of using tobacco will be influenced by local, national and global factors and by promotional versus mitigating factors.

Tobacco use is a global risk of major importance and wide-ranging uncertainty. The scope and magnitude of this risk will be influenced by local, national and global factors and by promotional versus mitigating factors. The future trends of tobacco use in low and middle-income emerging market nations such as Brazil and Mexico are likely to depend on the marketing and promotional activities on one hand, and on public health tobacco control policies on the other, and their respective abilities to influence the societal acceptability versus denormalisation of smoking. How effective traditional, evidence-based risk mitigating strategies will be in any nation depends on whether or not the measures are implemented in a comprehensive fashion and accompanied by effective enforcement. These policies where implemented have been embraced by smokers and non-smokers alike, even where smokers were initially reluctant or were opposed to them.

Ongoing tobacco product innovation and development together with marketing and promotion continue to highlight the potential need for progressive tobacco control policies.

However, ongoing tobacco product innovation and development together with marketing and promotion continue to raise the bar and potential need for progressive tobacco control policies, such as lowering addictiveness through product regulation. Brazil’s experience in the coming years should be informative for regulatory authorities in other emerging market nations as well as the US and elsewhere. Recent “big data” approaches could be further augmented with data that gauge public opinion, especially the attitudes of youth and women as potential indicators of forthcoming trends. Increasingly large databases and computational resources are becoming available to track and project the future course of the tobacco epidemic, which may be the single most important risk to determine longevity and mortality in the 21st century.

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Chronic diseases in India: Burden and implications

K. Srinath Reddy, Sailesh Mohan

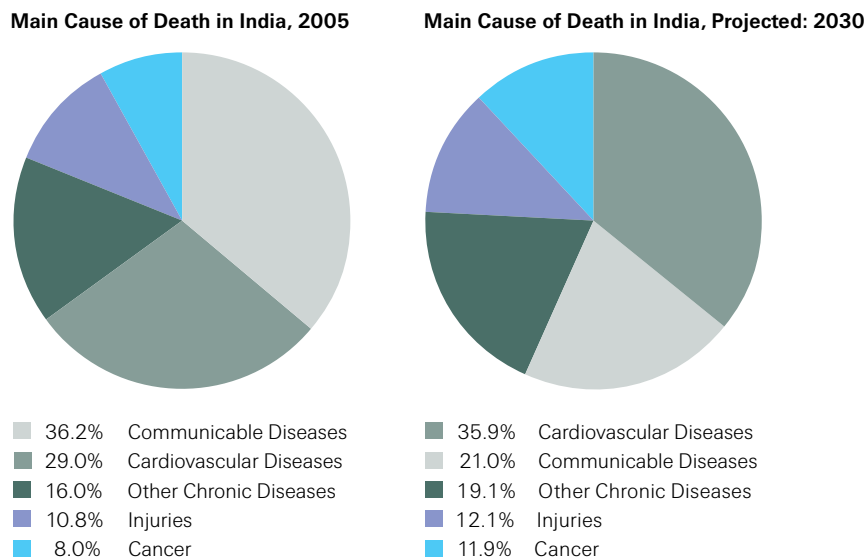
India currently faces the dual burden of communicable diseases and chronic non-communicable diseases (NCDs) such as cardiovascular disease (CVD), diabetes, cancer and chronic obstructive pulmonary disease (COPD). Success in controlling communicable diseases to some extent, as well as increased longevity and changes in people’s lifestyles driven by health transitions and economic progress, are contributing to the increase in NCDs. Increasing burden of NCDs has had not only obvious health implications, but also economic and developmental consequences. In this paper, we outline the major reasons for the increase in NCDs, the current and future risk factor and disease burdens, the responses so far and suggest key public health actions that can contribute to addressing and controlling NCDs effectively.

Why are NCDs increasing in India?

Deaths from non-communicable diseases (NCDs) have risen due to changes in demography, epidemiology and nutrition.

Substantial progress in societal development, health, nutrition and life expectancy occurred during the latter half of the 20th century. Consequently, deaths from communicable diseases have decreased, while those from NCDs have risen. This has been attributed to changes in demography (eg population ageing), epidemiology (eg the shift from communicable to non-communicable diseases) and nutrition (eg high caloric consumption and low physical activity levels). As a result, NCDs currently account for 53% of the total deaths and 44% of disability adjusted life years (DALYs) lost. Projections indicate a further increase to 67% of total deaths by 2030. CVD is the major contributor to this burden, attributable to 52% of NCD associated deaths and 29% of total deaths (Figure 1) ^{1,2}

Figure 1: Causes of death in India



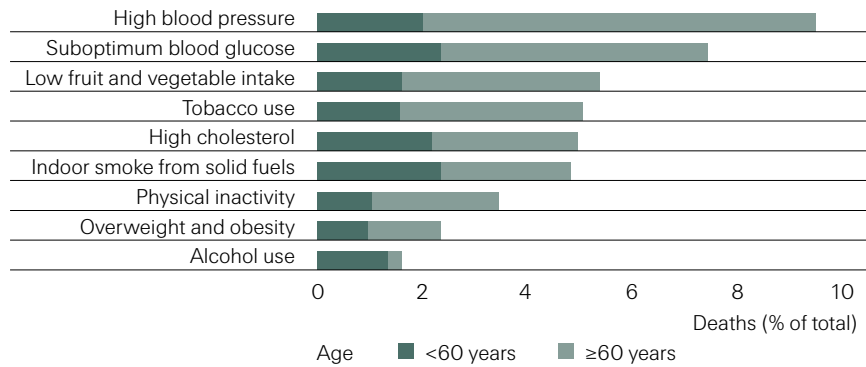
Source: Adapted from Patel V et al (2011)¹ and Mohan S et al (2011)²

Chronic diseases in India: Burden and implications

What are the major risk factors?

Chief NCD risk factors are shown in Figure 2 and their contribution to the disease burden summarised below.

Figure 2: Deaths (%) from Leading Risks in India



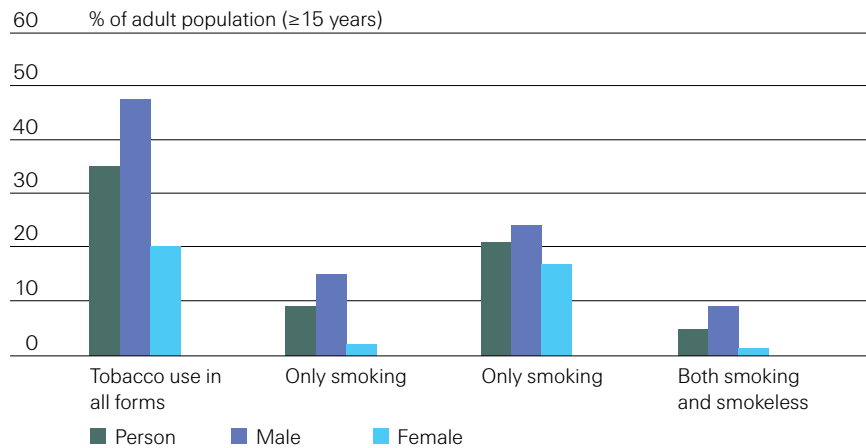
Source: Adapted from Patel V et al (2011)¹

Tobacco use

There are 275 million tobacco users in India. By 2030, nearly 1.5 million deaths will occur annually due to tobacco use.

In India, tobacco is widely used in many forms (eg bidis, cigarettes and electronic cigarettes). The country is the second largest producer and the third largest global consumer of tobacco. There are about 275 million tobacco users (Figure 3). Tobacco use is a leading preventable cause of premature, NCD-associated death and disability. Its use is increasing among India’s youth, women and the poor. Almost a million deaths per year are attributed to tobacco use, with most of these deaths occurring among the poor and the economically productive group aged 30–69. By 2030, nearly 1.5 million deaths will occur annually from tobacco use. However, it not only entails health implications, but also significant economic costs. The conservative cost of treating three major tobacco-related NCDs (cancer, heart disease and COPD) in 2002–2003 was estimated to be INR 308.3 billion (USD1=INR 60), which far exceeds the revenue added by tobacco taxes to the public exchequer^{3,4}.

Figure 3: High tobacco use in India



Source: Adapted from Global Adult Tobacco Survey⁴

Diet, physical activity and alcohol use

Oil and fat intake among the Indian population has increased substantially since the early 1990s.

Even though discernible changes in the per capita calorie consumption over the past few decades in India have not been reported, there have been noteworthy increases in edible oil and fat consumption, both in rural as well as urban areas. Oil intake had increased from 18 grams per person daily in 1990–1992 to 27 grams per person daily in 2003–2005, while fat intake increased from 41 grams to 52 grams per person daily during the same period. Aggregate consumption data also indicate an increasing trend in edible oil consumption, which has grown from 9.7 million tonnes in 2000–2001 to 14.3 million tonnes in 2007–2008, with a high proportion of unhealthy oils high in saturated and trans-fats that are linked to NCDs, particularly CVD².

Inadequate fruit and vegetable consumption, the lack of physical activity and the adoption of sedentary lifestyles are among the factors that are contributing to the rise of NCDs.

Conversely, fruits and vegetable consumption, which provides protection against NCDs, is inadequate, particularly among the poor. Similarly, physical activity, another protective factor is at less than recommended levels, with 29% of the population being insufficiently active. Rapid and extensive urbanisation, increased mechanisation of work and adoption of sedentary lifestyles are attributable to reduced activity levels².

Salt consumption is also very high in India.

Dietary salt consumption, a key determinant of hypertension and associated CVD, is also very high, with the average intake ranging between 9–12 grams/day, far exceeding the World Health Organization (WHO) recommended intake of ≤ 5 grams/day².

Alcohol consumption is on the rise and is highest among the poor and less educated.

Alcohol consumption, which results in not only adverse health outcomes, but also social implications, is increasing. It accounts for a significant proportion of neuropsychiatric disorders, fatal road traffic accidents and suicides. Use of alcohol is higher among the poor and less educated, but disconcertingly is also increasing among youth.

Cardiovascular disease

About 2.7 million people die of CVD annually in India. Roughly 30 million people suffer from coronary heart disease.

Currently, about 2.7 million people die of CVD annually. This figure is projected to increase by 1.5 million by 2030. Estimates suggest that currently there are about 30 million coronary heart disease (CHD) patients, with 14 million residing in rural and 16 million in urban areas. The prevalence of CHD in those aged ≥ 20 years ranges from 6.6%–12.7% in urban areas and 2.1%–4.3% in rural areas. During the past few decades, CHD prevalence has increased almost fourfold in rural areas and sixfold in urban areas as a result of varied health transitions. Paralytic stroke prevalence is 334–424 per 1 000 00 population in urban areas and 244–262 per 1 000 00 population in rural areas. Notably, about 10–12% of all stroke deaths in India occur in those below age 40, highlighting the huge impact on families, households and the nation's economy as it affects workforce productivity^{2,5}.

Diabetes mellitus

According to the International Diabetes Federation, there are about 65 million people with diabetes in India.

Type-2 diabetes mellitus has been rising rapidly. Until recently, India was often referred to as the 'diabetes capital' of the world. The most recent estimates from the International Diabetes Federation (IDF) suggest that there are about 65 million people with diabetes. This figure is projected to increase to 109 million by 2035⁶. Moreover, diabetes is an important risk factor for CVD; in persons with diabetes, CVD is the major cause of death and disability. Diabetes currently accounts for almost a million deaths annually.

Hypertension

Hypertension is the leading risk factor for CVD and accounts for nearly 10% of all deaths in India.

Hypertension is the leading risk factor for CVD and accounts for nearly 10% of all deaths in India. Currently 20–40% of adults in urban areas and 12–17% of adults in rural areas suffer from it. The number of people with hypertension in India is projected to nearly double from 118 million in 2000 to 213 million by 2025. Moreover, nearly 40% adults have pre-hypertension, a precursor condition with high likelihood of converting into hypertension if left unaddressed^{1,5}.

Chronic diseases in India: Burden and implications

Chronic obstructive pulmonary disease (COPD) is more common among men but on the rise among women.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is more common among men and has been attributed to the use of tobacco. The prevalence of the disease is also increasing among women due to indoor air pollution resulting from the use of solid fuels for cooking. The number of COPD patients is estimated to increase from 13 million in 1996 to 22 million by 2016, with many likely to require hospitalisation. This will lead to financial repercussions for both patients and the resource constrained healthcare system².

About 800 000 new cases of cancer and 550 000 deaths occur in India each year.

Cancer

Each year about 800 000 new cases of cancer and 550 000 deaths occur in India. The most common cancers in men are those of the oral cavity, oesophagus and lung, while women suffer primarily from cervical, breast and ovarian cancers. Early diagnosis and treatment are often delayed, with more than 75% of cancer patients first surfacing and seeking care when they are already in the advanced stages of the disease². This vastly decreases the likelihood of positive treatment outcomes. Tobacco use is one of the leading risk factors, while alcohol use contributes to a substantial proportion of head, neck and stomach cancers.

There is a huge gap between detection and adequate treatment of NCDs. The use of proven, inexpensive evidence-based secondary prevention therapies is also very low.

Inadequate management and secondary prevention

Notwithstanding the availability of proven and effective prevention and treatment strategies for major NCDs like hypertension and diabetes, their management vis-a-vis detection and control rates are abysmally low. There is a huge gap between detection and adequate treatment: less than half of those who have hypertension or diabetes are actually detected, less than half of those detected receive appropriate treatment and less than half of those receiving treatment have their blood pressure or blood sugar treated to recommended targets ("The rule of halves"). In addition to poor control rates, of considerable concern is the fact that once hypertension-related CVD occurs, the use of proven, inexpensive evidence-based secondary prevention therapies is also very low in primary and secondary care, leading to a large and escalating burden of avoidable and premature mortality². A recent global study indicated that up to 80% of individuals were not on proven and effective life-saving drug treatment after a stroke or heart attack. This results in avoidable complications, increased healthcare costs, poor quality of life, premature disability and death⁷.

Most people suffering from NCDs incur out-of-pocket expenses for their healthcare costs.

Economic impact of NCDs

NCDs and risk factors entail huge costs not only to individuals, but also to the national economy. Most people suffering from NCDs incur out-of-pocket expenses for their healthcare costs. Medicines account for up to 45% of this expenditure. In 2004, the annual income loss among working adults due to NCDs was INR 251 billion (USD 4bn).

The annual total cost of diabetes care in India was estimated to be USD 32 billion.

In 2010, the annual median direct cost per diabetic patient was reported to be USD 525, and the annual total cost of diabetes care in India was estimated to be USD 32 billion. During 2005–2015, the projected income loss due to CVD and diabetes alone is likely to exceed USD 237 billion. To obtain NCD care, individuals and families often resort to distress financing and pay vast amounts, which impoverish and ultimately drive people into poverty. Furthermore, families suffering from NCDs suffer income losses not only due to disease, but also due to care giving and premature death^{8, 9, 10}.

Special features of NCDs in India

CVD, diabetes and associated deaths in India occur at younger ages. The poor suffer increased exposure to risks such as tobacco use and hypertension; they are also more likely to suffer from CVD and diabetes.

In comparison to developed countries, NCDs, particularly CVD, diabetes and associated deaths in India occur at younger ages with related adverse health, economic and societal consequences. This is mainly attributable to the higher risk factor burden at younger ages, earlier disease onset (at least 10 years younger), premature mortality, and higher fatality rates of CVD-related complications. Indians also have a higher predisposition to develop CVD and diabetes at lower thresholds of overweight and obesity^{1, 2, 11}. Reports also indicate the reversal of the social gradient, whereby the poor suffer increased exposure to risks such as tobacco use, hypertension and acquiring diseases such as CVD and diabetes, a situation similar to that observed in developed countries that already have undergone health transitions¹². Compared to other countries, India suffers a very high loss in potential productive years of life because of premature CVD deaths in those aged 35–64: 9.2 million years were lost in 2000 and 17.9 million years are expected to be lost in 2030¹³. These factors are further compounded by the poor lacking access to expensive medical care once disease occurs, leading to widening disparities in care and social inequity.

Current efforts to address NCDs

The focus is still largely on providing acute care and not on providing chronic care.

The health system has not yet fully re-oriented to effectively address the rising burden of NCDs, as the focus is still largely on providing acute care and not on providing chronic care. Thus, there are considerable inadequacies in service delivery both at the primary and secondary care levels. Heterogeneity of providers and wide variations in the quality, availability and accessibility of care have led to disparities, with the rich having access to the most expensive, evidence-based care and the poor lacking access to basic primary care. Efficient referral systems within the public sector as well as between the public and private sectors are also weak. Required emphasis on early diagnosis and evidence-based management approaches are also limited in both the public and private sectors. Furthermore, in the absence of financial risk protection, most people with NCDs pay out of pocket to cover their healthcare costs.

The government has initiated a national programme to address NCDs in addition to existing programmes that address cancer, tobacco, mental health and healthcare of the elderly.

The government has initiated a national programme to address NCDs in addition to existing programmes that addresses cancer, tobacco, mental health and healthcare of the elderly. The National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) has hypertension and diabetes as two of the focus areas. It is being implemented in 100 districts and expected to cover the rest of the country within the 12th 5 year plan period. The NPCDCS aims at: a) assessment of risk factors, early diagnosis and appropriate disease management for high risk groups; and b) health promotion for the general population. Debates are ongoing on implementing universal health coverage strategies, health sector strengthening and reforms that can likely contribute to reducing NCDs¹⁴.

India has also taken steps to discourage the use of tobacco.

India is a signatory to the WHO Framework Convention on Tobacco Control (FCTC) and is implementing the Cigarettes and Other Tobacco Products Act, 2003 (COTPA), which requires smoking bans in public and work places, advertisement bans, prohibits sales to and by minors, and regulates the contents of tobacco products and graphical health warnings on tobacco product packages.

Many countries have now agreed to a goal of 25% reduction in NCDs by 2025 and to establish a global monitoring framework to measure progress.

The way forward to address NCDs

Following the landmark United Nations High Level Meeting on NCDs in 2011, which concluded that NCD prevention and control is a high priority issue, many countries have now agreed to a goal of 25% reduction in NCDs by 2025 and to establish a global monitoring framework to measure progress toward this goal¹⁵. The Ministry of Health and Family Welfare in India is in the final stages of establishing a national monitoring framework that is in alignment with the global framework and developing an action plan to prevent and control NCDs¹⁶. The aforementioned global goal and the framework are anticipated to provide an impetus to prioritise NCD control efforts in India to improve population health. A cohesive national action plan that incorporates effective public health interventions to minimise risk factor exposure in the whole population and to reduce the risk of disease related events in individuals at high risk is necessary. Despite many challenges that are likely to be encountered, there are also opportunities to initiate actions required for attaining the WHO-UN goal of 25% reduction in NCD-related mortality. This combination of the population approach and the high risk clinical approach is synergistically complementary, cost-effective, and sustainable; and provides the strategic basis for early, medium and long term impact on NCDs in India in alignment with the aforementioned WHO-UN mandate.

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The nutrition transition in India: Trends in dietary intake and associations with cardiometabolic outcomes

Shilpa Bupathiraju

India is facing an epidemic of diet-related non-communicable disease. Currently, India has the largest absolute number of persons with diabetes at approximately 61.3 million people. With rapid globalisation, urbanisation, and advances in agriculture and food production systems, India has witnessed a rapid nutrition transition in the past several decades. This transition is characterised by a shift away from the traditional Indian diet that was abundant in minimally processed foods, fruits and vegetables, to a diet that is rich in highly refined and processed grains, potatoes, salt, sugar-sweetened beverages, animal fats and products, and hydrogenated oils. When such changes are coupled with declining levels of physical activity in an increasingly urbanised environment, there has been a rapid escalation in the incidence of hypertension, obesity, insulin resistance, type 2 diabetes, and cardiovascular disease. Future research that is translational in nature is urgently needed to understand the effectiveness of a multi-pronged approach in preventing and controlling the rapid epidemic of cardiometabolic diseases such as type 2 diabetes and cardiovascular disease. Such research requires multi-disciplinary and multi-level coordination and will need to include all the relevant stakeholders, ie community, local governments, farmers, food establishments, worksites, policy makers, and clinicians in order to be truly effective.

Introduction

India has been undergoing a rapid transition on economic, demographic, epidemiologic, and nutritional fronts. The direct impact of this transition has been on the incidence of cardiometabolic outcomes, especially type 2 diabetes and cardiovascular disease.

Research on diet and nutrition in the Indian subcontinent has primarily focused on the problem of undernutrition, specifically in children and women of child-bearing age. However, in recent years, India has been undergoing a rapid transition on economic, demographic, epidemiologic, and nutritional fronts. The direct impact of this transition has been on the incidence of cardiometabolic outcomes, especially type 2 diabetes and cardiovascular disease. The most recent National Family and Health Survey (NFHS-3; 2005–2006) data indicate that the prevalence of overweight or obesity among ever married women has increased from 11% in NFHS-2 (1998–1999) to 15%. The simultaneous occurrence of undernutrition and malnutrition implies that adults in India are suffering from the dual burden of malnutrition¹.

Recent data from the Indian Migration Study have shown that migration into urban areas is associated with increases in hypertension, obesity, and type 2 diabetes.

Nutrition transition is occurring at a much faster pace in low and middle-income countries like India than in the West. Reasons for this include a shift in occupation structures from labour-intensive occupations to more sedentary and less strenuous work, a rapid introduction of the mass media, and migration from rural to urban areas. In fact, recent data from the Indian Migration Study have shown that migration into urban areas is associated with increases in hypertension, obesity, and type 2 diabetes. Not surprisingly, among this group, migration also resulted in an increase in physical inactivity². Misra et al³ have described the nutrition transition in India as occurring in 3 stages. The first stage is characterised by a transition from traditional staple foods to items more prevalent in the Western diet, such as increased consumption of bread, cakes, and cookies. In the second stage, the effects of globalisation are much more marked and there is easy access to a variety of processed and fast foods. In the final stage, some individuals, especially those of the higher income group, realise the adverse effects of their dietary habits and transition to a healthier diet and lifestyle. In this report, we briefly review trends in major food sources and their associations with cardiometabolic outcomes.

Cereals

Surveys have shown a decline in cereal intake among rural, urban slum and urban middle income groups despite reductions in the cost of cereals.

National trend data from the National Nutrition Monitoring Bureau (NNMB) surveys have shown a decline in cereal intake between 1975–80 and 1995–96 among rural, urban slum and urban middle income groups despite reductions in the cost of cereals. Still, cereals remain the main staple of the Indian diet and provide the bulk of calories⁴. When examining trends by income group, data from the National Sample Survey Organization (NSSO) indicate that although cereal consumption decreased in middle and high-income groups, consumption increased in the lowest income group.

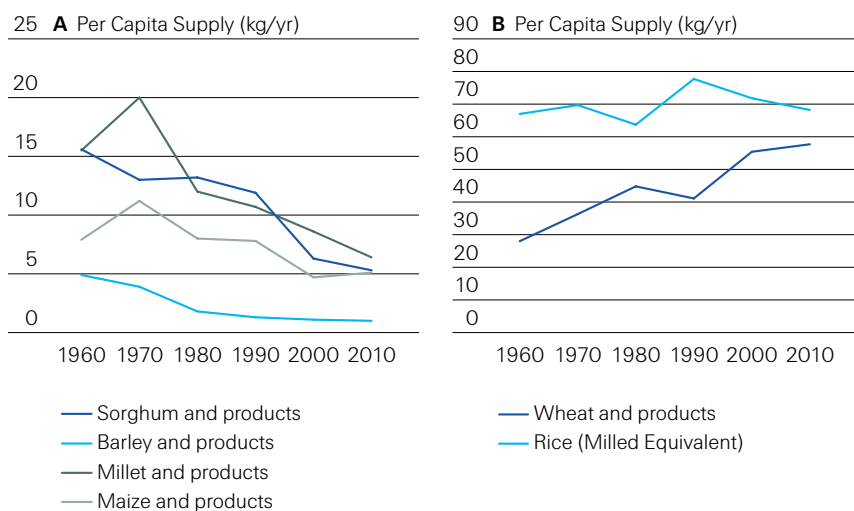
The nutrition transition in India: Trends in dietary intake and associations with cardiometabolic outcomes

The increased consumption of polished rice in India, which has a high glycaemic index, has been associated with higher rates of type 2 diabetes.

The declines in overall cereal intake are masked by increases in refined grains and a reduction in the consumption of traditional coarse-grains.

Per capita supply data from the Food and Agriculture Organization (FAO), which broadly reflect consumption patterns, indicate that the supply of coarse cereals like barley, sorghum, millet, and maize has declined drastically over the past four decades, while consumption of wheat and milled rice has increased (Figure 1A and 1B)⁵. Such changes are characterised by reductions in overall fibre intake, increases in overall energy-density, and increases in two important measures of carbohydrate quality (glycaemic index and glycaemic load) of the Indian diet. Highly polished white rice, whose use is prevalent among South Indians, has a high glycaemic index value of approximately 75–80. The high consumption of white rice, coupled with its high glycaemic index, results in a high glycaemic load in the Indian diet. We have previously shown that high glycaemic index and glycaemic load diets are associated with a 19% and 13% higher risk, respectively of type 2 diabetes⁶.

Figures 1A and 1B:
Trends in per capita supply (kilograms/year) of traditional coarse grains (A) and refined grains (B)



Source: Food and Agricultural Organization⁵

High intakes of dietary fibre were associated with a 69% lower odds ratio of type 2 diabetes.

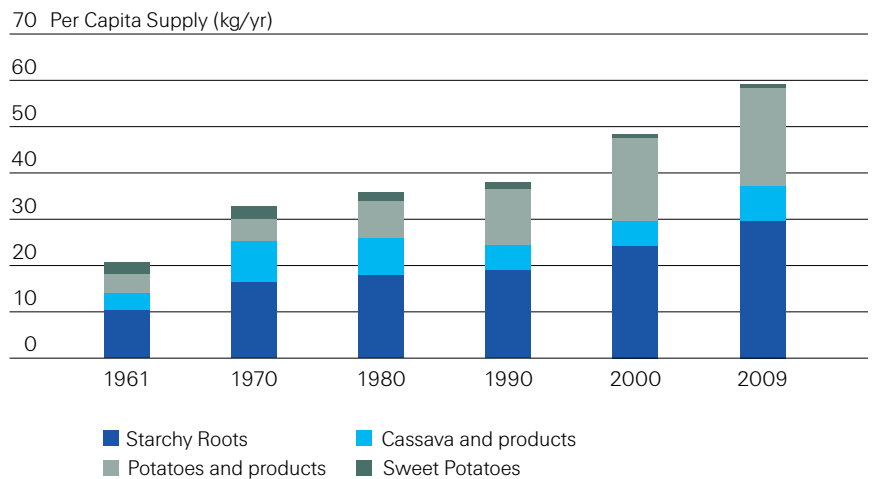
Such shifts in cereal consumption have important public health implications in South Asians who have fewer beta cells and are, therefore, more likely to be predisposed to type 2 diabetes in response to a high demand for insulin⁷. For example, in an urban sample of adults in Chennai, India, refined grain intake was associated with a nearly 5-fold higher odds (odds ratio, OR=5.31, 95% CI: 2.98–9.45) of newly diagnosed type 2 diabetes. Similarly, a high glycaemic index and high glycaemic load were associated with a 2.5 fold (95% CI: 1.42–4.43) and 4.25 fold (95% CI: 2.33–7.77) higher odds of newly diagnosed type 2 diabetes. On the other hand, high intakes of dietary fibre were associated with a 69% lower odds ratio (95% CI: 38%–85%) of type 2 diabetes⁸ emphasising the importance of switching back to traditional Indian diets that are rich in coarse grains and dietary fibre. In fact, randomised cross-over studies have conclusively shown that simple dietary changes, such as substituting brown rice for white rice, can have profound and immediate beneficial effects on glucose and insulin responses⁹.

Since 1961, the consumption of potatoes and its products has dramatically increased while consumption of sweet potatoes has decreased. Studies have shown that a daily serving of potatoes was associated with a higher risk of type 2 diabetes.

Starchy roots and tubers

Aggregate FAO data indicates that the per capita supply of starchy roots has increased since 1961. However, when examining individual roots and tubers, consumption of potatoes and its products has dramatically increased while consumption of sweet potatoes has decreased (Figure 2)⁵. These changes indicate not only an increase in the energy density of the Indian diet, but a greater susceptibility to development of chronic disease. In India, consumption of potato is gradually shifting from the fresh market to processed products in the form of chips and French fries, which have a high glycaemic index and glycaemic load. Recently, McCain Foods, the world’s largest manufacturer of French fries and assorted potato snacks, has made a foray into the untapped Indian market. It is estimated that out of the total snacks, potato based products like French fries, wedges, and other Indian snacks claim a 30% share in the fast food industry¹⁰ with the fastest growth seen in the sale of frozen French fries. Studies in the US have shown that a daily serving of potatoes is associated with an 18% higher risk for type 2 diabetes. Every 2 servings/week of French fries was associated with a 16% higher risk of type 2 diabetes. More importantly, substituting one serving of whole grains for one serving of potatoes was associated with a 30% higher risk for type 2 diabetes¹¹. While the potato is classified as a vegetable, many agencies including the World Health Organization (WHO) recommend that individuals meet their recommended intake for vegetables by excluding potatoes. The effects of sweet potatoes on chronic disease are far less well understood. Although they have a lower glycaemic index and are good sources of fibre and other micronutrients, a recent systematic review concluded that there is insufficient evidence about the use of sweet potatoes for type 2 diabetes¹².

Figure 2: Trends in per capita supply (kilograms/year) of total and individual starchy roots



Source: Food and Agricultural Organization⁵

Consumption of sugar in India is growing at a more rapid pace than the global average.

Sugars

According to a recent report on India’s Sugar Policy and the World Sugar Economy, the per capita consumption of sugar in India in 2012 was 20.2kg, which is lower than the global average of 24.8kg. Yet, consumption of sugar in India is growing at a more rapid pace than the global average. In fact, in the last five decades, the production of sugar among Indians has risen from less than 3% to more than 20% of sugar produced globally¹³. Food balance sheet data from the FAO demonstrate dramatic increases in per capita supply of raw sugar (Figure 3)⁵. Most of the sugar available in the open market is consumed in the form of sweets, baked goods, candies, ice cream and soft drinks.

The nutrition transition in India: Trends in dietary intake and associations with cardiometabolic outcomes

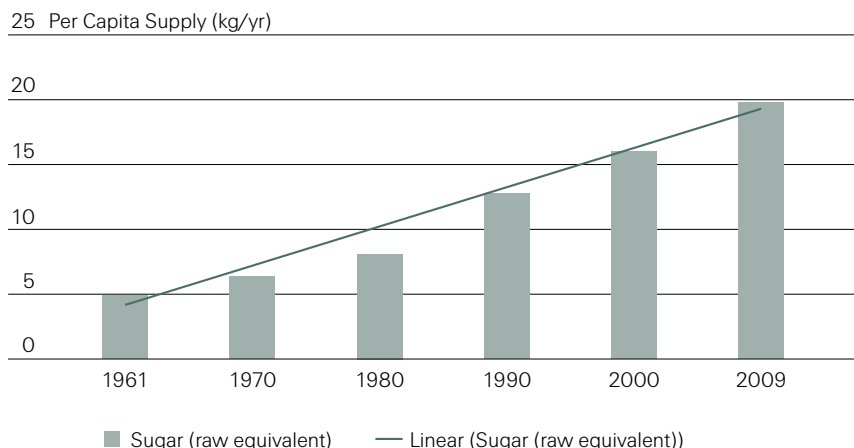
The consumption of soft drinks may rise given the efforts of multinationals to tap the market in India.

Urban residents consume more sugar than their rural counterparts. The Global Burden of Diseases Study found that consumption of sugar-sweetened beverages is linked to 133000 deaths from diabetes, 44000 deaths from cardiovascular diseases, and 6000 deaths from cancer.

Although carbonated beverage consumption has been historically low in India compared to the West, this is set to change as soft drinks companies are now targeting low and middle-income countries as the US market is saturated. For example, Coca-Cola plans to invest USD 5 billion in India by 2020 with the majority of this money being spent on increasing capacity in bottling units, expanding distribution, and brand building. Limited availability of clean drinking water in most areas and the increasing presence of refrigerators in small grocery stores have promoted the increased consumption among the new Indian middle-class who are now seeking to define themselves as part of a global consumer class.

Urban-rural differences in sugar intake highlight the effects of globalisation with urban participants reporting up to 35% higher sugar intake than their rural counterparts¹⁴. Interestingly, India does not use any high fructose corn syrup and sucrose is the primary sugar that is used in most carbonated beverages. Most recent data from the Global Burden of Diseases Study indicate that sugar-sweetened beverages consumption is linked to 13 3000 deaths from diabetes, 44 000 deaths from cardiovascular diseases, and 6000 deaths from cancer. Most importantly, nearly 78% of these deaths are from low and middle-income countries rather than high-income countries. Sales of sugar-sweetened beverages in India have increased by 13% every year since 1998, exceeding 11 litres per capita per year. It is estimated that if sugar-sweetened beverage consumption continued to increase linearly in accordance with secular trends, a 20% sugar-sweetened beverage excise tax would be expected to prevent nearly 11.2 million new cases of overweight and obesity (representing a 3% decline), and 400 000 cases of type 2 diabetes (representing a 1.6% decline) over the decade 2014–2023.

Figure 3: Trends in per capita supply (kilograms/year) of raw sugar equivalent



Source: Food and Agricultural Organization⁵

National aggregate statistics suggest a high consumption of unhealthful oils in India.

Fats and oils

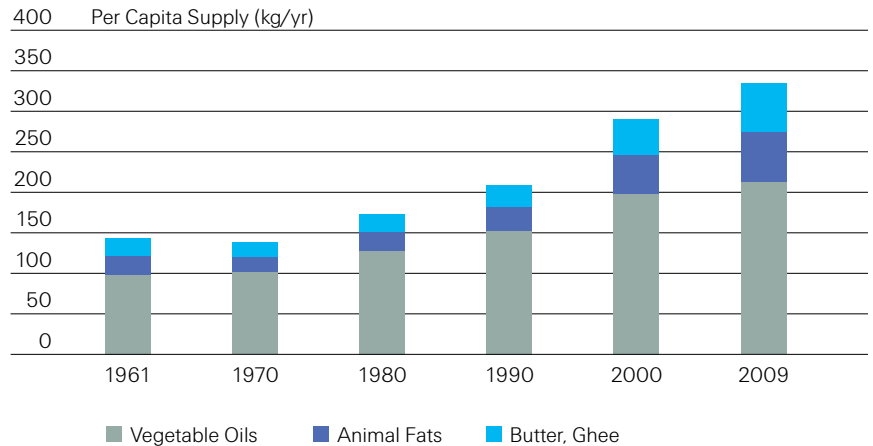
Although precise data on consumption of oils and fats at the individual and household level are missing, national aggregate statistics show high consumption of unhealthful oils. NSSO survey data showed that there has been an increase in the per capita consumption of edible oil; between 1993–94 and 2004–2005, there has been a rise in oil consumption both in rural and urban areas¹⁵. Time trends in the per capita supply fats and oils between 1961 and 2009 have shown that the supply of vegetable oils has nearly doubled while those of animal fats have increased threefold. Among animal fats, per capita supply of clarified butter or ghee, which contains over 60% of saturated fatty acids, has seen about a fourfold increase (Figure 4)⁵. While exact household and individual level data on oil consumption are unavailable, national aggregate data indicate that the share of raw oil, refined oil and vanaspati oil in the total edible oil market is estimated at 35 percent, 55 percent, and 10 percent, respectively¹⁶. Vanaspati oil or ghee is fully or partially hydrogenated

vegetable cooking oil that has a longer shelf life and is often used in food establishments and households as a cheaper alternative to clarified butter or ghee. Palm oil, rich in saturated fats, is the primary oil used for production of vanaspati.

The Food Safety and Standards Authority of India has issued a proposal to limit trans fat content of hydrogenated vegetable oil.

The Food Safety and Standards Authority of India has issued a proposal to limit trans fat content of hydrogenated vegetable oil to a maximum of 10%, which will be further reduced to 5% in 3 years¹⁷. However, there are no specifications for trans fats in other edible oils and fats. A recent analysis of trans fatty acid content in edible oils and fats in India revealed that, except in sunflower oil, the average trans fatty acid content in both mustard and soybean oil was above the prescribed limit (2%) of Denmark. The average trans fatty acid content in branded and unbranded butter was 15.1% and 18.9% respectively, which exceeded the prescribed Denmark limit by 3.5-fold to over 10-fold in branded and unbranded samples¹⁸. These data imply that trans fat intake is steadily increasing in the Indian diet given that the consumption of edible oil and animal fat is increasing. This represents a significant public health concern as there is no safe upper limit for trans fat intake. At the same time, no regulations exist for trans fats in packaged foods. However, the Government of India now requires manufacturers to list trans fat on the nutrition label if it exceeds 0.2 grams per serving. Still, India's lax food labelling laws have allowed manufacturers to define their own serving sizes. Therefore, many foods which have considerable amounts of trans fats (such as potato chips) are now labelled trans fat free by presenting nutrition labels for unreasonably small serving sizes.

Figure 4: Trends in per capita supply (kilocalories/day) of edible oils



Source: Food and Agricultural Organization⁵

The overall prevalence of hypertension in India was reported as 29.8%, indicating that over 370 million Indian adults suffer from elevated blood pressure.

Dietary salt

Based on a recent meta-analysis of population-based studies, the overall prevalence of hypertension in India was reported as 29.8%, indicating that over 370 million Indian adults suffer from elevated blood pressure. Estimates were higher in urban compared to rural areas (33.8% vs 27.6%), indicating the effects of rapid urbanisation on the country's changing cardiovascular risk profile¹⁹. High salt intake is an established risk factor for cardiovascular disease. The average salt consumption in India is estimated to be between 9–12 grams/day with higher intakes seen in urban compared to rural areas^{20, 21}. This level of consumption is far above the joint WHO and FAO recommended consumption of less than 5 grams/day²². Such high levels of consumption can partly be attributed to consumption of foods such as pickles (fruits and vegetables with spices that are preserved in salt and oil), papadams (crisp, thin seasoned discs with salt, spices and oil usually served as an accompaniment), namkeens (a salty Indian snack) and chutneys.

The intake of processed and ready to eat foods high in sodium tends to rise with income.

As income levels continue to increase, consumption of processed and ready to eat foods, which are typically high in sodium, has gone up. The efficacy of reducing salt consumption in lowering blood pressure has been well established, although the long-term effects on incidence of cardiovascular disease are less well understood. Using a Markov prediction model, Basu et al²³ estimated that if current consumption levels of salt remain unaltered in India, there would be approximately 8.3 million myocardial infarctions, 830 000 strokes, and 2 million deaths per year among Indian adults aged 40–69 years over the next three decades. However, a 25% reduction in salt intake (representing reduction of 0.1 g/year over the next 3 decades) would result in an annual reduction of 350 000 myocardial infarctions (4.6%), 48 000 strokes (6.5%), and 81 000 deaths (4.9%) among this group.

Although India is one of the largest producers of fruits and vegetables, consumption remains much below WHO recommended levels.

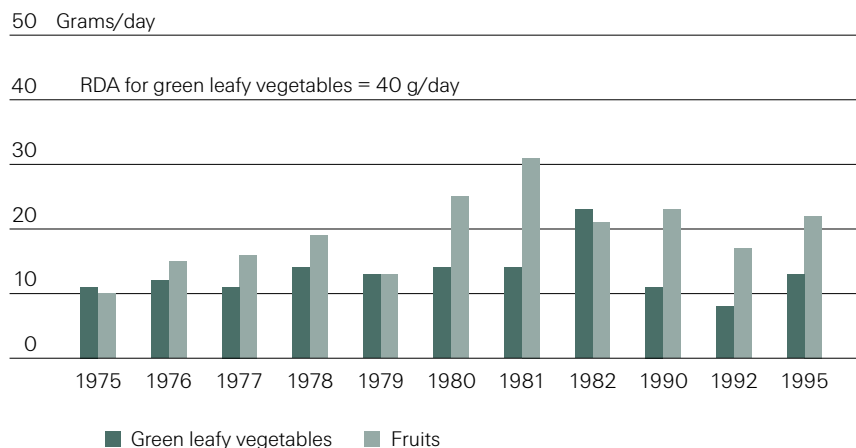
Fruits and vegetables

Although India is one of the largest producers of fruits and vegetables, consumption remains much below the WHO recommendation of 400 grams/day²². For example, in a study of urban adults in Chennai, overall consumption of fruits and vegetables was 265 g/day⁴. In another study of urban residents in Jaipur, nearly 70.3% of adults consumed <3 helpings of fruits and vegetables per day¹³. Despite a high prevalence of predominantly plant-based diets, consumption of fruits and vegetables remains low among Indians. Analysis of the INTERHEART data indicate that only 26.5% of South Asians consumed fruits and vegetables on a daily basis compared to 45.2% of control arm patients from the remaining 47 non-South Asian countries²⁴. National data from the National Nutrition Monitoring Bureau reveal that intakes of green leafy vegetables continue to be much below the recommended daily allowance (only one-third) of 40 g/day. Similarly, intake of fruits is extremely low (Figure 5)²⁵. Low fruit and vegetable intake has been recognised by the WHO as one of the major risk factors for cardiovascular disease. In a case-control study conducted in New Delhi and Bangalore, persons consuming a median of 3.5 servings/week had a 67% lower risk (95% CI: 36%–83%) of ischemic heart disease compared to those consuming 0.5 servings/week²⁶.

Gupta et al²⁷ found that cardiovascular mortality was higher among Indian states with lower intakes of fruit and vegetables.

Using an ecological study design, Gupta et al²⁷ found that cardiovascular mortality was higher among Indian states with lower intakes of fruit and vegetables (in grams/consumption units/day). In a population-based cross-sectional study on a representative population of Chennai in Southern India, a higher intake of fruit and vegetables explained nearly half (48%) of the protective effect against CVD risk factors, such as systolic blood pressure, BMI, waist circumference, total cholesterol and LDL-cholesterol. Given that fruit and vegetable intake continues to be below national and international recommendations, despite their abundance, policy efforts should focus on education and behavioural changes to promote fruit and vegetable consumption.

Figure 5:
Mean intake of fruits and green leafy vegetables – a 25 year report of the National Nutrition Monitoring Bureau²⁵



Source: National Nutrition Monitoring Bureau²⁵

Conclusion

Nutrition transitions in India are leading to higher rates of cardiovascular disease and type 2 diabetes.

India is in the midst of a public health crisis. Incidence of cardiovascular disease and type 2 diabetes are escalating as global free trade continues to fuel rapid economic and nutrition transitions, especially in urban settings. While rural India is still in the early stages of the nutrition transition, urban India is in the midst of the second stage of the nutrition transition where Indian diets are more westernised and there is widespread access to highly processed foods. A direct consequence of these transitions is the sudden increases in the prevalence of type 2 diabetes and cardiovascular disease.

The economic impact of cardiovascular disease and type 2 diabetes is estimated at nearly 240 billion international dollars.

The economic impact of these transitions is estimated to cost the country 236.6 billion international dollars for type 2 diabetes and cardiovascular disease alone. While it is now well established that increases in non-communicable diseases are fuelled by modifiable risk factors such as diet and physical activity, there is a paucity of research on the role of diet and lifestyle in the prevention of cardiometabolic outcomes in India.

A number of research studies could be undertaken to better understand the role of diet and lifestyle in India with the goal of reducing cardiometabolic outcomes.

Key research areas include: (i) understanding the feasibility, acceptability and efficacy of simple dietary interventions such as substituting brown rice for white rice on cardiometabolic risk, (ii) mechanistic research to understand the lower age of onset of cardiovascular disease and type 2 diabetes and the lower threshold for various risk factors among South Asians, (iii) the effect of policy changes such as taxation on sugar sweetened beverages and fast foods, as well as changes in food labelling laws on the incidence of type 2 diabetes and cardiovascular disease, (iv) the effect of educational campaigns via local and social media to discourage consumption of sugar-sweetened beverages and refined grains and to promote consumption of healthy foods and increase physical activity, (v) the effect of worksite interventions including provision of healthy food choices in the cafeteria, structured physical activity and behavioural change education on markers of cardiometabolic risk, and (vi) the effect of improvements in the built environment with parks, walkable, and bike-friendly streets and neighbourhoods, periodic celebrations of walk/bike days, and community yoga programmes on body weight and cardiometabolic risk factors. Such research needs to involve all sectors of the community, including local government bodies, the food and beverage industry, food establishments, worksites, local celebrities and leaders, farmers, and agricultural producers. Future research should be translational (from cells to communities) in order to develop a successful multi-pronged approach to prevent the epidemic of type 2 diabetes and cardiovascular disease.

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About the author

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Dr. Shilpa Bhupathiraju is a Research Associate in the Department of Nutrition at the Harvard School of Public Health. Bhupathiraju received her PhD in Nutritional Epidemiology from the Friedman School of Nutrition Science and Policy at Tufts University in 2011. As a Research Fellow at HSPH, she has been examining the dietary and lifestyle predictors in the prevention and development of cardiovascular disease and type 2 diabetes in the Harvard cohorts. Bhupathiraju received an American Heart Association postdoctoral fellowship grant to examine the association of quantity and variety in fruit and vegetable intake in the prevention of cardiovascular disease in both the Women's Health Initiative and the Harvard cohorts. As a Swiss Re fellow, Bhupathiraju explored the association between fruits and vegetable intake and cardiometabolic risk using data from the India Migration Study. She is especially interested in understanding how the nutrition transition in India is affecting rates of cardiovascular disease and type 2 diabetes in India.



Health risk factors in the adult Mexican population

Hiram Beltrán-Sánchez

The Mexican population has experienced dramatic changes in their physiological status resulting from major shifts in diet accompanied by changes in the epidemiologic profile. Infectious diseases were once predominant, but now chronic conditions are more prevalent. The shift from under-nutrition (low-calorie consumption) to over-nutrition (higher than needed calorie consumption) occurred over a short period of time and the health consequences are beginning to emerge. There is considerably high prevalence of health risk factors (eg overweight/obesity and hypertension) and chronic conditions (eg diabetes) in the adult population. Particularly important is the high prevalence of overweight/obesity, hypertension and diabetes among young adults aged 30–49. Nonetheless, major strides have been made in the last decade by implementing public health policies to ameliorate the health consequences of adverse health risk factors. If these policies reach their goals, we may see important improvements in health and well-being of the Mexican population in the years to come, which will have important consequences for health care costs.

Mexico has experienced improvements in health and survival since the mid-20th century, but the prevalence of overweight/obesity, hypertension and diabetes has increased.

Changes in the health status of the Mexican population have resulted from two general forces – (i) the demographic and epidemiologic transition and (ii) changes in nutrition and income.

The demographic and epidemiologic transition is characterised by a shift from high to low mortality and fertility. Infectious diseases have also declined, while non-communicable diseases have increased.

Introduction

The Mexican population has experienced important improvements in health and survival since the mid-20th century. For instance, declines in mortality rates below age 5 contributed to about half of the 26 year increase in life expectancy at birth between 1940 and 1990¹; while the prevalence of stunting in children under age 3 declined by about 22% between 1988 and 1999². Although important, these improvements have also been accompanied by considerable increases in the prevalence of health risk factors (eg overweight/obesity and hypertension) and chronic conditions (eg diabetes) in the adult population.

Changes in the health status of the Mexican population have resulted from two general forces – (i) the demographic and epidemiologic transition and (ii) changes in nutrition and income. These changes have led to major shifts in national patterns of health and disease because infectious diseases are no longer the leading causes of death and morbidity. Now chronic conditions, such as diabetes and cardiovascular disease, are more prevalent in Mexico and are currently the leading causes of death in the adult population³. Moreover, in the last decade, several risk factors for chronic disease, such as hypertension and cholesterol, seem to be on the rise with an increasing number of people being afflicted by overweight and obesity⁴.

Demographic and epidemiological transition

The demographic and epidemiologic transition is characterised by a shift from high to low mortality and fertility, with a consequent change in the disease structure of the population from a high infectious disease regime to non-communicable chronic conditions. The Mexican population experienced this transition since the second half of the 20th century with large declines in mortality rates resulting from major successes of medical interventions and improved standards of living. For instance, life expectancy at birth increased by 50% between 1940 and 1970 (from 40.5 years in 1940 to 61.5 years in 1970)⁵ and by 23% from 1970 to 2010, reaching a level of 75.4 years in 2010⁶. Of particular importance were the major declines in infant and child mortality, which dominated increases in life expectancy throughout the 20th century⁷.

Health risk factors in the adult Mexican population

Many populations across the globe have experienced dramatic changes in their physiological status resulting from major shifts in diet, growing concentration of jobs requiring low energy expenditure and environmental change.

Traditional dietary habits have changed and the traditional Mexican diet based on corn and beans, typical of rural areas in the mid-1980s, has now been replaced by high caloric industrially produced foods such as refined carbohydrates and sugar-sweetened drinks, as well as an increase in fat consumption.

The shift from under-nutrition to over-nutrition has occurred over a short period of time.

Nutrition transition

In recent years, many populations across the globe have experienced dramatic changes in their physiological status resulting from major shifts in diet, growing concentration of jobs requiring low energy expenditure and environmental change⁴. The nutrition transition is described as a shift from high prevalence of under-nutrition to the preponderance of diets related to chronic diseases. This transition typically results from rapid urbanisation processes and economic growth, concentration of jobs requiring low energy expenditure due to technological changes and innovations, and changes in food patterns and dietary intake, such as increased consumption of high calorie processed foods⁸. For low and middle-income countries, improved nutrition in the last decades had a major role in reducing infant and childhood mortality during the demographic and epidemiologic transition; for example, increased nutrition improves both resistance to disease and resources available for recovery from infection. Nonetheless, many of these countries experienced improved nutrition resulting from a rapid change in their diet and this shift is having a detrimental effect on the health status of the population due to excess calorie consumption.

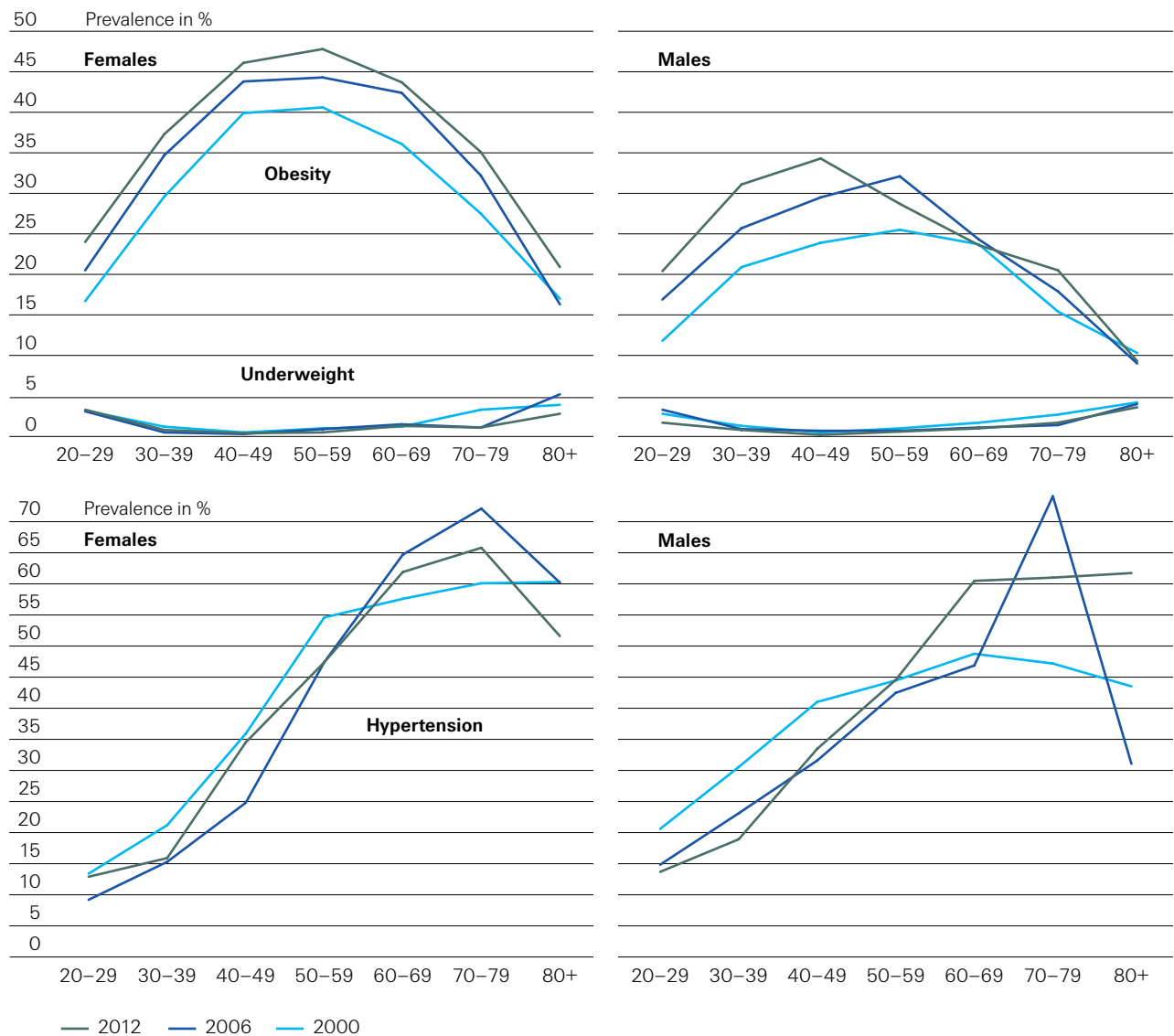
Mexicans have not escaped this trend and they too have experienced major dietary changes in the last decades. Traditional dietary habits have changed in that people are more likely to eat away from home⁹ and the traditional Mexican diet based on corn and beans, typical of rural areas in the mid-1980s, has now been replaced by high caloric industrially produced foods such as refined carbohydrates and sugar-sweetened drinks (eg soda, fruit juices etc) as well as an increase in fat consumption^{2, 10}. For instance, between 1988 and 1999, there was an increase of about 29% in total energy consumption from fat, while mean household purchases per adult equivalent indicated an increase of 37% and 6% in sugars and refined carbohydrates, respectively, between 1984 and 1998, along with a decline of about 29% in the purchase of fruits and vegetables^{2, 11}. Although urban areas first experienced these dietary changes, they have now swept throughout Mexico. In the 1990s, more urban areas typically located in the Northern part of the country and Mexico City had a greater increase in total energy consumption from fat relative to the less urban areas of the South²; however, in recent years, this pattern has become more homogeneous across the country, resulting from increasing fat consumption rates in the South⁹.

The shift from under-nutrition (low calorie consumption) to over-nutrition (higher than needed calorie consumption) in the Mexican population has occurred over a short period of time and the health consequences are beginning to emerge.

Major health risk factors in the adult population

Figure 1 shows results from nationally representative health surveys in Mexico in 2000, 2006 and 2012 for obesity, underweight, and hypertension for males and females among insurance relevant age groups. Obesity and underweight are defined as body mass index (BMI) ≥ 30 or $\text{BMI} < 18.5$, respectively, while hypertension corresponds to blood pressure $> 140/90$ mmHg and/or previous diagnosis of the condition.

Figure 1:
Prevalence of Obesity, Underweight and Hypertension among Insurance
Relevant Age Groups in Mexico: 2000–2012



Note: Obesity and underweight are defined as body mass index (BMI) ≥ 30 or $\text{BMI} < 18.5$, respectively, while hypertension corresponds to blood pressure $> 140/90$ mmHg and/or previous diagnosis of the condition.

Source: National Health Survey 2000, and National Health & Nutrition Surveys 2006, 2012.

Health risk factors in the adult Mexican population

Prevalence of adult obesity in Mexico has grown at an unprecedented pace during the last two decades, reaching the highest level in Latin America.

Obesity

Prevalence of adult obesity in Mexico has grown at an unprecedented pace during the last two decades, reaching the highest level (33%) in the Latin America region in 2012¹². The country attained this top ranking fuelled by a very rapid rate of growth: in 2000, the prevalence of obesity among males and females was about 70% of what it was in 2012, which suggests that obesity prevalence will double in about 19 years. Figure 1 clearly shows that obesity prevalence continues to increase in the last decade across all adult ages among females, with a peak for those aged 50–59, while among males, this pattern is true for those younger than 60. More worrisome are the high prevalence levels of obesity among younger adults in recent years, particularly females. For example, about one-fourth, one-third and almost half of females aged 20–29, 30–39 and 40–49, respectively, were obese in 2001¹², with males showing slightly lower values. In addition, obesity appears to be more prevalent in urban areas and among people with low levels of education¹³. On the other hand, underweight has reached an all-time low in the country, with prevalence rates below 5% across all ages, although underweight remains more prevalent in the southern part of the country¹⁴.

Contrary to the fast increase in body weight in the adult Mexican population, hypertension prevalence slightly declined among the young, but it increased among the old.

Hypertension

Contrary to the fast increase in body weight in the adult Mexican population, hypertension prevalence slightly declined among the young, but it increased among the old in the last decade (Figure 1). Overall, males tend to have higher prevalence of hypertension at younger ages (20–39), but the opposite is true at older ages (60+). For example, in 2012, about 20% and 15% of Mexican males and females aged 30–39 had hypertension, with a very rapid increase after this age reaching a level of about 60% over age 60. Some evidence indicates that about three-fourths (73%) of hypertensive individuals in 2012 received medical treatment for this condition¹⁵. In addition, there are marked differences in hypertension prevalence within the country, with rural areas and the northern part of Mexico showing higher prevalence rates¹⁶ and people with low levels of education showing higher likelihood of being hypertensive¹³. Importantly, there is a strong link between obesity and hypertension in the Mexican adult population in that obesity has been shown to triple the likelihood of hypertension^{13,17}.

The prevalence of type 2 diabetes among older adults is much higher, reaching about 19% and 24% among those aged 50–59 and 60–79, respectively, in 2012.

Diabetes

Type-2 diabetes (ie diabetes mellitus) is a major chronic condition affecting the adult Mexican population. Its prevalence in 2006 was roughly 14% after more than doubling during the prior 13 years¹⁸. However, the prevalence among older adults is much higher, reaching about 19% and 24% among those aged 50–59 and 60–79, respectively, in 2012¹⁵. Despite the relatively low prevalence of diabetes, this condition is responsible for a large disease burden in Mexico: it is the leading cause of death among women and the third leading cause of death among men¹⁹. In addition, there is a strong link between overweight/obesity and diabetes, and between diabetes and mortality. Some evidence among Mexican older adults (aged 50+) indicates that obese individuals are about three times more likely to become diabetic over an 11-year period²⁰. The subsequent link diabetes-mortality can raise mortality rates by about 17% among overweight and obese individuals, with mortality excesses representing losses of life expectancy at age 50 of about 2 to 3 years, or 9–12% of current values of life expectancy at age 50 in Mexico²¹. Part of the reason diabetes imposes such a disease burden is due to the rapid disease progression resulting from inadequate medical treatment. Some evidence indicates that the majority of diabetic patients (85%) aged 20 or older in 2006 received poor medical treatment, regardless of their access to health care or type of health insurance²². Moreover, diabetes appears to be more prevalent in urban areas and among people with low levels of education¹⁷.

Discussion

Mexicans are experiencing a rapid change in nutrition. While important, this shift has also been accompanied by a higher than needed total calorie consumption with detrimental health consequences.

Similar to populations in other middle-income countries, Mexicans are experiencing a rapid change in nutrition. While important, this shift has also been accompanied by a higher than needed total calorie consumption with detrimental health consequences. Overweight and obesity among adults, for example, is among the highest in the world¹², with over 70% of adults having BMI over 25, although there has been a levelling off in recent years¹⁵. Increases in body weight have led to a rise in associated co-morbidities such as hypertension and diabetes. More importantly, these co-morbidities are quite prevalent among young adults. Hypertension, which places one at a high risk for cardiovascular events, was present in about one-fifth and one-third of Mexicans aged 30–39 and 40–49 in 2012, respectively; by age 60, hypertension affected more than half of the population. Although diabetes prevalence was much lower than hypertension, there is a major burden associated with the disease due to high treatment costs, its fast progression and its high death toll.

The rates of early obesity and hypertension are still climbing.

More worrisome, perhaps, is the recent evidence suggesting that among adults the prevalence of high risk factors is likely to get worse before it gets better. The rates of early obesity and hypertension are still climbing and early high risk factors are precursors of detrimental health outcomes later in life. For instance, the prevalence of obesity increased for both males and females aged 5–11 between 1999 and 2012, from 9.6% and 8.3% in 1999 to 17.4% and 11.8% in 2012, respectively¹⁵; moreover, increasing body weight has also been observed among adolescents, particularly in urban areas²³. Similarly, the prevalence of hypertension was already about 11% in the late 1990s in a sample of junior high school students (aged 12–16) in Mexico City²⁴. In addition, young adults now will be the older adults of the next decades; the high prevalence rates of hypertension and diabetes among the former suggests that older adults in the coming years are likely to have a high number of health risk factors and co-morbidities.

The way forward to address population health in Mexico

The Ministry of Health has many programmes that include prevention as a major component, with a focus on obesity, diabetes, high blood pressure and cancer.

Major strides have been made in Mexico to implement public health policies to ameliorate the health consequences of adverse health risk factors. For instance, the Ministry of Health has many programmes that include prevention as a major component, with a focus on obesity, diabetes, high blood pressure and cancer²⁵. There is a programme for each disease providing general management and prevention guidelines for government health service providers to follow.

Mexico passed new legislation that bans tobacco advertising and mandates pictorial warning labels on tobacco cartons, while a ban on smoking in public enclosed places and workplaces was established in 2008.

Additionally, public health and tobacco control programmes have been substantially strengthened in the country since the late 1990s when member states of the WHO adopted the Framework Convention on Tobacco Control in 1999. Mexico passed new legislation that bans tobacco advertising and mandates pictorial warning labels on tobacco cartons, while a ban on smoking in public enclosed places and workplaces in Mexico City was established in 2008 and extended to the whole country later that year. Moreover, taxes on cigarettes have substantially increased. After a tax increase in 2007, the price of cigarettes rose by about 10%; in that year, there was a 29% decline in the average number of cigarettes smoked per day²⁶.

Mexico has also implemented a tax on sugary drinks and high calorie food products.

More recently, Mexico implemented a tax on sugary drinks (1 peso – about US\$0.08 or €0.04 – per litre) and on high calorie content products (from 5% to 8%) that took effect in January 2014. It is still too early to evaluate the effect of the latter tax policy on health outcomes, but preliminary evidence suggests there has been a decline in soda consumption.

Health risk factors in the adult Mexican population

Access to health care has dramatically improved in Mexico. Heavily to fully-subsidised health insurance is available to Mexicans without other forms of steady access to health care.

Importantly, a major health care reform was launched in 2004 called the “National System of Health-related Social Protection,” which aims to achieve universal health care coverage in the country by providing health insurance to people who are not part of or linked to the formal economically active population. Seguro Popular – the most common name used for the programme – offers heavily to fully-subsidised health insurance to Mexicans without other forms of steady access to health care, and covers a large variety of health conditions and treatments. Seguro Popular dramatically increased health care coverage during the last decade from 40% of the population in 2000 to 65% in 2010²⁷ and there is evidence that it has also helped decrease health care costs (eg out of pocket expenses) for many families²⁸. Similarly, access to health insurance, and the expansion of Seguro Popular in particular, have been shown to play a major role in diagnosis and treatment of diabetes among older adults (aged 50+)²⁹.

If the policies put in place to ameliorate the health consequences of adverse health risk factors are successful, we may see important improvements in health and well-being of the Mexican population in the years to come, which will have important consequences for health care costs.

Conclusion

Mexico experienced a change from under-nutrition (low-calorie consumption) to over-nutrition (higher than needed calorie consumption) in the last three decades. These changes have resulted in a considerably high prevalence of health risk factors (eg overweight/obesity and hypertension) and chronic conditions (eg diabetes) in the adult population. Despite many challenges encountered by policy makers, they have enacted several public health policies to ameliorate the health consequences of adverse health risk factors, including major health care reform, a smoking ban and taxation of tobacco products, as well as a recent tax on sugary drinks and high calorie content products. If these policies reach their goals, we may see important improvements in health and well-being of the Mexican population in the years to come, which will have important consequences for health care costs.

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