



Swiss Re
Centre for Global Dialogue

Risk Dialogue Series

Health Risk Factors Mexico



In collaboration with



HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

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Preface

Dear reader

We are very pleased to welcome you to this country edition of the Risk Dialogue Series, Health Risk Factors in Mexico.

Non-communicable chronic diseases (NCDs) are becoming increasingly prevalent in high growth and emerging markets. It is important to better understand these trends, both from a public health perspective and in order to build sustainable life and health insurance pools.

The publication is part of the joint research collaboration by Swiss Re and the Harvard T.H. Chan School of Public Health. The research undertaken by 45 colleagues from both institutions comprises the Systematic Explanatory Analyses of Risk factors affecting Cardiovascular Health (SEARCH) project. The aim of the collaboration is to better understand the relationship between risk factors and health outcomes in the major emerging markets of Brazil, China, India and Mexico. The health profile of these states is changing swiftly and significantly with economic growth. Incidents of NCDs are rising rapidly, providing a major challenge for public and private providers and funders of health care.

No major emerging market has gained weight as rapidly as Mexico in the last twenty years. The switch from a diet based around corn and beans to one heavy in processed food and sugary drinks has been abrupt. The result has been a rapid increase in obesity-related NCDs, such as diabetes and hypertension. The authorities are acting; but they have an awful lot to correct, with weight increases being considerable among younger cohorts. Given Mexico has a relatively young population, future increases in NCDs could be dramatic.

Mexico is a market with low insurance penetration. We believe that insurance can be one valuable player in the significant challenges facing the provision of public and private health in the country. We hope that these SEARCH articles will contribute to a better picture and understanding of health conditions in Mexico.

With best regards

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SEARCH – The search for health data and insights from Mexico

Eduardo Lara di Lauro

Mexico is an emerging country undergoing a rapid change in its health profile: in the space of a few decades it has gone from the challenges of undernourishment to those of over nourishment. Despite having a young demographic, the country is sitting on an obesity time bomb. That will entail huge health costs. Currently private insurance plays a relatively small part of the country's health care strategy; it potentially has a much larger role to fulfil. This SEARCH publication hopes to highlight health data and trends in the country that may make it easier for insurers to price, model and more widely distribute their products.

Life and health insurance and data

Life and health insurance involves providing coverage to a voluntary risk pool of individuals with a similar risk profile.

Life and health insurance is the provision of coverage from a voluntary risk pool of individuals who perceive themselves as having a similar risk profile. From an insurance perspective, there are three main generic reasons why more data is beneficial:

Having more data helps insurers control insurance risk ...

(i) Controlling insurance risk: The life insurance risk landscape is constantly shifting. Pandemics are potentially the most dramatic example of this – a sudden illness that may take many (relatively) young lives. We are currently witnessing a dramatic increase in the prevalence of chronic diseases, such as cancer and diabetes. These are frequently the product of changing lifestyles. Equally, societal changes can prolong lives. New treatments offer the potential to reduce premature deaths from certain diseases. All of these factors will affect the future claims experience for life and health private insurance pools and influence how insurers price their products.

... extend product coverage

(ii) Extending product coverage: Voluntary private life and health insurance cannot be all inclusive. Relatively healthy individuals will not willingly accept higher premiums in a pool with high risk individuals. Certain exclusions are inevitable in a private voluntary insurance system. However, insurance companies, using better data, are able to extend coverage and create differentiated rating systems, classifying applicants as preferred, normal or subnormal risks. A notable success in recent years has come with extending coverage to HIV infected individuals in South Africa¹.

... and create new products.

(iii) Creating new products: Life and health coverage has traditionally been distributed through agents, who are required to go through a potentially long underwriting process with their clients. This can be a barrier to retailing, particularly in a digital age, in which consumers can purchase most products quickly and easily with a click of a button. Insurers are seeking to use improved data to offer life and health products that can quickly and easily be offered with minimal underwriting².

In 2012, emerging markets accounted for 15% of the USD 2621 billion in global life and health premiums.

However, data is often lacking in emerging markets.

Chronic diseases are becoming more prevalent. Diabetes, which was virtually unknown in many emerging markets only thirty years ago, is now quite commonplace.

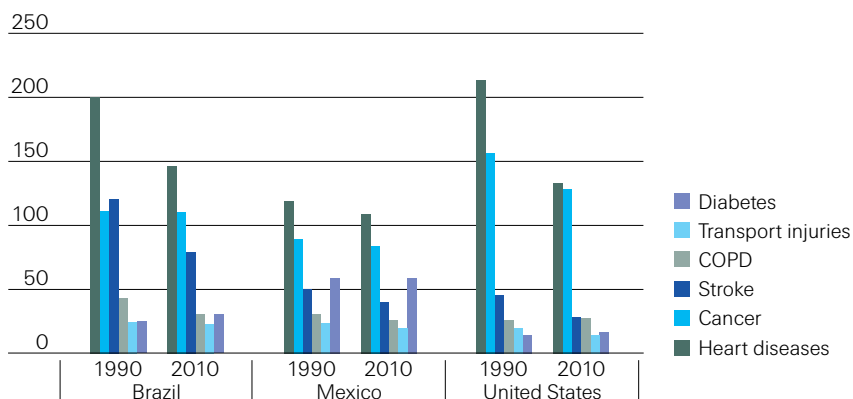
Figure 1: Diabetes in Mexico and stroke in Brazil are the third leading causes of death right after heart disease and cancer; mortality rates per 100 000 (age adjusted)

Data and emerging markets

Emerging markets are relatively underinsured. In 2012, they accounted for only 15% of the USD 2621 billion in global life and health premiums³. With economic growth, and particularly the growth of the middle class, this figure is expected to grow substantially in the coming years.

Major insurers are already well placed in the competitive market for new emerging market insurance customers. Frequently, however, standards of data reporting are not what they have experienced in their own developed markets. SEARCH is one attempt to correct and address this relative lack of historic data.

Even where data is quite good, the health of many emerging markets is in a state of flux. Throughout most of human history, the leading cause of death was infectious disease. As communicable diseases are controlled and eliminated, and as populations in many countries have started to age, chronic diseases are becoming more prevalent. Diabetes, for example, was virtually unknown in many emerging markets only thirty years ago. However, due to significant changes in diet, it is now quite commonplace (Figure 1).



Note: When comparing the 20 year transition of the leading causes of death in Brazil, Mexico and the USA from 1990 to 2010, one can see distinctive differences. While mortality rates of heart diseases declined by 27% in Brazil and 38% in the USA, they only decreased by 8% in Mexico. While stroke mortality rates declined in all countries at similar rates, the total mortality rate per 100 000 in 2010 is about twice as high in Brazil as in Mexico, and almost threefold higher than in the USA. This suggests a difference in stroke management practices or accessibility to stroke treatment in the three countries. Interestingly, diabetes mortality rates only slightly increased in all countries over the observed 20 year time horizon; however, total diabetes mortality rates in 2010 in Mexico were twofold higher than those in Brazil and 3.5 fold higher than in the USA. Note that part of the differences in mortality rates may be due to differences in death certificate reporting practices in the three countries.

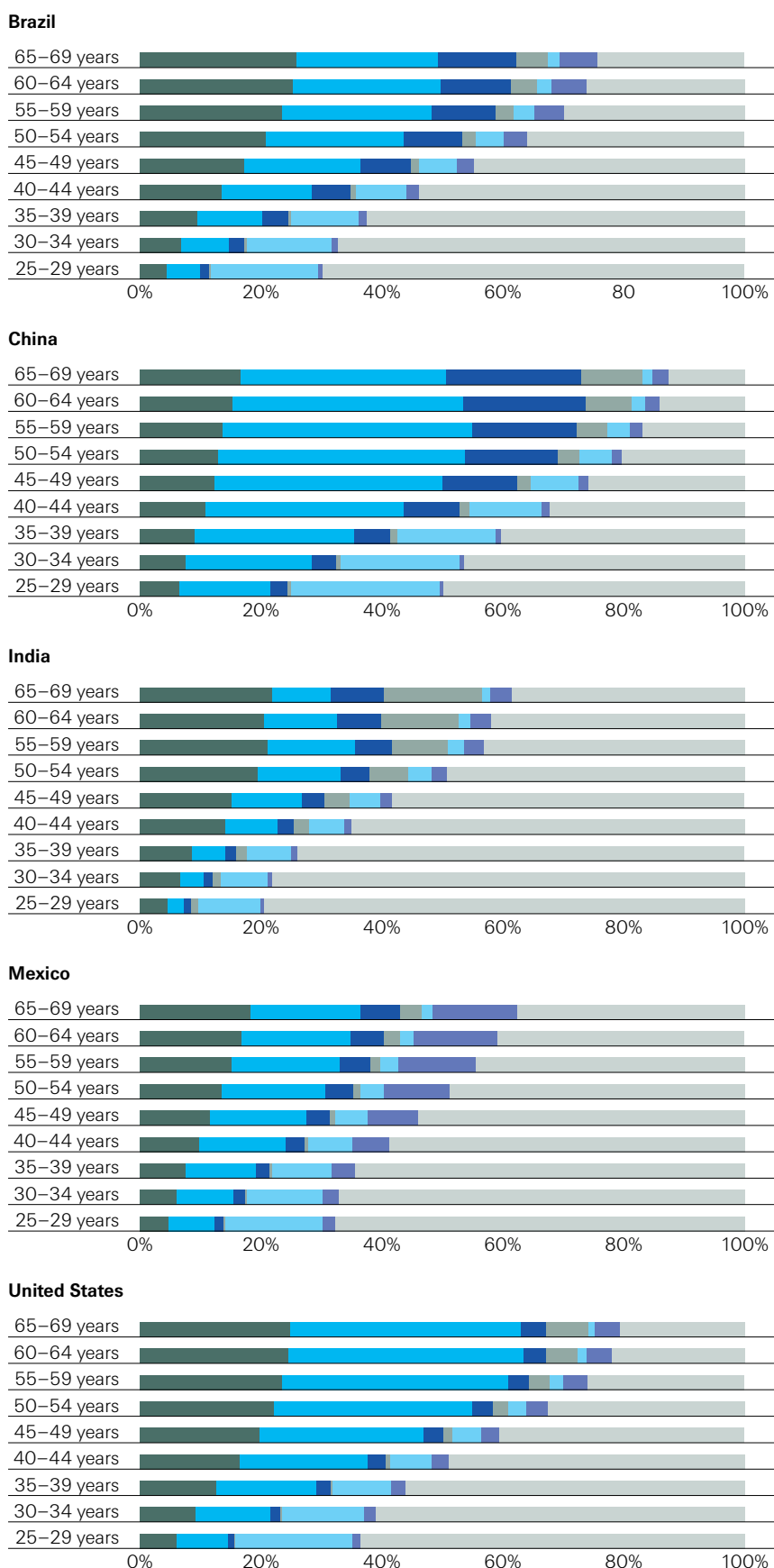
Source: Global Burden of Disease 2010

Some emerging markets are still coping with infectious diseases, while having to deal with the rise in chronic diseases.

The displacement of infectious disease with chronic conditions has evolved over many decades in developed markets. The pace of change is far more rapid in many emerging markets; to the point that some emerging markets are still coping with serious infectious diseases while having to deal with the rise in chronic diseases. This sudden shift towards chronic disease also means that insurers must face the challenge of anticipating future disease trends (Figure 2).

Figure 2:
Causes of death in 2010 in insurance relevant age intervals 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

SEARCH – The search for health data and insights from Mexico

The ultimate effects of these changes on human longevity have to be seen through the perspective of infrastructure development and public health.

One-third of Mexican adults are obese, making Mexico the most obese country in Latin America.

Mexico has witnessed a high growth in the number of obesity-related chronic conditions such as hypertension and diabetes.

The authorities are well aware of the current and potential future implications of obesity on public health.

Mexico has a relatively high prevalence for premature deaths as a result of car accidents and homicides.

Mexico spent around 6.2% of its GDP on health care in 2012.

The ultimate effects of these changes on human longevity have to be seen through the perspective of infrastructure development and public health. Again, there are wide variations within emerging markets, from the relatively sophisticated to those with considerable scope for improvement. This is another factor insurers must anticipate in their modelling.

SEARCH and Mexico

Mexico may not be the undisputed 'most obese country' in the world, but it is certainly one of the challengers. Recent studies suggest that Mexico's obesity rate may even be higher than that of the United States. With a prevalence of 33% of adults in 2012, it is the most obese country in Latin America. That undesirable state has been reached in a far shorter time span than in the US. The obesity rate doubled in the 19 years to 2012. The usual suspects of dietary transition and physical inactivity are both explanatory factors, with a number of Mexico-specific caveats, namely: a cultural preference for drinks high in sugar, partly the result of poor drinking water; proximity to the US and a preference for processed convenience foods; a highly urbanised population; and a culture or perception of violence in parts of the country that discourage walking or other exercise.

The net result is the high rate of growth of a number of obesity-related chronic conditions. The chances of suffering hypertension are about three times likelier for obese individuals versus those of normal weight. The rate of diabetes in adults doubled over 13 years to 2006 and stands at 14%. Despite this relatively low prevalence, it is a considerable disease burden – it is the leading cause of death in women, and the third leading cause of death among males. The worrying factor for Mexico is that the early rates of these diseases continue to rise, despite the government's stance that obesity is a public health issue; this suggests the country is sitting on something of a health time bomb. Obesity is also rising among younger age groups⁴.

The authorities are well aware of the current and potential future implications of obesity on public health. A number of programmes have been developed to promote healthier diets and more exercise; while smoking is prohibited in most public areas and cigarette advertising is controlled. Most eye-catching of measures by the government was a global first – an imposition of a 'soda tax' on high sugar fizzy drinks. Although few expect the tax to dramatically reduce short term consumption, the fact that the government has clearly labelled sugary drinks as unhealthy may have a significant longer term effect.

Several other factors make Mexico stand out in terms of life and health. As with other states in Latin America, the country has a relatively high international prevalence for premature deaths as a result of car accidents and homicides. Another notable factor of the life and health landscape is that Mexico has a relatively young demographic. The population pyramid still has a pyramid shape, unlike other major Latin American economies.

Healthcare in Mexico

Mexico spent around 6.2% of its GDP on health care in 2012. This figure is low compared to developed markets, and is relatively low when compared to other emerging markets. Brazil in the same year spent just under 9% of its GDP on health. Mexico's relatively low spending on health care may in part be due to the fact that Mexico has a relatively young demographic. The split between public and private spending on health care was largely equal, at 49% and 51% respectively⁷.

The Mexican healthcare system segregates the population into two groups – those with some type of social security coverage and those without social security coverage.

Public health systems are fragmented and deeply underfinanced.

In 2013, life and health premiums in Mexico were USD 14.7bn, making it the second biggest market in Latin America, behind Brazil.

Mexico has a high level of actual life insurance protection.

Figure 3: What are your main worries or concerns for the future that might lead you to consider buying insurance?

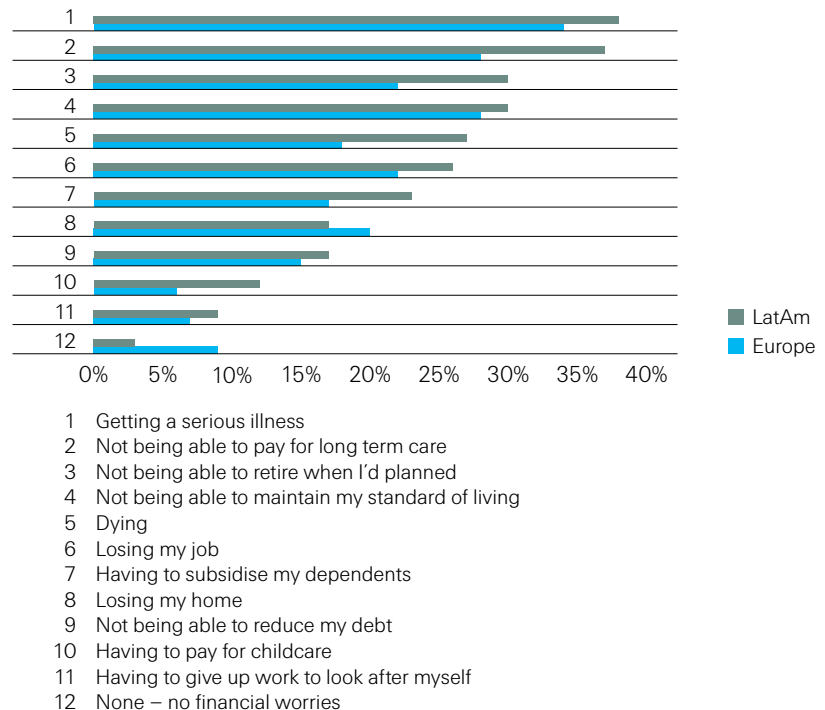
The Mexican healthcare system segregates the population into two groups – those with some type of social security coverage (those with a formal job) and those without social security coverage. The two main subsystems are the Social Security System (integrated mainly by IMSS, ISSSTE, ISSSFAM) and the public health insurance called Popular Health Insurance, “Seguro Popular de Salud” (SP).

Public health systems are fragmented and deeply underfinanced. There are serious challenges in allowing a universal guarantee of quality, equity and time. As a result, around 9 million high and middle income earners from a population of almost 120 million have some sort of private health coverage⁷. Most of these coverage holders pay twice for their healthcare, once to an under- or not used social security channel and once to a private channel.

Mexico and insurance

Mexican insurance coverage is low. Total insurance levels in the country account for just 2% of the country’s GDP, low even by emerging markets standards. In 2013, life and health premiums in Mexico were USD 14.7bn, making it the second biggest market in Latin America, behind Brazil. The penetration rate of just 0.92% not only remains significantly below the global average, but is also lower than the average in Latin America of 1.28%.

A Swiss Re survey in 2013 reported that Mexico has a high level of actual life insurance protection (48%), similar to other Latin American countries covered in the survey. On the other hand, additional protections for disability, sickness or unemployment are not as widespread, with only 26% of respondents who do not have any kind of coverage at all and 9% of respondents who are not even sure about what kind of policies they own⁵.



Notes: The threat of not receiving necessary healthcare treatment is the major concern, with respondents feeling highly vulnerable. People feel least concerned about becoming unemployed; a quarter of respondents feel fully secure about their employability.

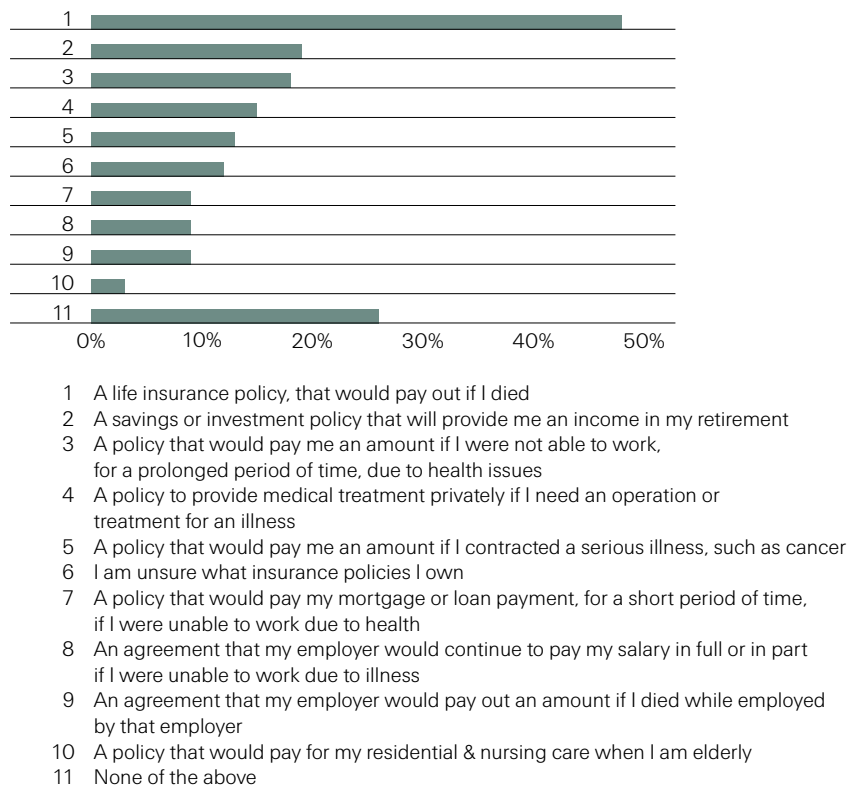
Source: Swiss Re⁵

SEARCH – The search for health data and insights from Mexico

Most Mexicans hope their savings would be adequate in case of illness.

In the event of a debilitating condition, most hoped that their savings would cover any eventuality; others placed (a somewhat optimistic) faith in social security.

Figure 4:
If you were to require care and support in later life, in your own home or in a care home, how would you pay it?



Notes: The research showed that 61% of Mexicans fear that they would suffer and struggle financially if they were affected by a long-term illness or disability, and that their families would not have any means of ensuring financial stability in the first years following their death. Most of those surveyed said that this is mainly due to a lack of sufficient savings/investments (56%); only 16% of the respondents mentioned insufficient insurance protection. This is an indication that in many cases insurance is still not considered a valid option to bridge a critical life situation.

Source: Swiss Re⁵

Many Mexicans seem willing to pay the cost of critical illness cover, but cite complexity of insurance as the reason for not purchasing it.

The irony of this was, when asked what they might pay for critical illness cover*, many respondents named a figure for which coverage already exists. When asked why they did not purchase cover, most cited the complexity of insurance. This suggests that insurers should develop products that are simpler, more easily distributed and understandable.

Swiss Re's mortality gap protection study in 2013 revealed that in order to feel financially secure, the Mexican population require around USD 1bn in extra life coverage.

Mexico is better financially provisioned than other emerging markets in a number of respects, not least mandatory individual retirement savings plans that are tax deductible. Nonetheless, the Swiss Re mortality gap protection study in 2013 revealed that in order to feel financially secure, the Mexican population require around USD 1bn in extra life coverage; a little under USD 40000 per economically active individual⁶.

* Critical illness cover is an insurance product, where the insurer is contracted to typically make a lump sum cash payment if the policyholder is diagnosed with one of the critical illnesses listed in the insurance policy.

Private health insurance

Nearly all of Mexico's private health expenditure has been funded out of pocket.

It is revealing and not surprising that 94% of Mexico's private health expenditure has been funded out of pocket. Given all the challenges involved in suddenly being confronted by potentially large medical bills, just six percent was funded by insurance⁷.

There are 34 companies offering health insurance; the five largest are multi-line insurers and have a market share of 73%.

There are 34 companies offering health insurance, the five largest are multi-line insurers and have a market share of 73%. Medical insurance accounted for around USD 3.7 billion of revenue in 2013, with around 7.8 million members. This represents just 7% of the population, indicative of a high growth potential. Due to favourable economic and demographic trends, premiums can grow up to USD 9bn over the next decade. Profitability has been a challenge for health insurers, remaining at around 4%, due to loss ratios at 76% - 78% and combined ratios (ie loss ratios plus administration and acquisition costs) that are between 96% and 100%. By far the biggest private health insurance claims arise from cancer treatment, followed by cardiovascular disease, diabetes and treatments for the nervous system⁷.

Providing improved insurance products

Private health insurers face the challenge of providing affordable private healthcare.

With a huge health protection gap and inability of government to provide adequate healthcare coverage to the population, private health insurance must accomplish its social function of providing affordable private healthcare.

If the behaviour of medical conditions and their impact are better understood, insurers will be able to design novel and proper products.

Recognising that the underlying components of premium rates are frequency and average cost of claims, if the behaviour of medical conditions and their impact are better understood, insurers will be able to design novel and proper products, including differentiated rating systems.

Insurers must understand properly the key trends in order to harness the health insurance opportunities.

Insurers must understand properly the key trends in order to harness the health insurance opportunities. They must analyse major demographic and social trends, such as aging societies; the decline of family units and elderly care, which frequently accompanies them; and the increasing size of urban populations, which are related to the growth of chronic conditions.

Mexico must address and discourage certain trends.

Mexico must address and discourage certain trends, such as increasing rates of obesity and sedentary habits as well as violence, which strongly impact healthcare costs.

Those with higher levels of education are demanding health care insurance.

The growth of the middle class in Mexico has been modest but is a fact. Those with higher levels of education are demanding health care insurance which social healthcare systems are unable to meet.

Future products to cover life and health will go beyond traditional offerings and encompass the health and social care spectrum.

In Mexico, as in many other markets, the convergence of social and demographic trends is creating an exciting time for growth in health insurance. Future products to cover life and health will go beyond traditional offerings and encompass the health and social care spectrum. Insurers can capitalise on these trends, utilising new technologies to help close societies' health protection gaps.

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One potential solution in Mexico would be to encourage employers to contribute to voluntary group insurance schemes.

Translating frequency and average cost data into knowledge and counting with solid evidence-based tools enable insurers to improve risk assessment and risk selection skills and therefore provide fair pricing and affordable rates.

Swiss Re believes that the commercial insurance industry has an important role to play in providing security and coverage in the event of illness or death.

One potential solution in Mexico would be to encourage employers to contribute to voluntary group insurance schemes, supported by the right tax breaks and incentives. These schemes should be on an 'opt out' rather than an 'opt in' basis. Individuals would have the chance to pay into insurance schemes in early adulthood when premiums are low. Medical plans could also include a savings component. These products could be distributed together to supplement public or private health plans.

Translating frequency and average cost data into knowledge and counting with solid evidence-based tools enable insurers to improve risk assessment and risk selection skills and therefore provide fair pricing and affordable rates. Insurers can stabilise premiums through higher customer retention supported by knowledge-backed underwriting. The analysis and data provided by the SEARCH project done in collaboration with the Harvard T.H. Chan School of Public Health is a valuable tool in supporting this expansion of the insurance knowledge base.

Swiss Re believes that the commercial insurance industry has an important role to play in providing security and coverage in the event of illness or death. The basis for offering these products and services is reliable data – and we hope this SEARCH publication helps to provide an overview of the major trends in the Mexican market.

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About the authors

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Eduardo Lara di Lauro is the Head of Health Insurance Latin America at Swiss Re. He is responsible for developing and implementing Swiss Re's Primary Medical Insurance strategies in Latin America, and has over 27 years of experience in the insurance industry. Prior to joining Swiss Re, he was Principal and Managing Director of a large US Healthcare Consulting Practice based in Mexico. He has published several articles and spoke at numerous forums on issues related to Life & Health insurance, health systems and managed care topics in Mexico, USA, Chile, Panama, Peru and Colombia. He served as the President of the Mexican Association of Actuaries and is a board member of the Health Committee of the International Actuarial Association. He is a Certified Actuary by the Mexican National College of Actuaries, and graduated from the Science Faculty of Mexico's National Autonomous University (UNAM).



Healthy Food
Fresh Fruit Smoothies

Healthy + Fresh
Breakfast Burritos
Fruit Plates & Bowls
Deli. Baguette
Green Salads
Nachos
Fruit Smoothies
CAFE

Healthy Food
Fresh Fruit Smoothies

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.

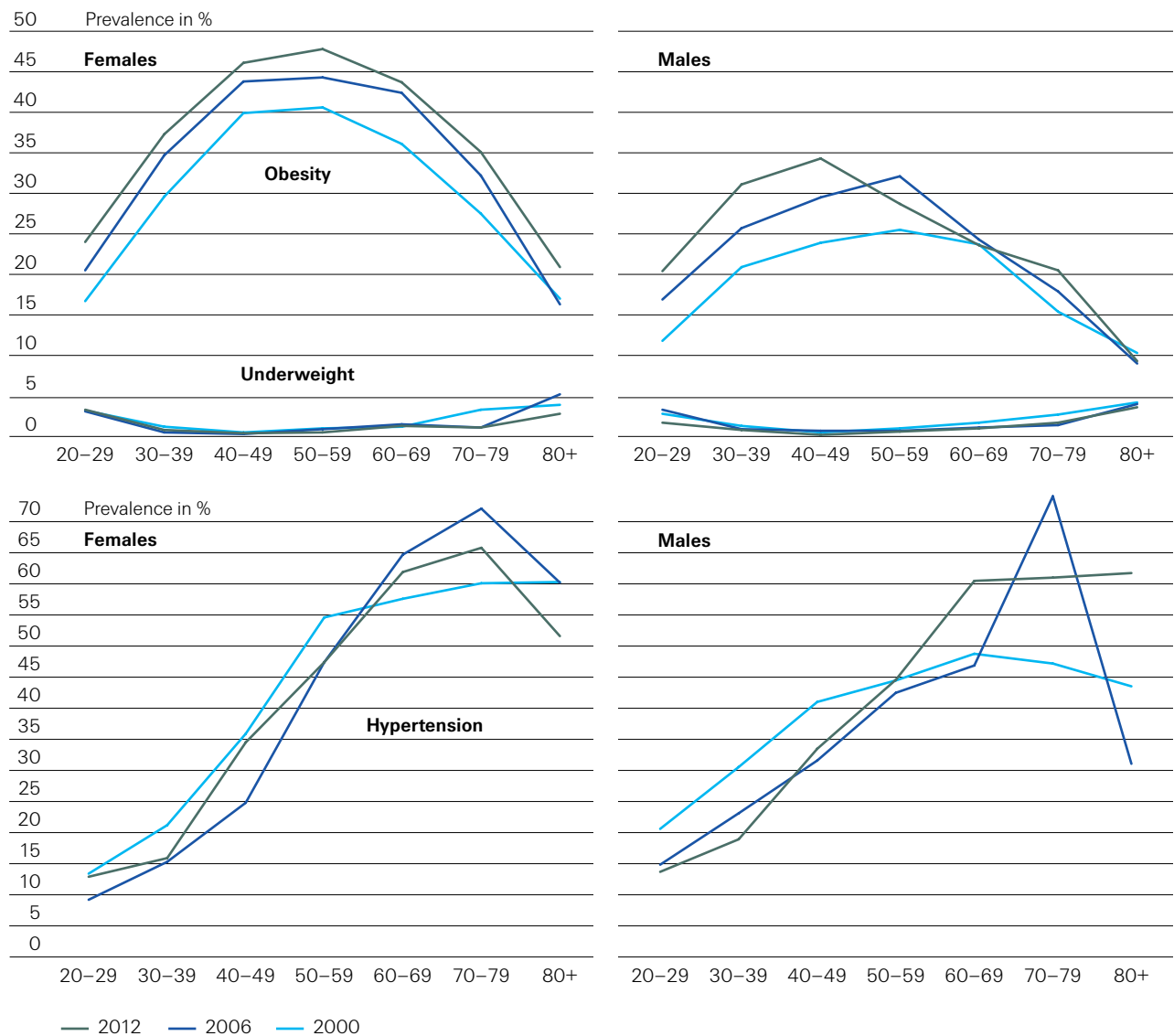
Mexicans have not escaped this trend and they too have experienced major dietary changes in the last decades. Traditional dietary habits have changed in that people are more likely to eat away from home⁹ and the traditional Mexican diet based on corn and beans, typical of rural areas in the mid-1980s, 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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Hiram Beltrán-Sánchez is a Research Associate at the Center for Demography of Health and Aging at the University of Wisconsin-Madison. His research focuses on studying national patterns of mortality, morbidity and health using biomarker indicators and multidisciplinary approaches to identify salient characteristics associated with the observed health profiles in low and middle-income countries, with particular emphasis on Mexico.



Air pollution and cardiovascular disease risk in Mexico City

Jennifer L. Nguyen, Douglas W. Dockery

Just two decades ago, the United Nations declared Mexico City the most polluted city in the world¹, leading some to nickname the city ‘Meksicko City’². Since then, Mexico City has made tremendous improvements in air quality. This progress is especially noteworthy because Mexico City experienced rapid urban and industrial progress and population growth over the same period, and illustrates that economic growth is possible without compromising air quality. Some of the actions that led to this marked improvement include instituting a driving restriction programme, strengthening the vehicle inspection and maintenance programme, reducing the sulphur content in diesel fuel, and substituting natural gas for fuel oil in industry and power plants³.

Introduction

Despite remarkable progress, air pollution levels in Mexico City – particularly ozone and particulate matter – regularly exceed the Mexican air quality standards.

Despite remarkable progress, air pollution levels in Mexico City – particularly ozone and particulate matter – regularly exceed the Mexican air quality standards. However, Mexico City’s pollution problem is not confined to its borders. Ozone and particulate matter can be transported long distances and influence the air quality and climates of places far from their origin.

This article provides a review of what is known about the association between air pollution and cardiovascular disease in Mexico.

This article describes the current state of the air quality in Mexico City. It also provides a review of what is known about the association between air pollution and cardiovascular disease in the Mexican population, and identifies areas that would benefit from further research.

Why is Mexico City prone to high pollution levels?

Mexico City’s mountainous borders, in combination with a stable climate and light winds, result in poor ventilation that promotes thermal inversions that prevent dispersal of air pollutants.

Mexico City is located in a nearly flat basin. Mountain ridges surround three sides (east, south, and west) of Mexico City, and two major volcanoes are located in the southeast region. These mountainous borders, in combination with a stable climate and light winds, result in poor ventilation that promotes thermal inversions that prevent dispersal of air pollutants. Mexico City is very population dense (population > 20 million)⁴, contains over 4 million vehicles that produce over 2.5 tonnes of particulate and gaseous pollutants annually, and also has a high concentration of industrial and commercial activities³.

Air pollution and cardiovascular disease risk in Mexico City

Mexico City uses a Metropolitan Index of Air Quality to communicate air quality conditions, health risks and recommendations to the public in a simple and effective way.

In 2011, the air was considered unhealthy on 212 days and very unhealthy on 29 days.

Figure 1:
The Air Quality Metropolitan Index (IMECA) used in Mexico City to communicate air quality conditions to the public

Air Quality & Public Health in Mexico City

Mexico City uses a Metropolitan Index of Air Quality (Indice Metropolitano de Calidad del Aire, or IMECA) to communicate air quality conditions, health risks and recommendations to the public in a simple and effective way. This color-coded numerical scale divides air quality into 5 categories – Good, Moderate, Unhealthy, Very Unhealthy, and Hazardous (Figure 1). IMECA scores are available continuously (24 hours a day) to the public via the Mexico City Ministry of Environment (Secretaría del Medio Ambiente).

In 2011, the air in Mexico City was classified as Good only for 5 days in the year, while 119 days were Moderate, 212 days were Unhealthy, and 29 days were considered Very Unhealthy. Mexico City residents are advised to stay indoors and to keep their windows shut when air quality is unhealthy or very unhealthy⁵.

Air quality is...	if the IMECA is between
Good	0 to 50
Moderate	51 to 100
Unhealthy	101 to 150
Very Unhealthy	151 to 200
Hazardous	over 200

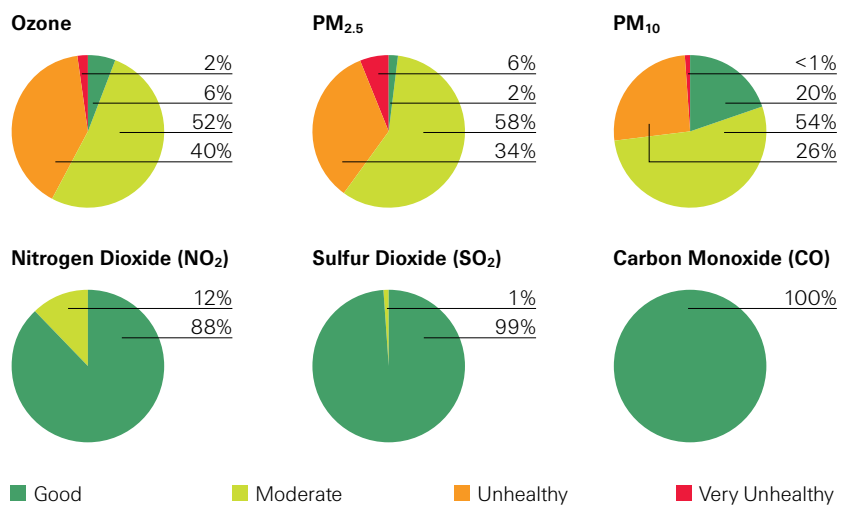
Source: Ministry for the Environment of the Government of the Federal District

Ozone is the #1 contributor to the poor air quality of Mexico City.

Why should Mexico City zone in on ozone?

Ozone is the #1 contributor to the poor air quality of Mexico City. In 2011, ozone levels at all 23 ozone monitoring sites were out of compliance with both the 1-hour and 8-hour Mexican Air Quality Standard (1-hour average: 0.11 ppm (parts per million) not to be exceeded more than once a year; 8-hour average: 0.08 ppm for the 5th maximum over a period of one year). Only on 22 (6%) days in 2011 were ozone levels acceptable (classified as Good, Figure 2). Ozone levels are high throughout the year because the subtropical latitude and high elevation (2240m above sea level) of Mexico City are conducive to ozone formation⁶. The highest ozone levels occur during the ozone season, from March to May⁵. High energy consumption in Mexico City makes this city prone to the urban heat island effect. Temperatures can reach up to 12°C above that in the surrounding suburban or rural area. Additionally, a changing climate is expected to bring even higher summer temperatures to Mexico City, further promoting the formation of ozone in this megacity.

Figure 2:
The percent of days in 2011 air pollution levels were considered good, moderate, unhealthy, or very unhealthy in Mexico City by pollutant



Notes: Ozone and PM_{2.5} are the biggest contributors to poor air quality in Mexico City. PM₁₀, PM_{2.5}: particulate matter with an aerodynamic diameter < 10 µm, < 2.5 µm, respectively.

Source: Ministry for the Environment of the Government of the Federal District

Studies have generally found an increased risk of cardiovascular mortality with higher ozone levels in the Mexican population.

The respiratory health effects of ozone occur much more rapidly than the cardiovascular effects.

After ozone, PM_{2.5} (particulate matter with an aerodynamic diameter < 2.5 µm) is the next biggest contributor to the poor air quality in Mexico City.

Ambient particulate matter pollution is the 9th leading risk factor accounting for the years of life lost in Mexico. It primarily contributes to the cardiovascular disease burden, and also accounts for a substantial portion of the disease burden from lower respiratory infections.

The strongest associations between air pollution and cardiovascular events worldwide are found for PM_{2.5} and smaller particles.

Cardiovascular mortality related to ozone exposure

Studies have generally found an increased risk of cardiovascular mortality with higher ozone levels in the Mexican population, though the magnitude of the association varies across studies⁷⁻⁹. Two meta-analyses of studies from China and Europe and another large study of 23 European cities have found a consistent increased cardiovascular risk of about 0.45% per 10 µg/m³ ozone increase. Characterising the adverse health effects of ozone is expected to become more evident in the future as air pollution profiles shift towards a larger photochemical component⁶.

The respiratory health effects of ozone occur much more rapidly than the cardiovascular effects. High ozone levels make it more difficult to breathe, can cause shortness of breath, coughing, and a sore throat, and can aggravate lung diseases such as asthma, emphysema, and chronic bronchitis. The biological mechanism for how ozone influences cardiovascular processes is yet to be elucidated. Potential pathways include increased oxidative stress, systemic inflammation, and changes in autonomic control¹⁰.

Particulates are another matter: PM_{2.5} and PM₁₀

After ozone, PM_{2.5} (particulate matter with an aerodynamic diameter < 2.5 µm) is the next biggest contributor to the poor air quality in Mexico City (Figure 2). All seven regulatory monitors recorded levels out of compliance with the annual air quality standard of 15 µg/m³. The municipality of Xalostoc (State of Mexico) registered the highest annual average at 24.8 µg/m³. PM₁₀ levels were also out of compliance with Mexican air quality standards in 2011. Six of the nine PM₁₀ regulatory monitors recorded annual levels exceeding the standard of 50 µg/m³; two of the three compliant stations only scarcely met the standard (48.0 and 49.9 µg/m³). Particulate matter levels are highest during the dry season (January–May and November–December)⁵.

Cardiovascular mortality and heart rate variability related to particulate matter

Ambient particulate matter pollution is the 9th leading risk factor accounting for the years of life lost in Mexico. Particulate matter pollution primarily contributes to the cardiovascular disease burden, and also accounts for a substantial portion of the disease burden from lower respiratory infections¹¹. Currently, the strongest evidence for air pollution-related cardiovascular health effects in the Mexican population is short-term exposure to PM₁₀. This evidence comes from two large multi-city studies investigating the health effects of air pollution in Latin America: the ESCALA study (Estudio de Salud y Contaminación del Aire en Latinoamérica)⁹, and the ADAPTE study (Adaptation to the Health Impacts of Air Pollution and Climate Extremes in Latin American Cities)¹². These studies found that the risk of cardiovascular death increased by 0.1% to 1.4% per 10 µg/m³ increase in PM₁₀. These results are consistent with meta-analyses of studies from China¹³ and Europe¹⁴ that found excess cardiovascular mortality risks of 0.4% and 0.9%, respectively, for the same PM₁₀ increment.

Although there is more evidence for adverse cardiovascular effects for PM₁₀ among the Mexican population, the strongest associations between air pollution and cardiovascular events worldwide are found for PM_{2.5} and smaller particles. These fine and ultrafine particle fractions can be easily inhaled deep into the lungs and translocate from the lungs into the systemic circulation¹⁵. One study has examined PM_{2.5} in relation to cardiovascular mortality in Mexico⁷ and found a higher excess risk of death (2.2%) than two studies found for PM₁₀ (< 1.5%)^{9,12}, consistent with the observational literature. Following cardiovascular mortality, the observational literature from Mexico on air pollution and cardiovascular disease is most developed for heart rate variability. Several studies have linked higher PM_{2.5} levels to decreased heart rate variability in the Mexican population¹⁶⁻¹⁸, consistent with what has been found in studies from other nations¹⁹.

Living in highly polluted areas increases cardiovascular stress markers

Observations among youth and young adults may hint at the biological processes involved in promoting cardiovascular disease from chronic air pollution exposure in the Mexican population.

Several studies have shown that children and young adults living in highly polluted areas of Mexico City have increased myocardial expression of proteins involved in oxidative stress and endoplasmic reticulum stress, differential expression of myocardial genes involved in inflammation, and increased endothelial dysfunction, compared to residents living in low pollution areas^{20–23}. Markers of cardiovascular function do not necessarily equate to development or increased risk of developing clinical or subclinical disease. However, these observations among youth and young adults may hint at the biological processes involved in promoting cardiovascular disease from chronic air pollution exposure in the Mexican population.

Gaps in air pollution-cardiovascular disease research among the Mexican population

There is a lack of research on more intermediate outcomes, such as cardiovascular-related hospital admissions or emergency room visits.

The observational studies that have been conducted thus far in Mexico have focused on cardiovascular-related mortality or measures of heart rate variability. These outcomes are extremes on the continuum of cardiovascular processes. There is a lack of research on more intermediate outcomes, such as cardiovascular-related hospital admissions or emergency room visits. Studies have been conducted looking at other air pollutants – sulphur dioxide, nitrogen dioxide, carbon monoxide, total suspended particulates – but they are limited to one or two studies that generally find much weaker associations than observed for particulate matter or ozone. There is also a gap in knowledge on exposure to air pollution generated at the personal level. No studies have been conducted in Mexico on environmental tobacco smoke (also known as passive smoking, second-hand smoke) in relation to cardiovascular outcomes.

Household air pollution from burning biomass for cooking is estimated to be the 12th leading risk factor for the disease burden in Mexico.

Household air pollution from burning biomass for cooking is estimated to be the 12th leading risk factor for the disease burden in Mexico, primarily affecting diseases of the cardiovascular and circulatory systems¹¹, but no observational studies have been conducted in Mexico thus far on this topic. This lack of evidence is not unique to Mexico unfortunately. A recent systematic review of household air pollution and cardiovascular outcomes identified only one observational study on this topic, conducted in China²⁴. Household air pollution is a major global public health problem. Over half of the world's population is exposed to household air pollution from using biomass fuels for cooking, lighting and heating²⁵.

Summary

The current observational evidence supports an association between particulate matter and ozone and adverse cardiovascular outcomes in Mexico City, particularly for mortality and decreased heart rate variability.

The current observational evidence supports an association between particulate matter and ozone and adverse cardiovascular outcomes in Mexico City, particularly for mortality and decreased heart rate variability. One study has estimated that approximately 30 000 premature deaths and 550 000 emergency room visits could be prevented in Mexico City if the city reduced ozone and PM₁₀ levels by about 10% from the projected levels for 2020 using readily available technologies²⁶. Worldwide, PM_{2.5} is the air pollutant most associated with cardiovascular risk, but among the Mexican population, more studies have examined PM₁₀ than PM_{2.5}. More studies on how PM_{2.5} affects cardiovascular risk among Mexico residents are needed. Mexico City is already prone to high ozone pollution levels. A changing climate is expected to bring even higher summer temperatures to Mexico City, further accelerating the formation of ozone in this megacity. Increased research on how ozone affects the cardiovascular system is needed, particularly as air pollution profiles shift to a higher photochemical component in the future.

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The Harvard T.H. Chan School of Public Health brings together dedicated experts from many disciplines to educate new generations of global health leaders and produce powerful ideas that improve the lives and health of people everywhere. As a community of leading scientists, educators, and students from around the world, we work together to take innovative ideas from the laboratory to people's lives – not only making scientific breakthroughs, but also working to change individual behaviors, public policies, and health care practices to create a healthier world.

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