



Swiss Re
Centre for Global Dialogue

Risk Dialogue Magazine No 17
Special edition

**Health risk factors in major
emerging markets**

Lost life expectancy due
to air pollution in China

Chronic diseases in India

Health risk factors in Brazil

Risk factors for cardiovascular
disease in Brazil and China



Risk Dialogue Magazine: Health risk factors in major emerging markets

First world diseases 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 effective life and health insurance pools.

It is with these goals in mind that the Centre together with Swiss Re Group Underwriting and the Swiss Re Foundation recently partnered with the Harvard School of Public Health to launch the SEARCH project, in order to better understand health risk factor trends in Brazil, China, India and Mexico. More details of the project can be found in the SEARCH article. The other articles, written by our collaborators, provide you with insights into some surprising key health risk factor developments in Brazil and China.

Annabelle Hett
Head Swiss Re Centre for Global Dialogue

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Lost life expectancy due to air pollution in China

Douglas W. Dockery, C. Arden Pope III

Recent smogs in Beijing and other Chinese cities have registered almost off the scale in terms of particulate pollution. We are currently unable to measure all health costs or full losses of life due to this 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 reality of the risk air pollution poses to Chinese city dwellers. Addressing air pollution and other environmental concerns must be a priority for the Chinese authorities, both to manage public health costs and to lessen a potential impediment to effective economic growth.

Air quality in the United States and Europe has shown substantial improvements over the last couple of decades. Cleaner air has contributed to increased life expectancy in these developed countries ¹. However, in many countries in the developing world, air pollution control has been sacrificed in the name of economic development.

The severe and deteriorating air pollution situation in China is a case in point. The high particulate air pollution readings in Beijing has 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 harming economic growth in China.

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 at least five years," Zhu Rongji told city officials when he was prime minister in 1999.² 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 to see people they were speaking to. The Harbin government reported an air quality index (AQI) score of 500, the



Figure 1: Harbin's landmark San Sophia church was barely visible Monday as heavy pollution forced the closure of schools and highways



Figure 2: A couple wearing smog masks take an afternoon stroll along The Embankment

Lost life expectancy due to air pollution in China

highest possible reading, and concentrations of PM_{2.5} — fine particulate matter that are 2.5 microns in diameter or smaller and especially harmful to health — of 1 000 micrograms per cubic meter (mg/m³).

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.

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 specifically increased.

In December 2012, the Global Burden of Disease analyses were published in *The Lancet*⁵. As part of that effort, average 2005 fine particle (PM_{2.5}) air pollution was estimated across the world (Figure 3)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; and indoor air pollution from burning solid fuels for heating and cooking as the fifth leading cause.

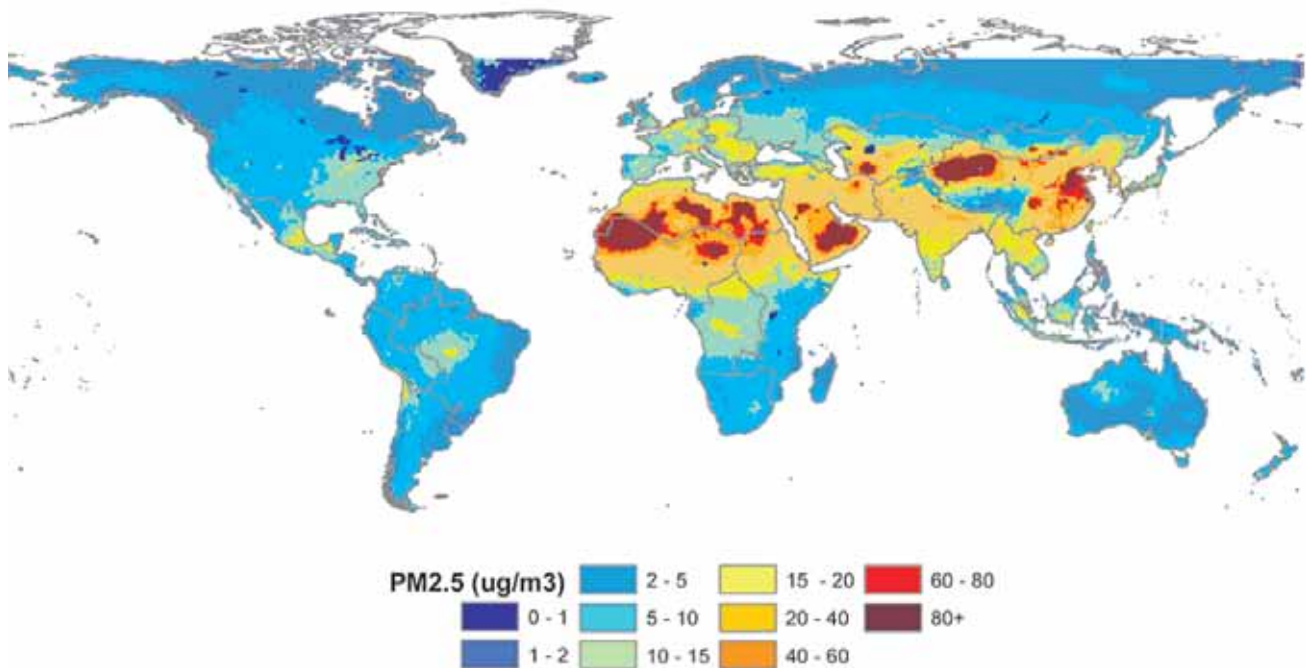
These huge numbers of excess deaths and total years of lost life expectancy are compelling, but fail to communicate the risk to an individual of life-long exposure to extremely high air pollution, or the risk to visitors or temporary residents. The objective of this commentary is to provide useful, comparable 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

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 States⁸. The counterfactual, baseline, life expectancy for non-smokers is calculated adjusting the rates for ages 18 years and older to be 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 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 µg/m³ mean PM_{2.5}), a moderately polluted city (25 µg/m³ mean PM_{2.5}), and a highly polluted city (55 µg/m³ mean PM_{2.5}) relative to a very clean city (5 µg/m³ mean PM_{2.5}) are estimated to be 7%, 14%, and 30%, respectively. The excess

Figure 3: Estimated 2005 annual average PM_{2.5} concentrations (µg/m³)⁶.



risk estimates for a highly polluted city may somewhat underestimate the effects of air pollution of Beijing for two reasons. First, average PM_{2.5} concentrations in Beijing are reported to be 58 µg/m³ in 2005⁶ and have been getting worse. Second, we are using more conservative risk estimates than would be obtained by linear extrapolations from U.S. cohort studies because of recent evidence that the exposure-response function flattens out at higher levels of exposure¹¹.

Results and discussion

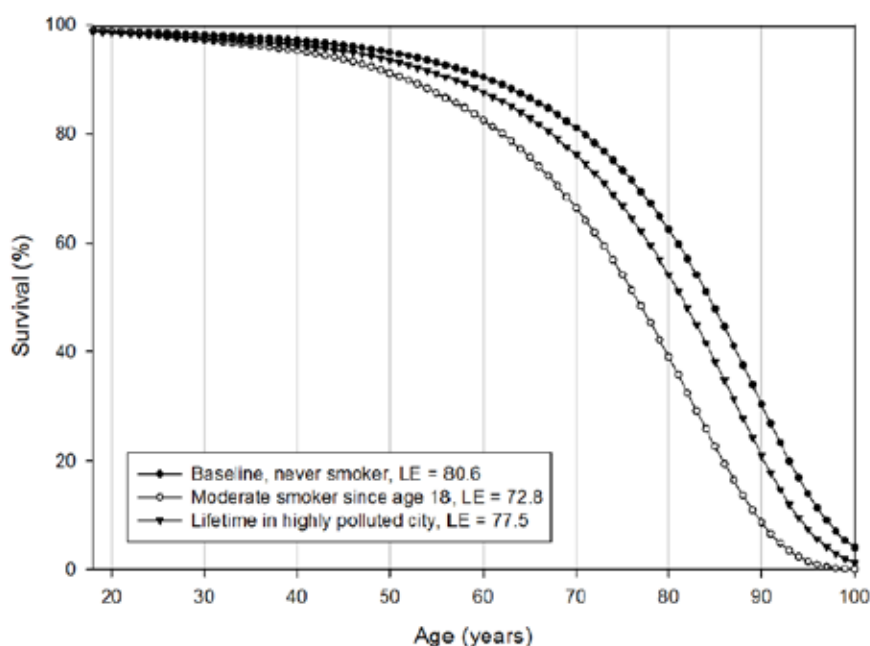
Figure 4 illustrates differences in the life-table derived survival curves and life expectancy for the different exposure stylised scenarios. Cigarette smoking significantly adversely alters the survival curves. A lifetime of exposure to ambient air pollution in a highly polluted city has a similar, 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 4).

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 –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 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.

As can be seen in Table 1, living with a smoker throughout adult life time 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 larger.

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.

Figure 4: Survival curves 18–100 years and estimated life expectancy (LE) for alternative excess risk assumptions



Lost life expectancy due to air pollution in China

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.

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.

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 ageing, 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 in lost life expectancy is less at age 35 years (5 days).

What does this mean for the individual?

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 suggest 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.

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	Years LE	Reduced years LE	Reduced days LE
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	Years LE	Reduced years LE	Reduced days LE
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	Years LE	Reduced years LE	Reduced days LE
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

For an individual, the implication of these results is not that their life is measurably shortened. Rather these estimates reflect the increase probability of death in each year. Again to illustrate, among one thousand (1 000) 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. (Note, 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. (Note; 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. Note that we assume that once the air pollution exposure is

removed (for example, by moving to a cleaner city) their 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 the individual 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 as discussed in the accompanying articles 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 (exposure to) ambient particles.¹² Office and home air conditioning has some limited benefit in reducing exposures to ambient outdoor air pollution. Indeed gaseous pollutants (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, for example, 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.

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

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 useful”¹³. 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.

We are currently unable to measure all health costs or full losses 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 measures of 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 effective economic growth.

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Douglas W. Dockery

Professor of Environmental Epidemiology, Department of Environmental Health, Harvard School of Public Health, Boston, MA

Doug Dockery, MS, ScD, is internationally known for his innovative work in environmental epidemiology, particularly in understanding the relationship between air pollution and respiratory and cardiovascular mortality and morbidity. He was one of the principal investigators of the landmark Six Cities Study of Air Pollution and Health, which showed that people living in communities with higher fine particulate air pollution had shorter life expectancies.

The International Society for Environmental Epidemiology honored him with its first award for Outstanding Contributions to Environmental Epidemiology in 1999 and the first Best Paper in Environmental Epidemiology Award in 2010.



C. Arden Pope III

Mary Lou Fulton Professor of Economics, Department of Economics, Brigham Young University, Provo, Utah

C. Arden Pope III, PhD has conducted or collaborated on various key studies of human health effects of short- and long-term air pollution exposure. He has played prominent roles in reviewing and interpreting this literature and is a widely cited and recognized expert on the health effects of air pollution.

He has been the recipient of various honors and awards including the Thomas T. Mercer Joint Prize from the American Association for Aerosol Research and the International Society for Aerosols in Medicine (2001) and is an Honorary Fellow of the American College of Chest Physicians (FCCP Hon, 2008).



Chronic diseases in India: Burden and implications

K. Srinath Reddy, Sailesh Mohan

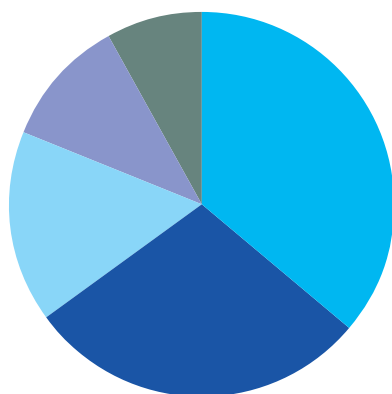
India currently faces the dual burden of communicable diseases and chronic non-communicable diseases (NCDs) such as cardiovascular disease (CVD), diabetes, cancer and chronic obstructive pulmonary disease (COPD). Success in controlling communicable diseases to some extent as well as increased longevity 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?

The latter half of the 20th century had brought in substantial progress in societal development, health, nutritional as well as life expectancy. Consequently, deaths from communicable diseases have decreased while those from NCDs have risen. This has been attributed to multiple health transitions such as demographic (population ageing), epidemiological (change from communicable to non-communicable diseases) and nutritional (high caloric consumption and low physical activity levels) transitions. 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}

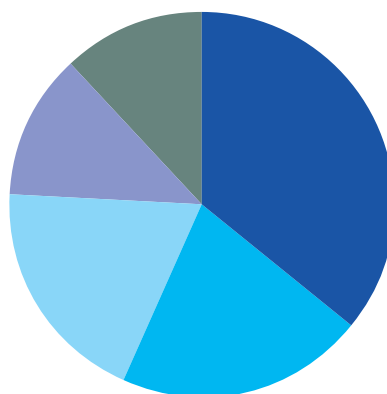
Figure 1: Causes of death in India

Main Cause of Death in India, 2005



- 36.2% Communicable Diseases
- 29.0% Cardiovascular Diseases
- 16.0% Other Chronic Diseases
- 10.8% Injuries
- 8.0% Cancer

Main Cause of Death in India, Projected: 2030



- 35.9% Cardiovascular Diseases
- 21.0% Communicable Diseases
- 19.1% Other Chronic Diseases
- 12.1% Injuries
- 11.9% Cancer

Source: Adapted from reference 1 and 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.

Tobacco use

In India, tobacco is widely used in many forms (bidis, cigarettes and smokeless forms) and the country is the second largest producer and the third largest global consumer. There are about 275 million tobacco users (Figure 3) and it is a leading preventable cause of premature, NCD-associated death and disability. Of concern, tobacco use is increasing among youth, women and the poor. Almost a million deaths occur due to tobacco use, with most of these deaths occurring among the poor and in the economically productive age group of 30–69 years. 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 with the conservative cost of treating three major tobacco-related NCDs (cancer, heart disease and COPD) in 2002–2003 estimated to be INR 308.3 billion, which far exceeds the revenue added by tobacco taxes to the public exchequer^{3,4}.

Diet, physical activity and alcohol use

Even though discernable changes in the per capita calorie consumption over past few decades in India has 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.

Conversely, fruits and vegetable consumption, which provides protection against NCDs, is inadequate, particularly among the poor. Similarly, physical activity, another protective factor is 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.

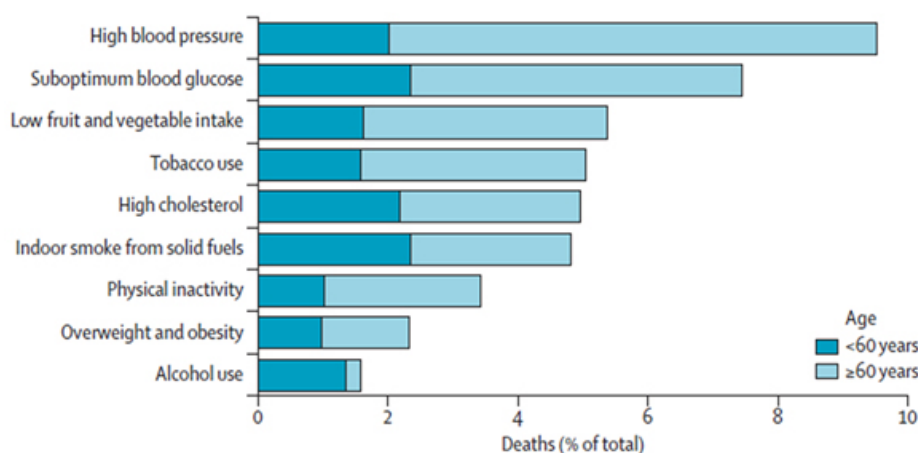
Dietary salt consumption, a key determinant of hypertension and associated CVD, is also very high with the average intake ranging between 9–12 grams/day, far exceeding the World Health Organization (WHO) recommended intake of ≤ 5 grams/day².

Alcohol consumption 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

Currently, about 2.7 million die of CVD and this is projected to increase by 1.5 million by 2030. Estimates indicate 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 and 2.1%–4.3% in rural India. During the past few decades, CHD prevalence has increased almost four-fold in rural areas and six fold in urban

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



Source: Adapted from reference 1

areas as a result of varied health transitions. Paralytic stroke prevalence is between 334–424 per 1 000 000 population in urban areas and between 244–262 per 1,000,00 population in rural areas. Notably, about 10–12% of all stroke deaths in India occur in those below 40 years, highlighting the huge impact on families, households and for the nation’s economy as it affects workforce productivity^{2,5}.

Diabetes mellitus

Type-2 diabetes mellitus has been rising rapidly, with the country until recently being often labeled as the ‘diabetes capital’ of the world. Most recent estimates of the International Diabetes Federation (IDF), report that there are about 65 million people with diabetes, with projected increase to 109 million by 2035.⁶ Moreover, diabetes is an important risk factor for CVD and CVD is the major cause of death and disability in persons with diabetes. 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. There are currently 20–40% adults in urban areas and 12–17% in rural areas who suffer from it. The number of hypertensives in India is

projected to nearly double from 118 million in 2000 to 213 million by 2025. Besides, nearly 40% adults have pre-hypertension, a precursor condition with high likelihood of converting into hypertension if left unaddressed^{1,5}.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is more common among men as the major underlying cause is tobacco smoking but is also increasing among women due to the adverse impact of indoor air pollution as a result of solid fuels usage 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 with consequent financial repercussions for both patients and the resource constrained healthcare system².

Cancer

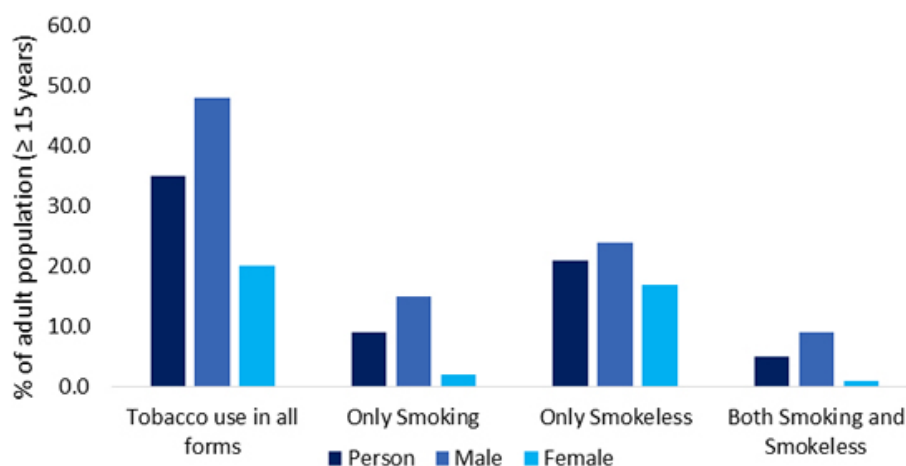
Each year about 800 000 new cases of cancer and 550 000 deaths occur in India. The most common cancers in men are those of the oral cavity, oesophagus and lung while in women the main sites are the cervix, breast and ovaries. Early diagnosis and treatment are often delayed, with more than 75% of cancer

patients presenting and seeking care when already in advanced stages of the disease.² 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.

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.

Figure 3: High tobacco use in India



Source: Adapted from reference 4

A recent global study indicated that up to 80% individuals were not on proven and effective life-saving drug treatment after a stroke or heart attack in countries like India. This results in avoidable complications, increased healthcare costs, poor quality of life, premature disability and death⁷.

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 to take care of 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. In 2010, the annual median direct cost per diabetic individual 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 be more than USD 237 billion. For obtaining NCD care, individuals and families often resort to distress financing and shell out vast amounts of catastrophic expenditures, 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

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 higher risk factor burden at younger ages, earlier disease onset (at least 10 years younger), premature mortality, and higher case fatality rate of CVD-related complications. Indians also have 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 transitions.¹² Besides, 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 years: 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 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 in providing chronic care. Thus, there are considerable inadequacies in service delivery both at the primary and secondary care level. Heterogeneity of providers, wide variations in the quality, availability and accessibility of care, has led to disparities with the rich having access to 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 public and private sectors. Furthermore, in the absence of financial risk protection, most people with NCDs rely on out of pocket expenses to meet healthcare costs.

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 one 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 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 obligates smoking bans in public and work places, advertisement bans, prohibition of sales to and by minors, regulating the contents of tobacco products and graphical health warnings on tobacco product packages.

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 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 goal.¹⁵ The Ministry of Health and Family Welfare, Government of 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 NCDs.¹⁶ The aforementioned global goal and the framework is 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 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 aforesaid WHO-UN mandate.

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K. Srinath Reddy

Prof. K. Srinath Reddy is presently President, Public Health Foundation of India (PHFI) and formerly headed the Department of Cardiology at All India Institute of Medical Sciences (AIIMS). He was appointed as the First Bernard Lown Visiting Professor of Cardiovascular Health at the Harvard School of Public Health in 2009. He is also an Adjunct Professor of the Rollins School of Public Health, Emory University and Honorary Professor of Medicine at the University of Sydney. PHFI is engaged in capacity building in Public Health in India through education, training, research, policy development, health communication and advocacy.



Sailesh Mohan

Dr Sailesh Mohan is currently a Senior Research Scientist and Associate Professor at the Public Health Foundation of India (PHFI). At PHFI, he is involved in research in non-communicable disease (NCD) prevention and control. Dr Mohan also serves as a Technical Expert to the World Health Organization, India on hypertension and NCD prevention and control.



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

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. 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 creation of the Pro-Sanitation Movement in 1916, of the National Department of Public Health in 1920, and of the Ministry of Education and Public Health Affairs in 1930⁸.

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 Poliomyelitis⁸.

Demographic transition

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 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.

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 1,000 live births in 1930; between 1930 and 1970, IMR declined by 29.2%, and between 1970 and 2005, it was reduced by 79.7%¹⁶. According to the 2010 Population Census, IMR was 15.6.

Overview of health risk factors in Brazil

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, 32¹⁷.

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 of 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% in 2012; while 47.5% had access to piped water in 1980, while in 2012 this figured increased to 84.3%.

National income increased between the 1960s-1990s more than 3 times, accompanied by an augmentation of social disparities¹⁸. Brazil became one of the most unequal countries worldwide – Brazil 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% richer and the 20% poorer, above 30²⁰.

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 (<http://atlasbrasil.org.br/2013/pt/>).

Epidemiological transition

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.

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, schistosomi-

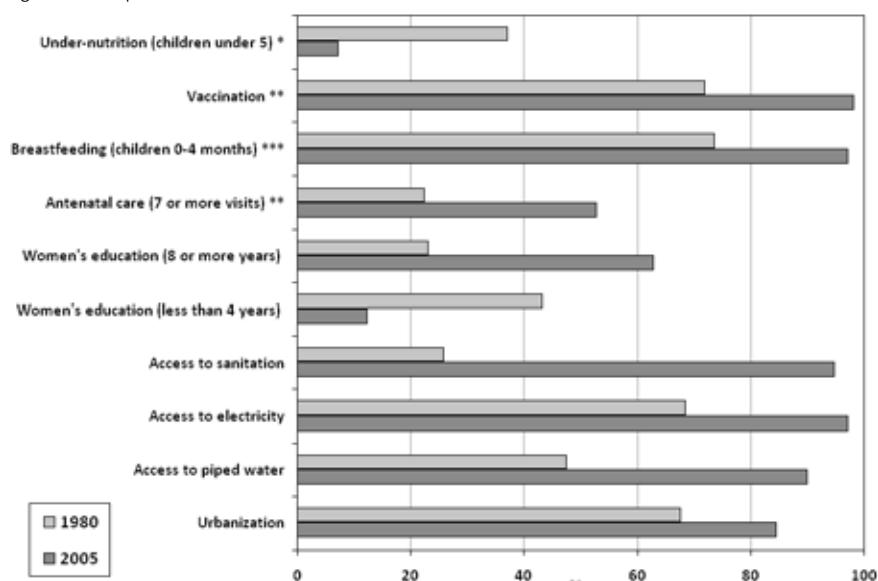
asis, malaria, hepatitis, HIV/AIDS and tuberculosis. Among the failures are the control of dengue and visceral leishmaniasis²³.

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 the 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 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.

Current situation regarding risk factors

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 inter-

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

views a year). It allows the analysis of risk and protective factors of NCDs found in the adult population (aged 18 years or older)²⁷.

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 commenced in 1996 (eg, increase taxes, use of picture warnings on cigarette packs, and bans/restrictions on advertising)³⁰.

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 for at least 30 minutes in 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 to watch three hours or more of TV a day³¹.

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.

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.

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.

Regarding access to health care, the Family Health Program, implemented in 1994, aimed at improving 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 1 000 families (or approximately 4 500 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) (http://dab.saude.gov.br/portaldab/historico_cobertura_sf.php).

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 suggested national goals of the programme are: 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 exam among 25 to 64-year-old women; and treat 100% of women diagnosed with precursory lesions of cancer.

In summary, on one hand Brazil has made significant progress in reducing infectious diseases, although problems still persist. On the other hand, NCDs currently represent the largest mortality and morbidity burden in the country, which can become more critical considering the ageing population and the increasing prevalence of overweight and obesity. 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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Marcia C. Castro

Marcia Castro is Associate Professor of Demography in the Department of Global Health and Population, Harvard School of Public Health, and Associate Faculty of the Harvard University Center for the Environment. The core of her research focuses on the development and use of multidisciplinary approaches, combining data from different sources, to identify the determinants of malaria transmission in different ecological settings, providing evidence for the improvement of current control policies, as well as the development of new ones.



Time trends of cardiovascular disease risk factors in China



Frank Hu, Yanping Li

Fueled by rapid urbanization and changes in dietary and lifestyle choices, cardiovascular and other chronic diseases have emerged as a critical public health issue in China. The prevalence of hypertension in 2010 reached 33.5% (an estimated 330 million hypertensive patients), and the awareness and control rates are extremely low. Type 2 diabetes is an increasing epidemic in China with more than 100 million people affected. Although the Chinese population has a lower BMI than the global average level, abdominal obesity has become especially common in Chinese adults. Despite tobacco control efforts, the prevalence of smoking in China remains at a high level and domestic production of cigarette continue to rise. With unprecedented growth in urbanization, work and transportation-related physical activity levels have declined sharply, accelerating the epidemics of obesity and chronic diseases, which not only affect health and quality of life, but also have economical and social consequences.

Cardiovascular disease is the leading cause of death in China, accounting for 37.8% of all deaths in 2010¹. Unhealthy diets, high blood pressure, tobacco smoking, high fasting glucose, physical inactivity and low physical activity, alcohol use, high body mass index (BMI) and high cholesterol contribute to the majority of the cardiovascular deaths in China¹. Most of these risk factors are preventable and could be modified by improving diet and exercise. Exploring the time trends of these risk factors can provide scientific information and evidence for developing strategies to reduce cardiovascular morbidity and mortality.

Dietary risk factors

China has experienced a dramatic shift from its tradition dietary pattern to a Western dietary pattern in recent decades. According to the annual report of National Bureau of Statistic of China², the annual consumption of whole grains

(unprocessed grains) of rural household per capita decreased from 266 kg in 1993 to 171 kg in 2011; similar trend was found in the urban population. Meanwhile, the annual consumption of meat, egg, fish and dairy products increased from 18.7 kg to 36.8 kg in rural areas and from 46 kg to 74 kg in urban areas from 1993 to 2011. Compared to other countries, such as Germany, Finland, South Korea, India, dietary changes have been the most drastic in China, which is rapidly adopting a Western, animal-based diet¹².

High blood pressure

High blood pressure is the second leading contributor to cardiovascular disease mortality in China¹. As shown in Figure 1, the prevalence of hypertension has been increasing steadily and substantially in the past several decades. The prevalence of hypertension was 5.11% in 1959 based on the first national survey of hypertension but the definition was not clearly recorded³. The prevalence increased to 7.73% in 1979 among people aged 15 years or above. From 1991, after the new definition of hypertension was applied, the prevalence of hypertension reached 13.6% among people aged 15 years or above⁵. In 2002, the prevalence of hypertension was 17.7% and 18.8% among population aged over 15 and over 18 years, respectively^{9, 13}.

It increased to 33.5% or an estimated 330 million in 2010¹¹. The prevalence of hypertension in Chinese adults was comparable to that in the US¹⁴. Based on the same definition, the overall prevalence of hypertension among U.S. adults aged over 18 years in 2003–2010 was 30.4%^{11, 14}. However, the awareness rate was much lower in the Chinese population (24%)¹³ as compared to that in the U.S. adult population (61%)¹⁴. The treatment rate among those affected individuals who were aware of their condition was similar in China (78%) and in the U.S. (74%). However, the control rate was much lower in China. Among those with hypertension, an estimated of 46% Americans had their hypertension controlled¹⁴, compared with only 25% of people with hypertension in China¹³.

Time trends of cardiovascular disease risk factors in China

Tobacco smoking

Despite tobacco control efforts, the prevalence of smoking in China remains at a high level. In 2010, 28.1% of adults (52.9% of men and 2.4% of women) or an estimated 301 million were current smokers in China, making China the largest consumer of tobacco products in the world¹⁵. At the same time, second hand smoking is highly common in China^{15–17}. In 2010, an estimated 740 million non-smokers were exposed to second hand smoking in China, based on the estimation of 2010 China Global Adults Smoking Survey (GATS) carried out by the Chinese Center for Disease Control and Prevention¹⁶.

China is also the world's largest tobacco manufacturer. China produces about 2.66 million tons of tobacco leaves each year, accounting for one-third of the world's tobacco production per year¹⁸. In 1952, China produced around 133 million cigarettes per year, which increased steadily to 1 649 million cigarettes in 1990 and remained flat for around 10 years, and then increased steadily again to 2,516 million cigarettes in 2012 (Figure 2). The fraction of deaths attributable to tobacco use increased from 12.8% in 1990 to 16.4% in 2010 in China¹.

High fasting glucose and diabetes

Type 2 diabetes is a growing epidemic in China, characterised by a rapid rate of increase over a short period of time as well as onset at a relatively young age and low body mass index¹⁹. Type 2 diabetes in China was rare in the 1980s⁴, with an estimated prevalence of 0.67%. In subsequent national surveys conducted in 1994⁶, 2000–2001⁷ and 2007–2008⁸, the prevalence of diabetes was 2.5%, 5.5% and 9.7%, respectively (Figure 3). The estimated number of adult diabetic patients was 92.4 million in 2008⁸, making China the country with the largest number of diabetic patients in the world.

In 2010–2011, the China Non-Communicable Disease Surveillance Group applied the 2010 American Diabetes Association diagnostic criteria by further including haemoglobin A1c \geq 6.5%, in addition to elevated fasting glucose, to a large national survey. This resulted in an estimation of overall prevalence of diabetes of 11.6% among Chinese adults 18 years or older¹⁰. This prevalence is similar to that in the US adults (11.3%)²⁰ and much higher than the average prevalence worldwide (8.3%)²¹. Similar to hypertension, the awareness, treatment and control rates of diabetes are very low in China. In 2010, the proportion of

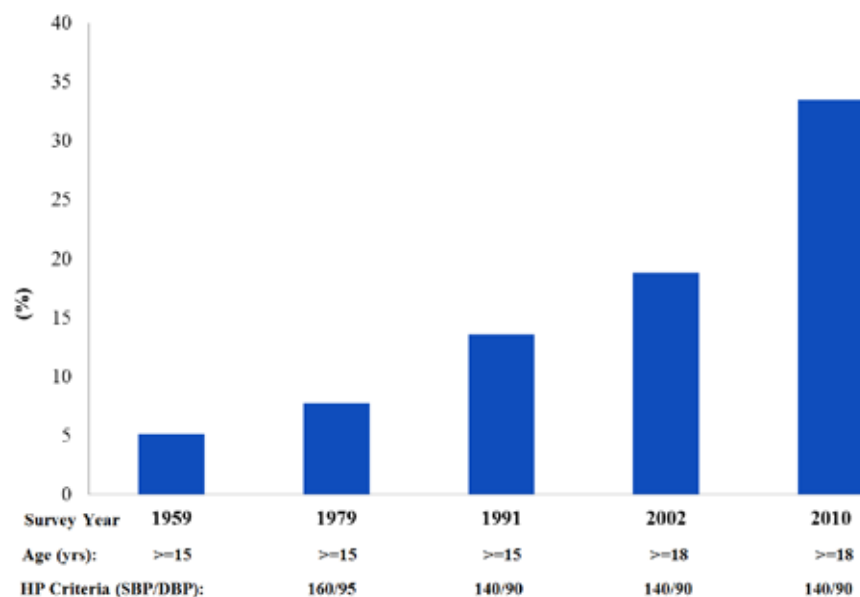
diabetes patients who were aware of their condition was 30.1%, and only 25.8% of diabetic patients received treatment for the disease, and only 39.7% of those treated had adequate glycaemic control¹⁰.

Physical inactivity and low physical activity

Rapid urbanisation, major shifts in types of employment and the growing use of new technologies have caused a steep decline in physical activity in China. The primary means of transportation have changed from walking and bicycling to driving. Meanwhile, China has seen a dramatic increase in sedentary lifestyles such as TV watching and computer use.

The bicycle was the most commonly used form of transportation in China in the 1970s and the rates of bicycle use continued to increase in the following 2–3 decades. By 1983, 37% of people commuted by bicycles compared to 19.5% by mass transit. In 1988, 57.1% of people commuted by bicycles compared to 37% by mass transit²². In the 1990s, the ownership of bicycles in Chinese households reached the peak. On average, each rural family owned 1.5 bicycles and each family in urban areas had

Figure 1: Time trend of prevalence of hypertension in 1959³, 1979³, 1991⁵, 2002⁹ and 2010¹¹



2 bicycles in the middle of the 1990s. After that, the ownership of bicycles in Chinese household dropped substantially. In 2011, the bicycle ownership was only 77 bicycles per 100 households in rural areas. While bicycle ownership decreased, car ownership in urban areas and motorcycle ownership in rural areas have experienced a sharp increase. In 2011, around 61% of rural households owned a motorcycle and 19% of urban households owned a car.

At the same time, TV ownership has increased from 38 sets per 1000 persons in 1985 to 135 sets per 100 households in urban areas in 2011 (112 sets per 100 rural households). Mobile phone ownership increased more rapidly than TV ownership in both rural and urban areas. In 2011, almost every family had more than one mobile phone. Another indicator of sedentary activity is increasing computer ownership. In 2011, the computer ownership was 82 sets per 100 households in urban areas and 18 sets per 100 households in rural areas.

Alcohol use

Alcohol-related disorders were among the ten most common causes of years lived with disability (YLDs) and cardiovascular mortality in China in 2010¹. Although light to moderate alcohol consumption is associated with a reduced

risk of cardiovascular morbidity and mortality, consumption of larger amounts of alcohol is associated with higher risks for stroke incidence and mortality²³.

Based on the WHO data, per capita alcohol consumption for Chinese aged 15 years and older was 1.03 liters in 1970, and rose to 5.17 liters in 1996, kept relatively stable afterwards, with 5.91 liters in 2005²⁴. According to the China Bureau of Statistics, the average annual liquor consumption was 6.5 kg in rural areas and 9.7 kg in urban areas in 1993. In the following two decades, alcohol consumption has been increasing in rural areas but decreasing in urban areas, leading to much higher consumption levels among rural than urban residents. In 2011, the average annual liquor consumption was 10.2 kg in rural and 6.8 kg in urban. There is a large gender difference in alcohol consuming patterns. Around 40% men regularly drink at least once per week, while less than 5% women drink alcohol regularly; this pattern did not change significantly between 1991 and 2009.

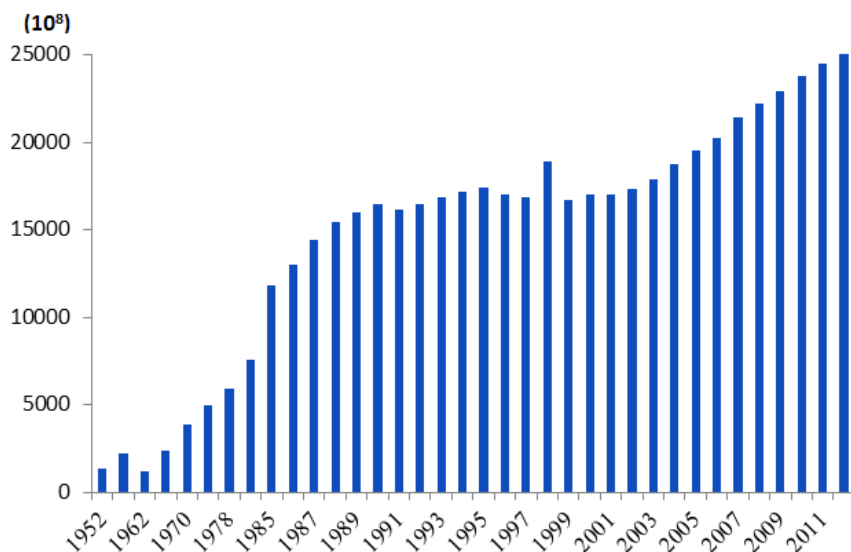
Data on heavy drinking and alcohol-related disorders are limited in China. According to the 2002 China National Nutrition and Health survey, the prevalence

of heavy drinking (men >25g/day, women >15g/day) in Chinese adults was around 4.7% (8.4% for male and 0.8% for female)²⁵. The prevalence of heavy drinking among alcohol consumers was 39.6% in urban areas and 54.7% in rural areas. The 45–59 years old age group had the highest prevalence of heavy drinking²⁵. In 2004–2008, the prevalence of heavy drinking among regular alcohol consumers was 37% when heavy drinking was defined as >60 g/day of alcohol for men on a weekly basis²⁶.

High cholesterol and dyslipidemia

Rapid transition to the Western dietary pattern with an animal-based diet in China has led to a rapid increase in serum cholesterol levels²⁷. In 1982–1984, the prevalence of borderline high or high total cholesterol (≥ 5.28 mmol/L) was 17.6% in men and 19.2% in women, which increased to 24% in men and 27.1% in women in 1992–1994. The prevalence increased to 33.1% in men and 33.8% in women in 1998²⁸, and then kept relatively stable afterwards, which was 31.3% in men and 31.7% in women in 2007–2008²⁹. The awareness, treatment, and control of borderline high or high total cholesterol were 11.0%, 5.1%, and 2.8%, respectively, in 2007–2008²⁹.

Figure 2: Time trend of domestic production of cigarettes in China (Data sources: National Bureau of Statistics of China)



Time trends of cardiovascular disease risk factors in China

Besides high cholesterol, high triglyceride and low high-density lipoprotein (HDL) were also common in the Chinese population. Low HDL (≤ 0.91 mmol/L) was reported in 7.4% adults (9.3% of men and 5.4% of women) in 2002 China National Nutrition and Health Survey⁹. In the 2007-2008 China National Diabetes and Metabolic Disorders Study, low HDL (defined as HDL <1.04 mmol/L) was observed in 22.3% of Chinese adults (27.1% of men and 17.5% of women)²⁹. Hypertriglyceridemia (defined as plasma triglyceride ≥ 1.7 mmol/L) was observed in 11.9% of adults in 2002 (14.5% of men and 9.9% of women)⁹.

High body mass index (BMI) and obesity

The Chinese population has a relatively low BMI. The BMI of men and women in China was 0.9 kg/m² and 1.2 kg/m² lower than the global average in 2008³⁰. Despite a steady increase in BMI in the past decades, China remains among the bottom 30% of countries with the lowest male and female mean BMI among the 199 countries and territories that joined the WHO Global Burden of Disease (GBD) project³⁰. However, compared to Caucasian populations, Chinese people

tend to develop diabetes and other chronic diseases at a relatively low BMI levels³¹: That is why the cut-off points of overweight and obesity have been defined at lower BMI levels for Chinese adults (24 kg/m² for overweight and 28 kg/m² for obesity)³².

Applying the Chinese BMI criteria, the prevalence of overweight and obesity was 13.6% in males in 1989 based on the data from the China Nutrition and Health Survey (Figure 4), which kept increasing rapidly from 1989 to 2009, and resulted in a prevalence of 39.6% in 2009. Among women, the prevalence of overweight and obesity was 17.6% in 1989, which rapidly increased to 40.5% in 2004 and kept flat afterwards (Figure 4).

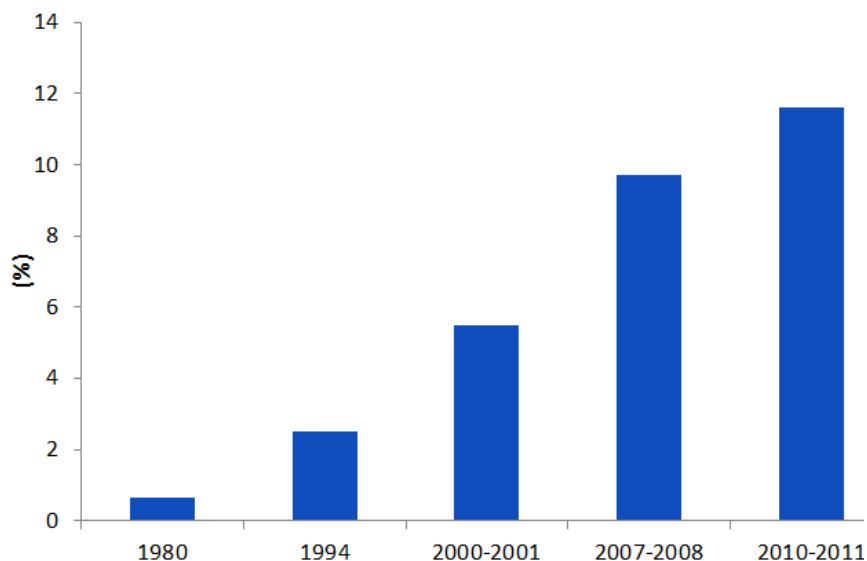
Waist circumference (WC), a maker of central or abdominal obesity, has been increasing steeply in Chinese population. The prevalence of abdominal obesity (WC³⁸⁵ cm for men and ³⁸⁰ cm for women) increased from 17.7% to 48.4% among men and from 28.8% to 53.5% among women (Figure 5).

An alarming trend of a dramatic increase in obesity has been observed in children. According to the age-sex-specific BMI percentile criteria for Chinese children and adolescent, the prevalence of overweight and obesity of children and adolescents aged 7-18 years was 1.24%, 4.98%, 8.83%, 11.7% and 14.6%, respectively, in 1985, 1995, 2000, 2005 and 2010³³. In 1985, the prevalence of overweight and obesity was 1.34%, 1.55%, 0.47% and 1.6% in boys and girls in urban areas, and boys and girls in rural areas, respectively. The corresponding prevalence of overweight and obesity of children and adolescents was 23.2%, 12.7%, 13.8% and 8.6%, respectively, in 2010³³.

Summary

China has experienced a dramatic shift from its tradition dietary pattern to a Western dietary pattern in recent decades. The prevalence of hypertension in 2010 was 33.5% (an estimated 330 million hypertensive patients), and the awareness and control rates are extremely low. Despite tobacco control efforts, the prevalence of smoking in China remains at a high level and domestic production of cigarette continue to rise. Type 2 diabetes is an increasing epidemic in China with more than 100 million

Figure 3: Prevalence of type 2 diabetes in China estimated at 1980⁴, 1994⁶, 2000-2001⁷, 2007-2008⁸ and 2010-2011¹⁰



people affected. Rapid transition to the Western dietary pattern with an animal-based diet in China has led to a large increase in serum cholesterol levels. Although the Chinese population has a lower BMI than the global average level, the prevalence of overweight and obesity is increasing rapidly in both adults and children, and abdominal obesity is especially common in Chinese adults.

Compelling evidence indicates that the current chronic disease epidemic is largely driven by changes in diet and lifestyle in China. Over the past several decades, traditional patterns of eating have been replaced with a Western diet high in animal products, processed carbohydrates, and sugar-sweetened beverages.

At the same time, overall physical activity levels have decreased considerably due to rapid urbanisation and industrialisation. China's limited chronic care infrastructure makes it ill-equipped to deal with an epidemic of chronic disease. Population-based intervention studies demonstrate the efficacy of preventive strategies to reduce disease burden. However, translating these findings into

practice requires changes in health systems and public policies.³⁴ To achieve the goals of improving health for all people, chronic disease prevention needs to be a national public policy imperative. Its great potential to cut medical costs and reduce widespread health and social inequalities in China cannot be realised without full involvement of all stakeholders. These include the government, healthcare, education, industry, urban planners, the media, the food production and service sectors, NGOs, communities, and individuals. Prevention is certainly beyond the scope of any one ministry or government agency.

Clearly, prevention of chronic diseases should be elevated to a top priority for national public policy because it can cut medical costs, improve quality of life, and reduce widespread health and social and inequalities in China.

Acknowledgement

Much of the data presented in this article were based on the China Statistic Yearbook 1996 to 2012 and the China Health and Nutrition Survey (CHNS). We thank the National Bureau of Statistics of China, National Institute of Nutrition and Food Safety, China Center for Disease

Control and Prevention, Carolina Population Center (5 R24 HD050924), the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, R24 HD050924, and R01-HD38700) and the Fogarty International Center for financial support for the CHNS data collection and analysis files from 1989 to 2011 surveys, and the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009.

Figure 4: Time trend of overweight and obesity

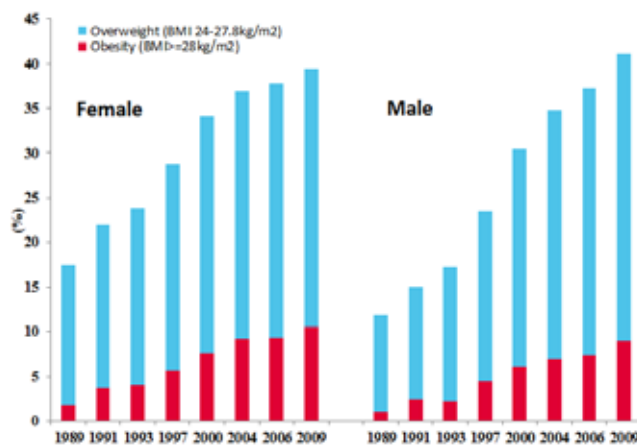
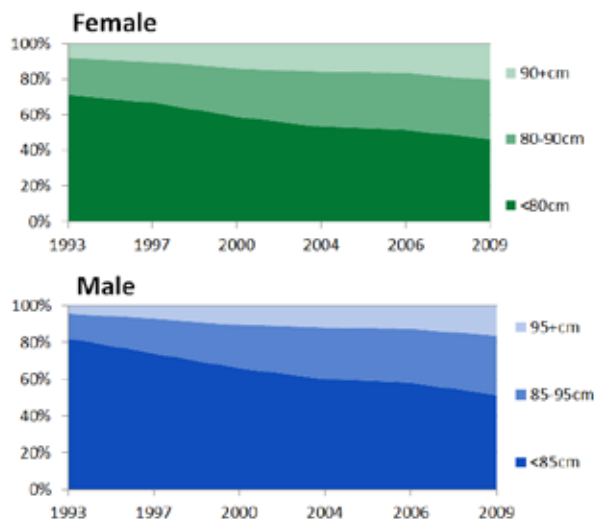


Figure 5: Proportion of waist circumference distribution



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Frank Hu, MD, PhD

Professor of Nutrition and Epidemiology, Harvard School of Public Health; Professor of Medicine, Harvard Medical School

Frank Hu is Professor of Nutrition and Epidemiology at Harvard School of Public Health and Professor of Medicine, Harvard Medical School and Channing Division of Network Medicine, Brigham and Women's Hospital. He is Co-director of the Program in Obesity Epidemiology and Prevention at Harvard. He also serves as Director of the Harvard Transdisciplinary Research in Energetics and Cancer (TREC) Center and Epidemiology and Genetics Core of Boston Nutrition and Obesity Research Center (BNORC).

Frank Hu is the recipient of the Kelly West Award for Outstanding Achievement in Epidemiology by American Diabetes Association in 2010. He has served on the Institute of Medicine (IOM) Committee on Preventing the Global Epidemic of Cardiovascular Disease.



Yanping Li, MD, PhD

Research Scientist, Department of Nutrition, Harvard School of Public Health

Yanping Li received her medical degree from Tianjin Medical School in China, a Master of Science from the Chinese Academy of Preventive Medicine in 2000, and PhD in 2008 from Wageningen University, the Netherlands.

Her research interests include: (1) Trends of lifestyle factors and their association with obesity and other chronic diseases among the Chinese population; (2) Fetal programming of chronic diseases and its interaction with lifestyle factors in adulthood; (3) Genes and environmental interactions in relation to the risk of obesity and diabetes; and (4) Restless legs syndrome and other sleep disorders among Americans.



Risk factors for cardiovascular disease in Brazil: Time trends and current status

Marcia C. de Oliveira Otto

As in other emerging economies, chronic conditions such cardiovascular disease (CVD) and diabetes have emerged as the major causes of mortality in Brazil, accounting for 37% of deaths in the country. Although there has been a considerable reduction of smoking and physical inactivity, the epidemiological transition in Brazil is marked by trends toward unhealthy diet patterns and a poor cardio-metabolic profile. This is characterised by increased consumption of processed foods, as well as a higher prevalence of overweight individuals, obesity, impaired fasting glucose and diabetes, potentially reversing the decline in CVD mortality in the medium- to long-term.

Brazil has recently experienced political and economic changes that have greatly influenced its demography, social structure and lifestyle. As mortality and fertility rates decreased over the past 40 years, life expectancy in Brazil has increased from 52 to 73 years of age; the proportion of people living in urban settings has increased from 55% to 80%; and the percentage of Brazilians with higher education (≥ 10 years of formal schooling) has nearly doubled¹. The modern Brazilian population is predominantly non-white, older and has a greater proportion of middle class inhabitants compared to 1970². As in other emerging economies, chronic conditions such cardiovascular disease (CVD) and diabetes have emerged as the major causes of mortality in Brazil, accounting for 37% of

deaths in the country^{3,4}. Improvements in health care quality and access over the past two decades have successfully contributed to the reduction of CVD mortality¹; however, current trends in lifestyle and metabolic risk factors show a shift toward unhealthy dietary patterns and poor metabolic health. This may reverse the decline in CVD mortality in the medium- to long-term. Understanding time trends and the current status of modifiable risk factors relevant to cardio-metabolic health may provide relevant information to inform strategies focused on disease prevention in Brazil.

Dietary factors

Increasing income and the availability of highly processed foods in Brazil, among other factors, have influenced the dietary patterns in the country, particularly in urban environments. Between 1999 and 2009, the household income per capita in Brazil increased by 25%^{2,5}, which paralleled an increase in dining out⁶. Between 1974 and 2009, there was a 15% decrease in energy intake from rice, and a 33% decrease in energy from beans, two of the major traditional food staples in the country⁷⁻⁹ (Figure 1). Similarly, a considerable decrease in mean energy intake from vegetables (27%) and fish (20%) were observed during the same period. There was, however, a substantial increase in energy intake from less healthy foods such as processed meat (102%) and ready-to-eat meals (250%) (Fig.1). Data from the same study suggests that diet patterns differ according to income levels. As purchasing power increases, Brazilians tend to consume less rice, beans and fish, and more red meat, processed meat and ready-to-eat meals⁸. Higher income levels were also associated with higher consumption of vegetables, fruit and fruit juices, dairy products and alcohol⁸ (Fig 2). Overall, time trends and analysis by income levels are consistent with a transition to lower consumption of traditional Brazilians foods and higher consumption of industrialised foods, as well as increased consumption of vegetables and fruits among Brazilians in higher income strata.



High body-mass index and obesity

Consistent with a worldwide trend, the prevalence of overweight and obesity has increased considerably in Brazil in recent decades. Results from surveys using anthropometric measurements in a nationally representative sample showed an over 2 fold increase in the prevalence of overweight (from 18.5% to 50.1%) and a 4-fold increase in the prevalence of obesity (2.8% in 1975 to 12.4% in 2008) among adult men between 1975 and 2008. During the same period, the prevalence of overweight in adult Brazilian women increased from 28.7% to 48%, while the prevalence of obesity in women doubled^{6, 10}. A study evaluating income-specific trends reported that changes in the prevalence of obesity in Brazil between 1975 and 1989 were 66% higher in men in the lower quintile of family income, compared to those in the highest quintile⁸. Consistent with the changes observed in adults, one third of Brazilian children between 5-9 years of age were overweight in 2008, with 17% obese boys and 12% obese girls¹⁰ (see Figure 3). Excessive adiposity is higher

in children living in urban areas, as well as in the southeast, the region with the highest population density in the country. On the other hand, between 1974 and 2009, childhood under nutrition assessed as low height for age decreased from 29% to 7% in boys and from 27% to 6% among girls 5–9 years of age^{6, 10}.

Dyslipidemia

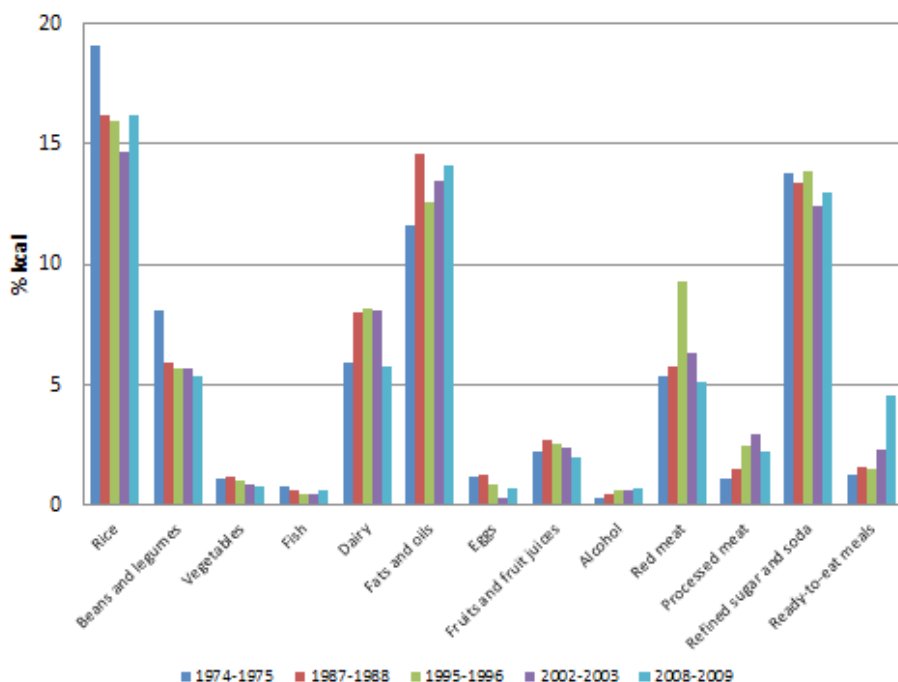
Very few studies have reported lipid levels in the Brazilian population. According to a recent report from the World Health Organization, the prevalence of high total cholesterol levels (≥ 5.28 mmol/L) among Brazilian adults in 2008 was approximately 43%, with no major differences between men and women¹¹. Data from 1980 to 2008 showed no major changes in the mean total cholesterol levels over the years, which suggests that recent improvements in health care have not affected hypercholesterolemia levels in the country¹¹. In a study which included over 1 500 children 7–14 years of age living in the large city of Campinas, the prevalence of high total cholesterol was 11% among girls and 8%

among boys. Compared to boys, girls had higher mean triglycerides and a total HDL-C ratio¹², which is a predictor of cardiovascular disease risk in adult populations.

High fasting glucose and diabetes

In a multi-centre study conducted in 1988 which included over 20 000 participants ages 30–69 years old living in 9 large cities in Brazil, the prevalence of each type II diabetes and impaired glucose tolerance was approximately 8%¹³. Nearly 46% of diabetes cases had not been diagnosed before, and 23% of previously diagnosed cases were untreated. The study showed no major differences in age-adjusted diabetes prevalence across sex, race or social-economic status categories¹³. Two cross-sectional studies which included participants of similar ages have subsequently been conducted in two large cities located in the state of Sao Paulo. In 1997, in Ribeirao Preto the prevalence of diabetes and impaired fasting was 12% and 8% respectively¹⁴. A study conducted in Sao Carlos in 2007 reported 13.5% of participants having diabetes and 5% having impaired fasting glucose levels¹⁵. The prevalence of metabolic disorders among obese participants in Ribeirao

Figure 1: Energy intake from different foods in Brazil, 1974–2009 (Source: Levi-Costa et al., 2005 and Levy et al., 2012^{7, 9})



Preto was over two times greater compared to the non-obese participants. In addition, the proportion of undiagnosed diabetes was 60% greater in obese participants compared to non-obese adults¹⁴. The lack of recent national data on metabolic risk factors including blood lipids and fasting plasma glucose level by sex, age and geographic location is a major limitation to the understanding of the potential impact these variables have on cardio-metabolic mortality and morbidity.

Hypertension

Time and regional trends on hypertension (blood pressure >140/90 mmHg) in Brazil were recently reported in a systematic review including data from over 120 000 participants in cross-sectional and cohort studies¹⁶. Combining data from studies published in different decades, investigators estimated the prevalence of hypertension as 36% in the 1980's, 33% in the 1990's and 29% in the 2000's¹⁶. Although the authors suggested a trend toward a lower prevalence of hypertension in Brazil, there are

limitations to the generalisation of early estimates that might prevent such a straightforward conclusion. In fact, results from a survey including adults living in 27 Brazilian state capitals reported a 3% increase in the prevalence of self-reported hypertension between 2006 and 2009 among men and women^{17, 18}. The high prevalence of hypertension in Brazil and its potential impact on cardiovascular health suggests the need for appropriate measures to reduce the prevalence of this important CVD risk factor in the country.

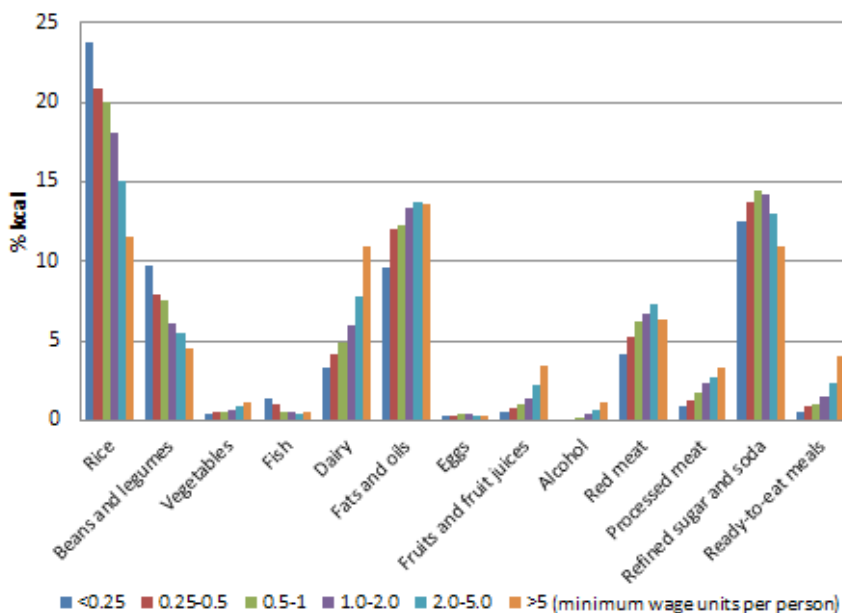
Smoking and physical activity

Brazil was one of the first countries to implement national anti-tobacco policies. Pricing policies implemented between 1991 and 1993 lead to nearly 80% increase in the price of tobacco products, and a subsequent 20% reduction on tobacco use. A study using national household survey data reported age-adjusted smoking prevalence decreased from 35% in 1989¹⁹ to 12.1% in 2012²⁰. In addition, the average daily number of cigarettes consumed by adults in Brazil decreased from 13.3 to 11.6¹⁹. The reduction in cigarette smoking consumption was similar across sex,

living conditions (urban vs rural), education and income levels, which suggests a significant impact of anti-tobacco policies across different strata of society.

Although there has been a considerable reduction in work-related physical activity due to the use of modern technology in the work place²¹, data from cross-sectional surveys in 27 state capitals showed a rise in physical activity in the country. In 2012, 35% of Brazilians met the WHO guidelines for physical activity (≥150 min/week of moderate to vigorous activity), an almost 2-fold increase compared to the estimates in 2006. In cross-sectional surveys including over 2,000 adults living in Sao Paulo city showed an increased prevalence of people meeting WHO guidelines for physical activity from 16% in 2002 to 61.5% in 2008²². Improvements in physical activity levels were similar among men and women, and interestingly, the greatest change was observed among those in low income categories²². According to the authors, changes in physical activity levels were largely influenced by the implementation of "Agita Brasil", a national

Figure 2: Energy intake from selected foods by income levels in Brazil (2002–2003)(Source: Levi-Costa, 2005)



Risk factors for cardiovascular disease in Brazil: Time trends and current status

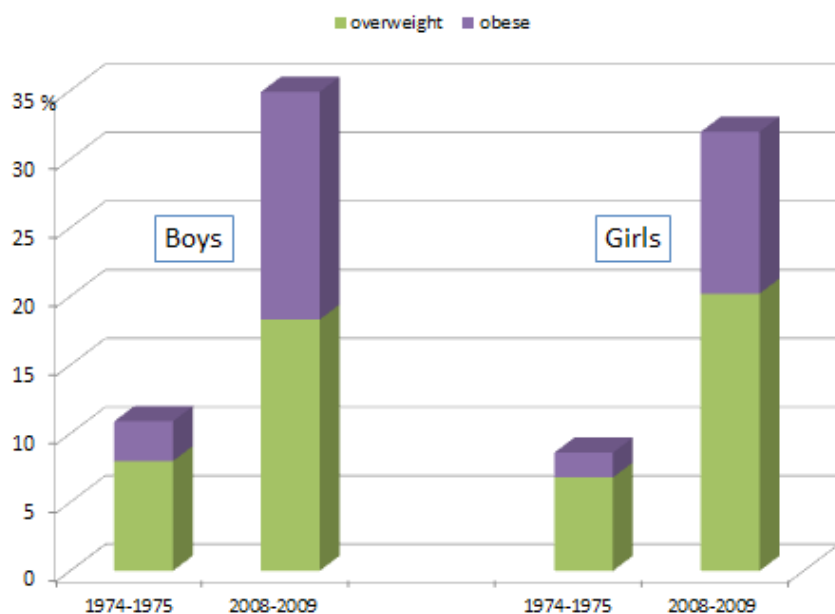
program to promote physical activity in 1997. Overall, improvements on national smoking prevalence and physical activity levels in large cities following implementation of health policies support the important role of population strategies to change behaviour.

Conclusion

Although there has been a considerable reduction of smoking and physical inactivity, the epidemiological transition in Brazil is marked by trends toward unhealthy diet patterns and a poor cardio-metabolic profile. This is characterised by increased consumption of processed foods, as well as a higher prevalence of overweight individuals, obesity, impaired fasting glucose and diabetes. Consistent with suboptimal lifestyle and health care management, recent data shows that 29% of Brazilian adults have hypertension and 43% have hypercholesterolemia. In 2011, the Brazilian Ministry of Health launched a national plan to reduce the incidence of non-communicable chronic diseases, with focus on physical activity,

tobacco control, food guidance and policy, treatment of diabetes and hypertension, cancer screening, and overall access to health care²³. Increasing engagement of other segments of the Brazilian society such as the media, the food industry, the service sector and education are necessary to the long term success of this strategy. In addition, the development of epidemiologic studies prospectively assessing relevant risk factors and their impact on health in different groups, including underserved populations, is essential to measure the effectiveness of this initiative, as well as to help design specific interventions for the prevention of cardio-metabolic disease in Brazil.

Figure 3: Prevalence of overweight and obesity among Brazilian children 5–9 years of age 1974–2009, source: Melo et al. 2010¹⁰



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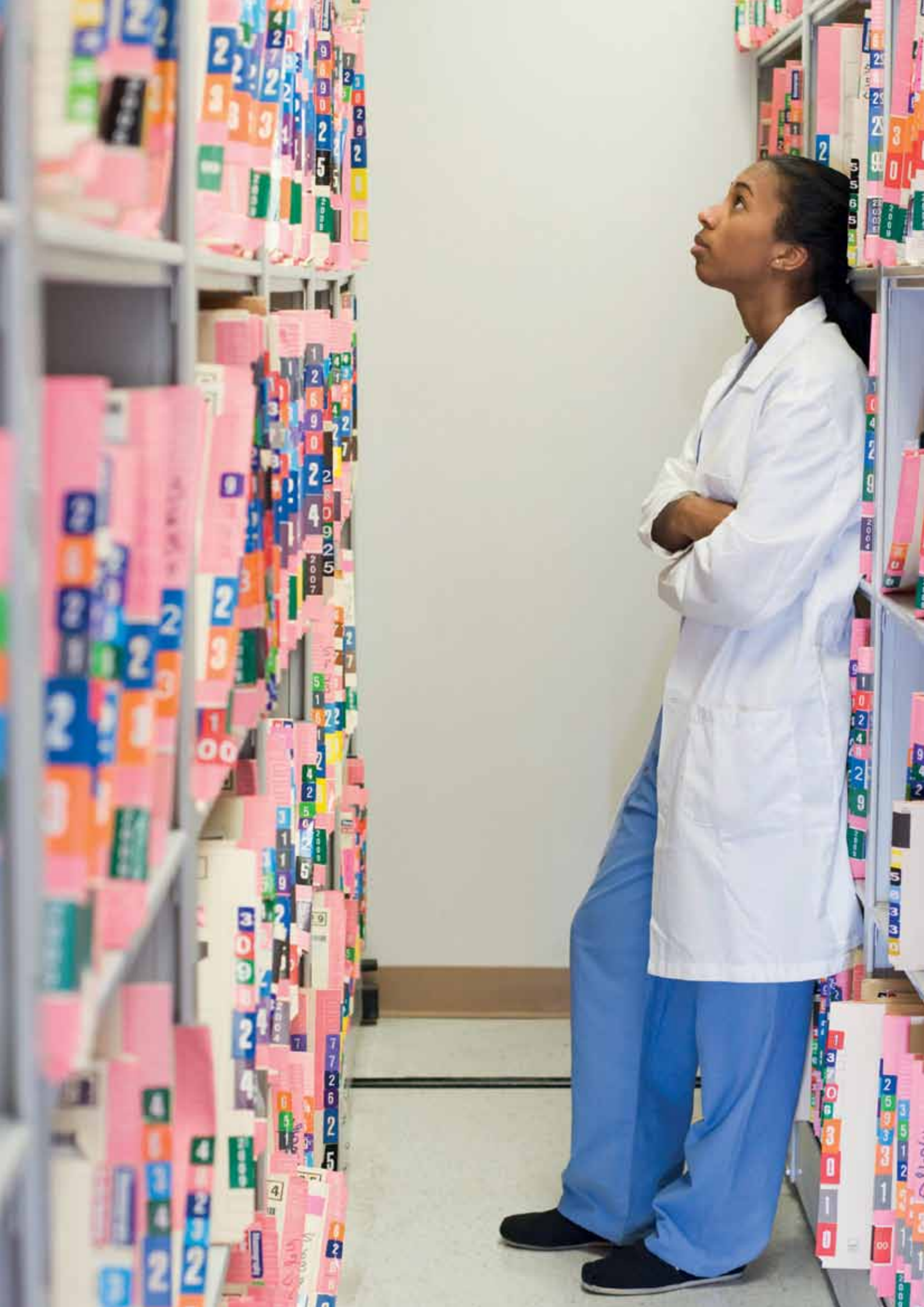
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Marcia C. de Oliveira Otto

Marcia Otto received her MS in Environmental Science from the University of Sao Paulo, Brazil. She completed her PhD at the University of Texas School of Public Health with focus on micronutrient intakes and their relationships with inflammation and cardiovascular disease, metabolic syndrome and type II diabetes in U.S. adults.

Her current research projects include evaluating the effects of circulating fatty acids on cardiovascular disease incidence and progression, the development of novel metrics to characterize dietary diversity and quality and their relation to cardiovascular and metabolic disease risk in a multi-ethnic population, and the impact of dietary and metabolic risk factors on the burden of chronic diseases in Brazil.



SEARCH – The search for health data and insights from high growth markets

Christoph Nabholz, Simon Woodward

Health conditions are evolving rapidly in high growth and emerging markets, as sedentary lifestyles and changing diets contribute to higher rates of first world diseases. This is a challenge both for public health systems and for rapidly expanding life and health insurance markets. In order to gain a better understanding of health trends in major emerging economies, Swiss Re and the Harvard School of Public Health have launched the SEARCH project - the Systematic Explanatory Analyses of Risk factors affecting Cardiovascular Health.

Life and health insurance in emerging markets

Life and health insurance is big business. Worldwide, life and health premiums in 2012 stood at USD 2 621 billion. Emerging and high growth markets accounted for 15% of this total, a little under USD 400 billion. This figure is expected to grow significantly. Over the next ten years, Swiss Re expects the global life and health market share of emerging and high growth countries to grow to 27% of the total¹.

Knowledge is vital to any sort of insurance. Without being able to estimate the risk, it is impossible for re/insurers to price premiums, so that risk coverage is affordable and that the risk pool is sustainable. Underwriters and actuaries require data. In the case of life and health, this data concerns illness, public health, life styles, environments and life expectancy.

Such data is well established in developed markets with long histories of life and health insurance products. It is frequently far less well established in high growth and emerging markets. China had virtually no private life and health insurance market coming into the 1990s; its premium volume currently stands at USD 130 billion. It has the potential for it to expand significantly. In order to further grow and develop these markets, and to encourage foreign competition, data is a key requirement.

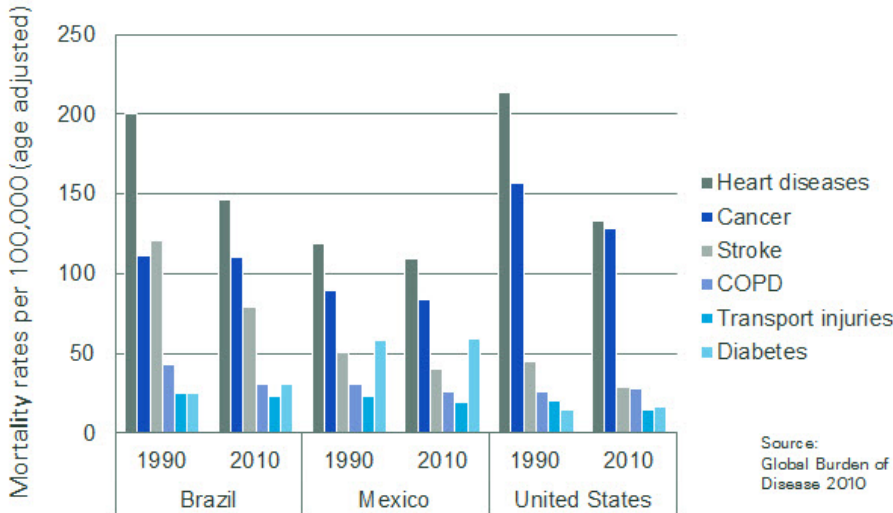
Changing health profiles

The expected expansion of life and health insurance products and services in high growth and emerging markets is occurring at a time when there is a dramatic shift in lifestyles in these countries. The shift to sedentary lifestyles and diets high in processed sugar and animal products has taken place over several decades in developed economies. We have a fairly good picture of the increased incidence of diseases strongly related to a switch in lifestyles, such as certain cancers, diabetes and obesity related conditions; even if we do not have a clear picture of the impact that lifestyle related diseases will have on overall longevity.

The transition to sedentary lifestyles and first world diets is in many cases happening over a much shorter time window in emerging markets. This transition is taking place in different circumstances to those in developed markets. High growth markets frequently have a heavy reliance on industry and highly pollutant fossil fuels. Although these economies are growing, there is a lack of money and/or services to treat non-communicable diseases. Moreover, some of these countries seem to have a greater genetic disposition to certain diseases, such as diabetes, than is generally found in developed economies.

Thus, we are not only considering countries with a relatively low provision of base historical data; these are also countries that find themselves in a rapidly altering health dynamic. In China in the 1980s Type 2 diabetes was very uncommon, almost unknown in much of the country; it now has a prevalence of 11.6%² of 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.³ In 2010, stroke mortality was higher in the Brazil than in the United States; and in Mexico, diabetes was the third leading cause of death (see figure 1).

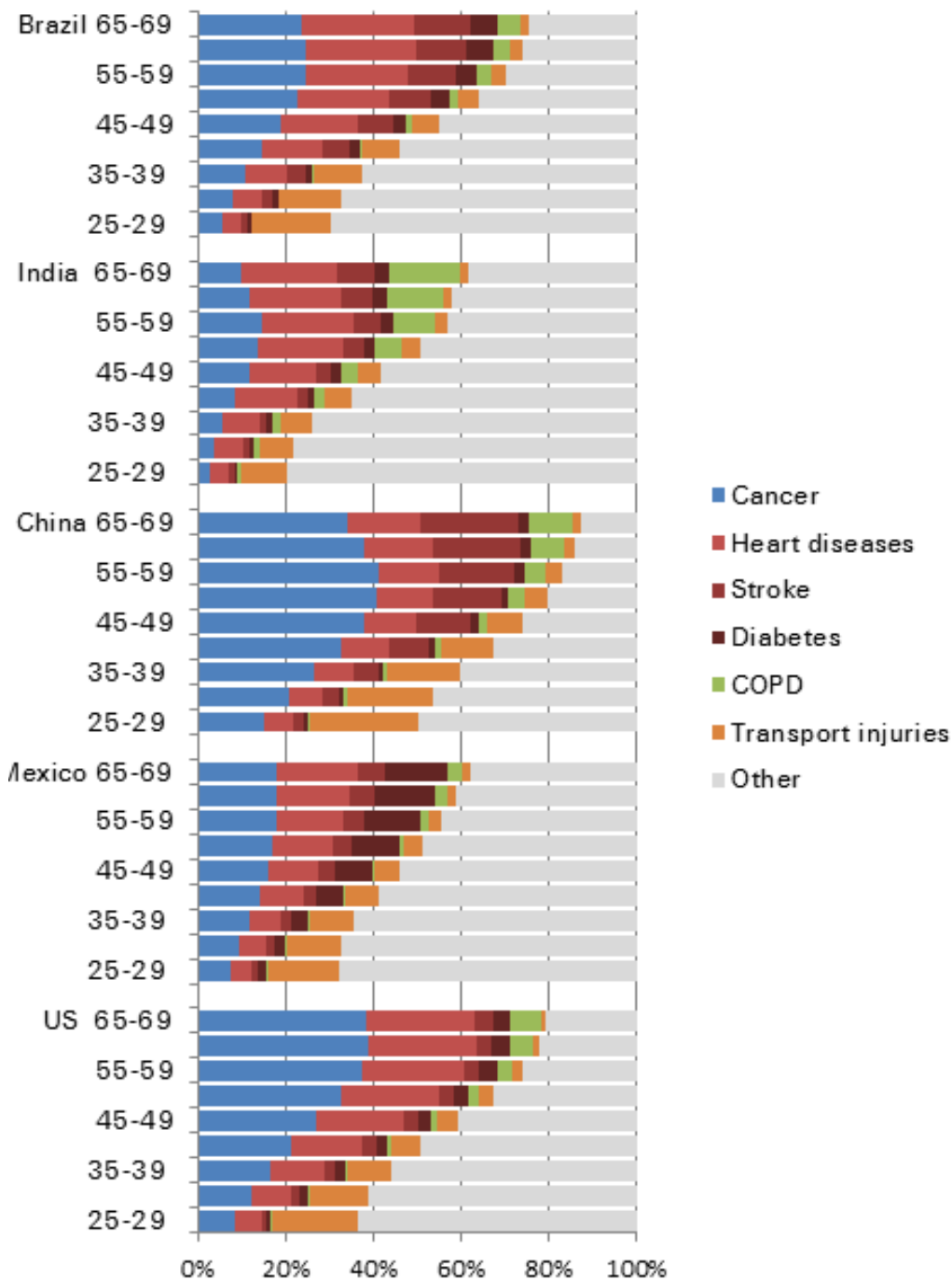
Figure 1: Stroke in Brazil and diabetes in Mexico is the third leading causes of death right after heart disease and cancer
 When comparing the 20 year transition of the leading causes of death in Brazil, Mexico and the USA from 1990 to 2010, one can see distinctive differences. While mortality rates 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 three fold 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 2 fold 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.



Mortality rates per 100 000 (age adjusted)
 Source: Global Burden of Disease 2010

Figure 2: Causes of death in 2010 in insurance relevant age intervals in selected states (% total mortality by age band)

In the younger age bands, death due to transport injuries is 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 shows a high lung disease or COPD (chronic obstructive pulmonary diseases) death rate (16% vs 7%; age band 50–69) most likely reflective of significant smoking and air pollution exposure; China has a heart disease mortality 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 for data

This is the context in which Swiss Re, in collaboration with the Harvard School of Public Health (HPSH), launched the joint SEARCH project in January 2013. The aim of both partners is the same: to gain good data and insights on mortality and morbidity in the key high growth markets of Brazil, Mexico, China and India. The main focus for Swiss Re is to better quantify health and disease risk factors which can contribute to our understanding of future mortality and health trends for the population who purchase private life and health insurance, particularly in high growth markets. The same data is used by HSPH to develop and test preventive health measures and health policies for the wider population.

High growth and emerging 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 2). There are proportionally more stroke deaths in China than the US; however, these can be expected to fall with medical progress. Other countries like 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 2). India is furthest from the US; communicable infectious diseases are more prevalent in India. Non-communicable chronic diseases – such as cancer, stroke and heart diseases – are typically more costly for insurers and public health authorities. Of greatest interest to insurers are those who purchase private life insurance - typically the relatively wealthy working population in the age groups between about 30 and 65. As demonstrated in figure 2, non-communicable diseases increase significantly as people transit into older ages. When looking at the four country profiles, cardiovascular diseases and stroke stand out.

The initial focus of SEARCH is on the risk factors for cardiovascular disease and stroke because:

1. It is the biggest cause of death in major emerging/ high growth economies (see figure 2).
2. It is closely associated with an established range of causal factors, such as smoking, diet and inactivity.
3. Altering causal factors for cardiovascular disease will have a significant effect on mortality. Factors include smoking bans, urban and housing designs that encourage physical activity, and emergency responses to coronary events.

A total of 45 researchers and health experts are involved in SEARCH, consisting of 11 Harvard professors, 15 Swiss Re health experts, 11 senior SEARCH research fellows, a senior project team and other collaborators. All SEARCH fellows have been awarded grants to help them conduct research based on existing data sets/ cohorts, supervised by Harvard professors and Swiss Re local market health experts.

SEARCH fellows are taking advantage of existing data sets and cohort studies in order to conduct their research and analysis. Several of the fellows were chosen specifically to help conduct country-specific literature reviews or an analysis of existing data sets and cohort studies that could be accessed and analysed for future research. These resources range from country-based surveys on a wide range of factors to global studies on a specific risk factor such as smoking.

Results at hand

The SEARCH project has already produced some preliminary results. Some of these can be viewed in the accompanying articles to this issue of the Risk Dialogue Magazine. One conference bringing contributors together has already been staged in Cambridge, Massachusetts and another one in Rüschiikon, Switzerland.

The SEARCH project has been undertaken in part to mark two landmarks – the 100th anniversary of the Harvard School of Public Health and the 150th anniversary of Swiss Re, both falling in 2013. Equally the study may mark another landmark – a point of rapid transition among high growth economies into an age that might be described as one of lifestyle diseases.

This is a hugely significant challenge for public health systems. Already there may be signs that some are becoming overwhelmed by the unprecedented increase in demand for their services. It is also significant for life and health insurers. Understanding these trends and data is crucial to establishing risk pools that are both sustainable and affordable. As such, life and health insurers can play an important role in the new emerging health landscape.

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Christoph Nabholz

Christoph Nabholz is Head of Business Development at the Swiss Re Centre for Global Dialogue. With his background in genetics he actively supports Swiss Re's R&D activities in medical trends and longevity research. Prior to joining Swiss Re, he was a postdoctoral fellow in genomics and functional genetics at Harvard University and has a Ph.D. in molecular genetics from the University of Freiburg, Switzerland.



Simon Woodward

Simon Woodward is a Senior Business Development Manager at the Swiss Re Centre for Global Dialogue. Simon is a graduate of St. Antony's College, Oxford and previously worked as an economic and political analyst. He worked in the communications department of reinsurer Converium, before coming to Swiss Re.

The Risk Dialogue Magazine is published three times a year in electronic form. It features articles contributed by speakers at the Swiss Re Centre for Global Dialogue. They reflect current themes being discussed at the Centre. This special edition features articles from the January 2014 issue: Risk Dialogue Magazine – Health risk factors in major emerging markets.

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Publisher: Swiss Re Centre for Global Dialogue

Design and production: Corporate Real Estate & Logistics/Media Production Zurich

Photos: Getty Images, iStock, David Ausserhofer

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Swiss Re Centre for Global Dialogue
Gheistrasse 37
8803 Rüschlikon
Switzerland

Telephone +41 43 285 8100
Fax +41 43 282 8101
global_dialogue@swissre.com
www.swissre.com/cgd