The Impact of Health on Worker Attendance and Productivity in Twelve Countries

Report to the APEC Business Advisory Council and US Chamber of Commerce

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Executive Summary

Many countries in APEC face serious challenges from the intersection of population ageing and the high incidence of non-communicable diseases (NCDs). These factors will lead, in some countries, to declining populations of workforce age and to poorer health for many actual or potential workers. The rapid economic growth achieved in many developing countries over recent decades has been driven in part by strong growth in a healthy labour force. This can no longer be relied upon, with the new trends implying an increasing incidence of poor health in a workforce that is growing more slowly, if at all. As such, these trends have important implications for the availability and productivity of labour, and are on a scale that could challenge the foundations of continued growth for many countries.

This study assembles the available empirical evidence, for twelve countries, on the impact of health on worker attendance and productivity, and documents the limited information available on the current prevalence and expected future incidence of key NCDs for these countries. On this basis it provides a preliminary analysis of the future potential impact of NCDs on worker attendance and productivity, to provide a knowledge base for more effective policy responses to this challenge.

All twelve countries studies show pronounced evidence of population and labour force ageing, both up to the present and out to 2030. Levels of disease burden also vary appreciably across the countries from the high levels exhibited by Saudi Arabia to Mexico with the lowest.

In analysing the costs to countries out to 2030, we concentrate only on economic costs in the narrow sense that they are included in GDP as currently measured, while recognising that there are many real and important social costs that should also be addressed. Even within economic costs we focus on reduced ability to work in the paid labour force and reduced productivity while at work. But increased prevalence of NCDs might impact on GDP in other ways also. For example, the costs of treating and caring for people with NCDs are high and growing rapidly. It is likely that some significant part of these costs will be met from individual or public savings, hence reducing the ability of the economy to fund new investment and growth. Some estimates suggest that these dynamic costs from reduced investment, which are excluded here, may be of a comparable magnitude to those which we do address.

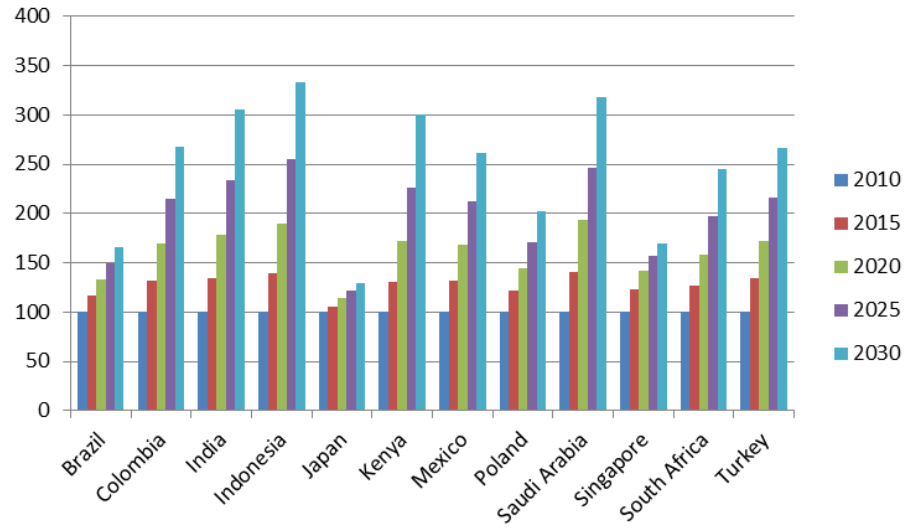
The results are presented in table ES1, both $ billion and as a per cent of GDP, and figure ES1 shown below:

Table ES1 Estimates of lost GDP from NCD deaths, absenteeism and presenteeism, 12 countries, to 2030

	2010	2015	2020	2025	2030
			($billion)		
Brazil	111.3	129.8	148.7	167.0	184.0
Colombia	14.2	18.7	24.0	30.5	38.1
India	81.5	109.6	145.2	191.2	249.2
Indonesia	34.1	47.3	64.7	86.8	113.6
Japan	225.4	237.7	256.6	275.4	290.7
Kenya	4.3	5.6	7.4	9.8	13.0
Mexico	39.0	51.2	65.8	82.7	102.0
Poland	22.5	27.6	32.5	38.5	45.7
Saudi Arabia	31.7	44.7	61.3	78.2	100.5
Singapore	7.9	9.7	11.2	12.3	13.3
South Africa	18.2	23.1	28.9	35.9	44.7
Turkey	39.0	52.4	66.9	84.2	103.7
			(share of GDP, %)		
Brazil	5.2	5.4	5.6	5.7	5.8
Colombia	4.9	5.1	5.2	5.3	5.4
India	4.8	4.8	4.8	4.9	5.0
Indonesia	4.8	5.0	5.2	5.4	5.5
Japan	4.1	4.2	4.4	4.5	4.6
Kenya	10.8	9.9	9.1	8.5	8.0
Mexico	3.7	3.8	3.8	3.9	3.9
Poland	4.7	4.9	5.1	5.3	5.5
Saudi Arabia	6.0	6.2	6.5	6.7	7.0
Singapore	3.3	3.4	3.5	3.6	3.6
South Africa	4.9	4.9	5.0	5.1	5.2
Turkey	5.3	5.6	5.8	5.9	6.0

Source: VISES estimates.

Figure ES1Indexes of the estimated real GDP lost from NCD deaths and non-fatal prevalence, twelve countries (indexes 2010=100)



Source: VISES estimates.

Figure ES3 expresses the real GDP lost for each economy as an index with a base at 2010=100, and hence shows the comparative growth in real costs across the countries.

A number of factors seem particularly pertinent in interpreting the estimates summarised in Table ES1 and Figure ES1. They emphasise the importance for the growth in real costs over 2010-30 of the interaction between high levels of poor health and an increasingly aged population.

This is particularly pronounced for such countries as Saudi Arabia with an economic cost of 7% of GDP by 2030 due to absenteeism, presenteeism and NCD. Its workforce (and population) is ageing very rapidly and its burden of disease from NCDs is the highest of any of the selected countries.

Turkey is another example of a country which combines poor health with a population structure which has a large and increasing proportion over 45. The economic cost due to absenteeism, presenteeism and NCD deaths is expected to increase from 5.3 to 6.0% of GDP over the period 2010 to 2030.

The economic cost to Brazil of these factors is also high, rising from 5.2% to 5.8% over the period 2010-2030. Its workforce is ageing at one of the highest rates and its disease burden from NCDs is also relatively high.

The highest estimated economic cost is for Kenya (Table ES1).This is largely due to the high contribution from NCD deaths. The contribution from presenteeism and absenteeism is relatively low.

Mexico which has one of the lowest estimated costs (only 3.9% by 2030 including NCD deaths) has the benefit of a particularly low NCD burden of disease. Its smoking rates and blood pressure levels are low and although its average BMI and diabetes prevalence is relatively high, its somewhat high burden of disease arising from diabetes is more than offset by low burdens for mental disorders and respiratory diseases.

Overall these estimates confirm that each country faces, in different ways and to different degrees, severe economic costs and broader health challenges from the intersection of high NCD incidence and population ageing. This is not a ground for pessimism, but does highlight the need for governments to give much higher priority to large scale programs to address the challenges of NCDs. After all, unprecedented levels of technology, expertise and medical practice are now available around the world, and there is a vast array of international experience demonstrating which programs are effective and which are not. There is also the experience of non-communicable diseases, whose incidence has most countries been reduced to only a fraction of what it was only 50-60 years ago, to demonstrate what can be achieved if health problems are given appropriate priority.

Context of the Study

In spite of very different circumstances, most countries face three challenges in common:

- their populations are ageing, in different ways and to different degrees;
- there is an existing high prevalence of non-communicable diseases (NCDs), such as heart and respiratory disease, stroke, cancer and mental illness; and
- many risk factors for the future incidence of NCDs are high, and in some cases continuing to rise.

Taken together these factors already impose heavy costs on business, governments and individuals, and threaten much greater costs in the future. In 2014, VISES prepared a report for the APEC Business Advisory Council (ABAC) and the Life Science Information Forum (LSIF) to understand, and quantify, the economic dimension of these costs out to 2030, for six APEC economies: Australia, China, Malaysia, Peru, the Philippines and the USA.

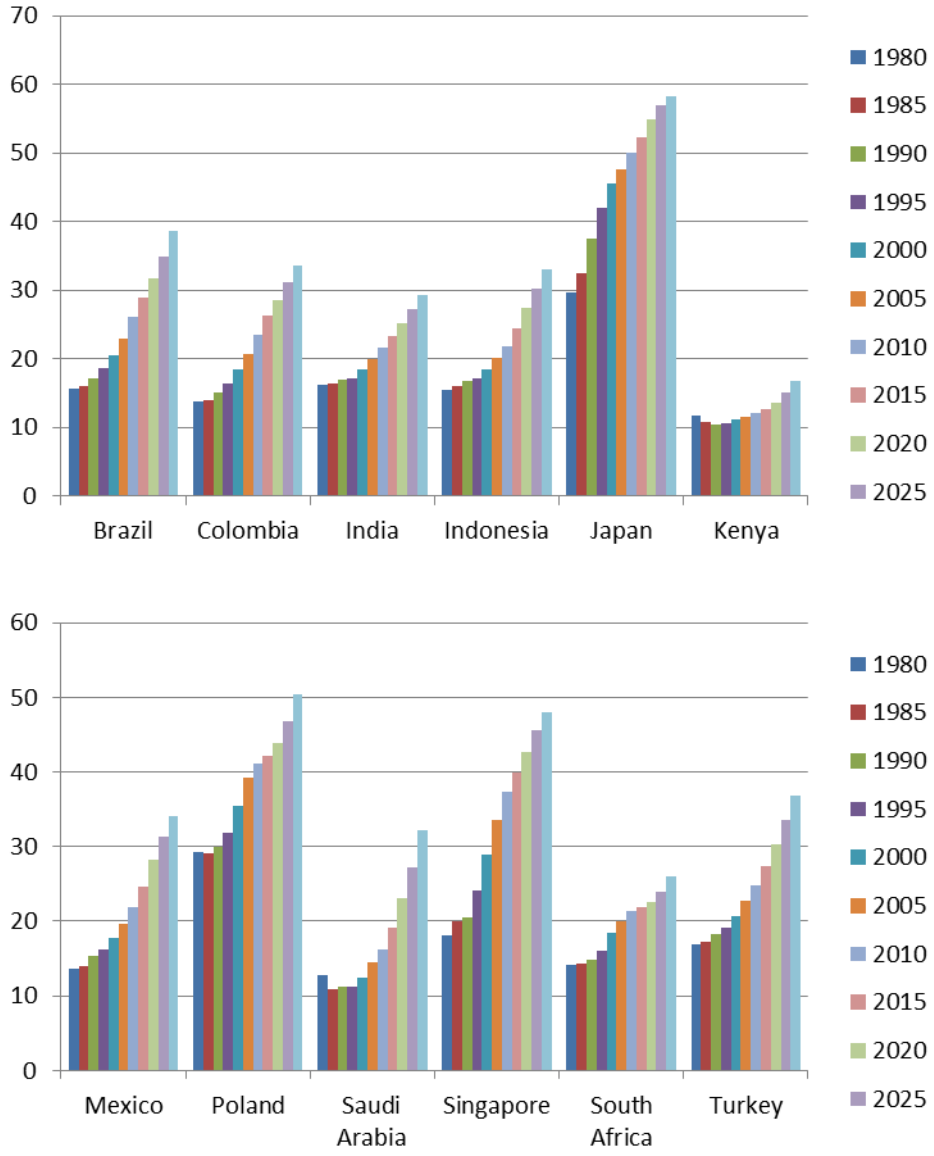
This study extends this analysis to a larger group of twelve countries namely Brazil, Colombia, India, Indonesia, Japan, Kenya, Mexico, Poland, Saudi Arabia, Singapore, South Africa, and Turkey.

This section sets out the broad context of the study, before the more detailed analysis is reported in the succeeding sections.

Population ageing

Many factors contribute to population ageing, most notably cyclical or secular fluctuations in the birth rate and increasing life expectancy at birth. The total fertility rate (TFR: in any given year the number of children that a hypothetical woman would have if she experienced throughout her lifetime the age-specific fertility rates prevailing in that year) was close to 3 in the developed world in the 1950s, but fell to about 1.5 by 2000, before subsequently recovering a little. In the 1950s, the TFR was close to 6 in most parts of the developing world, but again has fallen sharply at different times and at different rates across countries, to be close to or below 2 in most parts of the developing world by 2012. Death rates, especially those from communicable or infectious diseases, have also fallen rapidly in most countries, especially in the developing countries where they were a major constraint on population growth.

Figure 1 Share of population aged 45 years and over, 12 countries, 1980-2030 (projected)



Source: United Nations (2014).

Given different patterns in the fall in both fertility rates and death rates across countries, the pattern of ageing also differs greatly across countries. Another important factor is the extent of net overseas migration, whether inwards or outwards. Most migrants tend to be relatively young, so that strong net immigration (as in Australia and the USA) tends to modify the impact of ageing, by providing an influx of younger than average people. Equally, strong net emigration can accentuate the effects of ageing, as those leaving tend to be younger than average.

While no single indicator can capture the diversity of ageing patterns, which are discussed further in the next section, Figure 1 provides one summary indicator, the proportion of the population that is aged 45

years and over. The chart provides actual data for 1980-2010 and projections out to 2030 using the central case of the latest UN population projections (United Nations 2014).

The chart shows that some countries, such as Poland and Japan, were already old at the beginning of the period and are projected to become increasingly so reaching 50% and 60% respectively by 2030. Some countries such as Brazil, Columbia and Mexico have aged rapidly in the period 1980 to the present. The proportion over 45 has increased for Brazil for 15% in 1980 to almost 30% in 2015. Saudi Arabia, on the other hand, is projected to do most its ageing between 2015 and 2030, when the proportion aged over 45 is expected to increase from 19% to 32%, a rise of 13%. Finally Kenya is an example of country that began the period 'youthful' and has aged very little. In the period 1980 to 2015 the proportion over 45 began as the lowest of the group of countries at 11.7% and increased to only 12.6%. It is expected to increase by 4% to 16.7% by 2030, still the lowest of this group of countries.

The economic and social costs of NCDs

The value of a healthy year of life to an individual or to a community has many dimensions, as do the benefits foregone or the costs incurred by the loss or impairment of that healthy life year as a result of disease. Some benefits foregone or costs incurred are economic, even in the narrow sense that they are included in GDP as currently measured. These include the elements which are the particular focus of this study, namely reduced ability to work in the paid labour force and reduced productivity while at work. But increased prevalence of NCDs might impact on GDP in other ways also. For example, the costs of treating and caring for people with NCDs are high and growing rapidly. It is likely that some significant part of these costs will be met from individual or public savings, hence reducing the ability of the economy to fund new investment and growth. Table 1 provides a simple classification of the various costs of NCDs.

Table 1 Simple classification of costs of NCDs

Economic costs	Social costs
Lost working time from premature death	Loss of years of life
Lost working time (absenteeism)	Loss of the quality of life
Lost productivity while at work (presenteeism)	Broader community costs of mortality
Lost Productivity due to early retirement due to ill health	Cost of community and family support
Treatment and carer costs	Broader community costs of ongoing morbidity
Savings and investment impact of resources directed to treatment and care	

Many of the values foregone or costs incurred will not, however, be reflected in GDP figures, but will nevertheless be very real to the individual and the community. If a young mother dies from breast cancer or is seriously impaired by another disease, this is not only a great loss to her personally, but will have longer term ramifications for her family and for the broader community of which she is part. If a man in prime age gets a serious mental disease, this may impose many broader costs on his family, on the community (for example through disruption due to anti-social behaviour) and on his carers. All of these costs should be included in a full economic analysis, but here we concentrate only on economic

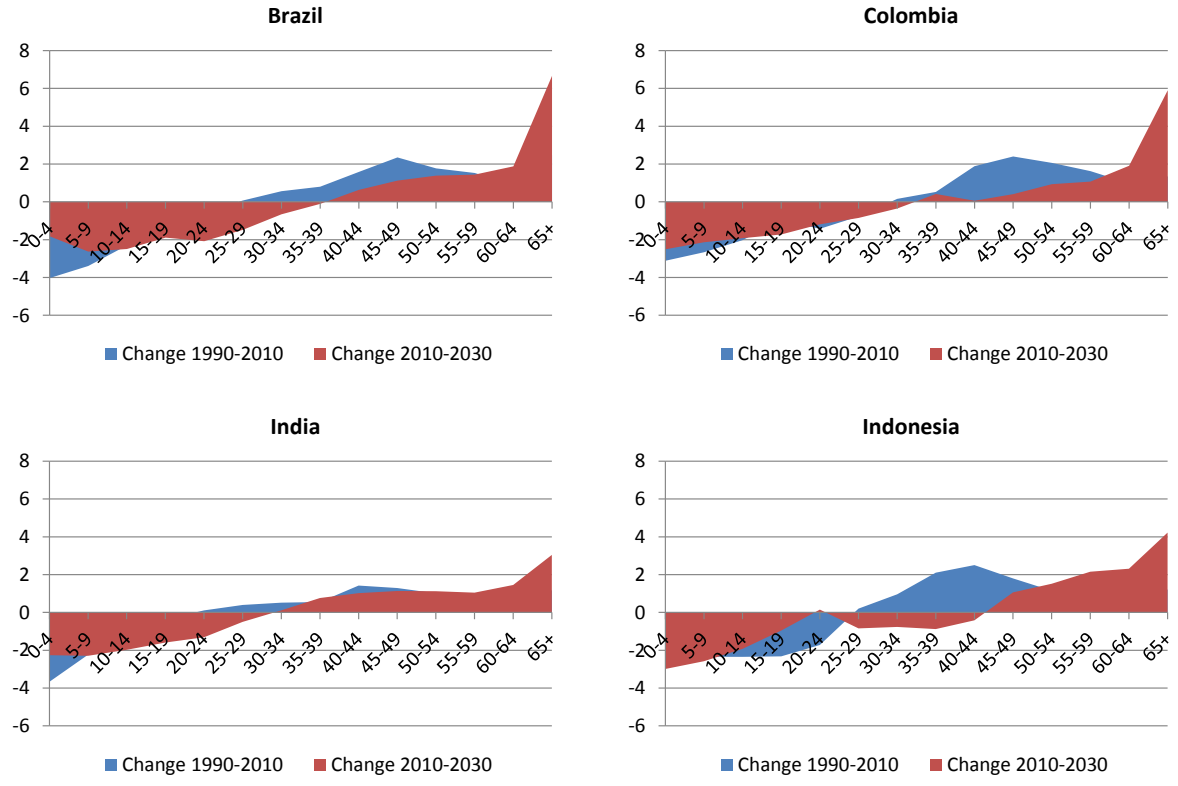
costs in the more limited sense of inclusion in GDP, and within that only on the first three economic costs shown in Table 1.

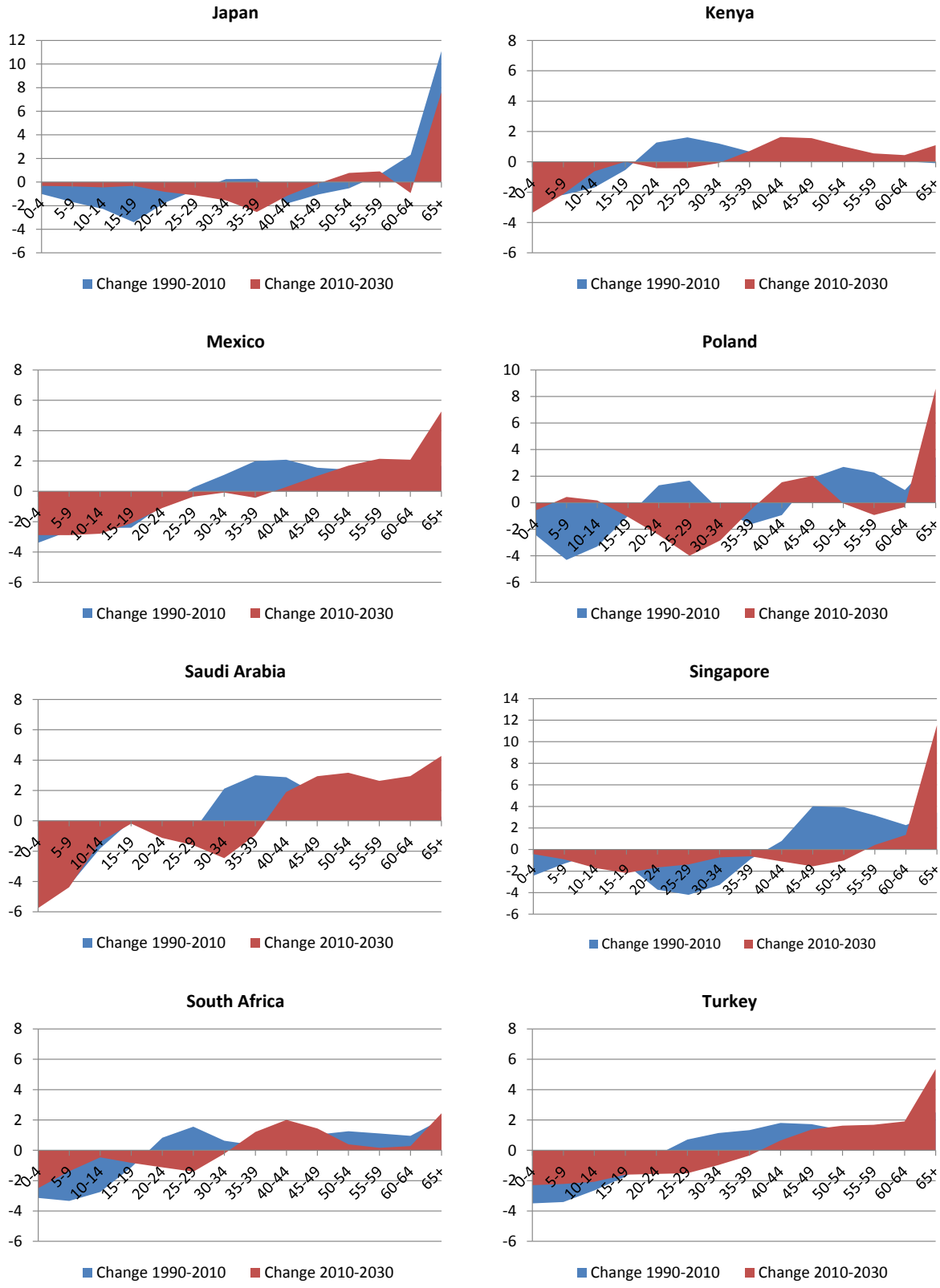
Population and Labour Force Ageing

Population ageing

Figure 1 above illustrated the nature and diversity of ageing in the twelve countries by use of a single indicator, the share of the population 45 years and over at any time. It is necessary to look beyond this measure to understand the ways in which the pattern of ageing is likely to influence the economic cost arising from a given burden of NCDs. Because we are focusing on work attendance and productivity costs, the ageing that is particularly relevant is that among persons of working age, that is aged 15 years or more until about 65 years. To analyse these effects more closely, Figure 3 shows for each economy the change in the share of the population in each age group over two periods over 20 years – 1990-2010 and 2010-30. The change is measured in percentage points of the total population for the economy, with the change during 1990-2010 shown in blue and the projected change during 2010-30 shown in red. The six component charts of Figure 3 are set on the same scale to facilitate comparison.

Figure 3 Measures of the extent and timing of population ageing, 12 countries, 1990-2010 and 2010-30 (projected), change in share of population in individual age groups (percentage points)





Source: VISES analysis of data from United Nations (2014).

Figure 3 illustrates the rapid transition in the age of the population of some of our selected countries. Although the ageing process is less advanced for the selected countries than some other countries, such as China and Japan, there is a pronounced shift in population to the older age groups for each of the countries considered in this report. The ageing process is evident for Brazil and other Latin American countries from 1990. In the period 1990 to 2010, there was a sizable increase in the population aged 35 to 55. In the second period, this population bulge will age further causing an increase in the population aged over 50. These are the years when chronic disease becomes more prevalent, with as we will see, serious implications for the ability to work.

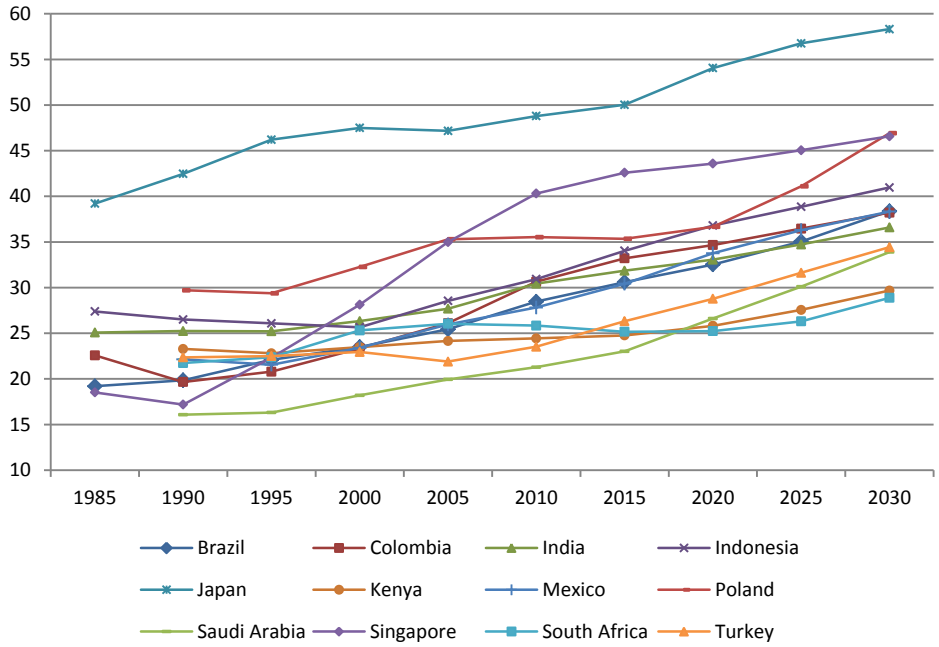
The position for Saudi Arabia is potentially quite critical. There was a sharp increase in those aged 30 to 45 between 1990 and 2010. This cohort is projected in the period 2010 to 2030 to swell the numbers aged over 50. This is accompanied by a quite significant reduction in those under 10.

Singapore and Indonesia, despite their very different populations display a similar ageing pattern. Both aged appreciably over the first period, 1980-2010, with a significant increase in population in the middle years – 30-50 for Indonesia and 40-60 for Singapore.

Labour force impacts

From our limited perspective in this study, the key aspect of ageing is how the population of working age is changing. As explained further below, in this study we make use of labour force data and projections out to 2030 from the International Labour Office (ILO). Reverting to our earlier summary measure, Figure 4 shows the actual and projected shares of the labour force aged 45 years and over. By 2010 this share was already quite high in the Japan (49%), and is projected to continue to rise out to 2030 reaching 58%. The proportion for Singapore was also high in 2010 (40%) having grown very rapidly from 17% in 1990. Along with Poland it is projected to reach 50% by 2030.

Figure 4 Share of labour force aged 45 years and over, 12 countries, 1980-2030 (projected) (%)

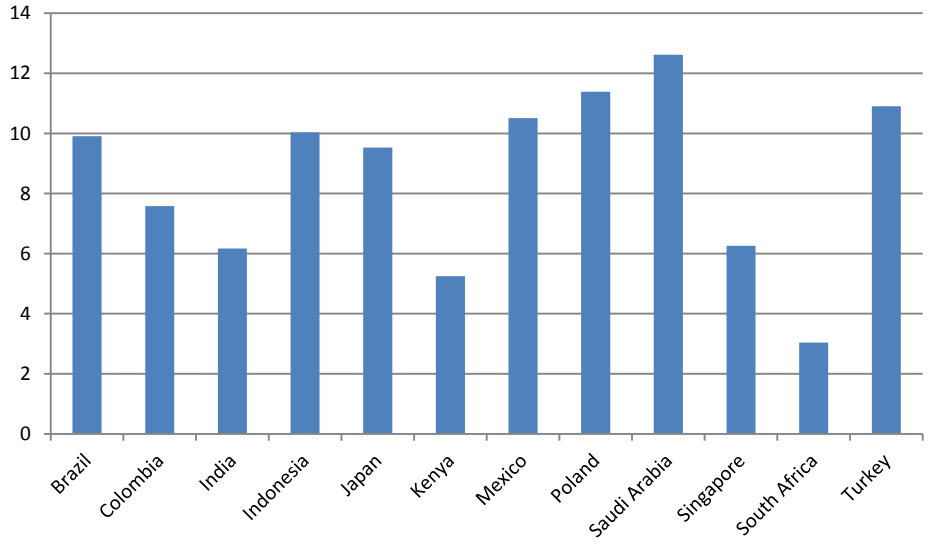


Source: ILO (2014).

The remainder of the countries all show a relatively steady growth in the proportion of the labour force aged over 40. Brazil and Mexico both increase from 28% in 2010 to 38% in 2030.

Finally, Figure 5 shows the summary measure of the rate of ageing as it affects the labour force for the twelve countries, namely the increase in the share of the labour force that is 45 years or over for the period 2010-30, measured in percentage points of the total labour force. An increase of 10 percentage points in this measure means that 10% more of the labour force is now to be found in the over 45 years age group.

Figure 5 Increase in the share of the labour force age 45 years and over, 12 countries, 2010-30 (percentage points)



Source: ILO (2014).

This measure confirms our earlier analysis, and highlights the fact that seven of the selected countries are particularly at risk, given the changing age structure of their labour force, to economics costs from NCDs, namely Brazil (where the over 45 years labour share rises by 9.9 percentage points over 2010-30), Indonesia (where the rise is 10 %), Japan (+9.5%), Mexico (+10.5%), Poland (+11.4%), Saudi Arabia, the largest at 12.6% and Turkey (with a rise of 10.9%).

Current and Future Prevalence of NCDs

To assess the economic cost associated with non-communicable diseases, it is necessary to have some measure of how many people are affected by these diseases and their severity. The data on the number of people who die due to a particular disease is usually sourced from death registrations, which record the cause of death and other characteristics of the person such as their age, sex and location. The coverage and reliability of death registrations varies from country to country, but is usually sufficient to produce reasonably good estimates of the numbers of deaths due to particular diseases by age and sex.

Estimating the non-fatal morbidity due to particular diseases, i.e. their non-fatal prevalence, is more difficult. In some countries registries are maintained for certain diseases, such as cancer and infectious diseases. For most non-communicable diseases however, prevalence estimates must rely on information collected from a variety of sources such as national health surveys, medical insurance databases, and information collected from hospitals and primary care clinics. This means that prevalence estimates can be sporadic and infrequent in many countries, especially those with developing health systems. If the only source of information is self-reported data from a national health survey, this relies on people knowing they have a disease and being able to describe their condition accurately.

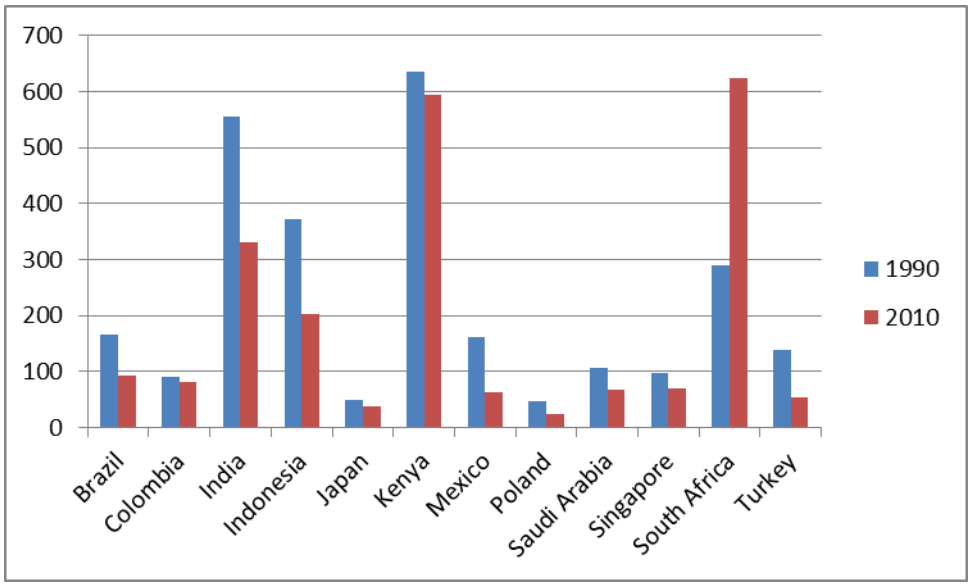
A number of organisations attempt to quantify the burden of disease in a particular country or set of countries by combining information on deaths or mortality with that on morbidity using prevalence measures. The most recent set of estimates by country are for 2010 have been done by a team of researchers based at the Institute for Health Metrics and Evaluation (IHME) at the University of Washington. Their initial results were published in *The Lancet* in 2012 (Murray et al. 2012) and further sets of estimates continue to be released. Results for 2013 are being released progressively (e.g. Murray et al 2015) but at time of writing detailed data by age and sex for each country are not yet available. It is possible to download information from their website about the number and rates of deaths by cause by age and sex. It also includes estimates of the number of disability life years (DALYs), which is a measure combining the deaths data and morbidity data. In estimating the latter, the researchers estimated the number of years lived with disability (YLD), which is defined as the prevalence of a disease multiplied by a disability weight reflecting the severity of the disease.

Unfortunately it is not possible to obtain yet from the IHME the underlying prevalence measures used to construct the YLD estimates. For the purposes of this study, we have therefore taken the country-specific YLD estimates by age and sex and produced estimates of prevalence using the disability weights which are publicly available (Salomon et al. 2012).

Trends in mortality and morbidity

The 2010 global burden of disease study published estimates of mortality and morbidity for all countries for the years 1990 and 2010. These data allow us to place the estimates of mortality by cause provided in Figure 2 in a longer time frame, and to consider inferred prevalence data. Again we use age-standardised rates to remove the effect of different age structures on death rates across countries. But they also highlight some of the data problems that researchers face in this area. While the years for which data are available are not the same, there are indications of some significant differences in mortality rates between the WHO data used in Figure 2 and the global burden of disease data used in Figures 6, 7 and 8.

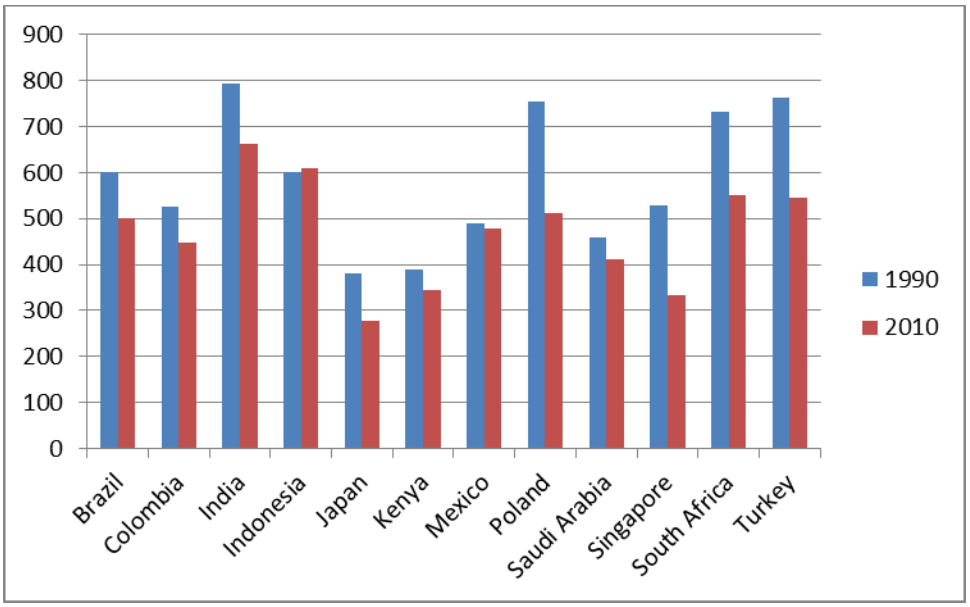
Figure 6 Age standardised death rates from communicable diseases, 12 countries, 1990 and 2010



Source: IHME (2010).

The data on deaths rates from communicable disease shown in Figure 6 indicate that for most of the countries deaths are low and declining. However rates for Kenya, India and South Africa remain high, although the death rate for India fell by almost half, while the death rate for South Africa more than doubled in the period 1990 and 2010.

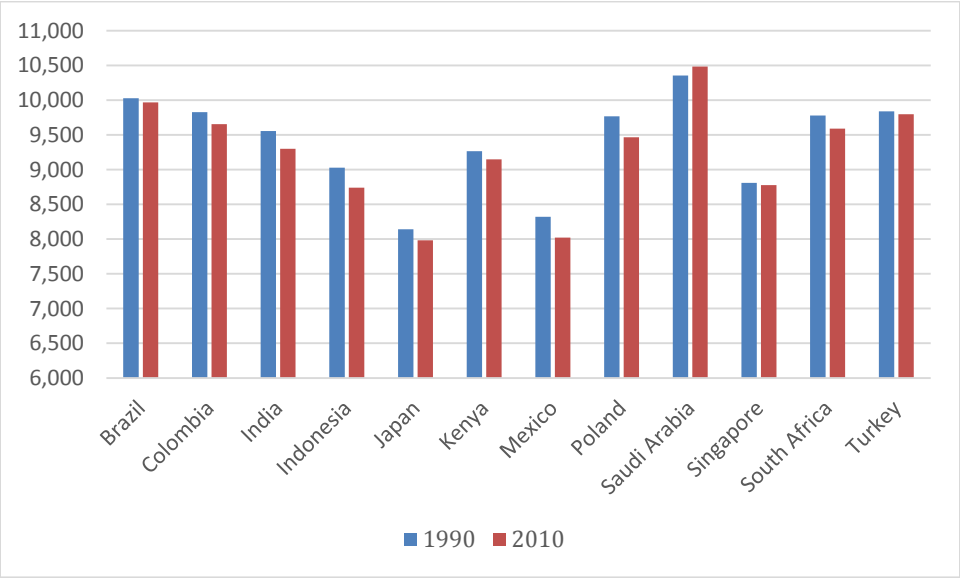
Figure 7 Age standardised death rates from non-communicable diseases, 12 countries, 1990 and 2010



Source: IHME (2010).

The reductions NCD death rates are significant in most cases, but remain high for most countries. Poland South Africa and Turkey achieved the largest falls.

Figure 8 Age standardised YLD rates from non-communicable diseases, 12 countries, 1990 and 2010



Source: IHME (2010).

The best measures we have of non-fatal prevalence of NCDs over this time frame are derived from the age standardised YLD rates produced by the IHME researchers. As noted above, these are produced as the product of estimated disease-specific prevalence, by age and sex, weighted by the disability weight for each disease and age-standardised. As such this YLD rate for a given economy can change as a result of various factors: for example, changes in the non-fatal prevalence of individual diseases over time (which might in turn reflect changes in the incidence of new cases or changes in survival rates from existing cases) or changes in the composition of NCD prevalence across diseases with different disability factors.

The data presented in Figure 8 show a remarkable picture of stability, with little change in the age-standardised rate YLD rate for NCDs in any of the countries over the two decades, in spite of the sharp falls in the NCD death rates for most of the countries shown in Figure 7. While this stability over the period is compatible with considerable variation within it, both more effective medical treatment to increase survival rates and deteriorating risk factors for many NCDs may help to explain the long run stability of the YLD rate. Recent trends in risk factors are of concern in most countries, and are reviewed briefly below.

Trends in risk factors

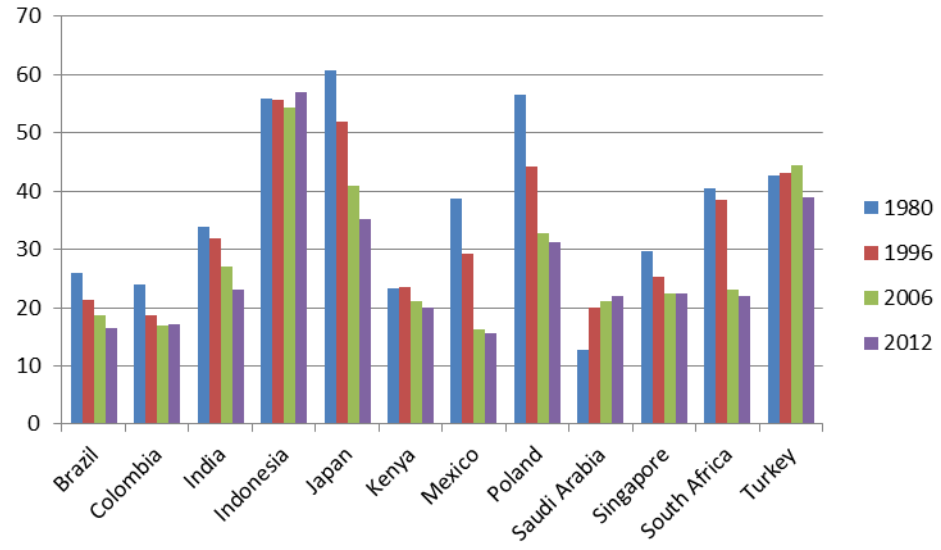
Certain risk factors increase the probability that a person will develop non-communicable diseases such as cardiovascular disease and cancer. The major risk factors include smoking tobacco, an inadequate diet, physical inactivity, high blood pressure (hypertension), high levels of cholesterol, being overweight and being diabetic. Trends in these risk factors can provide some insight into the prevalence of major disease.

In the same way as with morbidity, information on risk factors is patchy, particularly for developing countries, with the most common source being periodic national health surveys and one-off epidemiological studies. However, a number of researchers have attempted to provide as much information as possible on trends in the major risk factors. A number of articles in *The Lancet* in 2011 presented estimates for the years 1980, 1990, 2000 and 2008 of trends in systolic blood pressure (Danaei et al. 2011a), serum total cholesterol (Farzadfar et al. 2011), body mass index (Finucane et al. 2011), and fasting plasma glucose and diabetes (Danaei et al. 2011b). More recently Ng et al. (2014) have estimated smoking prevalence for the years 1980, 1996, 2006 and 2012. Given the data issues discussed above, these figures must be regarded as the best estimate possible by analysing the available data sets, rather than in any sense definitive figures, but we provide below a review of the findings of these and related studies.

Smoking

Smoking rates remain high, especially for men, in many developing countries, and especially in Asia of which Indonesia is a notable example. Figure 4a shows that, in terms of male smoking behaviour, there is great diversity across the selected countries. Indonesia has an extremely high male smoking rate of 57% in 2008 with no sign of any decline. Turkey also has a persistently high rate of about 40% for the period, although the 2008 rate of 39% was somewhat lower than earlier years. The rate in Poland, which in 1980 was one of the highest of the group, has fallen from 56% in 1980 to 30% in 2008. Except for Saudi Arabia, the rates for other countries in the group are declining, particularly so for Poland, Mexico and South Africa. Smoking rates for Brazil and Colombia are at modest levels.

Figure 4a Smoking rates, males, per cent of population, 12 countries, 1980 to 2012



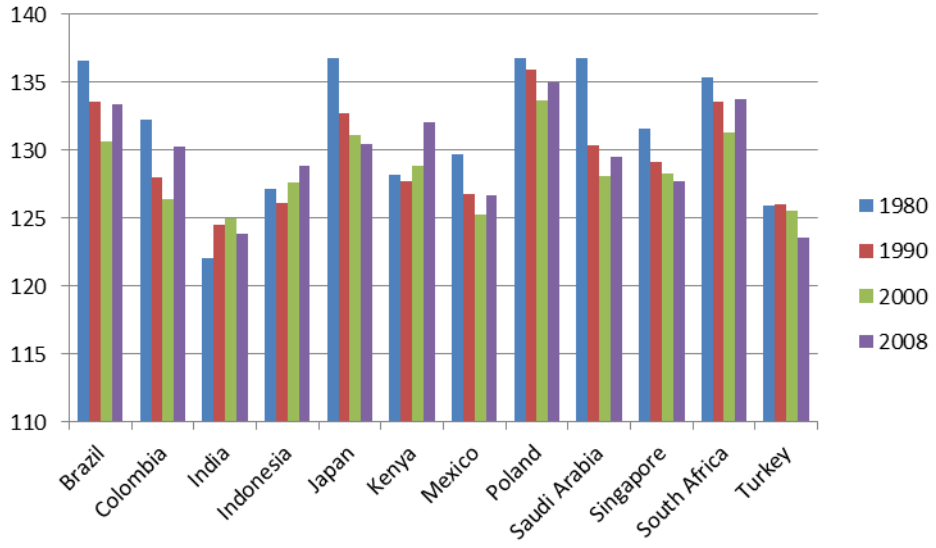
Source: Ng et al. (2014).

Female smoking rates are significantly lower than their male counterparts in most countries, particualrly in Asia.

Systolic blood pressure

High blood pressure or hypertension is an important risk factor for various forms of cardiovascular disease. High blood pressure can be treated by various forms of medication, and the levels reported in the studies are normally actual blood pressure after the effects of any treatment. Figure 5 shows that age-standardised mean systolic blood pressure (SBP in mm Hg) for males is high for Brazil, Poland and South Africa. Further, there is little sign of the consistent fall in blood pressure levels evident in advanced countries, such as Australia and the United States where levels were high but have declined substantially over the past 30 years. Much of this fall is likely to be from the effect of treatment rather than from improvement in the underlying cardiovascular condition.

Figure 5 Mean systolic blood pressure rates, males, 12 countries, 1980 to 2008 (SBP in mm Hg)

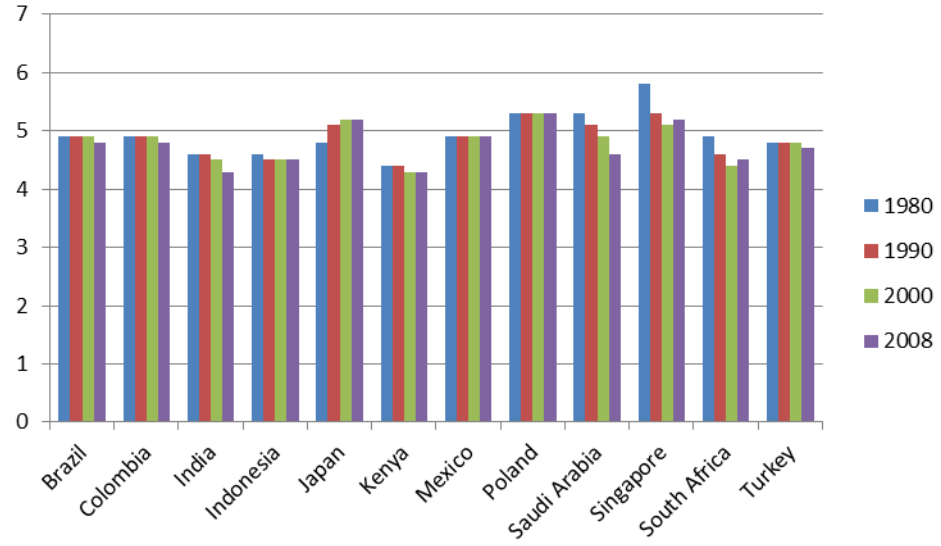


Source: Danaei et al. (2011a).

Cholesterol

As with high blood pressure, serum total cholesterol (TC) (reported in Figure 6 in mmol/L) is another risk factor for cardiovascular disease. With exception of Poland, cholesterol levels for this group of countries are relatively modest. The TC rate for Saudi Arabia was high, but has fallen significantly over the period.

Figure 6 Mean total cholesterol rates, males, 12 countries, 1980 to 2008 (mmol/L)



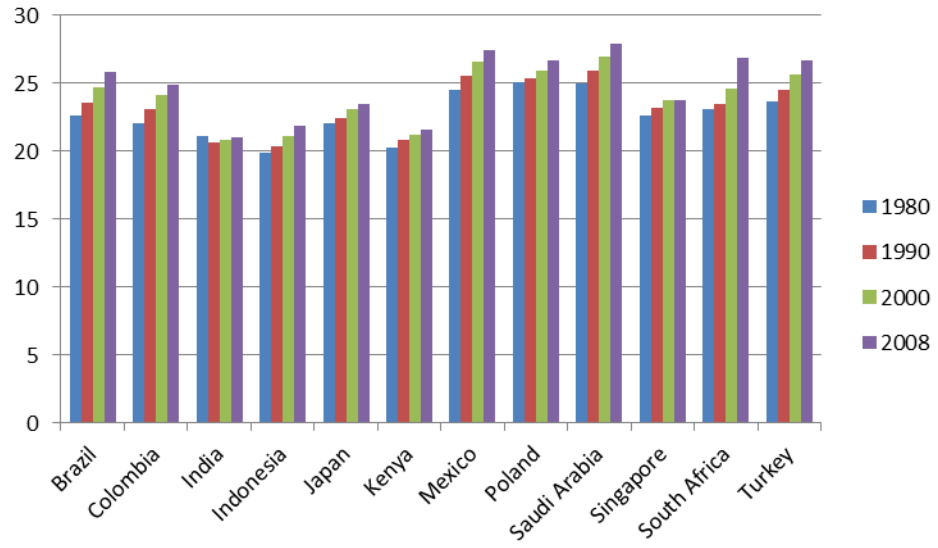
Source: Farzadfar et al. (2011).

Body mass index

Being overweight and obese is an important risk factor for many (NCDs). The widely used measure is the body mass index (BMI), which is defined as a person's weight in kilograms dividied by the square of their height in metres. Overweight is defined as values greater than 25 kg/m^2, while obesity is defined as greater than 30 kg/m^2.

BMI for males (Figure 7a) has increased in all countries, and on average those in Mexico, Poland, South Africa and Turkey would be considered overweight. Brazil at 25.8 and Colombia at 24.9 are now both entering this territory. India, Indonesia and Kenya remain below these levels, althugh they are rising in both Kenya and Indonesia.

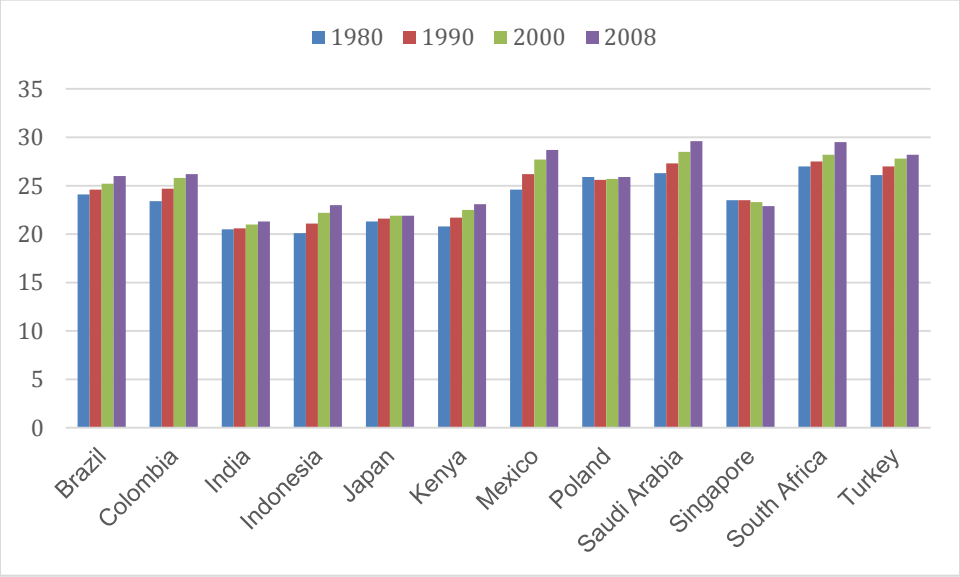
Figure 7a Mean BMI, males, kg/m^2, 12 countries, 1980 to 2008



Source: Finucane et al. (2011).

The BMI levels for females are significantly higher for a number of countries in this group. Average BMI levels for Mexico, Saudi Arabia and Turkey are approaching 30 indicating that a high proportion of the female population of those countries are obese. Average female BMI levels for Brazil and Colombia are increasing rapidly, and in 2008 were at similar levels to males at about 25. This means that a high proportion of females are overweight.

Figure 7b Mean BMI, females, kg/m^2, 12 countries, 1980 to 2008



Source: Finucane et al. (2011)

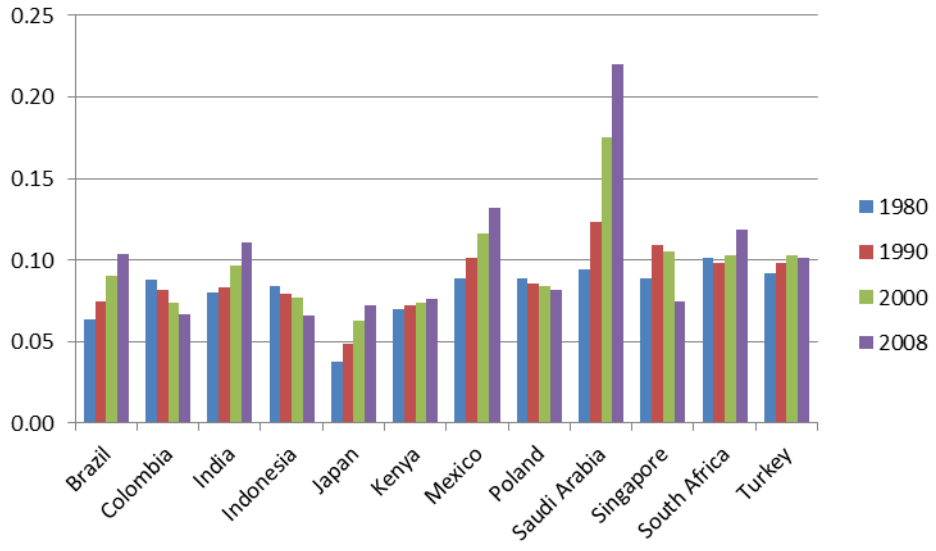
Diabetes

The final risk factor to be discussed is diabetes, which is both a disease in itself and an important risk factor for many other NCDs. As with hypertension, the measure of diabetes prevalence normally includes diabetes which is treated and controlled, as well as that which is not diagnosed or, if diagnosed, is not controlled by appropriate treatment.

For instance in Australia and the USA, a substantial proportion of the diagnosed level of diabetes is controlled, but it is known that in some developing countries, only a modest proportion of actual diabetes is diagnosed and only part of that is controlled.

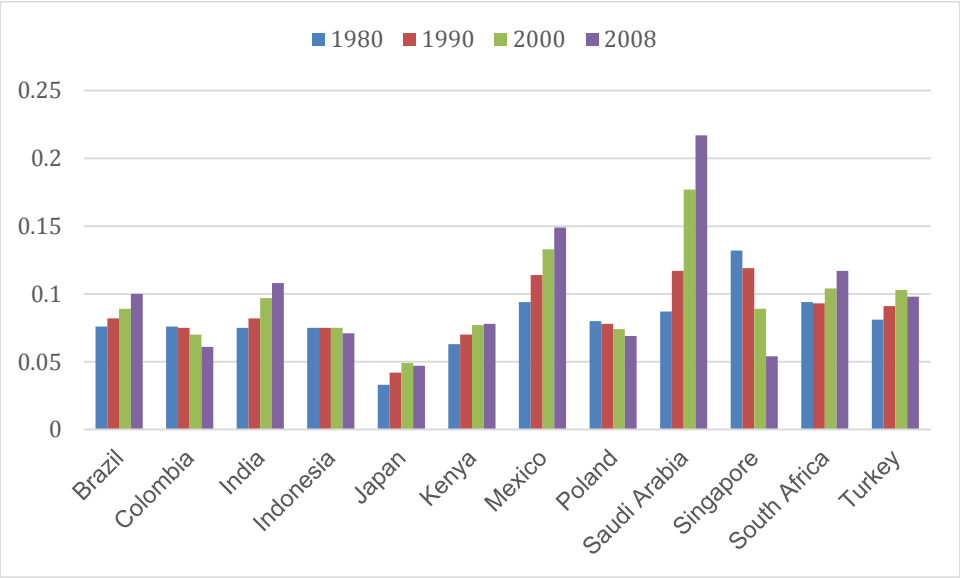
Figures 8a and 8b show that diabetes levels in Saudi Arabia are extraordinarily high and increasing for both males and females with prevalence rates exceeding 20%. Prevalence in Mexico is also high at 13% for males and 15% for females and trending upwards. Prevalence rates are increasing in most other countries but they are at or below 10%.

Figure 8a Diabetes prevalence, males, per cent of population, 12 countries, 1980 to 2008



Source: Danaei et al. (2011b).

Figure 8b Diabetes prevalence, females, per cent of population, 12 countries, 1980 to 2008



Source: Danaei et al. (2011b).

Conclusions on risk factors and mortality/prevalence assumptions

The foregoing analysis, limited though it is by the availability of data, leads to several tentative conclusions related to our projection assumptions for this study. First, age standardised mortality rates from NCDs have been declining in most of the countries studied, both over the 1990-2010 period and over 2004-12. But the rate of decline has been modest, on an annualised basis. Secondly, the levels of non-fatal, age standardised NCD prevalence implied by the burden of disease YLD data have been remarkably stable over the two decades from 1990-2020, perhaps because of both higher survival rates and a deterioration in lifestyle quality and in risk factors. Thirdly, some of the most important risk factors – such as blood pressure, cholesterol levels, diabetes and BMI – are high and/or rising in most of these countries, and smoking rates remain undesirably high.

On the basis of these conclusions, the key assumptions that we use in the detailed empirical analysis is that age standardised NCD mortality rates fall for all countries by 1% per annum over the period 2010-30, and that age-standardised NCD non-fatal prevalence rates remain stable for all countries over 2010-30 at their 2010 levels. These assumptions are broadly consistent with the historical record as reviewed above, and could even be viewed as somewhat optimistic given the risk factor trends. A more complex analysis than is possible here would take account of many relevant forms of variation: across countries, by gender and by disease.

Estimating the Worker Attendance and Productivity Costs of NCDs

Modelling methodology

As discussed above, the International Labour Office (ILO 2014) has produced projections of the labour force and labour force participation rates by age and sex for each country to the year 2030, based on

UN projections of population. For the modelling of the economic impact of mortality and morbidity, these population and labour force projections were used as the starting point for projections of mortality and morbidity for the years 2010, 2015, 2020, 2025 and 2030 for the twelve countries.

The modelling of the impact of NCDs is undertaken only for those 13 non-communicable diseases listed in Table 2 that were identified as most relevant to reductions in labour force participation and productivity using the disease descriptions from the 2010 Global Burden of Disease study (Murray et al. 2012).

Table 2 Disability weights and absenteeism and presenteeism assumptions, twelve countries

Disease	Disability weight	Percent productivity loss due to absenteeism per employee per year	Percent productivity loss due to presenteeism per employee per year
Ischemic heart disease	0.13013	2.8	6.8
Ischemic stroke	0.30300	2.8	6.8
Hemorrhagic and other non-ischemic stroke	0.30300	2.8	6.8
Diabetes mellitus	0.09463	0.8	11.4
Chronic obstructive pulmonary disease	0.19667	6.1	17.2
Asthma	0.05600	5.0	11.0
Migraine	0.43300	4.5	20.5
Tension-type headache	0.04000	4.5	20.5
Major depressive disorder	0.23000	10.7	15.3
Dysthymia	0.11000	10.7	15.3
Osteoarthritis	0.09100	2.5	11.2
Rheumatoid arthritis	0.33733	2.5	11.2
Neoplasm	0.32150	7.0	8.5

Source: Murray et al. (2012), Salomon et al. (2012) and Goetzel et al. (2004).

The number of deaths by age and sex and the number of years of life years lived with disability (YLDs) for 2010 for each of these diseases and for each economy were obtained from the country estimates on the 2010 Global Burden of Disease website.[1] For each of the twelve countries, the numbers of deaths by age and sex and disease for subsequent years were obtained by multiplying the population estimates by age and sex from the ILO for that year by the projected mortality rate for that age, sex and year. The central case reported below is mortality rates derived by assuming a uniform 1% per annum fall from 2010-30, but results are also reported with fixed mortality rates. The total number of deaths in any year from a particular disease was then obtained by summing across the age groups.

To estimate the number of deaths of people in the labour force, the projections by age and sex and disease for a particular year were multiplied by the relevant labour force participation rate for the age and sex category for that year for those aged 15 and over.

[1] At http://ghdx.healthdata.org/global-burden-disease-study-2010-gbd-2010-data-downloads

The projections of YLDs for the years 2015, 2020, 2025 and 2030 were obtained in a similar manner, by starting from the actual numbers of YLDs by age and sex and disease for 2010 and assuming fixed YLD rates by age, sex and disease out to 2030, so that the projected numbers of YLDs grew in line with the increase in population for the corresponding age and sex group.

Prevalence estimates were obtained from these YLD projections by dividing by the appropriate disability weights obtained from Salomon et al. (2012) and Murray et al. (2012). These weights are shown in Table 2 above. Prevalence estimates for those in the labour force were obtained in the same way as for deaths.

The result of these calculations was a table for each country showing the estimated number of deaths in the labour force for the years 2010 to 2030 for each of the 13 conditions. A similar table was obtained for prevalence estimates.

To estimate the economic impact of this burden of disease, estimates of the value of GDP in current USD were obtained from the World Bank for each of the twelve countries for 2010. These were divided by the size of the labour force in 2010 to calculate GDP per person in the labour force for 2010. For high-income countries Japan and Singapore, it was assumed that this productivity would increase by 1% per year over 2010-30, for low-income countries India, Indonesia and Kenya the assumption was 4% and 3% for the remaining countries.

To estimate the loss in economic output resulting from the projected deaths, it is assumed that all the deaths in the labour force are averted. That means that the increase in the labour force will be cumulative so that in a particular year it will consist of the deaths averted in that year plus those averted in previous years. For instance in Brazil, there will be 219,953 deaths averted in the labour force rising to a cumulative total in 2030 of 688,417 deaths averted. Multiplying these estimates of the additional numbers in the labour force in a particular year by the assumed productivity gives estimates of the additional GDP generated in each year because of these deaths averted.

To calculate the economic loss due to morbidity suffered by people in the labour force, it is necessary to quantify what impact disease has on labour force participation and on productivity at work. For this we use the estimates by Goetzel et al. (2004) on productivity loss due to absenteeism and presenteeism by disease fitted to the disease categories used in the modelling (Table 2). An extensive review of the literature in the various countries on these issues has been conducted for this project, but no better source of such estimates has yet been identified.

Multiplying the GDP per person in the labour force estimates by the loss in productivity from a disease gives the estimated reduction in GDP per person attributable to a particluar disease. Multiplying this by the prevalence in the labour force of that disease gives an estimate of the annual loss in GDP from that disease.

Summary estimates

The deaths averted in the labour force and the increase in GDP this represents, are shown in Tables 3 to 6. The projections of deaths averted are made under two scenarios. One assumes that death rates will remain constant, while the other assumes that death rates will decline at 1% per annum. Given that the assumed intervention is to avert all future NCD deaths, the first scenario will result in higher levels of projected deaths *averted* than the second. This results in the increase in the labour force being greater under the first scenario than the second, as shown in Tables 3 and 4 respectively. This means that the increase in GDP arising from the deaths saved will be higher for the first scenario (constant mortality rates) (Table 5) than the second (declining death rates at 1% per annum) (Table 6).

Table 3 Labour force increase due to deaths averted, 2010 to 2030, at constant mortality rates (persons)

Year	Brazil	Colombia	India	Indonesia	Japan	Kenya
2010	219,953	45,025	1,426,109	396,924	218,561	23,119
2015	362,418	71,749	2,339,465	644,070	283,656	38,929
2020	493,323	98,128	3,167,026	895,824	337,758	55,121
2025	611,180	123,530	3,881,007	1,142,869	378,234	71,663
2030	688,417	142,539	4,332,261	1,309,093	402,405	85,508

Year	Mexico	Poland	Saudi Arabia	Singapore	South Africa	Turkey
2010	105,427	42,593	10,177	3,452	27,822	55,988
2015	169,370	71,174	18,441	6,571	47,776	101,545
2020	231,585	90,428	28,107	8,912	65,014	143,393
2025	290,262	106,227	37,204	10,748	79,906	183,537
2030	329,642	118,390	45,398	11,677	87,819	208,656

Source: VISES estimates.

Table 4 Labour force increase due to deaths averted, reduced death rates 2010 to 2030 (persons)

Year	Brazil	Colombia	India	Indonesia	Japan	Kenya
2010	219,953	45,025	1,426,109	396,924	218,561	23,119
2015	344,656	68,233	2,224,808	612,504	269,755	37,021
2020	446,152	88,745	2,864,202	810,167	305,462	49,850
2025	525,651	106,243	3,337,892	982,934	325,303	61,634
2030	563,061	116,583	3,543,387	1,070,716	329,130	69,938

Year	Mexico	Poland	Saudi Arabia	Singapore	South Africa	Turkey
2010	105,427	42,593	10,177	3,452	27,822	55,988
2015	161,069	67,686	17,537	6,249	45,434	96,569
2020	209,441	81,782	25,420	8,060	58,798	129,682
2025	249,642	91,361	31,997	9,244	68,724	157,852
2030	269,616	96,832	37,132	9,551	71,828	170,661

Source: VISES estimates.

The two labour force tables show that the cumulative increase in the labour force if all NCD deaths were averted is substantial. On the constant mortality assumption, the labour force gains range from 11,677 in Singapore, to 1.3 million in Indonesia and over 4.3 million in India. On the assumption of 1% per annum reduction in death rates, the numbers are somewhat smaller, ranging from 9,551 in Singapore, to 1.1 million in Indonesia and over 3.5 million in India.

Tables 5 and 6 show the conversion of these labour force increases into increased GDP, using economy-specific estimates of GDP per employee. The figures rise sharply over time, as lives saved build cumulatively and the potential increment to GDP rises. Even on the reducing mortality rate basis, the GDP figures are large, and rising rapidly in the developing countries, reaching $28 billion per annum in India and $17.8 billion per annum in Indonesia by 2030, with corresponding figures for the smaller countries covered.

Table 5 Increase in annual GDP due to increase in labour force, constant mortality rates to 2030 (US$ billion)

Year	Brazil	Colombia	India	Indonesia	Japan	Kenya
2010	4,621	582	5,217	2,469	18,085	59
2015	8,003	1,075	10,413	4,875	24,668	121
2020	11,449	1,704	17,150	8,249	30,871	209
2025	14,908	2,487	25,570	12,804	36,334	330
2030	17,649	3,327	34,727	17,844	40,628	479

Year	Mexico	Poland	Saudi Arabia	Singapore	South Africa	Turkey
2010	2,199	1,118	552	289	562	1,596
2015	4,096	2,166	1,159	579	1,120	3,356
2020	6,492	3,190	2,047	825	1,766	5,495
2025	9,433	4,344	3,142	1,046	2,517	8,153
2030	12,420	5,613	4,444	1,194	3,207	10,745

Source: VISES estimates.

Table 6 Increase in annual GDP due to increase in labour force, reduced death rates 2010 to 2030 (US$ billion)

Year	Brazil	Colombia	India	Indonesia	Japan	Kenya
2010	4,621	582	5,217	2,469	18,085	59
2015	7,611	1,022	9,903	4,636	23,459	115
2020	10,355	1,541	15,510	7,460	27,919	189
2025	12,822	2,139	21,992	11,012	31,250	284
2030	14,435	2,721	28,404	14,595	33,230	392

Year	Mexico	Poland	Saudi Arabia	Singapore	South Africa	Turkey
2010	2,199	1,118	552	289	562	1,596
2015	3,895	2,060	1,102	550	1,065	3,192
2020	5,872	2,885	1,852	746	1,598	4,969
2025	8,113	3,737	2,702	899	2,165	7,012
2030	10,158	4,591	3,635	977	2,623	8,789

Source: VISES estimates.

The estimated reductions in GDP due to the impact of the ongoing non-fatal prevalence of the 13 diseases on labour force particpation and productivity are shown in Table 7. It is immediately evident that these morbidity costs, through both absenteeism and presenteeism, are much higher than the mortality costs, although the latter rise faster over time. For example in India by 2030, the costs of absenteeism and presenteeism reach $68.6 billion (1.4% of GDP) and $173 billion (3.4% of GDP) for presenteeism in India by 2030, compared to the costs of mortality of $28.4 billion.

For many of the chronic diseases listed in Table 2 and covered by the analysis ongoing morbidity is more important, and more disruptive of effective labour force involvement, than the threat of imminent death. Examples include pulmonary disease, migrane headaches, depression and rheumatoid arthritis. As a result a much larger number of people suffer from a chronic disease each year than die from one. Hence even the number of deaths from NCDs are cumulative in their labour force impact over time, the labour force costs from absenteeism and presenteeism are a substantial mutiple of those from deaths, for each country.

Table 7 Increase in GDP due to reduction in absenteeism and presenteeism, 12 countries

Country	Year	Total reduction in GDP USD billion Absenteeism	As % GDP	Total reduction in GDP USD billion Presenteeism	As % GDP
Brazil	2010	32.5	1.52	74.2	3.46
	2015	37.0	1.54	85.2	3.54
	2020	41.6	1.56	96.7	3.62
	2025	46.1	1.58	108.1	3.69
	2030	50.4	1.60	119.2	3.78
Colombia	2010	4.3	1.49	9.3	3.25
	2015	5.5	1.50	12.1	3.31
	2020	7.0	1.52	15.5	3.37
	2025	8.8	1.53	19.6	3.42
	2030	10.9	1.54	24.5	3.47
India	2010	22.5	1.32	55.4	3.24
	2015	30.2	1.33	74.9	3.29
	2020	40.1	1.34	99.7	3.33
	2025	52.7	1.35	131.9	3.39
	2030	68.6	1.37	172.6	3.44
Indonesia	2010	9.5	1.35	22.1	3.11
	2015	12.8	1.37	29.9	3.18
	2020	17.1	1.38	40.1	3.25
	2025	22.5	1.40	53.3	3.31
	2030	29.2	1.41	69.7	3.37
Kenya	2010	55.5	1.37	151.8	3.02
	2015	57.1	1.37	157.1	3.05
	2020	60.6	1.38	168.1	3.08
	2025	64.3	1.39	179.9	3.12
	2030	67.4	1.40	190.1	3.16
Japan	2010	0.5	1.01	1.2	2.76
	2015	0.8	1.02	1.7	2.80
	2020	1.1	1.04	2.5	2.88
	2025	1.6	1.06	3.6	2.96
	2030	2.3	1.07	5.1	3.03
Mexico	2010	9.6	0.91	27.2	2.59
	2015	12.2	0.90	35.1	2.59
	2020	15.3	0.89	44.6	2.61
	2025	18.8	0.88	55.8	2.61
	2030	22.9	0.87	69.0	2.63
Poland	2010	6.0	1.26	15.4	3.23
	2015	7.1	1.28	18.4	3.30
	2020	8.2	1.29	21.4	3.37
	2025	9.6	1.32	25.2	3.49
	2030	11.2	1.36	29.9	3.63
Saudi Arabia	2010	8.0	1.51	23.1	4.39
	2015	11.0	1.54	32.5	4.54
	2020	14.8	1.57	44.6	4.73

	2025	18.6	1.59	56.8	4.86
	2030	23.5	1.64	73.4	5.10
Singapore	2010	2.3	0.95	5.3	2.25
	2015	2.7	0.96	6.5	2.29
	2020	3.1	0.95	7.4	2.30
	2025	3.3	0.96	8.1	2.33
	2030	3.6	0.97	8.8	2.38
South Africa	2010	5.3	1.40	12.4	3.30
	2015	6.6	1.41	15.5	3.31
	2020	8.1	1.42	19.1	3.34
	2025	10.0	1.43	23.7	3.38
	2030	12.4	1.44	29.6	3.43
Turkey	2010	11.5	1.58	25.8	3.53
	2015	15.0	1.60	34.1	3.63
	2020	18.8	1.62	43.1	3.71
	2025	23.2	1.64	53.9	3.80
	2030	28.4	1.65	66.6	3.87

Source: VISES estimates.

Interpreting the estimates

The overall estimates of the GDP losses arising from deaths (from 2010 onwards) and from absenteeism and presenteeism from the prevalence of NCDs in the actual and potential workforce are summarised in Table 8 and in Figure 14. Table 8 shows the total estimated losses in US$ billions, at 2010 values, at five year intervals over 2010-30, and also these costs as a share of GDP for each economy. Figure 14 expresses the total real value of the losses at an index, with 2010 set equal to 100, and hence shows the growth in costs in each economy from the 2010 base.

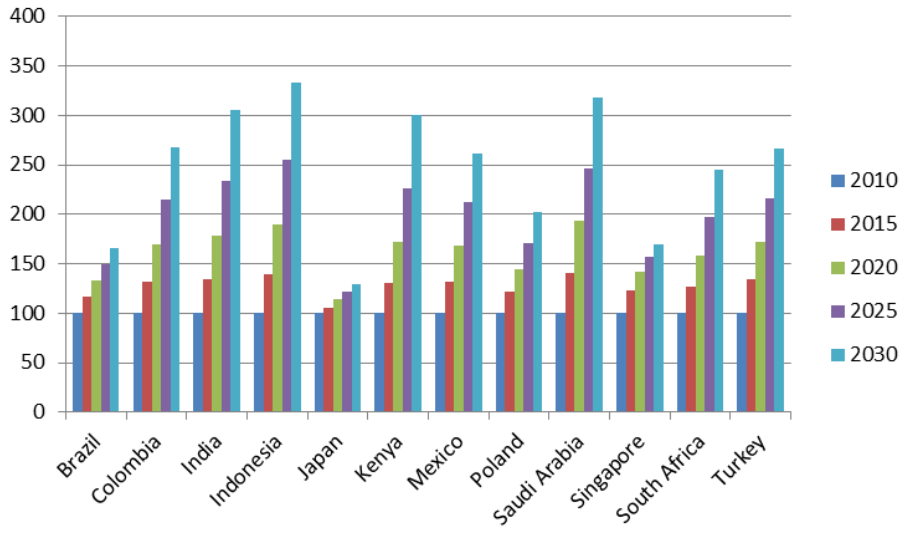
In interpreting these estimates, it is important to note that they primarily reflect the pattern of ageing of the population of labour force age in the various countries and the level of age standardised NCD mortality and non-fatal prevalence rates in 2010. In countries such as Japan where ageing is well advanced and 2010 mortality and prevalence rates are relatively high, the cost by 2010 is already relatively high and the future growth in cost more limited. This in part reflects the fact that many of the costs of the interaction of ageing and NCDs are felt beyond the years of labour force age.

Table 8 Estimates of lost GDP from NCD deaths, absenteeism and presenteeism, 12 countries, to 2030

	2010	2015	2020	2025	2030
					($billion)
Brazil	111.3	129.8	148.7	167.0	184.0
Colombia	14.2	18.7	24.0	30.5	38.1
India	81.5	109.6	145.2	191.2	249.2
Indonesia	34.1	47.3	64.7	86.8	113.6
Japan	225.4	237.7	256.6	275.4	290.7
Kenya	4.3	5.6	7.4	9.8	13.0
Mexico	39.0	51.2	65.8	82.7	102.0
Poland	22.5	27.6	32.5	38.5	45.7
Saudi Arabia	31.7	44.7	61.3	78.2	100.5
Singapore	7.9	9.7	11.2	12.3	13.3
South Africa	18.2	23.1	28.9	35.9	44.7
Turkey	39.0	52.4	66.9	84.2	103.7
			(share of GDP – %)		
Brazil	5.2	5.4	5.6	5.7	5.8
Colombia	4.9	5.1	5.2	5.3	5.4
India	4.8	4.8	4.8	4.9	5.0
Indonesia	4.8	5.0	5.2	5.4	5.5
Japan	4.1	4.2	4.4	4.5	4.6
Kenya	10.8	9.9	9.1	8.5	8.0
Mexico	3.7	3.8	3.8	3.9	3.9
Poland	4.7	4.9	5.1	5.3	5.5
Saudi Arabia	6.0	6.2	6.5	6.7	7.0
Singapore	3.3	3.4	3.5	3.6	3.6
South Africa	4.9	4.9	5.0	5.1	5.2
Turkey	5.3	5.6	5.8	5.9	6.0

Source: VISES estimates.

Figure 14 Indexes of the estimated real GDP lost from NCD deaths and non-fatal prevalence, 12 countries, (indexes 2010=100)



Source: VISES estimates.

A number of factors seem particularly pertinent in interpreting the estimates summarised in Table 8 and Figure 14. The figure in particular emphasises the importance for the growth in real costs over 2010-30. of the interaction between high levels of poor health and an increasingly aged population.

This is particularly pronounced for such countries as Saudi Arabia with an economic cost of 7% of GDP due to absenteeism, presenteeism and NCD by 2030. Its workforce (and population) is ageing (see figure 5) very rapidly and its burden of disease from NCDs is the highest of any of the selected countries (figure 8). From the analysis of risk factors both diabetes and BMI levels as presented in Figures 7a and 7b are high.

Turkey is another example of a country which combines poor health with a population structure which has a large and increasing proportion over 45. The economic cost due to absenteeism, presenteeism and NCD deaths is expected to increase from 5.3 to 6.0% of GDP over the period 2010 to 2030.

The economic cost to Brazil of these factors is also high, rising from 5.2% to 5.8% over the period 2010-2030. Its workforce is ageing at one of the highest rates (figure 5) and its disease burden from NCDs is also relatively high (figure 8).

The estimated economic cost for Kenya is the highest in Table 8.This is largely due to the high contribution from NCD deaths. The contribution from presenteeism and absenteeism is relatively low.

Mexico, which has one of the lowest estimated costs (only 3.9% by 2030 including NCD deaths) has the benefit of a particularly low NCD burden of disease. Its smoking rates and blood pressure levels are low and although its average BMI and diabetes prevalence is relatively high, its somewhat high burden of disease arising from diabetes is more than offset by low burdens for mental disorders and respiratory diseases.

Estimates and the Broader Cost Picture

Substantial as they are, it is crucial to note that these estimates are only a part of the full economic and social costs arising from NCDs, and even of the economic costs in the narrow sense of costs likely to be reflected in GDP as currently measured (see Table 1 above). The main economic costs excluded are the costs of treating and caring for those with NCDs of the type we are discussing here. Not only do these treatment costs need to be met by firms, individuals and governments, but some of the resources required will be diverted from savings, reducing the level of investment and hence the future growth capacity of the firm or the economy. Some have argued that these dynamic costs are the most important of all the economic costs, and they have not been considered here.

For example, Bloom et al. (2013) modelled the costs of NCDs for China and India in a closed Solow model consisting of only firms and households in two ways, with two key effects:

1. Productive capital is reduced by a reduction in savings to the extent that savings are diverted to finance increased health costs. This reflects the effect on the incentives for savings and

investment in both physical and human capital due to complex interactions between the costs of earlier retirement imposed on firms, finding replacement workers, training costs and lower life expectancy leading to lower savings.

2. Labour supply is reduced by age specific mortality so a higher death rate from NCDs is associated with a higher reduction of workers in a particular cohort.

Their model does not attempt to incorporate morbidity, or more subtle effects on labour supply and productivity through absenteeism or presenteeism, which is a central element of our analysis (and the major source of costs).

These authors find that the economic costs of NCDs to China, in undiscounted constant US$, amount to some $11 trillion over the 20-year period, with most of this effect coming from the savings and investment effect. This compares with our estimate, which totals about $7 trillion for China from the mortality and absenteeism/presenteeism alone. Thus Bloom et al. (2013) find that for China the savings and investment effects are very large.

Other papers (such as de Vol et al. 2007) which have adopted a production function approach to measure the impact of NCDs on the growth of GDP, especially through the impact on investment and the growth of the capital stock, have found that the costs of NCDs through these effects are very large. But these methods are theoretically complex and data intensive, and have not been attempted in this project. It should be noted, however, that the narrowly economic costs that are thereby excluded from this study may well be of a similar order of magnitude again to those that are identified here.

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