

# 15<sup>th</sup> Seminar on Current Issues in Retirement Benefits (CIRB)

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## Factors affecting Population Mortality Improvements

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# Agenda



- Introduction to Mortality improvement
- Factors affecting improvements in Population mortality
- Discussion regarding Assured lives mortality improvement assumptions

- It is the rate of change in mortality between two ages over time.
- Another way to assess mortality improvement is to analyze life expectancy

The World Health Organization (WHO) defines life expectancy as; "*the average number of years a person is expected to live on the basis of the current mortality rates and prevalence distribution of health states in a population*".

- The expectation of life at birth is the most widely used indicator for analysing mortality transition at population level.
- The relationship between mortality transition and improvements in expectation of life at birth is essentially reciprocal but the exact connection is not straightforward.
- As mortality transition varies by age, any analysis of mortality transition requires examination of changes in the age-specific mortality rates and how changes in mortality at different ages contribute to the change in mortality all ages combined

# Population mortality and Public health policies



- Ideally, there should be congruence between transition in population mortality and evolution of the health policy as public health policies have a direct reflection on the levels and trends in mortality.
- On the other hand, evolution of health policy should essentially be a response to the health status of the population as reflected in terms of changes in mortality
- With the improvements in the health status of the population, the disease profile changes, there is a shift in the patterns of causes of death and a transition in the age pattern of mortality.
- Evolution of the health policy, therefore, should also be a response to mortality transition resulting from the improved health status of the people.

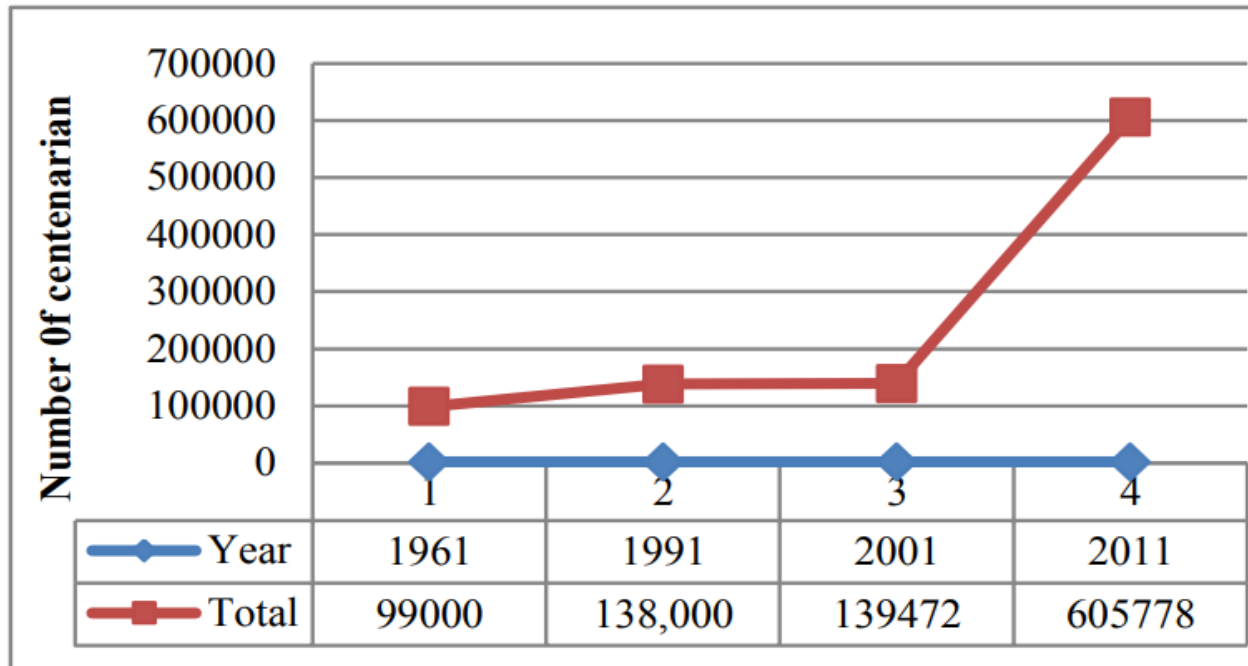
# How long do you think people could potentially live?

## Google says humans could live for 500 YEARS - and is investing in firms hoping to extend our lives five-fold

- Google Ventures' Bill Maris said he thinks humans can live to 500 years old
- This will be due to medical breakthroughs and a rise in biomechanics
- Google's director of engineering Ray Kurzweil previously said we'd be uploading our brains to machines by 2045
- Google Ventures has invested in genetics firms and cancer startups
- Tech giant also set up **Calico** - anti-ageing research and development labs
- Mr Maris said: 'We have the tools to achieve anything that you have the audacity to envision. I just hope to live long enough not to die'
- But professor Sir Colin Blakemore believes there's a limit on human life
- Neurobiologist believes 120 years 'might be an absolute to human lifespan'
- This is because living for longer is 'so rarely exceeded' that even with medical advances, it is unlikely this threshold will be raised

Should we be worried?

# How many centenarians we have in India?



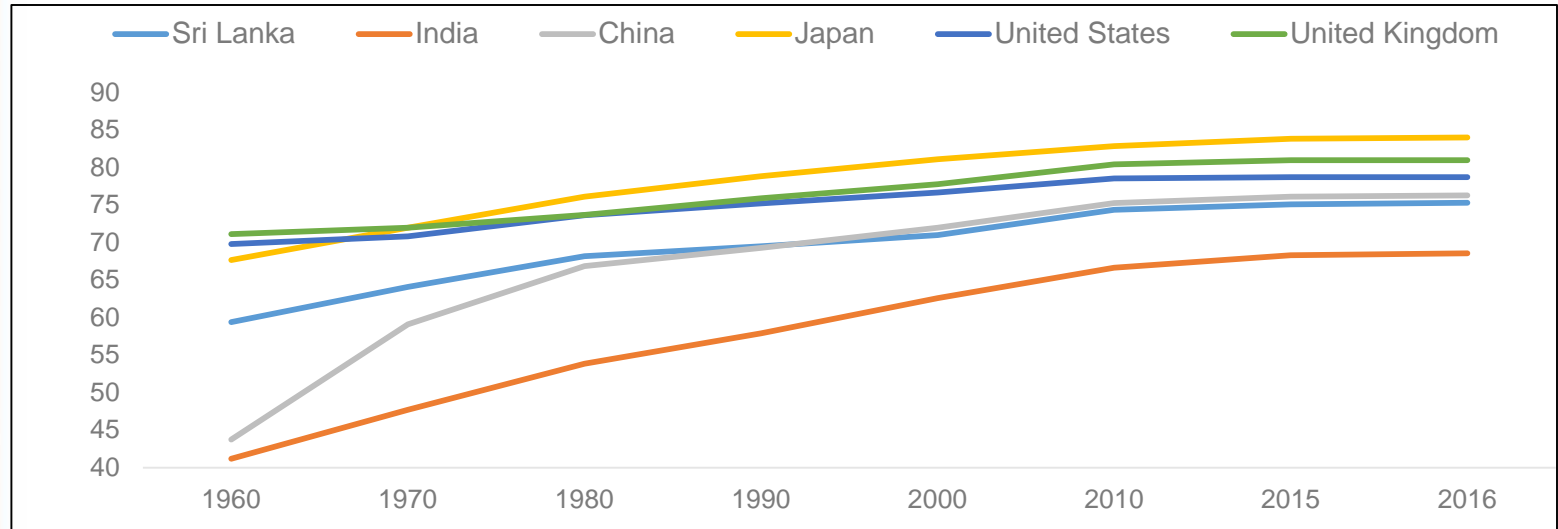
**Figure 4: Number of centenarians in India.**

Data source: compiled by author from-- 1. Ranjan Irudaya (2006), Population Aging and Health in India, Centre for Enquiry into Health and Allied Themes (CEHAT), Mumbai, p. 1, and 2. Census data 2001-11.

# Life expectancy at birth in different countries



Institute of Actuaries of India



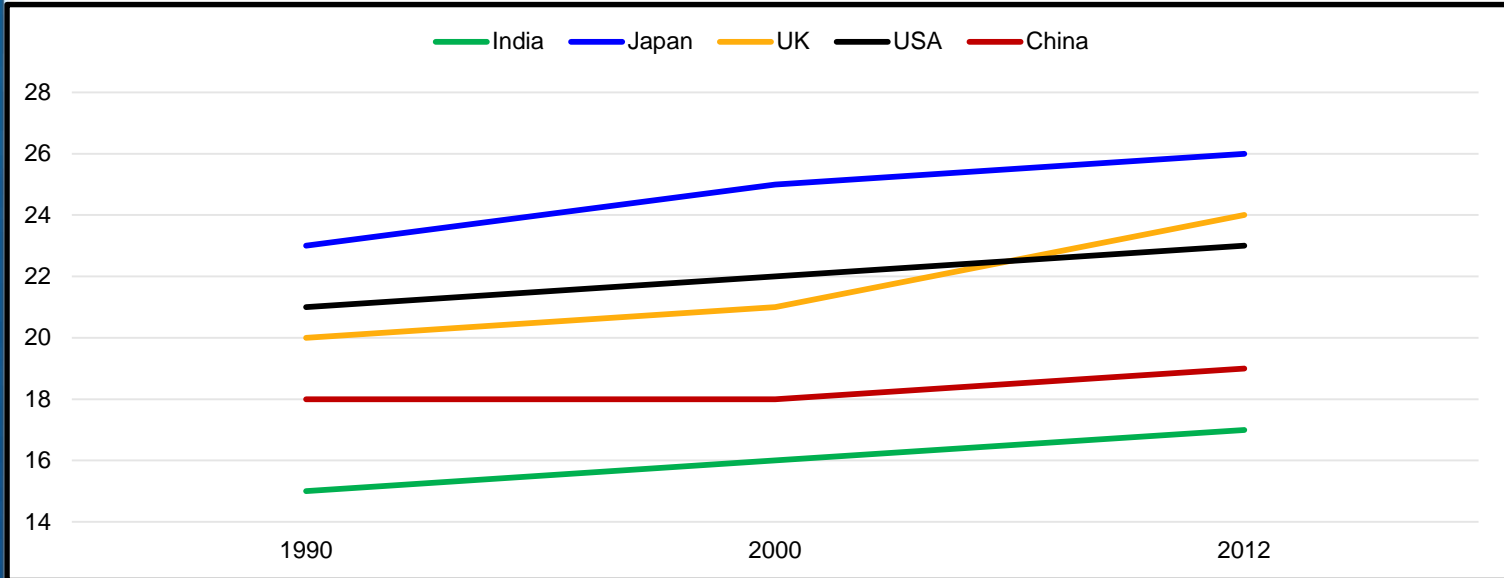
Country Name / Year	1960	1970	1980	1990	2000	2010	2015	2016	Annual Improvement (1960 – 2016)
<b>Sri Lanka</b>	59.37	64.10	68.17	69.51	71.00	74.35	75.09	75.28	0.42%
<b>India</b>	41.17	47.72	53.84	57.92	62.58	66.63	68.30	68.56	0.91%
<b>China</b>	43.73	59.09	66.84	69.29	71.96	75.24	76.09	76.25	1.00%
<b>Japan</b>	67.67	71.95	76.09	78.84	81.08	82.84	83.79	83.98	0.39%
<b>United States</b>	69.77	70.81	73.61	75.21	76.64	78.54	78.69	78.69	0.22%
<b>United Kingdom</b>	71.13	71.97	73.68	75.88	77.74	80.40	80.96	80.96	0.23%

Source: WHO

# Life expectancy at Age 60 in different countries



Institute of Actuaries of India



Country Name / Year	1990	2000	2012	Annual Improvement (1990 – 2012)	Annual Improvement (2000 – 2012)
India	15	16	17	0.60%	0.55%
Japan	23	25	26	0.59%	0.36%
United Kingdom	20	21	24	0.87%	1.22%
USA	21	22	23	0.43%	0.40%
China	18	18	19	0.26%	0.49%

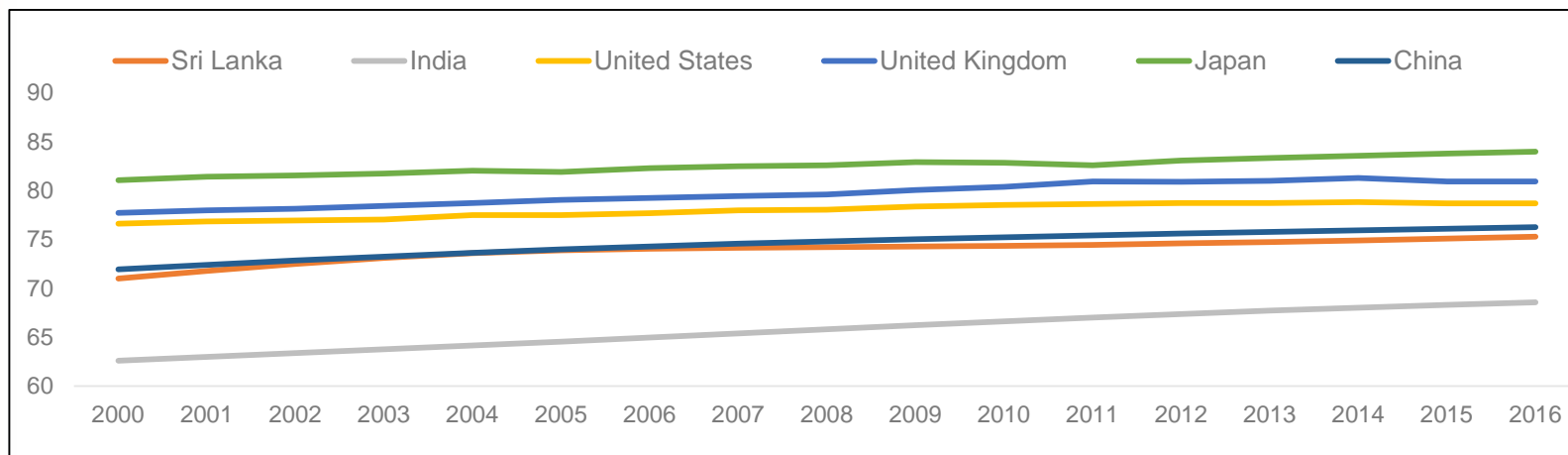
Source: UN data bank



# Life Expectancy at Birth between Years 2000 and 2016



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Country Name	Annual Improvement (2010 – 2016)
Sri Lanka	0.37%
<b>India</b>	<b>0.57%</b>
United States	0.17%
United Kingdom	0.25%
Japan	0.22%
China	0.36%

The rate of population annual mortality improvements in India continues to be higher compared to other countries.

# Factors affecting Population mortality Improvement



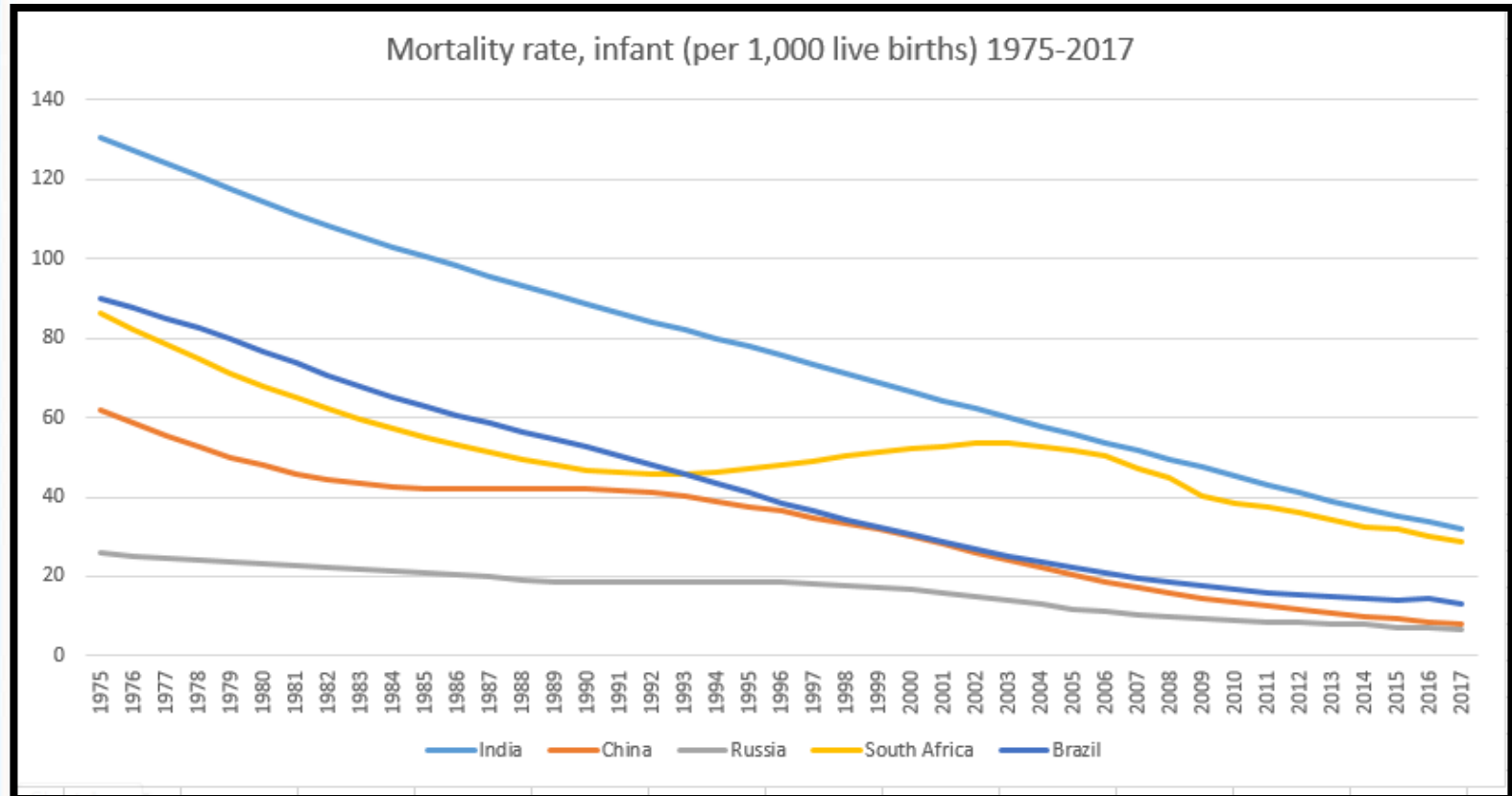
- Infant Mortality rate
- Maternal Mortality Rate
- Levels of malnutrition
- Net National Income per capita
- Urban population
- Literacy rates
- Tobacco Use
- Access to healthcare
- Accidental Death rates
- Advancement in Medical sciences
- Deaths due to Non-communicable diseases

# Factors affecting Population mortality Improvement



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## Decrease in Infant Mortality Rate



Annual reduction in Indian infant mortality averaging over 41 years is circa 3.3% and 4.84% over the last 7 years.

IMR in 2016 is 34 per 1000 lives and aim is to bring it down below 25 per 1000 live births by 2030

# Factors affecting Population mortality Improvement



## Maternal Mortality Rate (per 100,000 live births)

The table shows comparison of maternal mortality rate of different countries

Country Name / Year	1990	2000	2010	2015
Sri Lanka	75	57	35	30
India	556	374	215	174
China	97	58	35	27
Japan	14	10	6	5
United States	12	12	14	14
United Kingdom	10	12	10	9

While significant improvements have been made since 1990, the mortality rate is considerably higher compared with developed countries

The MMR in 2018 is 130 and the aim is to bring it down to 70 before 2025

# Factors affecting Population mortality Improvement



## Levels of Malnutrition in children aged 0-59 months

Survey Year	Severe wasting	Wasting	Overweight	Stunting	Underweight
1988-90		20%		63%	56%
1991-92		20%		62%	53%
1992-93	7%	20%	3%	58%	51%
1996-97		18%	6%	46%	38%
1998-99	6%	17%	3%	54%	46%
2005-06	7%	20%	2%	48%	44%
2013-14	5%	15%	0%	39%	29%
2015-16	8%	21%	0%	38%	36%

The World Bank estimates that India is one of the highest ranking countries in the world for the number of children suffering from malnutrition.

The prevalence of underweight children in India is among the highest in the world, and is nearly double that of Sub Saharan Africa with dire consequences for mobility, mortality, productivity and economic growth.<sup>[6]</sup>

The 2017 Global Hunger Index (GHI) Report by IFPRI ranked India 100th out of 118 countries with a serious hunger situation. Amongst South Asian nations, it ranks third behind only Afghanistan and Pakistan with a GHI score of 29.0 ("serious situation").<sup>[7]</sup>

# Factors affecting Population mortality Improvement



## Increase in Net National income per capita

Country Name / Year	1970	1980	1990	2000	2010	2015	2016	2010 / 1970	2016 / 2010
<b>Sri Lanka</b>	NA	252	440	799	2,605	3,461	3,459	3.2x	4.3x
<b>India</b>	103	237	317	382	1,160	1,383	1,465	3.7x	3.8x
<b>China</b>	110	164	271	840	3,667	6,331	6,342	7.6x	7.6x
<b>Japan</b>	1,669	7,847	20,649	30,468	35,088	28,050	31,136	18.3x	1x
<b>United States</b>	4,591	10,137	19,943	31,210	40,904	49,058	49,726	6.8x	1.6x
<b>United Kingdom</b>	2,220	8,638	16,139	24,187	33,816	37,410	34,204	10.9x	1.4x

Amounts in USD

The historical data (from year 1970 to 2010) suggests high growth rate in per capita national income in (now) developed nations.

Whereas from year 2010 to 2016, the increase in per capita income in the developing countries is much higher than the developed countries.

The per capita net national income during 2017-18 is estimated to be Rs. 1.1 Lakhs.

# Factors affecting Population mortality Improvement



## Increase in Urbanization

### Urban Population as % of Total population

Country Name / Year	1960	1970	1980	1990	2000	2010	2015	2016
Sri Lanka	16	20	19	19	18	18	18	18
India	18	20	23	26	28	31	33	33
China	16	17	19	26	36	49	56	57
Japan	63	72	76	77	79	91	93	94
United States	70	74	74	75	79	81	82	82
United Kingdom	78	77	78	78	79	81	83	83

A significant % of population is current living in rural areas as compared to developed countries.

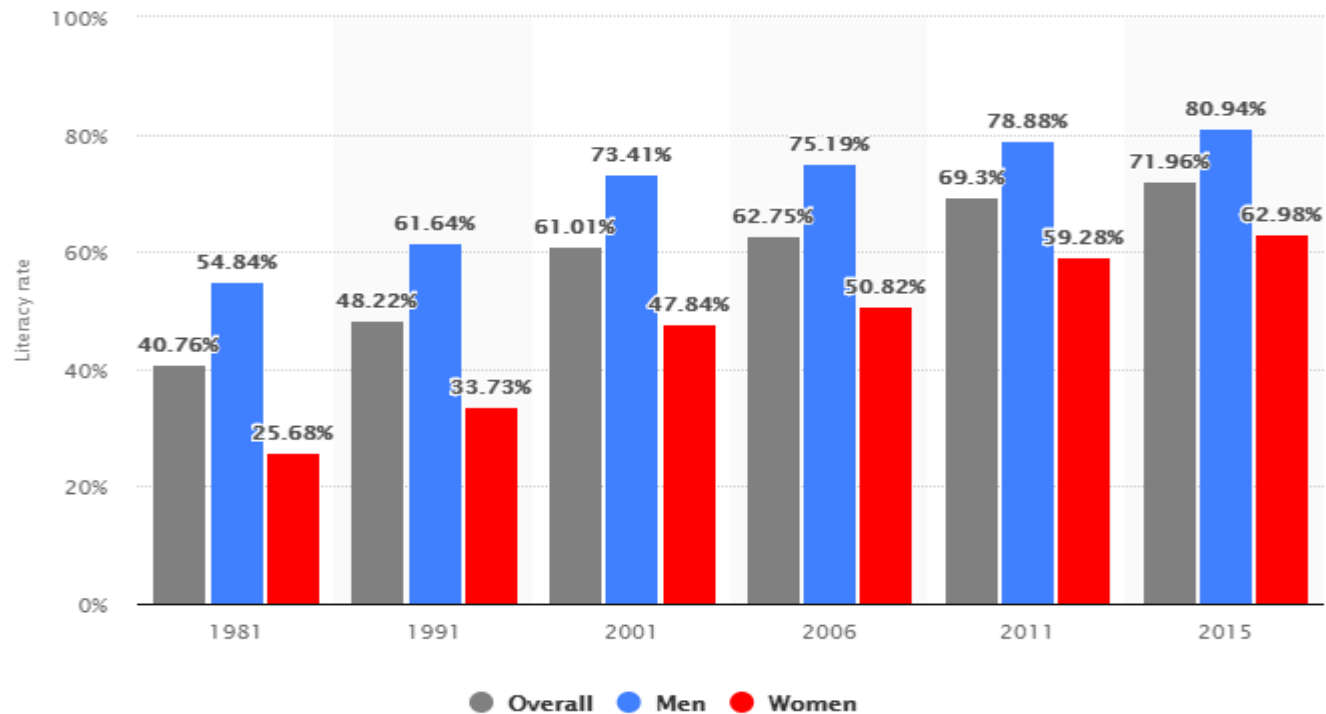
Government has launched Smart Cities Mission to improve urbanization which will increase among other things access to health care facilities

# Factors affecting Population mortality Improvement

## Literacy Rates



### India: Literacy rate from 1981 to 2015



Literacy rates in developed countries is close to 100%.



# Factors affecting Population mortality Improvement

## Tobacco Usage

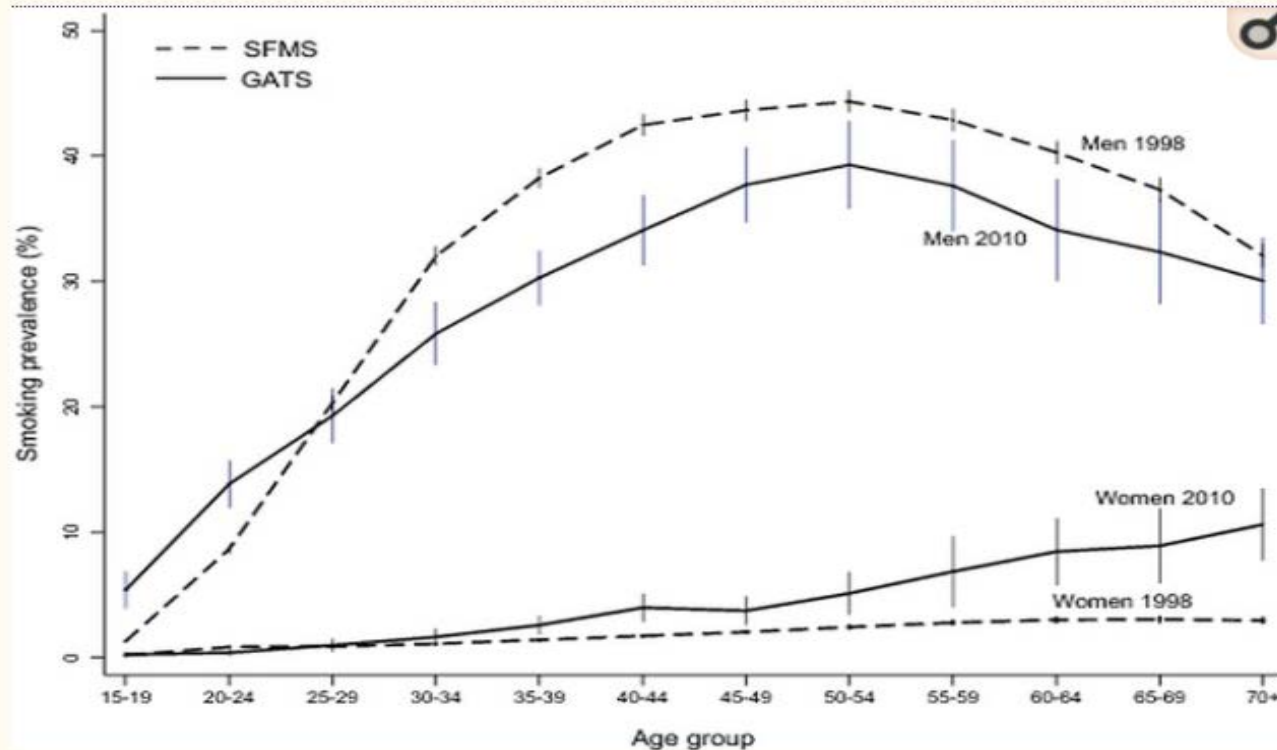


Figure 1

Smoking prevalence by age and gender (with 99% CI): 1998–2010. GATS, Global Adult Tobacco Survey; SFMS, Special Fertility and Mortality Survey.

# Factors affecting Population mortality Improvement



## Tobacco Usage – Global Adult Tobacco Survey 2017

### Significant changes compared to GATS 1

- 17% relative decrease in tobacco prevalence
- Tobacco use among 15-24 year olds showed relative reduction of 33% and for 15-17 year olds there was a 54% reduction.
- The age of initiation of tobacco use increased by 1 year ( 17.9 to 18.9).
- While there was a decrease in second-hand smoke exposure in public places (6%) and at home (13%), there was no decrease in workplaces.
- 9% (83 % to 92%) more believed that second-hand smoke is harmful
- 7% (89% to 96%) more believed that smokeless tobacco is harmful

### Areas of concern

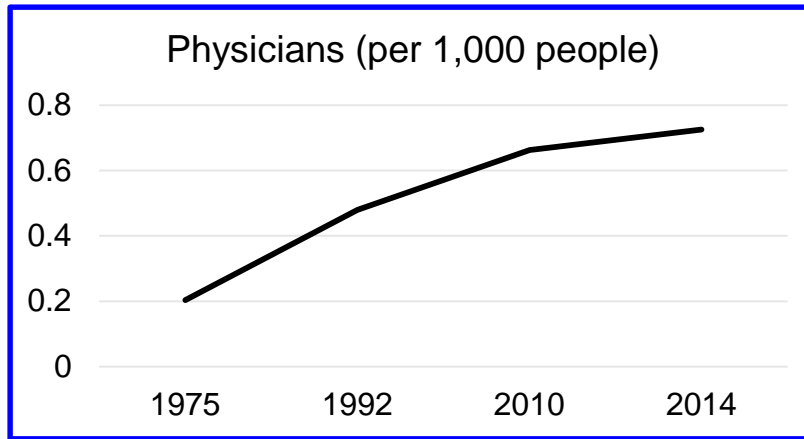
- 68% of smokers, 17% of bidi smokers, and 50% of smokeless tobacco users purchase loose tobacco.
- 30% of those who work indoors are exposed to second-hand smoke
- 23% adults are still exposed to SHS at public places.
- Nearly 10% of people still notice some form of tobacco advertisement.
- Despite the gutka ban, 51 million people were still able to buy gutka

Prevalence of Tobacco use is estimated to be circa 40%

# Factors affecting Population mortality Improvement

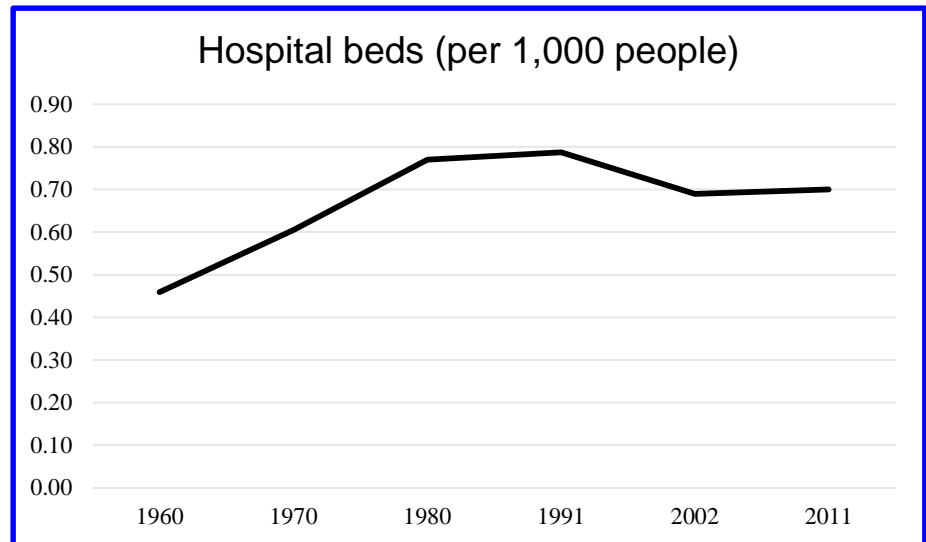


## Access to Health care – a key requirement



World average is 1.48 physicians per 1000 people as at 2013.

World average is 2.91 hospital beds per 1000 people as at 2005.



Ayushman bharat is expected to significantly improve access and quality of health care

While there are significant medical advancements, access to health care is key to ensure that it is made available to a larger population

# Factors affecting Population mortality Improvement



## Accidental Death rates

Average incidence of accidental deaths per year and average annual rates of accidental deaths for decades 1971 onwards reveal not only increasing accidental deaths in India but also continuous annual increase in the rate of accidental deaths (accidental deaths per 1 lakh population ) from **18.8 during 1971- 80 to 32.6 in 2013**.

The incidence of accidental deaths has shown an increasing trend during the period 2003 - 2013 with an increase of 54.3% in the year 2013 as compared to 2003. increase in the rate of accidental deaths during the same period was 25.5%.A total of 4,00,517 accidental deaths were reported in the country during 2013 (5,535 more than such deaths reported in 2012) showing an increase of 1.4% as compared to 2012. However, the average rate of Accidental Deaths has remained same 32.6 in 2012 and 2013.

Year	Average accidental deaths per year	Average Rate of accidental deaths per year
1971-80	113952	18.8
1981-90	145740	19.2
1991-2000	222840	24.0
2001-2010	310168	27.9
2011	390884	32.3
2012	394982	32.6
2013	400517	32.6

The incidence of accidental death rates in India are rising and this offsets some of the mortality improvements

# Indicator of Population mortality improvement



## Cause of death, by non-communicable diseases (% of total)

Country Name / Year	2000	2010	2015	2016
Sri Lanka	72.9	80.4	82.5	82.8
India	<b>46.1</b>	<b>55.9</b>	<b>61.7</b>	<b>62.7</b>
China	81.6	87	89	89.3
Japan	80.4	80.7	81.9	82.4
United States	88.0	88.4	88.2	88.3
United Kingdom	85.0	89.3	88.6	88.8

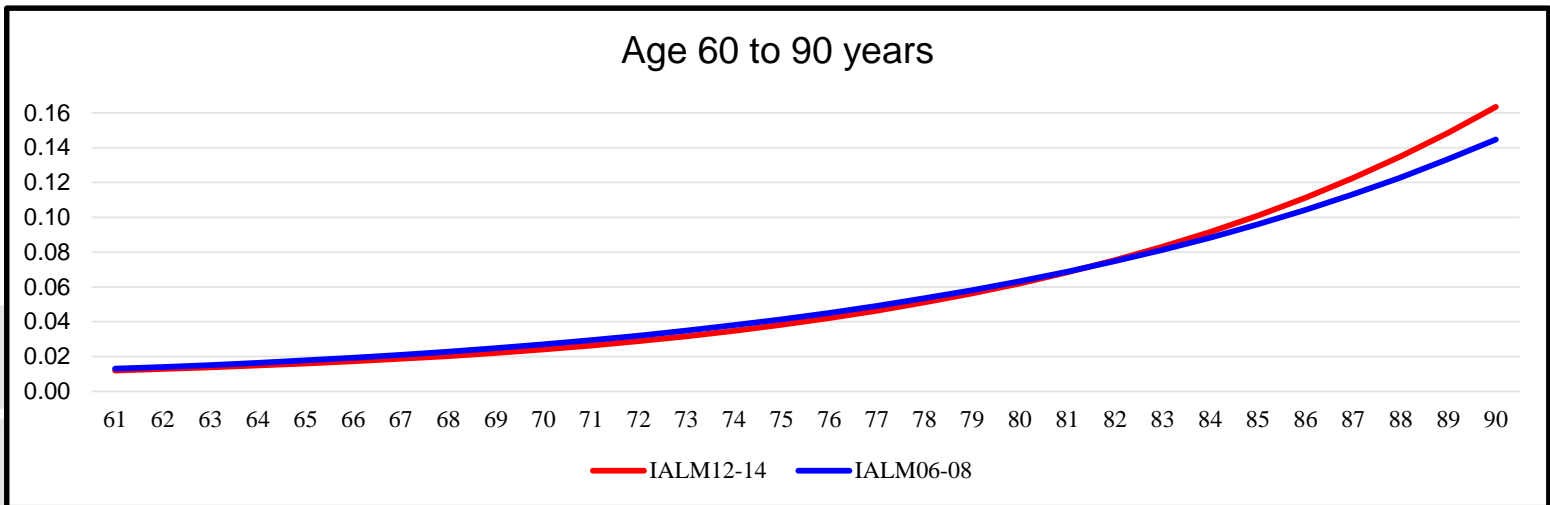
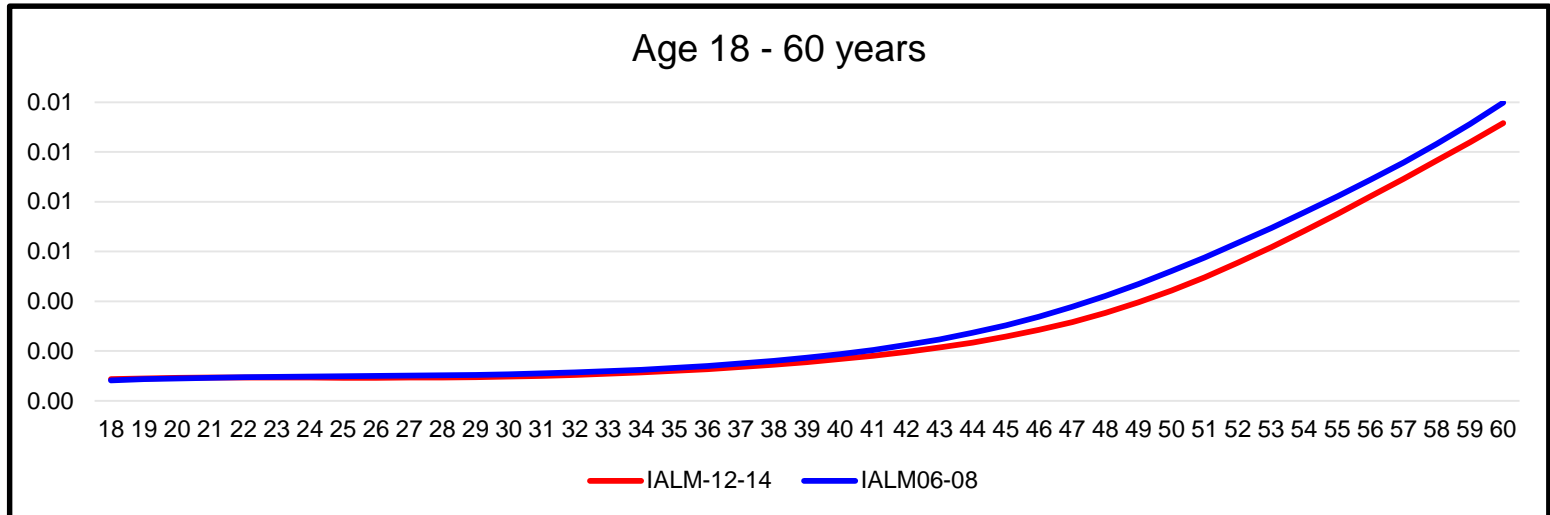
The % of death from non-communicable continue to be lowest in India.

With increase in urbanization, improved socio-economic status, better hygiene & sanitation together with medical advancements, we can expect proportion of deaths due to communicable diseases to further reduce over the next few years.

# Mortality Improvements in assured lives



## Comparison of IALM 06 – 08 v/s IALM 12 – 14

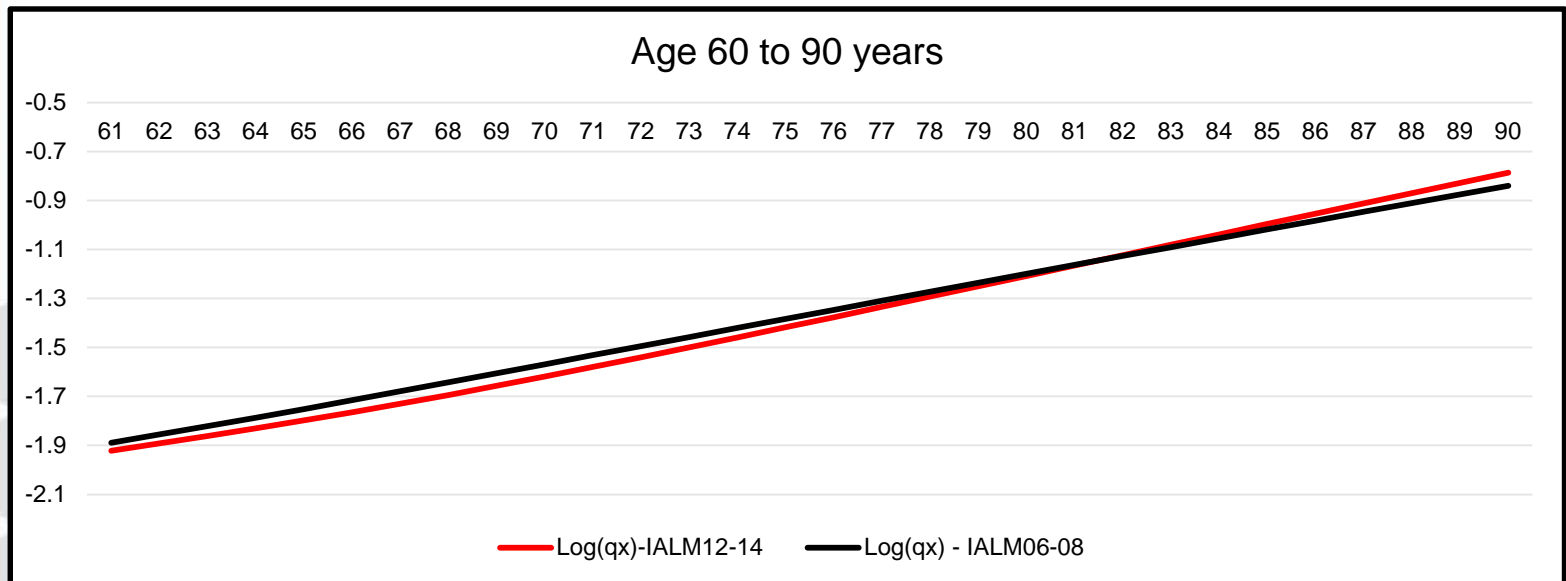
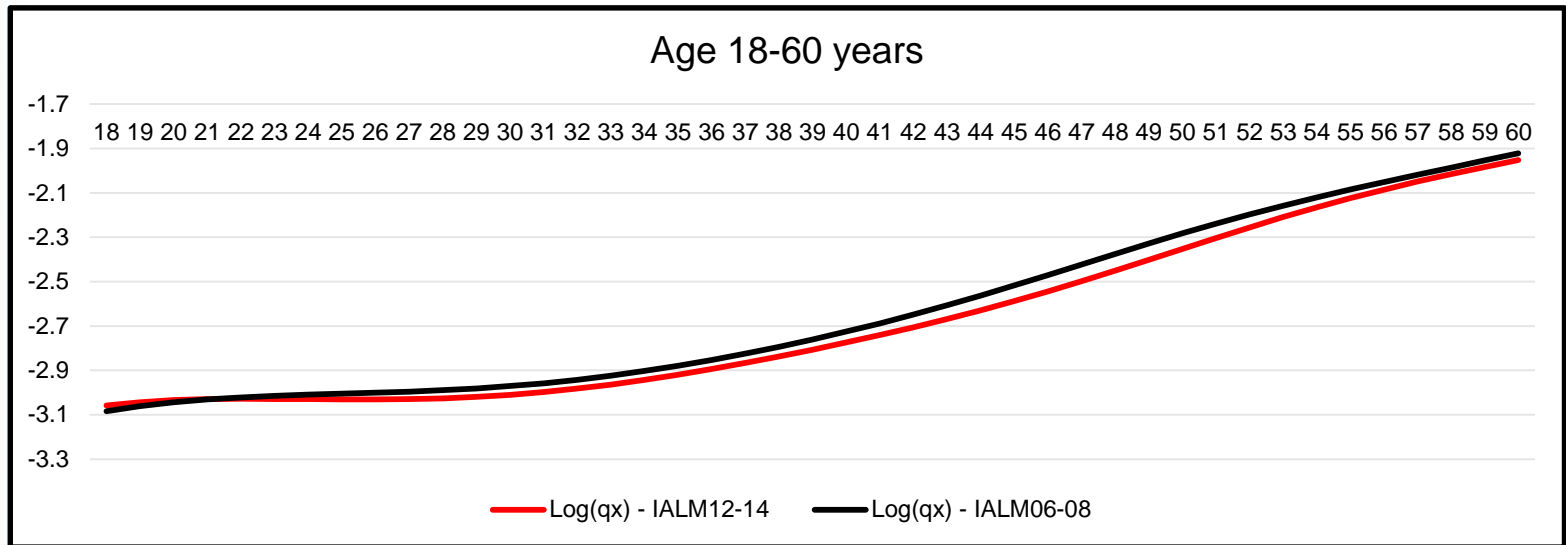


# Mortality Improvements in assured lives



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## Comparison of IALM 06 – 08 v/s IALM 12 – 14



# Mortality Improvements in assured lives



## Comparison of IALM 06 – 08 v/s IALM 12 – 14

Age Band	% annual improvement
25-29	1.26%
30-34	1.51%
35-39	1.63%
40-44	2.18%
45-49	2.81%
50-54	2.19%
55-59	1.24%
60-65	1.46%
<b>Grand Total</b>	<b>1.78%</b>

## Comparison of Life expectancy

Age Last Birthday	IALM 06 - 08	IALM 12 - 14
2	73.40	74.58
20	57.48	58.14
35	43.25	43.88
60	21.51	21.83

It is extremely difficult to fully articulate the amount of mortality improvement that has been observed in an insured-lives population from the industry data as there are changes in underwriting protocols, product mix, distribution mix between the two study period which can have a significant impact



# Mortality Improvements in insured population



## Factors impacting the mortality improvement assumption in insured population

- **Base table assumption**

The mortality improvement assumption should vary depending on the base mortality table. For e.g. mortality improvement assumption should vary when the base table is set at 30% of IALM vs say 100% of IALM.
- **Underwriting status**

The lives that are medically underwritten and have been categorized as standard / preferred are likely to experience least expected amount of mortality improvement. Medically substandard lives are likely to benefit more from medical advancements
- **Duration**

Lives that have been recently underwritten are likely to experience least amount of mortality improvements.
- **Socio-economic profile**

Lives with better socio-economic profile are likely to exhibit faster mortality improvement than the population in general. This is due to effective use of medical and technological advancements.
- **Age Cohort**

Different age cohort are likely to exhibit different levels of mortality improvements
- **Smoker status**

Smokers are likely to exhibit lower mortality improvements than non-smokers.

# Mortality Improvements in annuitants in other markets



## Improvements in Male Population Mortality in developed countries

	Ages					
	0-1	1-20	20-35	35-65	65-85	85-100
<b>US</b>						
1940-1960	3.2%	3.4%	2.6%	0.8%	0.3%	0.02%
1960-1980	3.7%	1.1%	-0.3%	1.1%	0.3%	0.04%
1980-2000	2.9%	2.5%	1.7%	1.5%	0.7%	-0.01%
2000-2007	0.8%	1.6%	-0.7%	1.0%	1.5%	0.2%
<b>Canada</b>						
1940-1960	4.0%	4.0%	2.3%	0.4%	0.3%	0.03%
1960-1980	4.7%	1.6%	0.3%	0.9%	0.3%	0.05%
1980-2000	3.6%	4.0%	2.3%	2.2%	0.8%	0.00%
2000-2007	0.2%	2.0%	1.2%	1.8%	1.7%	0.2%
<b>UK</b>						
1940-1960	4.7%	6.8%	6.2%	1.5%	0.3%	0.02%
1960-1980	3.1%	1.5%	1.1%	0.7%	0.2%	0.02%
1980-2000	4.0%	2.8%	-0.2%	2.2%	0.9%	0.03%
2000-2007	1.5%	1.9%	1.6%	1.9%	1.8%	0.2%

Average Annual Improvement in Rates of Mortality Between Indicated Ages (tqx)  
Human Mortality Database, 1940-2007

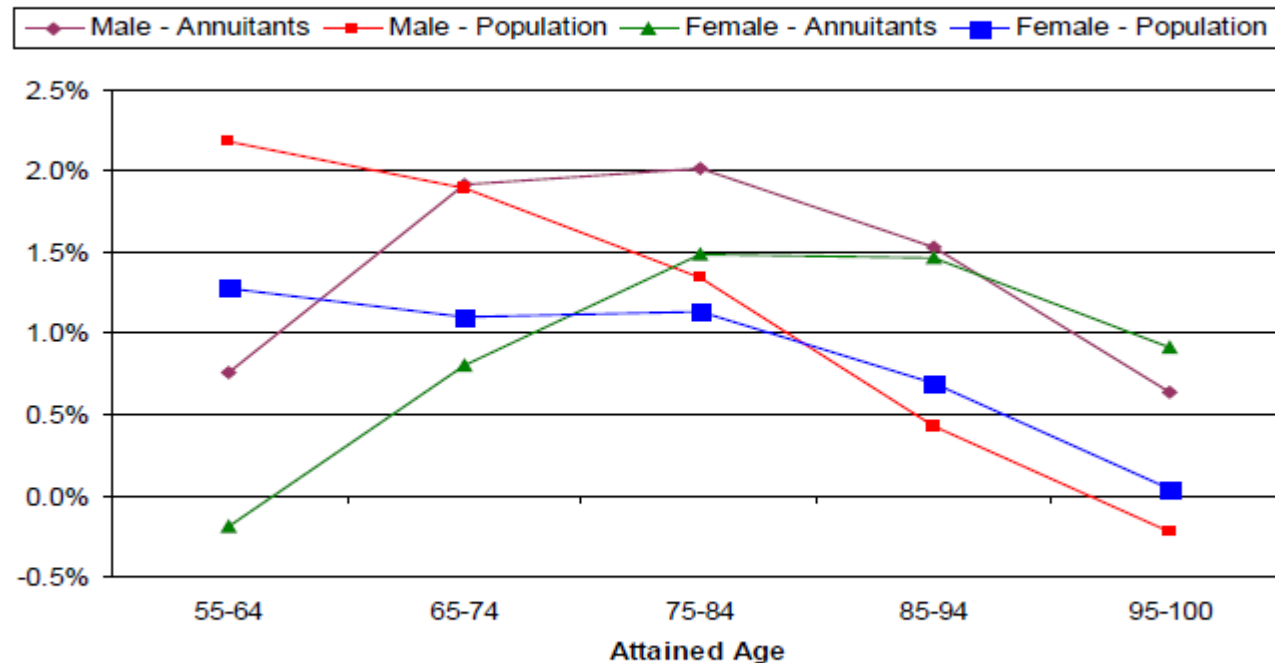
It is interesting to note that older aged lives are exhibiting higher mortality improvements in the recent years in developed nations

# Mortality Improvements in annuitants in other markets

**Evidence of self-selection & higher socio-economic status in annuitant mortality improvements**



**Chart 33: US Individual Annuitant vs. Population Mortality Improvement  
Experience Period 1973-2002**



Source: SOA Individual Annuity Experience Studies, Table Manager, HMD

- Mortality improvements are difficult to articulate and estimate particularly for insured population.
- For a developing country like India, the population is likely to continue to experience faster mortality improvements than developed nations for a foreseeable future.
- The insured lives too are likely to exhibit higher mortality improvements than the population due to improving socio-economic profile

Thank you very much for your attention !!