Mortality rates have fallen dramatically over time

Starting in developed countries in 18\textsuperscript{th} century

Continuing to fall today

In just past century life expectancy has increased by over 30 years

At the same time mortality rates remain much higher in poor countries
Difference in life expectancy between rich and poor countries ~ 30 years

Difference persists despite remarkable progress in health improvement in the last half century

There has been a rapid convergence of older adult mortality rates since 1970 in rich countries

Outside the rich countries average health is strongly correlated with income

Life expectancy per family is lower for countries with lower per capita income
convergence of older adult mortality rates since 1970 in rich countries, particularly among men (Deaton, 2004, Figure 7). Outside of the rich countries, average health is strongly correlated with income. As shown in Figure 1, the current version of a graph first drawn by Preston (1975) in which countries are represented by circles and the size of the circle is proportional to population, life-expectancy is profoundly lower for countries with lower levels of per capita income.

In the years just after World War II, life expectancy gaps between countries were falling across the world. Poor countries enjoyed rapid increases in life-expectancy in the 1950s, 1960s and 1970s, with the gains in some cases exceeding an additional year of life expectancy per year. The HIV/AIDS epidemic and the transition in Russia and eastern Europe have changed that situation. The best estimates of life-expectancy in some sub-Saharan African countries are lower now than they were in 1950. Life expectancy in Russia fell by nearly seven years over the 1990s. However, at least up to the 1990s, compound welfare measures that incorporate both health and income show both much greater inequality at any point in time and much greater international convergence than do income measures alone (Becker, Philipson and Soares, 2005).

There is also a positive relationship between income and health within countries—low-income people live shorter lives than high-income people in a given country. Americans in the bottom 5 percent of the income distribution in 1980 had a life-expectancy at all ages that was about 25 percent lower than the corresponding life-expectancies of those in the top 5 percent of the income distribution (Rogot, Sorlie, Johnson and Schmitt, 1992). These “health inequalities,” also known as

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**Figure 1**

**The Preston Curve: Life Expectancy versus GDP Per Capita**

*Source:* Reproduced from Deaton (2003, Figure 1).

*Note:* Circles are proportional to population.
In the years just after WW II life expectancy gaps between countries were falling across the world.

Now-poor countries enjoyed rapid increases in life expectancy in the 50s, 60s and 70s.

The HIV/AIDS epidemic has changed that situation.

Estimates of life expectancy is some sub-Saharan African countries are lower now than they were in 1950.
Determinants of Historical Decline in Mortality

Life expectancy at birth for hunter-gatherers was 25 years.

There had been little, if any, progress by the Roman Empire (200 AD).

Even in 1700 life expectancy at birth in England the Netherlands, the richest countries in the world at that time, was only 37 years.

In the 18th century mortality began to decline.

By 1820 life expectancy at birth was about 41 years.

It had increased six years from the previous century.
Between 1820 and 1870, the period of greatest industrialization, life expectancy remained stable at about 41 years.

Since 1870, mortality has fallen relatively continuously, as well as more rapidly than in the first phase.

Life expectancy in England climbed to 50 years in the first decade of the 20th century, and is about 77 years today.

Similar transition took place in all developed countries.

Reduction in mortality was not uniform by age.

Bulk of historical reduction in mortality occurred at younger ages.
Infants and children are the most vulnerable to infections, their mortality rates were most affected by the decline in infections. The sources of the reduction in infectious disease mortality have been extensively debated in the demographic community. We discuss the relevant factors in (possible) order of historical importance and conclude with some open issues.

**Improved Nutrition**

Agricultural yields increased significantly during the eighteenth century. Better-fed people resist most bacterial (although not viral) disease better, and recover more rapidly and more often. The British physician and demographer Thomas McKeown was the first person to argue for the importance of nutrition in improved health, writing several seminal papers on the topic which culminated in his widely read 1976 book. McKeown argued by residual analysis: neither personal health care nor public health appeared to have had much impact prior to the 1900s, when most of the mortality decline had already occurred. In a famous example, McKeown showed that mortality from tuberculosis fell by 80 percent before there was any effective treatment for the disease. The same is true for other infectious diseases as well. However, many analysts found unconvincing both McKeown’s dismissal of public health, as well as the argument by elimination that nutrition was the crucial factor (for example, Szreter, 1988; Guha, 1994).

Direct evidence on the role of nutrition in improved health and mortality reduction comes from the work of Robert Fogel, in a series of papers summarized...
Decline in infectious disease explains this disparate age pattern.

In 1848, 60% of deaths in England were from infectious disease.

Between then and 1971 infectious disease mortality declined by 95%.

Since infants and children are the most vulnerable to infections

⇒ their mortality rate was most affected by the decline in infections.
Sources of reduction in infectious disease mortality

Improved nutrition

Agricultural yields increased significantly during the 18th century

Better fed people resist most bacterial (although not viral) disease better and recover more rapidly and more often.
Public Health

Although public health and economic growth are positively correlated, it is not the sole explanation.

Even at a given level of income, people live substantially longer today than they did in the past.

For example, China in the year 2000, has the income level of the U.S. in the 1880s, but the life expectancy of the U.S. in 1970 (72 years)

Estimates show that only 15% of the increase in life expectancy between 1930 and 1960 is the result of increases in income alone.
Public health improvements are very important:

- filtering and chlorinating water supplies
- building sanitation systems
- draining swamps
- pasteurizing milk

Big public health did not fully come into its own until the acceptance of the germ theory of disease in the 1880s and 1890s

Led to a wave of new public health initiative and the conveyance of state health practices to individuals
Urbanization

Lack of improvement in mortality between 1820 and 1870

⇒ due in large part to greater spread of disease in newly enlarged cities
Vaccination

Prior to the 20th century, there was little effective medical treatment for infectious disease – since late 19th century several vaccines:

- rabies (1885)
- plague (1897)
- diphtheria (1923)
- tuberculosis (1927)
- tetanus (1927)
- yellow fever (1935)
- polio (1955)
- measles (1964)
- mumps (1967)
- rubella (1970)
- hepatitis B (1981)
Medical treatments

Quantitatively, more important for mortality was the development of therapeutics for people with disease.

Penicillin was the wonder drug of its era (1940s)

Medical interventions in the post WW II era which reduced cardiovascular disease
History of mortality reduction can be seen as encompassing three phases:

(1) Middle of the 18th century to the middle of the 19th century, improved nutrition and economic growth played the largest role.

(2) The closing decades of the 19th century and into the 20th century -- public health mattered more.

(3) Dating from 1930s -- era of big medicine starting with vaccination and antibiotics, and then expensive and intensive personal interventions that characterize the medical system today.
Determinants of mortality in poor countries

Life expectancy is much lower, and mortality rates are much higher in poor countries than in rich countries
convergence of older adult mortality rates since 1970 in rich countries, particularly among men (Deaton, 2004, Figure 7). Outside of the rich countries, average health is strongly correlated with income. As shown in Figure 1, the current version of a graph first drawn by Preston (1975) in which countries are represented by circles and the size of the circle is proportional to population, life-expectancy is profoundly lower for countries with lower levels of per capita income.

In the years just after World War II, life expectancy gaps between countries were falling across the world. Poor countries enjoyed rapid increases in life-expectancy in the 1950s, 1960s and 1970s, with the gains in some cases exceeding an additional year of life expectancy per year. The HIV/AIDS epidemic and the transition in Russia and eastern Europe have changed that situation. The best estimates of life-expectancy in some sub-Saharan African countries are lower now than they were in 1950. Life expectancy in Russia fell by nearly seven years over the 1990s. However, at least up to the 1990s, compound welfare measures that incorporate both health and income show both much greater inequality at any point in time and much greater international convergence than do income measures alone (Becker, Philipson and Soares, 2005).

There is also a positive relationship between income and health within countries—low-income people live shorter lives than high-income people in a given country. Americans in the bottom 5 percent of the income distribution in 1980 had a life-expectancy at all ages that was about 25 percent lower than the corresponding life-expectancies of those in the top 5 percent of the income distribution (Rogot, Sorlie, Johnson and Schmitt, 1992). These “health inequalities,” also known as

---

**Figure 1**

The Preston Curve: Life Expectancy versus GDP Per Capita

![The Preston Curve: Life Expectancy versus GDP Per Capita](image)

*Source:* Reproduced from Deaton (2003, Figure 1).

*Note:* Circles are proportional to population.
marked differences in who dies and from what. In poor countries, 30 percent of
deaths are among children, compared with less than 1 percent among rich
countries. In rich countries, most deaths are from cancers and from cardiovas-
cular diseases; in poor countries, most deaths are from infectious diseases. Most of these
diseases are but a historical memory in rich countries; today they kill people in poor
countries almost exclusively.

Yet there have been enormous improvements in life expectancy over the last
half century in today’s poor countries. In India and China, life expectancies have
risen by nearly 30 years since 1950 and, even in Africa, where there has been much
less economic progress, life expectancy rose by more than 13 years from the early
1950s to the late 1980s, before declining in the face of HIV/AIDS. The worldwide
decline in mortality after the World War II happened because 200 years worth of
progress against mortality in the now-rich countries was rapidly brought to bear on
mortality in the rest of the world. Measures such as improvements in water supply,
Life expectancy is much lower, and mortality rates are much higher in poor countries than in rich countries.

Also marked differences for who dies and from what.

In poor countries 30% of deaths are among children compared with less than 1% in rich countries.

In rich countries -- most deaths are from cancers and cardio-vascular diseases (non-communicable disease).

In poor countries -- most deaths are from infectious diseases (are but a historical memory in rich countries).
Yet there have been enormous improvements in life expectancy over the last half century in today’s poor countries.

In India and China life expectancy has risen by 30 years since 1950.

Even in Africa, where there has been much less economic progress, life expectancy rose by more than 13 years, between 1950 and 1980 (before HIV/AIDS).

World-wide decline in mortality after WW II happened because 200 years’ worth of progress against mortality in the now-rich countries was rapidly brought to bear in the rest of the world.
Measures such as improvements in water supply, cleansing the environment of disease, use of antibiotics, immunization of children

⇒ combined development of which in developed countries has taken many years
⇒ were introduced to the rest of the world over a relatively short span of time

Because those who previously died were mostly children

Because subsequent reduction in fertility followed only slowly

Rapid deployment of life-saving public health

⇒ population explosion of last half century
There is a great deal more to be done before health in poor countries resembles that in rich countries

Problem is not primarily lack of suitable treatments

Diarrheal disease and respiratory infections (1\textsuperscript{st} and 4\textsuperscript{th} leading causes of death world-wide) are easily and cheaply treatable:

- oral rehydration therapy (mixture of salts and sugar stops dehydration)

- antibiotics
Malaria has been fully controlled in rich countries by environmental measures

→ arguably can be controlled by similar measures (insecticide-impregnated bed-nets) in poor countries

Many of most successful programs in poor countries (immunization campaigns, eradication of smallpox and polio)

→ Campaigns run from outside the country by international organizations (WHO or UNICEF)

Some argue, although successful, these programs have done little to improve the domestic health care systems on which further progress on reducing mortality may depend
Role of economic growth in health improvements in poor countries has been controversial.

For the two largest countries, India and China:

- negative correlation between decadal rates of economic growth and rates of progress in reducing infant and child mortality

Just as in historical record -- no presumption that economic health will improve health without deliberate public action
Figure 4: Infant mortality and PPP GDP per head, India and China
Notes from “Nutrition in India: Facts and Interpretations” (Deaton and Dreze)

Indian economy is at historically unprecedented growth rates and is now one of the fastest growing economies in the world.

Real per capita income in India which was 2/3 of Kenya’s and Nigeria’s in 1950, is now 2 ½ times as large as per capita income in both countries.

Per capita calorie intake is declining same for many other nutrients.

More than ¾ of the population live in households whose per capita calorie consumption is less than minimum requirement in India.

Anthropometric indicators of nutrition in India for both adults and children are among the worst in the world.
Proportion of underweight children remained virtually unchanged between 1998 and 2006 (47% for the age group 0-3)

Under nutrition levels in India remain higher than for most countries in Sub-Saharan Africa

- even though those countries are much poorer
- and have higher levels of infant and child mortality
Leading hypothesis is that while real incomes have increased:

- offsetting reduction in calorie requirements
- due to declining levels of physical activity
- improvements in the health environment
- net effect is slow reduction in the per capita calorie consumption

Historical evidence of related episodes

- Britain from 1775-1850 (in spite of rising real wages) no apparent increase in real consumption of food

Per capita calorie consumption also appears to have declined in contemporary China in the 1980s and 1990s
2,100 calories. But all subsequent official poverty calculations have held the lines fixed in real terms, so that the official poverty ratios have declined as the distribution of per capita expenditure has moved upwards. As has been suggested by several authors, including Palmer–Jones and Sen (2001) and Ray and Lancaster (2005), we could take the calorie basis of the original lines more seriously and compute the fraction of the population living in households whose per capita calorie consumption falls beneath 2,400 calories in the rural sector and beneath 2,100 calories in the urban sector. Such calculations are shown in Table 5. Because the distribution of per capita calories is moving to the left over time, these numbers show rising poverty rates, from two thirds of the rural population in 1983 to four-fifths in 2004–05, and from 65 percent to more than 75 percent in India as a whole. Without understanding why per capita calories are falling despite rising per capita expenditures, it is difficult to adjudicate between these “calorie” poverty rates and the conventional “expenditure” poverty rates.

Table 5: Fractions of the population living in households with per capita calorie consumption below 2,100 urban and 2,400 rural

<table>
<thead>
<tr>
<th>Year</th>
<th>Round</th>
<th>Rural</th>
<th>Urban</th>
<th>All India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>38</td>
<td>66.1</td>
<td>60.5</td>
<td>64.8</td>
</tr>
<tr>
<td>1987–8</td>
<td>43</td>
<td>65.9</td>
<td>57.1</td>
<td>63.9</td>
</tr>
<tr>
<td>1993–4</td>
<td>50</td>
<td>71.1</td>
<td>58.1</td>
<td>67.8</td>
</tr>
<tr>
<td>1999–0</td>
<td>55</td>
<td>74.2</td>
<td>58.2</td>
<td>70.1</td>
</tr>
<tr>
<td>2004–5</td>
<td>61</td>
<td>79.8</td>
<td>63.9</td>
<td>75.8</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on NSS data.

The fact that calorie shortfalls (based on fixed calorie norms) are not automatically associated with self-reported hunger is shown by the evidence on the latter reported in Table 6. Except for the 1987–88 round, the NSS consumption surveys have included a question on food adequacy. In 1983 and 1993–94, respondents were asked whether everyone in the household got “two square meals a day”, while in 1999–2000 and 2004–05 the question was whether everyone in the household got “enough food every day”. Table 6 shows the fractions of people who did not
Table 6: Percentages of rural households reporting lack of food: India and major states

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J &amp; Kashmir</td>
<td>1.8</td>
<td>0.0</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Himachal</td>
<td>3.9</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Punjab</td>
<td>2.2</td>
<td>0.1</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.5</td>
</tr>
<tr>
<td>Haryana</td>
<td>1.8</td>
<td>0.6</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>4.2</td>
<td>1.5</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>10.7</td>
<td>3.3</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Bihar</td>
<td>34.0</td>
<td>6.8</td>
<td>6.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Assam</td>
<td>14.9</td>
<td>9.9</td>
<td>7.2</td>
<td>5.5</td>
</tr>
<tr>
<td>West Bengal</td>
<td>36.5</td>
<td>14.3</td>
<td>11.3</td>
<td>11.7</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.6</td>
</tr>
<tr>
<td>Orissa</td>
<td>35.1</td>
<td>14.2</td>
<td>7.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2.5</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>14.1</td>
<td>2.6</td>
<td>3.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Gujarat</td>
<td>3.1</td>
<td>2.2</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>13.0</td>
<td>4.4</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>14.4</td>
<td>3.2</td>
<td>2.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Karnataka</td>
<td>17.3</td>
<td>3.9</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Kerala</td>
<td>17.5</td>
<td>9.4</td>
<td>3.2</td>
<td>2.5</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>17.2</td>
<td>2.8</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>17.3</td>
<td>5.2</td>
<td>3.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Note: Questions not asked in the 43rd Round. – means state did not exist or there were no rural households in the sample. The question in the 38th and 50th round is “Do all members of your household get two square meals a day?” with possible responses 1 (yes, throughout the year) 2 (in some months) 3 (no). In the 55th and 61st round the words “two square meals a day” are replaced by “enough food every day.” The table shows the fractions of people living in households where the answer was other than 1. Note that samples are often small in the smaller states.

have adequate food (in that sense) throughout the year There are several reasons to treat these numbers as suggestive rather than definitive: the phrasing of the question is not identical in different years, there may be translation issues, and the changes from 1983 to 1993–94 are suspiciously large in several states such as Bihar and Madhya Pradesh. In so far as they are reliable, these figures show that the fraction of rural persons going hungry has fallen from 17.3 percent in 1983 to 2.5 percent in 2004–05. In the latest survey, only West Bengal, Orissa, Assam, and Bihar are above the national average, with Chhattisgarh and Kerala at the average. The relatively high prevalence of self-reported hunger in Kerala is somewhat puzzling and raises
the distribution. The bottom of the picture shows the urban curves—at the same level of real per capita expenditure, urban households consume fewer calories per head—and, apart from the curve for the 38th round in 1983 which cuts across the others—there is again a steady fall in the curves over time. Note that the rural calorie Engel curve in 2004–05 is close to the urban curve in 1987–88, a point to which we shall return.

Figure 1: Calorie Engel curves, rural and urban India, 1983 to 2004–05

Because the NSS has changed its questionnaires over this period, the graphs in Figure 1 are subject to numerous qualifications, but we do not believe they are seriously misleading. They show that in both urban and rural sectors better-off households (at least measured by per capita expenditure) consistently consume more calories than worse-off households, at least on average. The fall in calories in Table 1 comes about because the calorie Engel curves are shifting down over time. Why they should do so in a country as poor and malnourished as is India will be one of our main concerns in Section 3. For the moment, note that because the calorie Engel curves do
Per capita consumption of calories has fallen at all levels of per capita household expenditure.

The calorie Engel curves are shifting down over time.

Look at the nutrition status of Indian children.
Table 9: Child Nutrition Indicators, 1975-9 to 2004-5

<table>
<thead>
<tr>
<th></th>
<th>Proportion (%) of undernourished childrena</th>
<th>Percentage decline (1975-9 to 2004-5)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-for-age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 2 SD</td>
<td>77</td>
<td>69</td>
</tr>
<tr>
<td>Below 3 SD</td>
<td>37</td>
<td>27</td>
</tr>
<tr>
<td>Height-for-age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 2 SD</td>
<td>79</td>
<td>65</td>
</tr>
<tr>
<td>Below 3 SD</td>
<td>53</td>
<td>37</td>
</tr>
<tr>
<td>Weight-for-height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 2 SD</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Below 3 SD</td>
<td>2.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Prevalence of nutritional deficiency signs (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oedema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marasmus</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Bitot spots</td>
<td>1.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Angular stomatitis</td>
<td>1.8</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>5.7</td>
<td>5.7</td>
</tr>
</tbody>
</table>

a Based on NCHS standards (see Table 11).
b Difference between the 1975-79 and 2004-5 figures, as a ratio of the former.


there have been reductions of around 50 per cent in the prevalence of severe undernutrition (measurement below 3 standard deviations of the median of the reference distribution), whether one looks at weight-for-age (37 percent of the child population to 18 percent) or height-for-age (53 percent to 25 percent). The retreat of severe undernourishment can also be seen from the

3 The undernutrition figures are very similar for boys and girls. There is, in other words, little evidence of major gender differences in anthropometric achievements, according to NNMB data. The same conclusion follows from NFHS data. For instance, according to NFHS-3, boys and girls had exactly the same “mean z-scores” in 2005-6, not only in terms of weight-for-age but also in terms of weight-for-height and height-for-age (International Institute for Population Sciences, 2007, p. 270). This pattern is
However, there are significant differences between these two sources as far as trends in child nutrition are concerned.

**Table 10: Countries with the Highest Levels of Child Undernutrition, 1996-2005**

<table>
<thead>
<tr>
<th>Country</th>
<th>Proportion (%) of children with low “weight for age”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nepal</td>
<td>48.3</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>47.5</td>
</tr>
<tr>
<td>India</td>
<td>46.7</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>45.8</td>
</tr>
<tr>
<td>Yemen</td>
<td>45.6</td>
</tr>
<tr>
<td>Burundi</td>
<td>45.1</td>
</tr>
<tr>
<td>Madagascar</td>
<td>41.9</td>
</tr>
<tr>
<td>Sudan</td>
<td>40.7</td>
</tr>
<tr>
<td>Lao (People’s Dem Rep)</td>
<td>40.4</td>
</tr>
<tr>
<td>Niger</td>
<td>40.1</td>
</tr>
<tr>
<td>Eritrea</td>
<td>39.6</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>39.3</td>
</tr>
</tbody>
</table>

Source: *World Development Indicators, 2007*. Figures apply to the most recent year for which data are available within the reference period. There is a significant margin of error for individual countries.

**Recent Trends in Child Nutrition**

Until recently, trends in anthropometric indicators presented a reasonably clear picture. Whether one looked at, say, the heights or weights of children, or the “Body Mass Index” (BMI) of adults, the dominant pattern was one of sustained improvement. We have already noted some of these trends in the preceding section, as they emerge from NNMB data (Table 9). The first two rounds of the National Family Health Survey (NFHS-1 and NFHS-2) appeared to be broadly consistent with the NNMB data in this respect. For instance, according to NFHS data, the proportion of underweight children declined from 52 per cent in 1992-3 to 47 per cent in 1998-9 (International Institute for Population Sciences, 2000a, p. 267). NNMB data suggest a similar rate of decline—about one percentage point per year in the 1990s (Table 9). As discussed below, BMI data for Indian adults also show a sustained improvement over time, albeit from levels of height and weight that were (and still are) among the lowest in the world.
Close to half of all Indian children are under weight and about half suffer from anemia

There is an apparent stalling of nutritional improvement
below 2 cm per decade at age 3, and barely 1 cm per decade at age 5. The NNMB data also suggest that the growth rates of heights and weights were particularly slow in the later part of this period, with, for instance, very little growth in the heights of children at age 5 between 1996-7 and 2004-5.

Here again, however, there are significant differences between NNMB and NFHS data. For instance, a comparison between NFHS-1 and NFHS-3 suggests that children’s height at age 3 increased by about 2.5 cm per decade between 1992-3 and 2005-6, which looks much closer to the Chinese rates of increase. Further work is required to reconcile these different sources, and to assess the comparative progress of nutrition indicators in India and China.

Adult Weights and Heights
Recent nutrition trends can be further scrutinized from available data on adult weights and heights. A useful starting point is the “Body Mass Index” (BMI), defined as the ratio of weight (in kilos) to the square of height (in meters). Table 12 presents the proportion of men and women

<table>
<thead>
<tr>
<th></th>
<th>Proportion (%) of adults with Body Mass Index below 18.5</th>
<th>% decline (1975-9 to 2004-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>56</td>
<td>49</td>
</tr>
<tr>
<td>Women</td>
<td>52</td>
<td>49</td>
</tr>
</tbody>
</table>


6 This is subject to the earlier qualifications about missing data for specific states in some years. However, as with other anthropometric data for children, it is unlikely that the basic trends would be altered if a consistent series for the same states were to be constructed.
Table 13: International BMI Data (Women Aged 15-49 Years)

<table>
<thead>
<tr>
<th></th>
<th>Mean BMI</th>
<th>Proportion (%) of women with BMI &lt; 18.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>South Asia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>20.5</td>
<td>35.6</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>20.2</td>
<td>34.3</td>
</tr>
<tr>
<td>Nepal</td>
<td>20.6</td>
<td>24.4</td>
</tr>
<tr>
<td><strong>Sub-Saharan Africa</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eritrea</td>
<td>20.0</td>
<td>37.3</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>20.2</td>
<td>26.5</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>20.9</td>
<td>20.8</td>
</tr>
<tr>
<td>Chad</td>
<td>20.8</td>
<td>20.3</td>
</tr>
<tr>
<td>Madagascar</td>
<td>20.8</td>
<td>19.2</td>
</tr>
<tr>
<td>Niger</td>
<td>21.4</td>
<td>19.2</td>
</tr>
<tr>
<td>Senegal</td>
<td>22.3</td>
<td>18.2</td>
</tr>
<tr>
<td>Nigeria</td>
<td>22.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Zambia</td>
<td>21.6</td>
<td>15.0</td>
</tr>
<tr>
<td>Congo 2005</td>
<td>22.9</td>
<td>13.2</td>
</tr>
<tr>
<td>Guinea</td>
<td>21.8</td>
<td>13.2</td>
</tr>
<tr>
<td>Mauritania</td>
<td>24.3</td>
<td>13.0</td>
</tr>
<tr>
<td>Kenya</td>
<td>22.7</td>
<td>12.3</td>
</tr>
<tr>
<td>Uganda</td>
<td>22.2</td>
<td>12.1</td>
</tr>
<tr>
<td>Benin</td>
<td>22.4</td>
<td>10.7</td>
</tr>
<tr>
<td>Tanzania</td>
<td>22.3</td>
<td>10.4</td>
</tr>
<tr>
<td>Rwanda</td>
<td>21.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Ghana</td>
<td>23.1</td>
<td>9.3</td>
</tr>
<tr>
<td>Malawi</td>
<td>22.0</td>
<td>9.2</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>23.1</td>
<td>9.2</td>
</tr>
<tr>
<td>Mozambique</td>
<td>22.1</td>
<td>8.6</td>
</tr>
<tr>
<td>Gabon</td>
<td>23.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Lesotho</td>
<td>25.1</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Population-weighted average for sub-Saharan Africa (23 countries)</strong></td>
<td>21.9</td>
<td>15.8</td>
</tr>
</tbody>
</table>

Source: “Demographic and Health Surveys” (DHS) data available at www.measuredhs.com. The reference years vary between 2000-1 and 2005-6. India’s National Family Health Surveys (NFHS) are part of the DHS series.

with BMI below 18.5 (a standard cut-off conventionally associated with “chronic energy deficiency”) in the nine NNMB states. The proportion of individuals with low BMI, like that of underweight children, declined steadily during the last 30 years or so. In spite of this, Indian adults today (like Indian children) have some of the highest levels of undernutrition in the world,
Rate of growth of men’s height is 0.056 cm a year.

More than 3 times the growth of women’s height (0.018 cm a year)

This is in contrast to Chinese adults where both men and women have been gaining around 1 cm per decade

- Chinese men grown taller at twice the rate of Indian men
- No evidence in China of differential disfavoring of women as we see in India.

Growth rates of China are in line with historical experience

India is making much slower progress -- especially for women
Possible arguments for the decrease in calorie consumption

Food budget has been squeezed out because the cost of meeting the non food requirements is increasing

- Suppose households have access to school which was not available earlier
- School expenses would become a new item in the household budget
- Food expenditure would be curtailed to make room for them

Change in consumer tastes away from high-calorie foods
Declining needs for calories

⇒ decline in total fertility rate could be a source of reduction since pregnant women need more calories

Improved epidemiological environment

⇒ clean water
⇒ reduces the prevalence of disease
⇒ may also reduce calorific needs
especially diarrhoeal disease, and removes a potentially major source of calorie wastage. Other improvements in the disease environment may also reduce calorific needs. For instance, child vaccination rates have risen, and child health improves with mother’s education, which has also risen rapidly in recent years. To the extent that these and other improvements in the health environment reduce the susceptibility of children (and adults) to disease and infection, calorie requirements would be reduced.

Figure 10: Access to piped water, 1981 and 2001

Another possible source of reduction in calorie requirements is the reduction of activity levels (especially in rural areas), see for example Rao (2000, 2005). Aside from reducing

---

8 Calorie requirements increase sharply during episodes of diarrhoea. Note, however, that adults or children often reduce caloric intake during episodes of diarrhoea, contrary to expert recommendations (Scrimshaw et al, 1983). In that case, reduced exposure to diarrhoea may be irrelevant as an explanation for the calorie decline, though it will enhance the nutritional effects of any given calorie intake.
Another possible source of reduction in calories:

- reduction in activity levels (especially in rural areas)

Even improved access to piped water:

- can reduce the energy requirements associated with fetching and carrying water

Also the extension of road coverage
Farewell to Calorie-based Nutritional Assessment

Looking across the districts of India

→ correlation between average calorie intake and nutrition status of children is negative
epidemiological environment, the composition of the population, and other factors. Thus, simple comparisons of nutrition levels (say, between different regions or periods of time) based on average calorie intake can be very misleading. Indeed, average calorie intake in India is lower today than it was twenty years ago, yet the nutritional status of the population has improved. Similarly, looking across the districts and regions of India, the correlation between average calorie intake and, say, the nutrition status of children is negative, as Figure 13 illustrates: child

![Proportion of underweight children, 2004-5](image1)

![Per capita calorie consumption 2004-5](image2)

**Figure 12: Underweight children and per capita calorie consumption**

nutrition is worse in regions with higher levels of per-capita calorie intake.\(^\text{12}\) Even if there were a simple relationship between individual nutritional status and calorie consumption, there would be

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\(^{12}\) Figure 12 juxtaposes region-level NSS data on calorie intake in 2004-5 with district-level child nutrition data in 2002-4 from the second round of the Reproductive and Child Health (RCH) survey, also
Related puzzle:

➡️ child under-nutrition is also quite high among well-off households
need to be considered. On the one hand, some studies (e.g. Agarwal et al 1987, 1991) suggest that the anthropometric achievements of children in affluent Indian families are much the same as those of well-nourished children elsewhere, and indeed these Indian children are included in the international reference population that forms the basis of the most recent WHO “child growth standards” (World Health Organization, 2008). On the other hand, the NFHS data tell a different story, whereby a substantial proportion of Indian children are undernourished even among well-off households. To illustrate, Table 16 shows standard child nutrition indicators for different economic classes, defined in terms of the “wealth index” presented in the NFHS-3 report. As this table makes clear, child undernourishment declines sharply with increasing values of the index, as one might expect. However, even among the top 20 per cent of households, substantial proportions of children are undernourished: 20 per cent of children are underweight, 25 per cent are stunted, and 13 per cent are wasted (again, much the same figures as the sub-Saharan African averages).

Table 16: Child Nutrition and “Wealth”

<table>
<thead>
<tr>
<th>“Wealth index”</th>
<th>Proportion (%) of undernourished childrena</th>
<th>Weight-for-age</th>
<th>Height-for-age</th>
<th>Weight-for-height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td></td>
<td>57 (-2.2)</td>
<td>60 (-2.3)</td>
<td>25 (-1.2)</td>
</tr>
<tr>
<td>Second</td>
<td></td>
<td>49 (-2.0)</td>
<td>54 (-2.1)</td>
<td>22 (-1.1)</td>
</tr>
<tr>
<td>Third</td>
<td></td>
<td>41 (-1.8)</td>
<td>49 (-1.9)</td>
<td>19 (-1.0)</td>
</tr>
<tr>
<td>Fourth</td>
<td></td>
<td>34 (-1.5)</td>
<td>41 (-1.6)</td>
<td>17 (-0.9)</td>
</tr>
<tr>
<td>Highest</td>
<td></td>
<td>20 (-1.1)</td>
<td>25 (-1.1)</td>
<td>13 (-0.7)</td>
</tr>
<tr>
<td>All categories</td>
<td></td>
<td>42.5 (-1.8)</td>
<td>48.0 (-1.9)</td>
<td>19.8 (-1.0)</td>
</tr>
</tbody>
</table>

a “Mean z-scores” in brackets (expressed in terms of standard deviations).

Source: International Institute for Population Sciences (2007a), page 271. All figures pertain to children below the age of five years (note that the corresponding figures in Table 11 apply to children below the age of three years).

---

This index is constructed through “principal components analysis” from a list of 33 household assets and housing characteristics (such as ownership of various durables, access to electricity, and type of cooking fuel). For further discussion, see International Institute for Population Sciences (2007a), pp. 43-45.
Why is child under-nutrition also high among well-off households?

Possible Hypotheses:

(1) **Social Determinants**: poor epidemiological environment, inadequate social support, inappropriate social norms related to child feeding

(2) **Genetic Potential**: Indian children are naturally shorter even when they are well nourished

(3) **Gradual Catch-up**: Indian children have the same genetic potential as children in the reference population, but it takes time to catch up with the genetic potential given the history of under-nutrition
Main Message

Urgent need for better nutrition monitoring in India

Examination of recent evidence on nutrition is far from conclusive

Nutrition situation in India is full of puzzles
Notes from “Health Care Delivery in Rural Rajasthan” (Banerjee, Deaton, Duflo)

WHO has argued that better health care is key to improving health as well as economic growth in poor countries.

Little systematic evidence on how to influence the quality of health care delivery in developing countries.

This example from rural Rajasthan suggests

- there is an extensive system of health care delivery which is quite dysfunctional
- makes reform of the system quite a challenge
In several Indian states:

- 43% of health care providers in public primary health care centers were absent

- 41% of providers are unqualified

Some evidence that between 1986 and 1996 there was a worsening of inequalities in access to health care
Rural Rajasthan Data

Data from Udaipur district or Rajasthan:

- one of the poorest districts in India
- large tribal population
- unusually high illiteracy (only 5% of women are literate)

Households are very poor:

- Average per capita household expenditure is 470 rupees
- More than 40% of people live below the poverty line
- Households have little in the way of durable goods
- 21% have electricity
Their health is also very poor:

- 93% of adult men and 88% of adult women have BMI, less than 21, (considered cut-off for low nutrition in the U.S.)
- 30% or more would have difficulty walking 5 km, drawing water from a well, or working unaided in the fields
- 20% have difficulty squatting or standing up from a sitting position

Yet when asked to report their own health status:

- less than 7% consider themselves to be in bad health
- according to life satisfaction measures – not dissatisfied with life
These people are presumably adapted to the sickness that they experience in that they do not see themselves as particularly unhealthy or unhappy.

At the same time -- accurately report themselves as low financial status:

• 70% of the people see themselves as poor
Use of Health Care

The average household spends 7% of its budget on health.

The poor spend less in absolute amounts -- but spend the same share of their budget.
The continuous facility survey (CFS) may be the most original part of the project. We identified all the public facilities (143) serving the sample villages, and hired one para-worker living close to each facility, who was given the responsibility of checking the facility every week. The para-worker pays an unannounced visit to the facility during opening hours, checks whether the facility is open, and counts the number of doctors, nurses, other medical and non-medical personnel, as well as clients present at the facility. If the facility is closed because the staff is performing a scheduled village visit, the para-worker goes to the village that the staff is supposed to be visiting, and checks whether he or she can be found in that village. To ensure the quality of data collected in the continuous facility survey, we have put in place a strictly enforced monitoring system – every four weeks all the CFS para-workers of a block met, and we collected their data entry forms. They were also given a schedule indicating on which day they must complete their visit in each week of the following month. Two members of the team of investigators used motorcycle transport to visit several facilities every day, following the schedule given to the CFS para-worker. The para-workers were paid only if their visits have been completed on the planned day, and if there were no unexplained discrepancies between their report and that of the CFS monitor. The CFS monitors also visited the facilities on different days, so that we could check that there was no collusion between the para-worker and the facility staff. This survey took place for 13 to 14 months, including a ‘pilot period’ of one to two months in each facility, where the system was fine-tuned. We report data for 12 months for each facility. The survey is complemented by a detailed one-time facility survey, which, among other things, will allow us to identify correlates of absenteeism in the centres.

### Health Status

The households in the Udaipur survey are poor, even by the standards of rural Rajasthan. Their average per capita household expenditure (PCE) is Rs 470, and more than 40 per cent of the people live in households below the official poverty line, compared with only 13 per cent in rural Rajasthan in the latest official counts for 1999-2000. Only 46 per cent of adult males (14 years and older) and 11 per cent of adult females report themselves literate. Of the 27 per cent of adults with any education, three-quarters completed standard eight or less. These households have little in the way of durable goods and only 21 per cent of households have electricity.

In terms of measures of health, 80 per cent of adult women and 27 per cent of the adult men have haemoglobin levels below 12 grams per decilitres. Five per cent of adult women and 27 per cent of the adult men have haemoglobin levels below the recommended levels. The households in the Udaipur survey are poor, even by the standards of rural Rajasthan. Their average per capita household expenditure (PCE) is Rs 470, and more than 40 per cent of the people live in households below the official poverty line, compared with only 13 per cent in rural Rajasthan in the latest official counts for 1999-2000. Only 46 per cent of adult males (14 years and older) and 11 per cent of adult females report themselves literate. Of the 27 per cent of adults with any education, three-quarters completed standard eight or less. These households have little in the way of durable goods and only 21 per cent of households have electricity.

In terms of measures of health, 80 per cent of adult women and 27 per cent of the adult men have haemoglobin levels below 12 grams per decilitres. Five per cent of adult women and 1 per cent of adult men have haemoglobin levels below the recommended levels.
cent of adult men have haemoglobin levels below 8 grams per
decilitres. Strikingly, using a standard cut-off for anaemia (11 g/
dl for women, and 13 g/dl for men), men are almost as likely
(51 per cent) to be anaemic as women (56 per cent) and older
women are not less anaemic than younger ones, suggesting that
diet is a key factor. The average body mass index is 17.8 among
adult men, and 18.1 among adult women. Ninety-three per cent
of adult men and 88 per cent of adult women have BMI less
than 21, considered to be the cut-off for low nutrition in the US
[Fogel 1997]. We also used peak-flow meter measurement to
measure lung capacity in an attempt to detect asthma or other
respiratory disorders such as (chronic bronchitis). Among adults,
the average peak-flow meter measurement is 316 ml per expir-
ation (anything below 350 ml for an adult 1.60 metres tall is
considered to be an indicator of respiratory difficulties).

Symptoms of disease are widespread, and adults (self) report
a wide range of symptoms; one-third report cold symptoms in
the past 30 days, and 12 per cent say the condition was serious.
33 per cent reported fever (14 per cent serious), 42 per cent (20
serious) reported ‘bodyache’, 23 per cent (7 serious) per cent
reported fatigue, 14 (3 serious) per cent problems with vision,
42 (15) per cent headaches, 33 (10) per cent backaches, 23 (9)
per cent upper abdominal pain, 11 (4) per cent had chest pains,
and 11 (2) per cent had experienced weight loss. Few people
reported difficulties in taking care of themselves, such as bathing,
dressing, or eating, but many reported difficulty with the physical
activities that are required to earn a living in agriculture. Thirty
per cent or more would have difficulty walking 5 km, drawing
water from a well, or working unaided in the fields. Eighteen
to twenty per cent have difficulty squatting or standing up from
a sitting position.

In Table 1, we show the number of symptoms reported in the
last 30 days, body mass index, fraction of individuals with
haemoglobin count below 12, peak-flow meter reading, high
blood pressure, low blood pressure, broken down by third of the
distribution of monthly per capita expenditure, which we col-
lected using the abbreviated consumption questionnaire. Indi-
viduals in the lower third of the per capita income distribution
have, on average, a lower body mass index, lower lung capacity,
and are more likely to have a haemoglobin count below 12 than
those in the upper third. Individuals in the upper third report the
most symptoms over the last 30 days, perhaps because they are
more aware of their own health status; there is a long tradition
in Indian and developing-country literature of better-off people
reporting more sickness [Murray and Chen 1992, Sen 2002].

Yet, when asked to report their own health status, shown a
ladder with 10 rungs, 62 per cent placed themselves on rungs
five through eight (more is better), and less than 7 per cent place
themselves on one of the bottom two rungs. Unsurprisingly,
old people report worse health, and women at all ages also consist-
tently report worse health than men, which appears to be a
worldwide phenomenon [Sadana et al 2002] and richer people
report better health than poorer people, but most people report
themselves close to the middle. Nor do our life-satisfaction
measures show any great dissatisfaction with life: on a five point
scale, 46 per cent take the middle value, and only 9 per cent say
their life makes them generally unhappy. Such results are similar
to those for rich countries; for example, in the US, more than
half of the respondents report themselves as a three (quite happy)
on a four-point scale, and 8.5 per cent report themselves as
unhappy or very unhappy. These people are presumably adapted
to the sickness that they experience, in that they do not see
themselves as particularly unhealthy nor, in consequence,
unhappy. Yet they are not so adapted in their reports of their
financial status, which was also self-reported on a 10-rung ladder.
Here the modal response was the bottom rung, and more than
70 per cent of the people live in households that are self-reported
as living on the bottom three rungs.

IV
Patterns of Health Care Use

In the household survey we also asked where people go to get
health care. Table 2 shows these results. We see that adults visit
a health facility on average 0.51 times a month. The poor, defined
here as people who are in households in the bottom third of the
distribution of PCE (average Rs 219) per month, visit a facility
0.43 times in a month, while an adult in the middle third of the
distribution (average PCE Rs 361) visits a facility 0.54 times a
month.

<table>
<thead>
<tr>
<th>Distance from road</th>
<th>Number of Subcentres and Aid Posts</th>
<th>PHC and CHC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Km from road</td>
<td>5103</td>
<td>0.56</td>
</tr>
<tr>
<td>&gt;0 and &lt;=5 km from road</td>
<td>1478</td>
<td>0.55</td>
</tr>
<tr>
<td>&gt;5 km from road</td>
<td>403</td>
<td>0.38</td>
</tr>
<tr>
<td>Closest to Udaipur</td>
<td>2315</td>
<td>0.53</td>
</tr>
<tr>
<td>Farther</td>
<td>2254</td>
<td>0.58</td>
</tr>
<tr>
<td>Farthest</td>
<td>2415</td>
<td>0.54</td>
</tr>
<tr>
<td>Distance from the nearest town</td>
<td>2350</td>
<td>0.56</td>
</tr>
<tr>
<td>Closest to town</td>
<td>2396</td>
<td>0.55</td>
</tr>
<tr>
<td>Farther</td>
<td>2238</td>
<td>0.54</td>
</tr>
<tr>
<td>Reservations for women</td>
<td>2583</td>
<td>0.57</td>
</tr>
<tr>
<td>Electricity</td>
<td>3123</td>
<td>0.56</td>
</tr>
<tr>
<td>Water</td>
<td>1564</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Table 6: Absenteeism by Types of Facilities

<table>
<thead>
<tr>
<th>Number of Visits</th>
<th>Fraction of Medical Personnel Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcentres and Aid Posts</td>
<td>PHC and CHC</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Distance from road</td>
<td>5103</td>
</tr>
<tr>
<td>&gt;0 and &lt;=5 km from road</td>
<td>1478</td>
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</tr>
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</tr>
<tr>
<td>Farthest</td>
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<tr>
<td>Closest to town</td>
<td>2350</td>
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<tr>
<td>Farther</td>
<td>2396</td>
</tr>
<tr>
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<td>2583</td>
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<tr>
<td>Electricity</td>
<td>3123</td>
</tr>
<tr>
<td>Water</td>
<td>1564</td>
</tr>
</tbody>
</table>

Note: Some data covers only a subset of facilities.
month and an adult in the highest group (average PCE Rs 770) visits the facility 0.55 times a month. The difference between the top third and the middle third, on the one hand, and the bottom third on the other, is significant, and remains so with village fixed effects. Of these 0.51 visits, only 0.12 visits (less than a quarter) are to a public facility. The fraction of visits to a public facility is highest for the richest group, and lower for the other two groups, but about the same for each. Overall, the rich have significantly more visits to a public facility than the poor. No one uses public facilities very much, and if anything, the poor use them less than the non-poor.

The majority of the rest of the visits (0.28 visits per adult per month) are to private facilities. The rest are to ‘bhopas’ (0.11 visits per adult per month), who are traditional healers. For the poor, the fraction of visits to a bhopa is well over a quarter of all visits, while for the richest group it is about an eighth of all visits.

In terms of expenditure, columns 1 and 2 of Table 3 show the monthly expenditure on health, calculated in two ways, namely, from the expenditure survey, and from the expenditures reported in the adult and children survey. The numbers are similar, except for the rich where the expenditure derived from the expenditure survey is much larger than that calculated from the addition of last month’s visit. Column 3 shows the expenditure as a fraction of household total expenditures, and from the expenditures reported in the adult and children survey, as a fraction of personal expenditures. The average household spends 7 per cent of its budget on health. While the poor spend less in absolute amounts, they spend the same amount as a share of their budget. Column 4 shows the average health expenditure for adults. It is about Rs 60 rupees, or 13 per cent of the monthly PCE of the family. This fraction is highest for the poorest (15 per cent) and lowest for the richest group (11 per cent). Poor adults spend 13 per cent of their total health expenditure at public facilities, 23 per cent on bhopas, and the rest at private facilities. The rich spend 23 per cent of their total health expenditures at public facilities, and less than 10 per cent on bhopas, while the middle group spends more than 17 per cent of their health expenditures on bhopas and 13 per cent at public facilities. The rich, therefore, spend a significantly larger fraction of their health expenditure on public facilities than the poor, and a significantly smaller fraction on bhopas. Part of the difference in the consumption of public health care can be attributed to where the rich live, since, once we control for village fixed effects, the difference is smaller (5 per cent) and insignificant.

V Public Health Care Facilities

Official policy provides for one subcentre, staffed by one trained nurse (ANM), for every 3,000 individuals. Subcentres and primary health centres (PHCs) or community health centres (CHCs), which are larger than PHCs, are supposed to be open six days a week, six hours a day. In principle, the system is intended to provide more or less free and accessible health care to anyone who chooses to use the public health care system, with the sub-centres, staffed by a trained nurse (ANM) providing the first point of care, the PHCs or CHCs the next step, and the referral hospitals dealing with the most serious health problems. In our data, each subcentre serves 3,600 individuals on average, and is usually staffed by one nurse. A primary health centre serves 48,000 individuals and has on average 5.8 appointed medical personnel, including 1.5 doctors.

Why then do we see people not making use of the public health system and relying on private health care and bhopas? This is a population where almost no one is really rich and the poor, who are just as reluctant to use the public system as anyone else, are actually extremely poor.

In part, the answer must lie in the way the public system actually works. Public health facilities were surveyed weekly, and we have on average 49 observations per facility. Table 4 summarises the

<table>
<thead>
<tr>
<th>Table 6: Pattern in Opening of Centre</th>
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<table>
<thead>
<tr>
<th>A. F statistics</th>
<th>PHC and CHC</th>
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<tbody>
<tr>
<td>Facility dummies</td>
<td>6.16</td>
</tr>
<tr>
<td>Day of visits dummies</td>
<td>no</td>
</tr>
<tr>
<td>Facility dummies* day</td>
<td>no</td>
</tr>
<tr>
<td>Time of visit dummies</td>
<td>no</td>
</tr>
<tr>
<td>Facility dummies* time of visit</td>
<td>no</td>
</tr>
<tr>
<td>Adjusted R2</td>
<td>0.12</td>
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<tr>
<td>Observations</td>
<td>6342</td>
</tr>
<tr>
<td>B. Fraction of facility level regressions where the dummies are jointly significant</td>
<td></td>
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<tr>
<td>Day of visit dummies</td>
<td>0.095</td>
</tr>
<tr>
<td>Time of the day dummies</td>
<td>0.086</td>
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</tbody>
</table>

Notes: 1 Panel A report F statistics and p value for the joint hypothesis that the dummies are significant in a regression where the dependent variable is the fraction of personnel present on the day of the visit.

2 Panel B reports the results from running a separate regression for each facility, where the dependent variable is the fraction of personnel present on the day of the visit, and the explanatory variables are day of the visit dummies, time of the visit dummies, and season dummies.
The picture painted by the data is bleak

Villagers’ health is poor despite heavily using health care facilities and substantial spending on health care.

The quality of public services is abysmal and private providers are generally unqualified.

At the same time, villagers seem content with what they are getting:

- 81% report that their last visit made them feel better
How to stop Malaria?

881,000 die each year
91% in Africa
85% under 5
The Case for Bednets

- Malaria is transmitted by mosquitoes, mainly at dusk.
- Long Lasting Insecticide Treated Bednets prevent mosquitoes to bite
The Case for Bednets

- They don’t bite an un-infected person, so they are less likely to get malaria themselves (DIRECT effect).
- They don’t bite an infected person, so they are less likely to carry the parasite (INDIRECT effect, or externality).
- The externality is not linear: when enough people sleep under a bednet, mosquito don’t have enough to eat, and end up dying: there is a distinct advantage to get 50% coverage.
The traditional economics argument

- Traditional economics tells us that, whenever there is an externality, such that the **private incentives** are not aligned to the social benefit, tax or subsidies should be used to align private incentives.
- Here, this would argue for subsidizing bednets, but only if the private benefits are not large enough that people already buy one at full price.
- Moreover, with a new good (such as LLIN nets), people need to learn how to use it, and be convinced it is worthwhile: giving nets for free may be a way to get the ball rolling.
Less conventional economics

• But there are some arguments that go in the opposite direction. They are based on less traditional economics
  ○ Psychological sunk cost effect. Normally, once you have purchased something, how much you paid for it should not matter. But perhaps, in fact, it does matter: how much you pay give you a sense of the value of a good.
  ○ Selection effect: if you give things away for free, even people who do not intend to use it will get it: again, you will waste bednets.
  ○ Entitlement effects: if you give things away for free, people will expect to get that thing (and perhaps everything else!) for free in the future
Heated policy debate

- Jeff Sachs, WHO: Give bed nets for free.
  - We know the science, no need to do experiment
- Easterly, Dambisa Moyo, Population Service International: don’t give them for free.
  - We know the economics, no need to do experiment!
- The true question of course is the extent to which they should be subsidized...
What we need to know

- We need to know:
  - The price elasticity of the demand for bednets: if people are willing to purchase a price at the full cost, then subsidies are not needed—if they are not willing to purchase one at ANY price, then price subsidies may be needed
  - The immediate effect on use: are people who pay for bednet more likely to use one. How much do they need to pay?
  - The longer term effects—Will it wreck markets?
    - On people who get it for free: will they buy nets in the future?
    - On their friends and neighbors? Will they hold out for a free bednet?
How can we find out?

- Anecdotes...
Photo: Minakawa et al. 2008, "Unforeseen misuses of bed nets in fishing villages along Lake Victoria,"

Malaria Journal
How can we find out?

- **Anecdotes...**
  - There are certainly plenty. But usually they cut both ways.

- **Compare purchase/use at various prices**
  - Some clinic may give them for free, other villages may not have that system, so any bednets are more likely to be obtained in the market
  - Do we see fewer in those villages?
  - Do we see that the few we see are used differently?
But the problem is...

- What is the right counterfactual: what would have happen in the other situation?
- For example
  - Bednets may be distributed for free in area where malaria is a huge problem.
  - So even if people had to pay for them, they would have been more likely to get them
Purchase when bednets are expensive

[Diagram]
- High malaria
- Low malaria

Purchases
Purchase when bednets are free

Purchases

High malaria

Low malaria
True effect of price on purchase

- High malaria
  - Expensive
  - Free

- Low malaria
  - Expensive
  - Free
Our estimate of effect if we compare low and high malaria regions
The bias

Effect
Bias

High malaria
Low malaria

Purchases
Observed demand at various prices
Demand we would observe in region with free bed net, if bednets were not free
Bias in elasticity
Problem and solution

**Problem:**
- What we observe in the world reflect:
  - Selection bias: behavior of people would be different in different places, **EVEN IF THE PRICES WERE THE SAME**
  - The actual treatment effect.
- And we don’t know how to separate those two effects: we do not observe how people would have behaved with a low price in the high price region (and vice-versa)

**Solution:**
- *Randomly* assign different prices in the same region
- Now, there is no *systematic* difference between people who face a high price and people who face a low price.
- Of course there is still the usual random noise: the sample must be large enough, and there will be some uncertainty around our estimates of the mean effects.
Dupas’ experiments

- First experiment (with Jessica Cohen)
  - Randomly chose clinics, and offer bednets at different prices.
  - Track purchase, and usage, in those clinics
- Findings: Compare purchase and usage at each price
Weekly Net Sales Across ITN Prices
Program ITN Usage Rates (Conditional on Take-up), by ITN Price
Effective Coverage: Program ITN Usage Rates, Unconditional on Take-up
Dupas’ experiments

- **First experiment (with Jessica Cohen)**
  - Randomly chose clinics, and offer bednets at different prices.
  - Track purchase, and usage, in those clinic
- **Findings: Compare purchase and usage at each price**
  - Number of sales falls quickly with price
  - Usage, conditional on getting a net, does not fall
  - So effective take up indeed declines quickly with price
Policy Implications

- What is the best price at which to charge for bednets?
- One possible way to ask the question: price that will minimize the cost per malaria death averted
- Trade off:
  - Free bednets: more coverage
  - But it cost you money...
- It turns out that in this case, the CHEAPEST way to avert malaria from the policy perspective is free bednet. Why?
The controversy

- When Dani Rodrik posted these findings on his website some people objected. Their main objections were:
  - Pregnant women: all of them really need the bednets
  - Product was well known in Kenya
  - Long term effect may differ from short term effect

- This questions are all about *external validity*: Is the experiment valid outside of a specific context
What is the next step needed to check these objections:

- A different country: Uganda, Madagascar
- Kenya, but not pregnant women
- A new kind of bednet
- An experiment for the long term effects:
  - Entitlement effect
  - Social effects
A New Experiment

- New experimental design by Pascaline Dupas to try to address most of these questions
- Randomization done in the general population (men and women)
  - Phase 1: Different discount vouchers are randomly distributed to individuals, for buying a new kind of bednets available in shops, at various price-
    - Check purchase, use, and purchase by neighbors
  - Phase 2: After a few months, the new bednet is available for the same price for every one
If people must pay for bednets, will they purchase them?

<table>
<thead>
<tr>
<th>Cost</th>
<th>Rate</th>
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<tbody>
<tr>
<td>Free</td>
<td>100%</td>
</tr>
<tr>
<td>$0.65</td>
<td>80%</td>
</tr>
<tr>
<td>$1</td>
<td>60%</td>
</tr>
<tr>
<td>$1.60</td>
<td>40%</td>
</tr>
<tr>
<td>$2</td>
<td>20%</td>
</tr>
<tr>
<td>$3</td>
<td>0%</td>
</tr>
</tbody>
</table>
When people get bednets for free, will they \textit{use} it?
Do free nets discourage future purchases?
Do neighbors buy nets if other got it for free?

- Average (33% receive free): 50%
- If All receive free: 66%
Conclusion

- When we have a policy question, e.g. “what is the optimal price to charge for a bednet”, we need to start by unpacking the question:
  - What do we need to know to answer the question properly? Let’s not assume any answer, or replace real answers by anecdotes, or observations that may be very misleading

- We can then design an experiment that will get us the answer to these questions.

- This is what J-PAL (poverty action lab) does...

- Examine critically whether this first experiment is enough: perhaps we need more data to conclude...

- Other than the answer to the policy question, what are the lessons from the experiments: in particular, what is the key puzzle here that we will need to answer in our section on health?