

## Measuring health

### Introduction

This activity looks at ways of measuring the health of a population. Students learn how to use scattergraphs to investigate correlations between health indicators and other factors that may affect health.

### Resources

Information is provided as an excel spreadsheet, or as Figure 1 and a set of graphs, Figures 2 – 6. Access to computers would allow students to plot their own scattergraphs and investigate factors other than those suggested here. An interactive whiteboard could be used to make this a whole class activity. An alternative source of data is <http://www.gapminder.org/>. This allows you to select countries and different indicators and plots the graphs.

### The activity

This activity can be done in small groups with a general discussion at the end or as a whole class activity on an interactive whiteboard. It could also be used to practice IT skills.

Start by giving out only page 1 and 2 and Figure 1 to encourage discussion of the issues.

Four scattergraphs are provided with questions. Students could also be encouraged to test their own hypothesis by plotting a suitable scattergraph. The whole activity would take about 1½ hours but part could be left out or done for homework.

### Suggested answers to questions

Students may well suggest others.

- How would you decide which country has the healthiest people?  
*how long they live*  
*incidence of TB/cancer*  
*time off work sick*
- What information would a government need to help them decide the best way to spend a limited amount of money to improve health in the country?  
*what are causes of death?*  
*what social factors seem to correlate with good health?*

#### How science works

**Ba** If something happens only when a factor is present, we say there is a correlation between the factor and the outcome. If one variable increases (or decreases) steadily in value as the value of another variable increases, this is even stronger evidence that the two variables are correlated.

**Bb** A scattergraph is a useful way to show the strength of a correlation.

**Bc** A correlation between a factor and an outcome suggests that the factor *may* be a cause of the outcome, but does not prove a causal link. Both could be caused by another factor.

**Be** In some situations, a causal factor can increase the probability of an outcome but not invariably cause it. This is also called a correlation. It can occur when a combination of factors is needed for the outcome to happen.

3. How would you know if health is improving?  
*collect data on causes of death or death rate over several years*
4. Look at the data in the excel spreadsheet in Figure 1.
- (a) Which of the countries shown appears to have the healthiest population?  
*Sweden*
- (b) Which of the countries shown appears to have the least healthy population?  
*Kenya, Nigeria, Ethiopia*
- (c) Do your answers to (a) and (b) depend on which indicators you decide are the most important?  
*Nigeria if life expectancy important*  
*Kenya if TB or HIV*  
*Ethiopia if maternal mortality*

### Use of scattergraphs

5. (a) Is there a correlation between the number of doctors and life expectancy?  
*yes but not strong, no correlation above 200 doctors per 100 000*
- (b) Are there exceptions? Use the data in the spreadsheet to identify one such country .  
*yes Hungary, lower than expected or Bangladesh, higher than expected*
- (b) Do the data suggest that more doctors would increase life expectancy in the UK?  
*would be very small effect*
- (c) Do the data tell us that not enough doctors is a cause of a reduced life expectancy?  
*no, correlation cannot prove causation but they do suggest that it may be one the factors involved*
6. Use the data to investigate the correlation between clean water and the death rate for children under 5 as shown in **Figure 3**.
- (a) How would you describe the relationship?  
*an inverse correlation between death rate and access to clean water*
- (b) Do the data suggest that dirty water might be a cause of death in small children?  
*yes definitely suggests that dirty water might be a cause, it is a very strong correlation/ almost all the points are close to a straight line but correlation alone does not prove causation*
- (c) Is there a causative mechanism that would explain the correlation?  
*yes, cholera and other diarrhoeal diseases are know to be transmitted in water*
- (d) Use Figure 1 to identify one country that does not fit the general pattern.  
*India, higher than expected mortality*  
*Ethiopia, lower than expected mortality*

7. There appears to be relationship between GDP per capita and life expectancy at birth. See **Figure 4**.
- (a) What does GDP per capita mean?  
*The value of all the goods and services produced in a country divided by the total number of people*
- (b) Describe the relationship shown.  
*There is a strong correlation at low GDP/ below \$5000 per capita  
 A small increase in wealth makes a large difference in life expectancy  
 Above \$5000 there is a slight but much less significant effect.*
- (c) The data do not tell us that money itself actually improves health. Suggest **two** explanations for the shape of the graph  
*Better nutrition, housing, clean water can be provided on modest income  
 Extreme poverty leads to severe ill health  
 greater provision of expensive health care like doctors and medicines have an effect but a much less significant one*

### Use and limitations of data

9. (a) Describe **one** limitation of information like this that only gives an average value for the whole country.  
*Average does not tell us about the spread of results. There may be great inequality within a country*
- (b) Describe **two** reasons why the data from some countries may not be very accurate  
*Data collection may be inaccurate, for example not all deaths may be recorded.  
 Sample may not be representative of the whole country.*
10. If you are providing medicines you need to know the total number not a ratio.
- (a) Calculate the total number of people in Kenya with TB, using the rate per 100 000 and the total population.  
*888 per 100 000  
 population 33.5 million  
 total infected  
 $\frac{33.5 \times 888}{100} = 297\,480 = 300\,000$  people*
- (b) How many people in Bangladesh do not have access to clean water?  
 *$100 - 74\% = 26\%$   
 $\frac{139 \times 26}{100} = 36$  million*

### Changes in health of a population

The UK Government keeps records of the health and of causes of death.

**Figure 6** shows the death rate in the UK for men since 1996, from the three main causes of death.

12. Summarise the most important conclusions we can draw from Figure 6.  
*Deaths from circulatory diseases have fallen sharply  
 slight drop in cancer  
 no or very slight change in respiratory*

13. (a) Calculate the percentage decrease in deaths from circulatory diseases between 1996 and 2006.

$$4000 - 2500 = 1500 \text{ drop}$$

*as a percentage*

$$\frac{1500 \times 100}{4000} = 37.5\%$$

$$4000$$

(b) How was this information obtained? Do you think it is accurate?

*From death certificates*

*Yes cause of death has to be recorded.*

(c) Which cause of death do you think should be the greatest cause for concern, perhaps deserving the most research funding?

*Circulatory because it is still the greatest cause of death*

*Cancer because it is nearly as high and current measures are not having a large effect on the death rate*



## Measuring health

### Introduction

Life expectancy in Britain is 79 years. In some low income countries it is only 45 years. Why the difference?

Doctors only help people when they are ill. We need clean water to stop people getting ill.

The only way to improve the health in my country is to have more doctors

People in my country are poor. They can't afford good food. That's why they get sick.

All the people quoted above have a hypothesis for the cause of ill health in their country. Who is right?

### The activity

- In a small group suggest one further hypothesis to explain low life expectancy in a low income country.
  - Discuss questions 1 – 3 below.
- Which country in the world has the healthiest people? How could you decide? What other ways, apart from life expectancy, are there of comparing health in different countries?
  - How should a government spend a limited amount of money to improve health in the country? What information would they need to help them make decisions on the best use of the money?
  - How would you know if health is improving?

### Using data

In this activity you look at data from the United Nations Development Program (UNDP) to see how statistics can be used to help answer these questions.

**Figure 1** shows data on several countries for 2004 taken from [http://hdr.undp.org/hdr2006/pdfs/report/HDR\\_2006\\_Tables.pdf](http://hdr.undp.org/hdr2006/pdfs/report/HDR_2006_Tables.pdf)

The information, apart from life expectancy, is all expressed as some form of ratio: a percentage, per 1000 or per 100 000 are the most common.

The first 5 columns of data are health indicators.

The last 6 columns give information on other factors that may be relevant to health.

**Figure 1**

country	Health indicators					Factors that may affect health					
	Life expectancy at birth / years	under 5 mortality rate per 1000 live births	maternal mortality per 100 000 live births	HIV prevalence % aged 15- 49	TB prevalence per 100 000	access to clean water % of population	doctors per 100 000 people	one year olds fully immunised against measles %	annual population growth rate %	GDP per capita /US\$	total population / millions
Sweden	80.3	4	2	0.2	3	100	328	94	0.3	29541	9
UK	78.5	6	13	0.2	9	100	230	81	0.3	30821	59.5
Hungary	73	8	16	0.1	30	99	333	99	-0.3	16814	10.1
Saudi Arabia	72	27	23	0.2	55	90	137	97	2.3	13825	24
Brazil	70.8	34	260	0.5	77	90	115	99	1.2	8195	183.9
Jamaica	70.7	20	87	1.5	9	93	85	80	0.4	4439	2.6
India	63.6	85	540	0.9	312	86	60	56	1.3	3139	1087.1
Bangladesh	63.3	77	380	0.1	435	74	26	77	1.7	1870	139.2
Sudan	56.5	91	590	1.6	370	70	22	59	2	1949	35.5
Kenya	47.5	120	1000	6.1	888	61	14	73	2.5	1140	33.5
Nigeria	43.4	197	800	3.9	531	48	28	35	2	1154	128.7
Ethiopia	47.8	166	1000	2.3	533	22	3	71	2.3	756	75.6

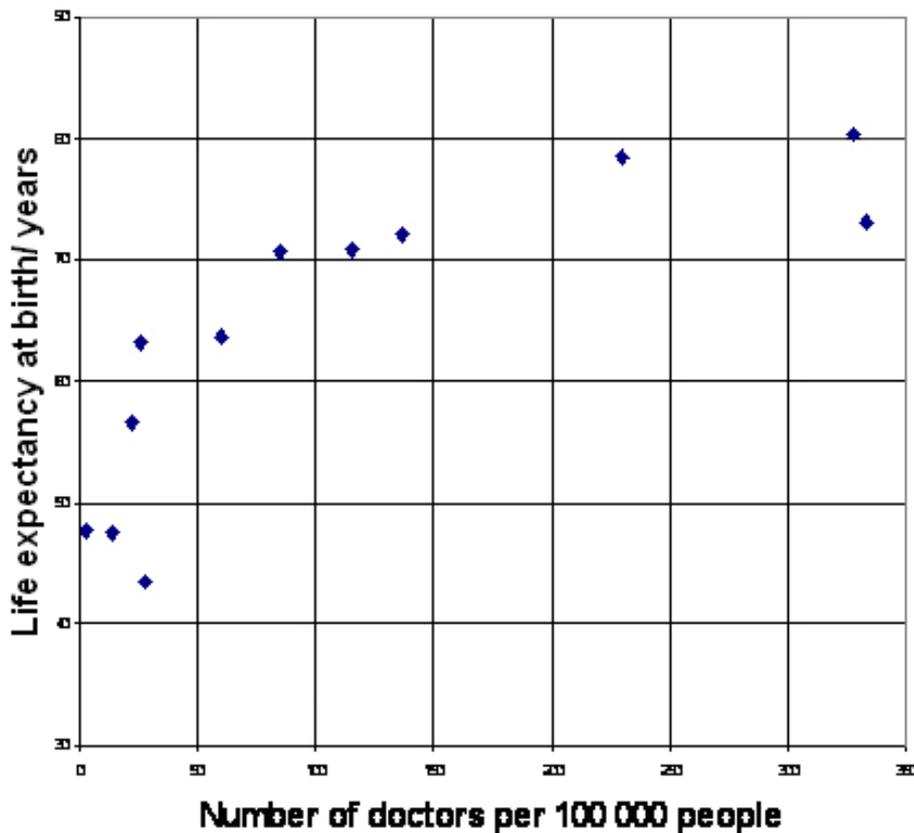
**Which country in the world has the healthiest people? How could you decide? What other ways, apart from life expectancy, are there of comparing health in different countries?**

4. Look at the data in **Figure 1**.

- Which of the countries shown appears to have the healthiest population?
- Which of the countries shown appears to have the least healthy population?
- Do your answers to (a) and (b) depend on which indicators you decide are the most important?

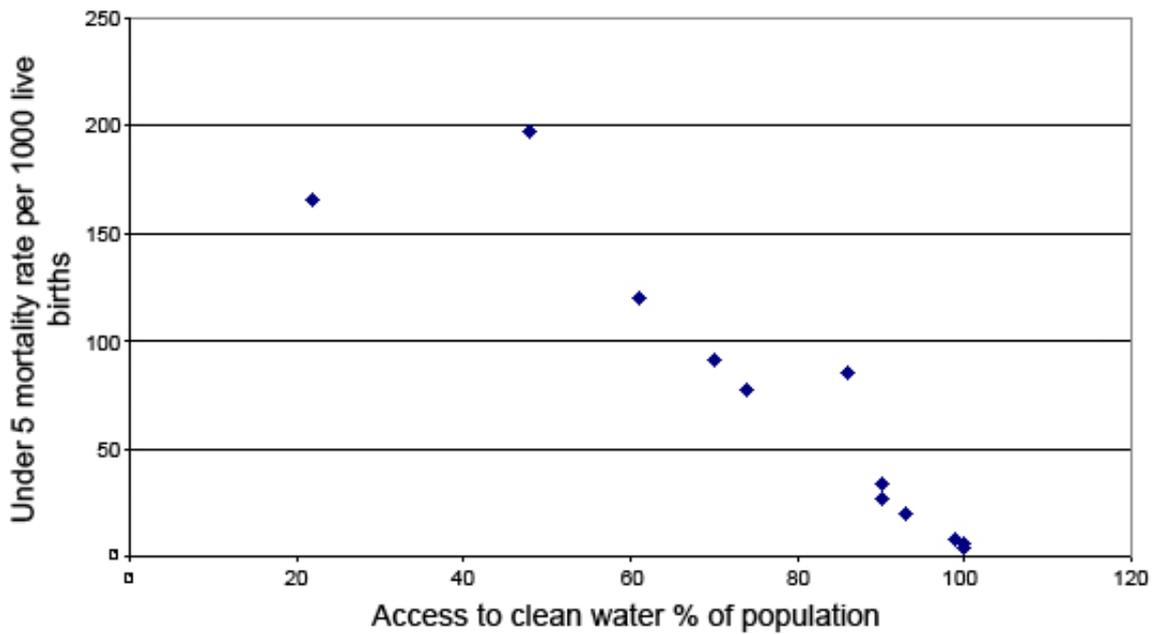
**How should a government spend a limited amount of money to improve health in the country? What information would they need to help them make decisions on the best use of the money?**

Look at the data in **Figure 1**. Choose one of the factors that may influence health and see whether there is a correlation between that factor and one of the indicators of health using a scattergraph.

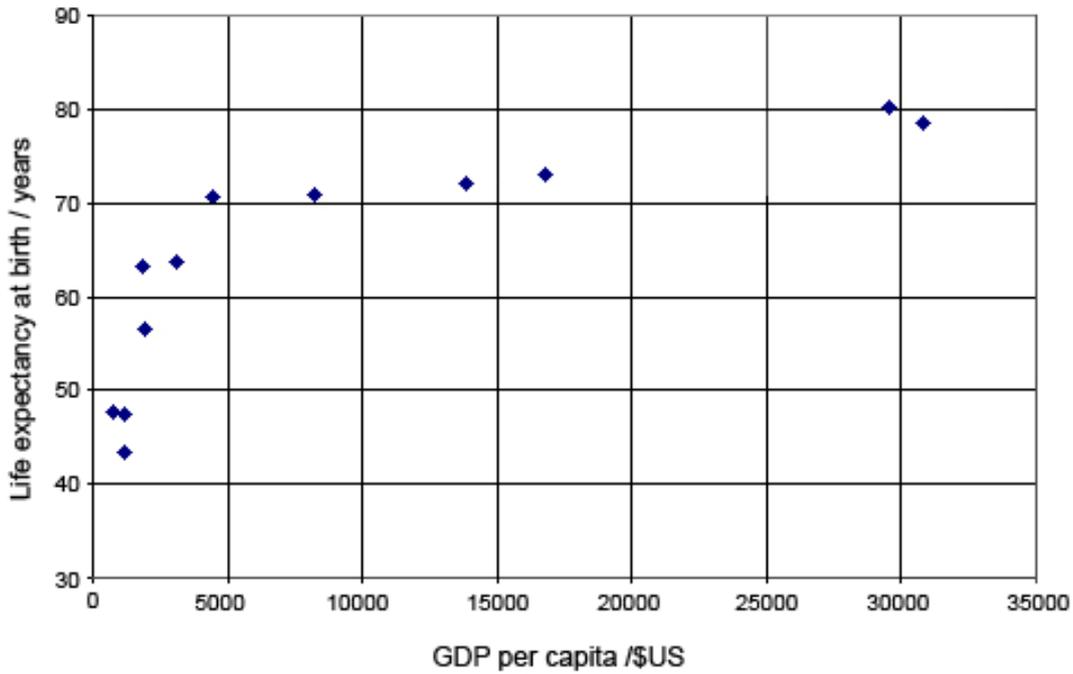
**Figure 2 Relationship between number of doctors and life expectancy at birth**

5. **Figure 2** shows how a scattergraph can be used to relate life expectancy to the number of doctors.

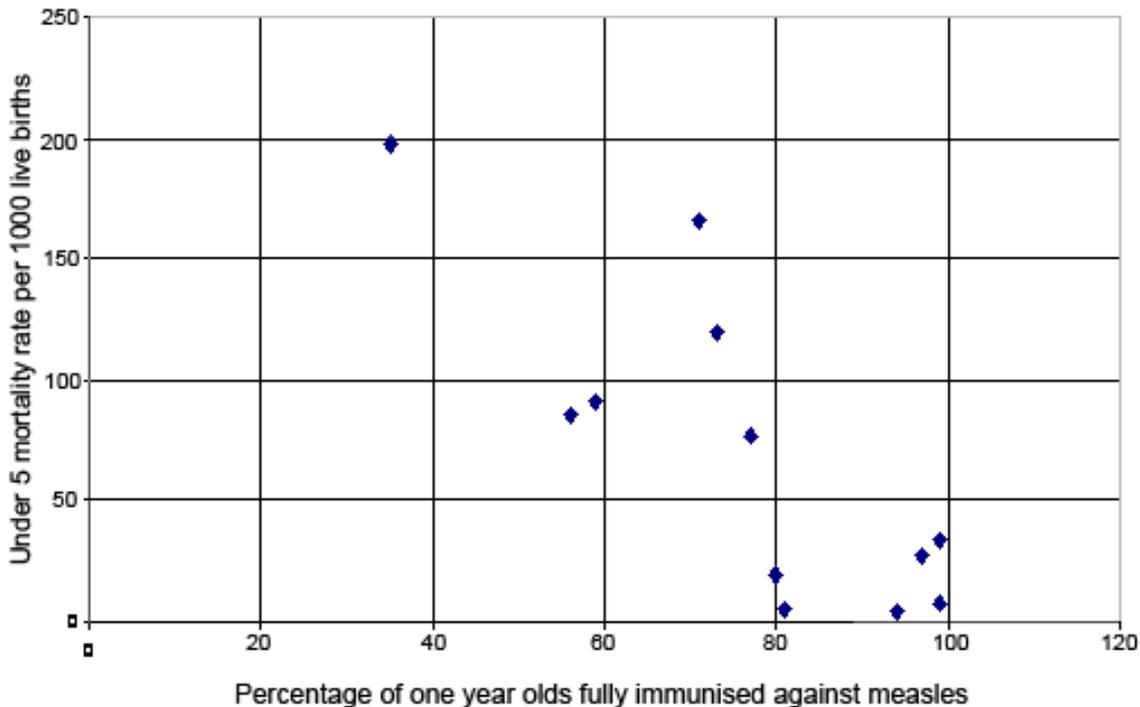
- Is there a correlation between the number of doctors and life expectancy?
- Are there exceptions? Use the data in the spreadsheet to identify one such country.
- Do the data suggest that more doctors would increase life expectancy in the UK?
- Do the data tell us that not enough doctors may be a cause of a reduced life expectancy?

**Figure 3 Relationship between under 5 mortality rate and access to clean water**

6. Use the data to investigate the correlation between clean water and the death rate for children under 5 as shown in **Figure 3**.
- How would you describe the relationship?
  - Do the data suggest that dirty water might be a cause of death in small children?
  - Is there a causative mechanism that would explain the correlation?
  - Use Figure 1 to identify one country that does not fit the general pattern.

**Figure 4 Relationship between GDP per capita and life expectancy at birth**

7. There appears to be relationship between GDP per capita and life expectancy at birth.
- What does GDP per capita mean?
  - Describe the relationship shown.
  - The data do not tell us that money itself actually improves health. Suggest **two** explanations for the shape of the graph

**Figure 5 Relationship between immunisation and under 5 mortality rate**

8. Write **three** questions that could be answered using the data in Figure 5

#### Use and limitations of data

9. (a) Describe **one** limitation of information like this that only gives an average value for the whole country.
- (b) Describe **two** reasons why the data from some countries may not be very accurate
10. If you are providing any health service, like medicines, you need to know the total number not a ratio. Use the information in Figure 1 to answer these questions.
- (a) Calculate the total number of people in Kenya with TB, using the rate per 100 000 and the total population.
- (b) How many people in Bangladesh do not have access to clean water?

#### Conclusions

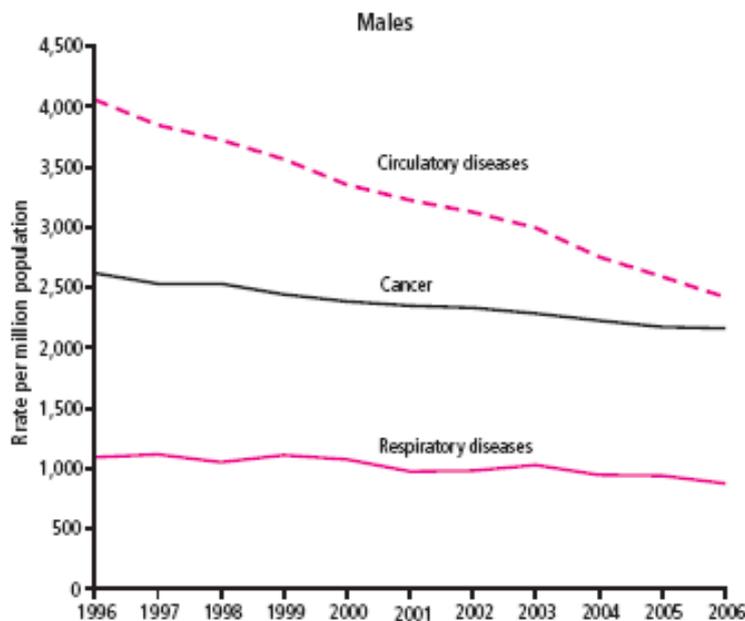
11. Choose one of the low income countries in Figure 1. Suggest the **two** measures you think would have the most benefit in improving people's health.

## How would you know if health is improving?

### Changes in health of a population

The UK Government keeps records of the health and of causes of death. **Figure 6** shows the death rate in the UK for men since 1996, from the three main causes of death.

**Figure 6** Death rate from three causes of death in the UK



[http://www.statistics.gov.uk/downloads/theme\\_health/Death\\_registration\\_2006.pdf](http://www.statistics.gov.uk/downloads/theme_health/Death_registration_2006.pdf)

12. Summarise the most important conclusions we can draw from **Figure 6**.
13. (a) Calculate the percentage decrease in deaths from circulatory diseases between 1996 and 2006.
  - (b) How was this information obtained? Do you think it is accurate?
  - (c) Which cause of death do you think should be the greatest cause for concern, perhaps deserving the most research funding ?