Fruit and vegetables and cancer

Introduction
This activity reviews the advantages and disadvantages of case control and cohort studies, in the context of research on the link between fruit and vegetable consumption and cancer risk.   It includes data analysis on the results of this research.

The activity
Get students to discuss the work in small groups and summarise their conclusions for discussion in the whole class.
Part 1 is intended as a quick illustration of how difficult it is to collect accurate data on diet.
Part 2 encourages them to think more about the advantages and disadvantages of case control and cohort studies. You might want to give each group a single scenario to produce a recommendation for, and then ask them to present and justify their decision to the rest of the class.
Part 3 is data analysis.

Suggested Answers
Part 1
The research study mentioned asked other family members, particularly the mothers if they were available.

Part 2
Scenario A
Case control is the only way results could be obtained in this time frame. Recruiting enough participants to make results statistically significant could be a problem. You would need to work with several cancer hospitals and a large team of interviewers.   Recall of their past diet is not going to be very accurate. It would be easiest to recruit patients with some other condition not related to cancer as control group. Important to record other factors such as age, smoking or family history.
Scenario B
This is a preliminary study because there is no information available so a case control would be most suitable as it is cheaper and quicker. You have access to cancer patients making this easier. You can use patients from the nearby general hospital as controls.   Recall of past diet may not be very accurate. You will have to make sure you have corrected for other variables
Scenario C
For more reliable results use a cohort study. Time does not seem to be an issue. Regular reporting of current diet is likely to be more reliable than any record based on recall. A very large group of currently healthy participants will be needed to ensure that there is a large enough group of cancer patients as the diseases develop over time.

How Science Works
Ab If we make repeat measurements of the same quantity, the values are likely to vary. This might be because the quantity we are measuring is changing, or because of measurement error. If errors are random, the average of several measurements is the best estimate of the value of the quantity. The smaller the spread of the measured values and the larger the number of repeat measurements, the more confident we can be that the mean is close to the 'true' value.
Af In many situations, scientists have to observe or measure a sample of the objects or cases they are studying (for example, observations in the field, cases of an illness, etc.). Data are more reliable if systematic sampling and observing/measuring methods are used.
Bf Claims about large groups are usually based on measurements on a sample of the population (all the individuals in the group). The sample should be selected randomly, or carefully chosen to represent the population accurately. Failure to do this will introduce bias. The larger the sample, the more confidence we can have in any claim about the population.
Bg To investigate the hypothesis that a factor increases the probability of an outcome, scientists compare a sample exposed to the factor with a control sample that is not. This is called a cohort study. The two samples should be selected randomly from each population, or carefully matched on all the other factors that might have an effect. To assess the outcome of a cohort study, scientists compare the number of cases in the two groups after a period of exposure. To judge that a factor does affect the outcome, the difference must be big enough not to be attributable simply to normal variation.
Bh Correlation between a factor and an outcome can be investigated using a case-control study. A sample of cases of the outcome is compared with a matched sample where the outcome is not present.

Part 3

1. Discuss the results shown in Figure 3 and write a conclusion based on these data. Remember to include both positive and negative results. (Two results do not indicate any benefit.)
    Points that might be made:
    Single portions of both fruit and vegetables seem to reduce the risk of most cancers with relative risks between 0.9 and 0.7.
    However there is considerable uncertainty in these results and in most cases the relative risk reduction might be as little as 0.05.
    The evidence for fruit reducing the risk of stomach cancer is stronger with a useful reduction in risk.
    The evidence for risk reduction for fruit and breast cancer and for vegetables and bladder cancer is uncertain.

2. Discuss the results shown in Figure 4 and write a conclusion based on these data.   Remember to include both positive and negative results. (Only two results do indicate a real benefit).
    When cohort studies are analysed there is almost no evidence of benefit from fruit or vegetables. In almost all cases a relative risk of 1, no benefit, is within the 95% CI of outcomes.
    The mean for almost all cases shows a slight benefit so further studies might show an effect.
    Only fruit and lung cancer and fruit and bladder cancer show a definite very slight benefit.

3. Using what you know about the differences between case control and cohort studies, suggest some reasons for the different results obtained from the two types of study. *Cohort studies will give more accurate recall of diet and over a longer period of time.*
    However they may have much smaller samples of cancer patients which might explain the wider confidence intervals in the results.

4. This is a careful study but it is not really useful as evidence for the benefits of 5 portions a day. Suggest a reason why the researchers may have analysed the effects of a single 100g portion a day.
    They probably did not find enough people who ate more portions of fruit and vegetables to make a large enough group.
    If people know the purpose of the study there is a risk that they may exaggerate their intake. One portion is an assumption.

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We are all told to eat more fruit and vegetables to reduce our risk of cancer, stroke or heart disease. This activity looks at some of the evidence behind the advice on cancer.

Part 1 Your diet
How easy is it to remember what you ate last week? Fill in the table below.

Food group	number of portions yesterday	average number of portions per day over the last week
carbohydrate - bread, pasta		
protein - meat, fish, cheese, eggs		
fruit and vegetable including juice		
fat - milk, cheese, butter, chips		

- How reliable do you think the information in this table is?
- How could it be made more reliable?
- One published research project asked people about their diet as teenagers when they were in their 40s and 50s.   Suggest one way this data could be made more reliable.

Part 2 Types of study
There are three ways of designing an investigation into the effect of any factor: case control study, cohort study and randomised controlled trial. The last is not ethical or possible in this case. You will find more information in the textbook on pages 84-85 and 129-130. You will work through the activity discussing your answers with a partner as you work, and then with the class.
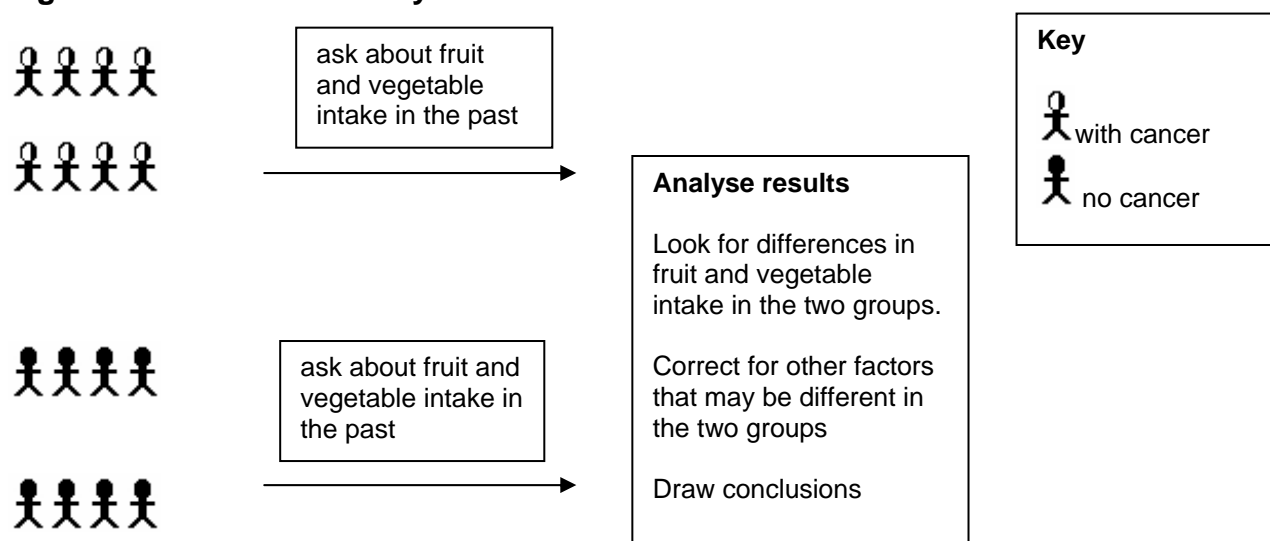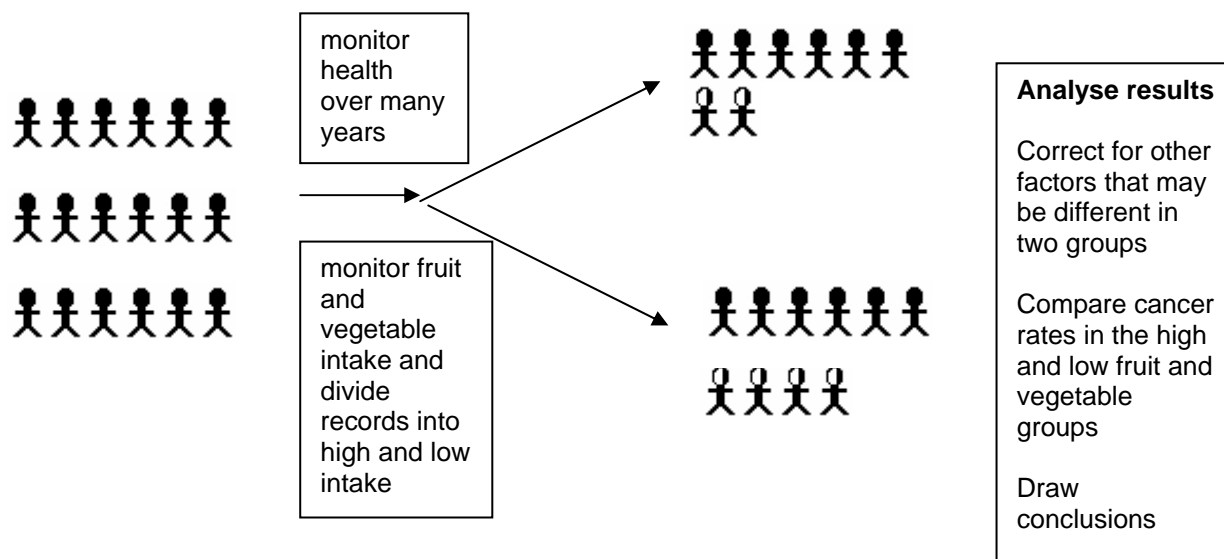
Figure 1 Case control study

Figure 2 Cohort study

monitor health over many years

monitor fruit and vegetable intake and divide records into high and low intake

Analyse results

Correct for other factors that may be different in two groups

Compare cancer rates in the high and low fruit and vegetable groups

Draw conclusions

1. Summarise the main differences between the two types of study shown.

2. Suggest three other factors that would have a significant effect on cancer rates.

3. Imagine you are part of a team of researchers. You are planning to investigate whether fruit and vegetables really do reduce the risk of cancer. First the team has decide what type of study to organise.   For each of the scenarios below decide which type of study would be most suitable and then discuss how you would plan the study.   Remember the importance of a control group.

The points you will want to consider may include:
*   Is time important? Which type of study will produce results more quickly?
*   How will we recruit enough participants?
*   How accurate will the data be on the participants' fruit and vegetable intake?
*   How can we correct for other factors that might also affect cancer risks?

Scenarios
   A The government has become more interested in preventive health care and has commissioned you to investigate whether it would be worth making fruit consumption a significant part of their anti-cancer campaign.   They want results as soon as possible, certainly before the next election.

   B You work in a large cancer hospital and have the impression that many of your patients do not have a very healthy diet.   You think that green vegetables might be particularly important in reducing risk, but can find no information on this. You would like to investigate whether there is a link between intake of green vegetables and cancer risk. You might be able to collaborate with doctors in a nearby general hospital.

   C You work in a statistics department and have good collaboration with the local health services. You have seen some reports published that show that fruit does reduce risk and others that show it does not. You suspect that most of these have significant bias and want to produce better conclusions.

Part 3 Evaluating results

Figure 3 and Figure 4 show the results of a meta-analysis of studies investigating this same issue.   A meta-analysis is a study where the results of several independent studies are combined for statistical analysis. The advantage is that it provides a much larger number of participants.

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3. Using what you know about the differences between case control and cohort studies, suggest some reasons for the different results obtained from the two types of study.

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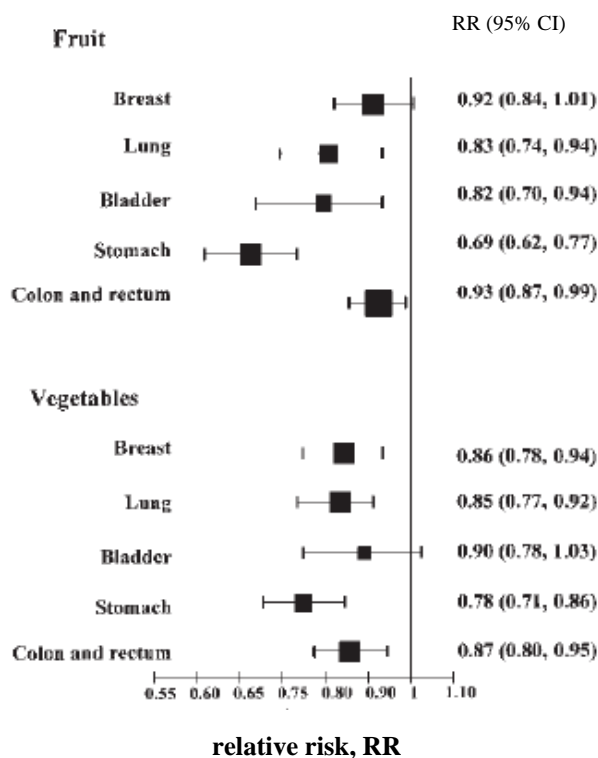

relative risk, RR

Figure 3 Meta-analysis of case control studies on fruit and vegetable intake.

Estimated relative risk for the development of 5 cancers with an increase in fruit or vegetable intake of 100g /day (one portion)
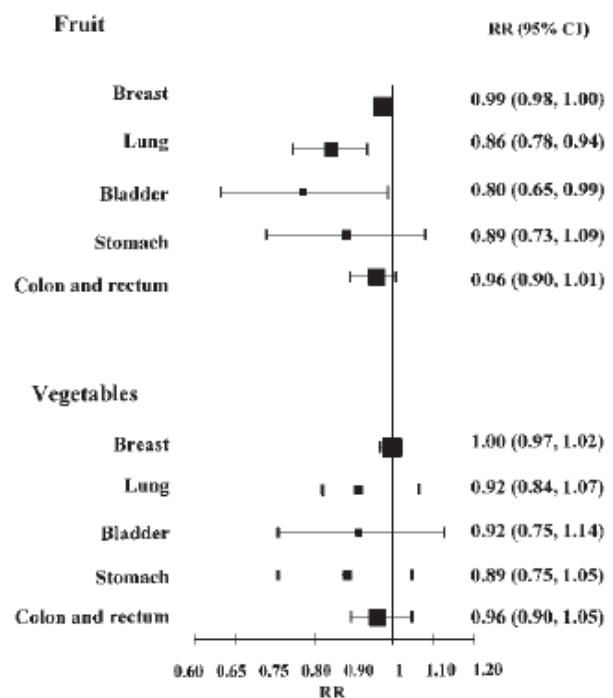
Figure 4 Meta-analysis of cohort studies on fruit and vegetable intake

Estimated relative risk for the development of 5 cancers with an increase in fruit or vegetable intake of 100g /day (one portion)

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