MMR – don’t die of ignorance

Commentary

Thislesson has two really important ideas. One is that correlation is not the same as causation; agreement between two sets of data doesn't prove that one has caused the other. The other is that small scale studies can be misleading. It uses the well-known example of the MMR vaccination scare and refers to two studies, the case study of the 12 autistic children and a large scale observational study in Denmark.

Students should already have some understanding of how vaccination is used to develop people's resistance to a range of illnesses. This lesson could be used as an introduction to more work on ethical issues in Biology, the treatment of diseases, and lessons in which correlation and cause & effect have a significant role.

Resources

bs_mmr_worksheet_01 ‘Is there a correlation?’ • bs_mmr_worksheet_02 ‘Measles and Immunisation graph’

Learning objectives

- Understand the difference between correlation and cause & effect.
- To apply this understanding to a variety of contexts.
- To explore the professional responsibility of scientists when their research could have serious consequences.

Learning outcomes

By the end of the lesson students will have:

- applied an understanding of data and relationships to a situation
- engaged with the ethical dilemma facing doctors reporting on evidence and decisions.

Key vocabulary

correlation • cause • effect • vaccination

Obstacles to learning

Students may hold misconceptions relating to the presence or absence of causal links

Starter

Ask students to look at the two graphs on the resource sheet (bs_mmr_worksheet_01) and answer these questions:

- When does graph A reach a maximum? When is it at its lowest? What is the general trend?
- When does graph B reach a maximum? When is it at its lowest? What is the general trend?

Establish that the overall trend is similar. Now tell the students that one of the graphs shows ice cream sales over a year and the other shows pollen count. Ask them if they can work out which is which. (The difference is that one is based on daily figures and the other is based on monthly figures. That doesn't help answer the question. In fact, A is the ice cream one.) Explain that the idea of correlation is an important one in science. It means agreement between sets of data.

How good is the correlation between these graphs – do they show the same pattern in the data? Explore these questions with the class:

- Did the pollen count cause the ice cream sales to rise?
- Did the sale of ice cream cause the pollen count to rise?
- Is there any link?

There is, of course, a correlation, but it's not a causal link between these two variables. Ice cream sales rise in hot weather and the release of pollen is triggered by long days and warm breezy weather. Emphasise that just because the correlation is strong, it doesn't mean that there is a causal link between these variables. It may mean that there is some other factor (such as long sunny days in this case) that is causing both.

In medical research, scientists are often trying to determine if one thing causes another, but this can be difficult if the proposed cause only creates the outcome in *some* cases, or if the outcome has lots of possible causes, or if

there is a long delay between proposed cause and effect. Looking for a connection between cause and effect (between a treatment and a cure, or a health risk and a disease) can be thought of as a switch and light. It's easy to discover, in a room with a lightswitch, whether the switch makes the light come on. But in medicine we often encounter more difficult problems: often health risks are like a light switch that makes the light come on, but only sometimes, and sometimes the light comes on even when the switch isn't pressed, and in any case, even when the light does come on, it's several years after the switch is pressed. In situations like these we often need studies with large numbers to detect small, subtle effects.

Main activity

Formally introduced objectives and outcomes, relating back to the starter.

Explain to students that autism is a condition which affects between one and two people in every thousand, affecting neural development and causing restricted and repetitive behaviour. It affects social behaviour and language; its causes are unknown. It is usually diagnosed from the age of three onwards.

In Britain, as in many countries, the majority of children are vaccinated against measles, mumps and rubella using a combined vaccine (MMR). A British doctor wrote a report on 12 children who had been vaccinated with the MMR vaccine and were subsequently diagnosed as autistic. The result of this report was that media interest was raised; many anti-MMR stories appeared and there was a significant fall in the number of children given the MMR vaccine.

Ask students to work in groups to consider these questions:

- Does the fact that the children in the report were diagnosed with autism after being given the MMR vaccine prove that the vaccine caused the autism?
- At the time of the report being written well over 90% of children had the MMR vaccine. Why should it not be a surprise if some of those children are diagnosed with autism?
- What kind of survey would have helped to identify whether the MMR vaccine caused autism?

Ask students to look at the graph on bs_mmr_worksheet_02. This may need some careful introduction as there are two sets of data being displayed. The timing is significant: the story first started to appear in newspapers in 1998 and reached a height of interest in 2002. It then started to wane.

Ask students to look at the graph and consider these questions:

- What happened to the MMR vaccination rates of children?
- What happened to the incidence of measles?
- Is there a causal link?

It was subsequently established beyond reasonable doubt that there is no causal link between MMR vaccination and autism. The doctor had a commercial interest in the alleged link and was subsequently struck off. The scare affected no other countries; MMR vaccination rates are rising again.

Explain to students that one of the things this story illustrates is the importance of working with large-scale surveys wherever possible. Say that such a study was carried out in Denmark: the Madsen study. Because Denmark tracks patients and the care they receive they have been able to study the correlation between vaccination and illness; the data clearly shows that there is no correlation between MMR vaccination and the incidence of autism.

Explain that the study was based on data from over half a million children (nearly 100% of the children born): over 440,000 had been vaccinated and there was no greater incidence of autism amongst children vaccinated as amongst those not vaccinated. Say that the author of the study, Dr Madsen, pointed out that even in developed countries measles kills one in every 3000 people and causes pneumonia in one in 20.

Ask students to identify the features of this study that make its findings reliable and suggest what they might say to someone who still wasn't convinced and decided to 'play it safe' by not having their child vaccinated for MMR?

Plenary

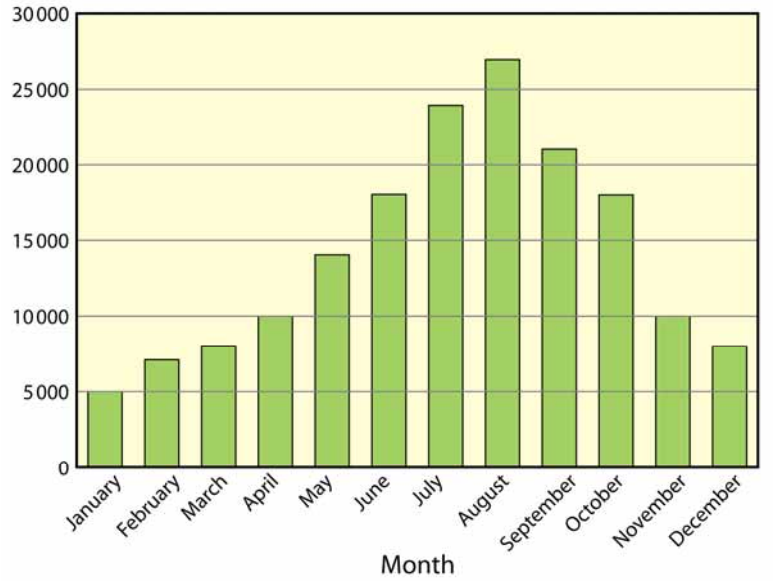
Ask students to consider these points of view, decide what their responses are, and be ready to share their ideas:

- "The doctor who wrote the original report was right to alert people to his concerns and suggest that more research should be carried out."
- "The media got hold of the story and turned it into a huge scare. It's their fault."
- "There was never any evidence to prove a link. Thousands of children have caught diseases that could otherwise have been avoided."

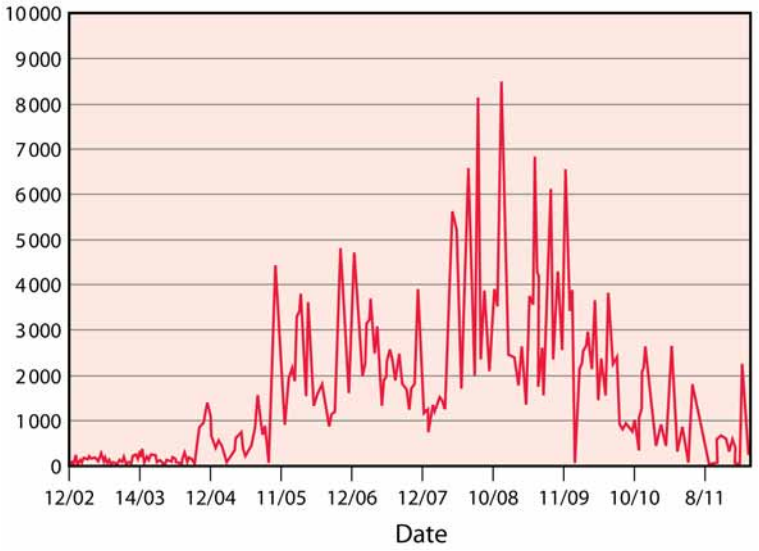
MMR worksheet 01

Is there a correlation?

Graph A.

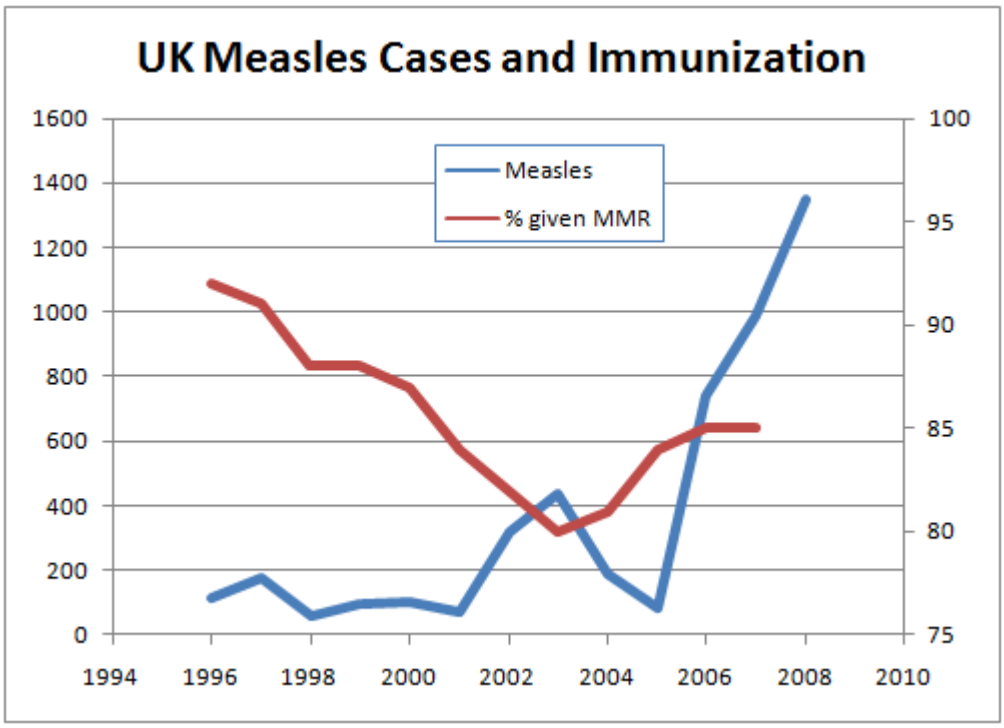


Graph B.



MMR worksheet 02

Measles and Immunization graph



Source: Health Protection Agency