

## Practical 4: Chance and bias

### Objectives

At the end of this practical, students should be able to:

1. Recognise the need to consider different possible explanations for an observed exposure-disease association
2. Explain the distinction between selection bias and information (or measurement) bias
3. Explain how selection bias occurs in different types of studies, and its potential impact
4. Describe how systematic errors in measurement of exposures and/or outcomes can occur in different types of studies
5. Describe how information bias can distort estimates of an association between an exposure and outcome
6. Be aware of ways to minimise bias at the design stage of a study
7. Be aware of methods used to assess the role of chance for a given association

Several studies have shown a link between maternal depression following childbirth and poor infant growth. In this practical, you will consider different studies which explore this association.

### Question 1: Postnatal depression and infant growth in Goa, India

A study conducted in Goa, India, explored the association between postnatal depression and infant growth ([Patel et al. 2003](#)). The researchers recruited 171 mothers attending an immunisation clinic with their babies 6-8 weeks after giving birth. Upon enrolment, mothers were interviewed using the Edinburgh Postnatal Depression Scale (EPDS). The EPDS is a 10-item questionnaire developed to measure maternal mood in the postnatal period. Women scoring 12 or more were classified as cases with potential postnatal depression, while women scoring less than 12 were classified as non-cases.

After 6 months of follow-up, growth outcome measurements were obtained for 142 of the 171 infants. Babies whose weight or height was in the lowest 5% for the population were considered to be underweight or short-for-age, respectively.

**Question 1a:** The prevalence of postnatal depression at 6-8 weeks among women recruited into the study was 22%. Does this mean that we can generalise that 22% of women who give birth in Goa will suffer from postnatal depression 6-8 weeks post birth? Justify your answer.

The researchers reported risk ratios of 2.3 for having underweight babies in mothers suffering from postnatal depression compared to those who were not suffering from depression (95% CI 1.1, 4.7) and 2.9 for having short-for-age babies compared between the same two groups of mothers (95% CI 1.3, 6.8).

**Question 1b:** Interpret these risk ratios. Do you think these results are due to chance? (hint: think about what a confidence interval that included 1.0 would mean).

**Question 1c:** Comment on loss to follow-up in this study. Suggest possible reasons for this loss to follow-up. Do you think loss to follow-up could bias the association between maternal depression and poor infant growth outcomes in this study?

**Question 1d:** How might the researchers assess whether selection bias may have influenced the results of this study? How might the researchers assess whether loss to follow-up might have introduced bias into the study?

**Question 1e:** The EPDS is a screening questionnaire that identifies “probable” cases of depression by checking the presence of a range of symptoms. It is not as accurate as a clinical diagnosis and so the mental health status of some women may have been misclassified. Misclassification of exposure could be differential with respect to the outcome, meaning that the chance of misclassification depends on the child nutritional status. For instance, women with an underweight child may be more likely to be classified as depressed by the EPDS compared to women with a normal weight child. Alternatively, the misclassification of exposure (depression) could be non-differential, i.e., mothers are equally likely to be misclassified whether or not their child had poor growth outcomes.

- (i) Can you think of the situations under which the misclassification of depression using the EPDS would have been differential in the context of this study?
- (ii) Can you think of the situations under which the misclassification of depression using the EPDS would have been non-differential in the context of this study?
- (iii) Assuming the misclassification was non-differential, then how may this have affected estimates of the association between postnatal depression and poor child growth outcomes? How would this affect our interpretation of the results of this study?

## Question 2: Common mental disorders and infant nutrition in Pakistan

A study was conducted to assess the link between maternal common mental disorders (CMD) and infant nutritional status in Rawalpindi, Pakistan ([Rahman et al. 2003](#)). Infants and their mothers were recruited while attending a clinic for measles immunization (received at age of 9 months). In this area, coverage of immunization was 99% of infants and all received their immunization in clinics. Researchers identified and recruited the mothers of 82 undernourished infants (low weight-for-age), and randomly selected the mothers of another 82 healthy infants.

The mothers were screened for CMD (which includes anxiety and depression) using a 20-item check-list of symptoms, the SRQ-20. Those reporting 10 or more symptoms were classified as suffering from CMD while those scoring less than 10 were classified as not suffering from CMD.

Few women refused to take part in the study and the response rate was 96%.

**Question 2a:** Do you think the non-responders may have introduced selection bias into the study?

**Question 2b:** Researchers found that the odds ratio of the association between maternal CMD and infant undernutrition was 3.9 (95% CI 2.0-7.9). Do you think that it is likely that these results were due to chance? (hint: again, think about what a confidence interval that included 1.0 would mean).

**Question 2c:** How do you think recall bias might have been present in this study? Discuss ways in which recall bias might affect the above estimate of the association between maternal CMD and infant undernutrition.

Can you think of another way to measure exposure (CMD) that would result in less severe recall bias to the researchers of this study?

**Question 2d:** The SRQ-20 asks about symptoms occurring in the past month when the infant was 8 months old. Comment on whether obtaining information on the last month only could influence our interpretation of the association between maternal CMD and undernutrition in infants.

### Question 3

Consider the following scenarios taken from real case-control studies (See Lecture 7). Do you agree with the conclusions?

- a) Head trauma and brain tumour ([Monteiro et al, 2006](#)). A case-control study was undertaken including people newly diagnosed with brain tumours as cases and age-sex-matched people from the population as controls. Cases and controls were asked whether they had received head traumas in the past. Reports of having received a head trauma was significantly more common among cases than controls (OR=1.5, 1.2-2.2).

Conclusion: Head trauma causes brain tumours

- b) Coffee drinking and pancreatic cancer ([McMahon et al, 1981](#)). A case-control study recruited people diagnosed with pancreatic cancer as cases. Controls were selected from gastro-intestinal clinics in hospitals and included many people with stomach ulcers. The relative risk associated with drinking one to two cups of coffee per day compared to none was 1.8 (95% confidence limits, 1.3 to 3.0), and that associated with three or more cups per day compared to none was 2.7 (1.6 to 4.7). They concluded that coffee drinking leads to pancreatic cancer.

Conclusion: Coffee drinking is a cause of pancreatic cancer.

#### Question 4 (Optional question to do in your own time): Postnatal depression and infant weight in the UK

A study conducted was the UK to assess whether children born to women with postnatal depression had higher subsequent risk of undernutrition ([Wright, 2006](#)).

**Table 1: Infant weight at 12 months**

|                         | Low weight | Normal weight |
|-------------------------|------------|---------------|
| Postnatal depression    | 2          | 70            |
| No postnatal depression | 27         | 534           |

**Question 4a.** In this study, researchers reported a risk ratio of 0.6 (95% CI 0.1, 2.4). Interpret this risk ratio. Are the results likely due to chance?

**Question 4b.** Suppose that two further studies were conducted to assess the association between maternal depression and undernutrition in infants. One reported a rate ratio of 4.0 (95% CI 0.5-8.0) while the other reported a rate ratio 1.5 (95% CI 1.2-1.8). Which of these studies would provide more convincing evidence for a link between depression and undernutrition? Why?

## Bibliography

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Rahman A, Iqbal Z, Bunn J, Lovel H, Harrington R, Impact of maternal depression on infant nutritional status and illness, *Arch Gen Psychiatry*, 2004; 61: 946-952.

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