

Practical: MEASUREMENT ERROR AND BIAS

Question 1. Imagine a cross-sectional study assessing the relationship between obesity and blood pressure in a general population.

- a. How would a sample size of 10 affect the study results?
- b. How would sample recruitment from i. hypertension clinic, ii. local gym affect the study results?
- c. How would a response rate of 35% affect the study results?
- d. How would using a blood pressure machine that gave random readings affect the study results?
- e. How would measuring blood pressure only once as soon as walk into clinic affect the study results?
- f. How would asking participants to fill in own weight and height affect the study results?
- g. How would asking participants to give their last BP reading affect the study results?

Question 2.

The **Survey of Health, Ageing and Retirement in Europe (SHARE)** is an important research infrastructure for studying ageing in Europe. The researchers invited households (randomly selected from population registers) in several European countries to participate. All adults aged 50+ years were eligible to participate. The table below shows the absolute numbers and response rates in wave 1 in 2004. https://share-eric.eu/fileadmin/user_upload/SHARE_Working_Paper/WP_Series_41_2019_Bergmann_et_al.pdf

Table 2: Breakdown of all baseline/refreshment samples in Wave 1 by country

Country	Households with ≥ 1 interview	Household response rate (RR1)	Household response rate (RR3)	Household response rate (RR5)
Austria ^a	1169	36.6%	44.3%	51.9%
Belgium ^a	2519	34.3%	35.0%	40.3%
Denmark	1175	63.2%	63.3%	67.1%
France ^a	2053	58.2%	73.8%	97.5%
Germany	1992	57.6%	57.7%	58.2%
Greece ^a	1981	54.3%	59.5%	68.7%
Israel	1667	64.2%	64.3%	64.5%
Italy	1771	52.5%	52.8%	55.2%
Netherlands	1946	60.9%	60.9%	61.3%
Spain	1686	50.2%	50.2%	51.1%
Sweden	2137	53.7%	53.8%	53.9%
Switzerland ^a	706	32.0%	37.6%	44.0%
<i>Total</i>	<i>17114</i>	<i>52.2%</i>	<i>55.0%</i>	<i>60.1%</i>

Note: ^a Screening country.

Average response rates are calculated by taking into account the number of households with at least one interview in each country.

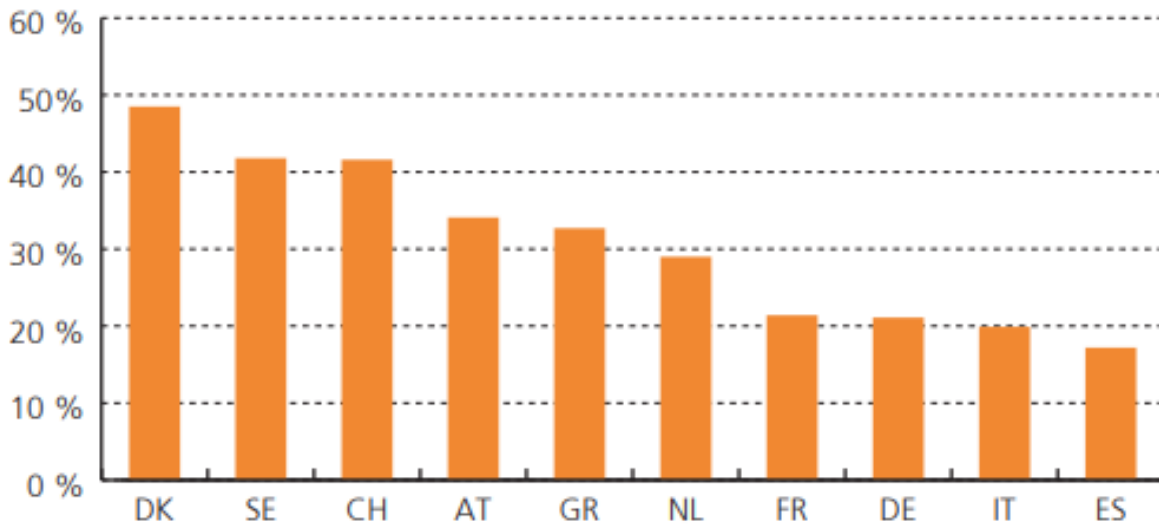
Response Rate 1 (RR1), or the minimum response rate, is the number of complete interviews (I) divided by the number of interviews (complete (I) plus partial (P)8) plus the number of noninterviews (refusal and

break-off (R) plus non-contacts (NC) plus others (O)) plus all cases of unknown eligibility (unknown if housing unit exists (UH) plus unknown, other (UO)).

Response Rate 3 (RR3) discounts the number of households with unknown eligibility by weighting it with the proportion of cases actually eligible.

Response Rate 5 (RR5) is either a special case of RR3 in that it assumes that $e=0$ (i.e. that there are no eligible cases among the cases of unknown eligibility) or the rare case in which there are no cases of unknown eligibility. In this respect, RR5 represents the upper bound of the presented response rates.

The proportion of respondents in very good or excellent health (by country)



- What do you think about these response rates?
- What can you say about the differences in self-rated health between countries?

Question 3.

A UK charity supporting patients with asthma conducted a survey of quality of life among persons with asthma. They approached all 16439 asthma patients on their database, and responses were obtained from 4106 patients. Among respondents, 1955 reported that asthma has posed severe and long-term limitations on their daily activity.

- What was the response rate?
- What was the prevalence of severe long-term limitations on daily activity in this study?
- Is there likely to be important selection and information bias in the survey findings?
- The publication called for extensive policy measures to alleviate the common and severe life limitations suffered by asthma patients. Do you agree with this conclusion? Why?

Question 4

Below is a part of the abstract from a study of the association between socioeconomic status and autism (Kelly et al, *Autism* 2019;23(1):131-140. doi: 10.1177/1362361317733182)

There has been recent interest in the relationship between socioeconomic status and the diagnosis of autism in children. Studies in the United States have found lower rates of autism diagnosis associated with lower socioeconomic status, while studies in other countries report no association, or the opposite. This article aims to contribute to the understanding of this relationship in the United Kingdom. Using data from the Born in Bradford cohort, comprising 13,857 children born between 2007 and 2011, it was found that children of mothers educated to A-level or above had twice the rate of autism diagnosis, 1.5% of children (95% confidence interval: 1.1%, 1.9%) compared to children of mothers with lower levels of education status 0.7% (95% confidence interval: 0.5%, 0.9%). No statistically significant relationship between income status or neighbourhood material deprivation was found after controlling for mothers' education status.

- a. Can you think of any biases that may explain this finding?
 - a. Selection?
 - b. Information?

Question 5.

Hypothetical example of case-control study examining the association between heavy drinking and myocardial infarction (MI).

In an imaginary case-control study in one large city, MI cases were ascertained from hospital admissions for acute MI during one year in the largest hospital in the city. Controls were recruited from a random sample of the voter register during the same year. Cases and controls were asked about their alcohol consumption and heavy drinking occasions. We can assume that cases and controls were similar in terms of sex and age.

The study results were as follows.

	Cases	Controls
Heavy drinker	21	30
Not heavy drinker	192	215
Total	213	245
% heavy drinkers		

- a. What were the target population and study sample?
- b. What assumption would you have to make before accepting that the use of population controls was appropriate?
- c. Calculate the odds ratio and % heavy drinkers in cases and controls
- d. What do you need to know in order to assess whether selection biases might be operating here?
- e. The response rate was 62% in cases and 50% in controls. What do these response rates suggest?
- f. A brief questionnaire was given to all non-responders, including the question “do you ever drink to excess?” Overall, 20% of case non-responders and 25% of control non-responders replied “yes” to that question. What do you make from this new information? Does it solve the problem of non-response in this study? Can you safely assume that all case non-responders are heavy drinkers?

g. The study also collected blood samples. The researchers analysed the liver enzyme GGT, which is associated with alcohol consumption. The proportion of those with increased GGT levels (a biomarker associated with heavy drinking), were as follows:

Reported drinking status	Cases	Controls
Heavy drinkers	73%	71%
Non-heavy drinkers	31%	2%

Without any formal calculations, what do these figures suggest about reporting of heavy drinking among cases and controls?

h. How would this affect the estimates of the association between heavy drinking and MI?