Practical 1: Epidemiologic Measures I

Objectives

This practical is linked with Practical 2, which you will do next week.

At the end of Practical 1 students should be able to:

- **Understand the distinction between prevalence and incidence**
- **Understand the need for denominators when measuring disease frequency**
- **Calculate and interpret different measures of disease frequency (prevalence, prevalence odds, risk/incidence, incidence odds, rate)**

At the end of Practical 2 students should be able to:

- Calculate and interpret different measures of disease frequency (prevalence, prevalence odds, risk/incidence, incidence odds, rate).
- Calculate and interpret ratios and difference figures.

Question 1

1. A methadone clinic which serves people who use heroin sought to measure patient outcomes in 2016. As patients were registered at the clinic, they were followed up monthly and asked whether they had experienced a heroin overdose (i.e. use of drug leading to loss of consciousness) since their last visit.

Patient number	January	February	March	April	May	June	July	August	September	October	November	December	Outcome	Person-months
1										X			Lost to follow-up	10
2												X	No overdose	11
3					X								Overdose	3
4										X			Lost to follow-up	6
5									X				Overdose	2
6											X		Lost to follow-up	4

Blue boxes indicate the months where follow up occurred, with the last month of follow up marked with an X.

a. What was the incidence risk of heroin overdose for this clinic?
   = 2 / 6 = 0.33 = 33%
   = 3.3 overdoses per 10 people at risk between January and December 2016.
   = 33 overdoses per 100 people at risk between January and December 2016.

b. Calculate the (i) person-months at risk for each patient and (ii) the total person-months of observation in the study.
   (i) See table

   (ii) 36 person-months

c. Calculate the incidence rate of heroin overdose in this study

= 2 overdoses / 36 person-months = 0.0556 overdoses/person-month = 56 overdoses per 1000 person-months

Note that if you wanted to calculate the incidence rate using person year, this is the calculation: 2/36 person-months, so 36 person months=3 person years (36/12) = 2/3person-years = 0.66/person-year= 66 per 100 person years (in period of Jan-Dec 2016).

d. For what reasons might a patient be lost to follow up? What are the implications of these lost patients?
   - Participant moves
   - Participant can't be located by study staff
   - Participant withdraws consent from study
   - Participant dies (for any reason)
   - Participant no longer uses non-prescription injection drugs
   - Participant dies (because of an overdose)

The last reason is the most important. If a participant has died from an overdose, the outcome will not be counted in the study. The rate calculation will underestimate the true rate of overdose. There are 3 participants who were lost to follow-up, and so if any of them had an overdose, the rate calculation would end up quite different from 56/1000 person-months.

There are further implications when trying to estimate a rate ratio or rate difference, i.e. to compare the rate of overdose across different exposure groups. One must be concerned that the undercount of cases varies by exposure group. In that case, the calculated rate ratio (or rate difference) will not reflect the truth. You will go into depth about this kind of situation in a later lecture!

Question 2

2. John Snow is considered one of the founders of modern epidemiology. He investigated several major outbreaks of cholera in London in the 1800s and provided evidence that access to a particular water source was associated with cholera deaths.

   In 1854, John Snow compared cholera deaths across areas of London supplied by different water providers (1). His findings are below.

Local water provider	Population	Cholera deaths from 8 July to 26 Aug 1854	Incidence risk per 100,000 people
Southwark and Vauxhall Company (S&V)	167,654	844	503.4
Lambeth Company	19,133	18	94.1
Total	186,787	862	461.5

a. What are the comparison groups for John Snow's investigation?

   The comparison is of people living in areas where Southwark & Vauxhall Company was the local water provider versus those living in areas where Lambeth Company was the local water provider.

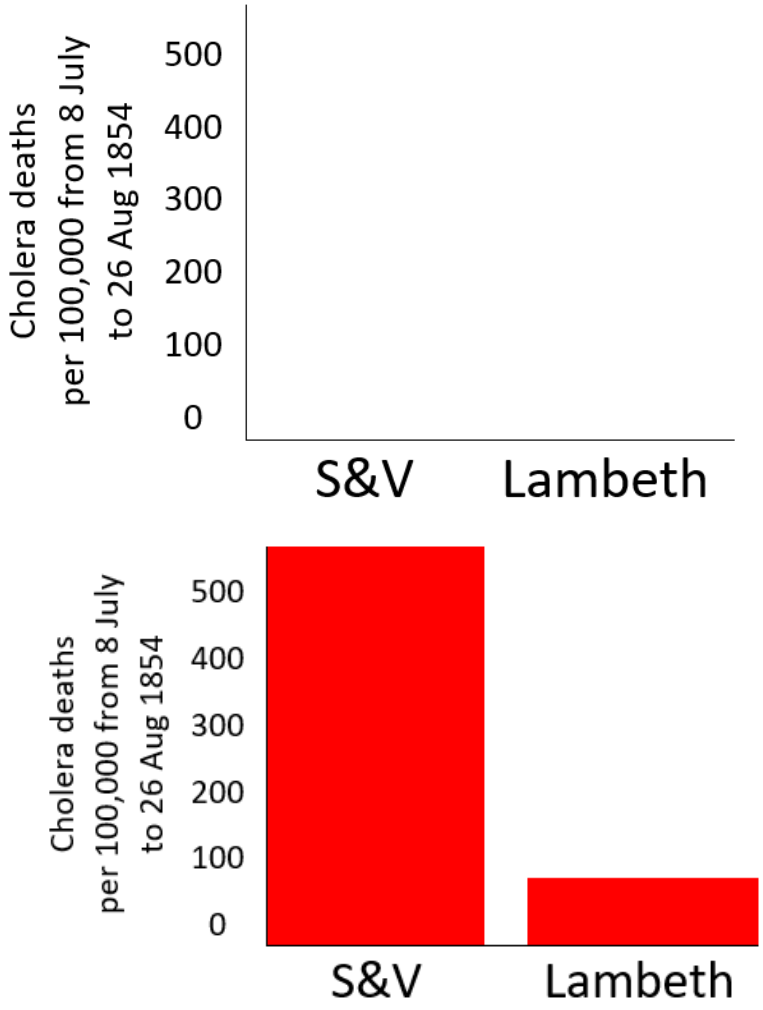
b. Complete the bottom row of the table and calculate an overall incidence risk of cholera deaths.

   See table.

c. Calculate the incidence risk of cholera deaths for each local water provider. Report this as deaths per 100,000 population.

   See table. Note that the table could also have been improved by specifying that the risk is for a period of about a month and a half.

d. Use the values from the table to complete the bar chart.



More about John Snow:

Watch Dr Ros Stanwell-Smith discussing John Snow here: http://www.londonlive.co.uk/news/2018-07-20/pump-reinstated-in-soho-to-remember-great-scientist,

Read more in the award-winning book “Ghost Map” by Steven Johnson, available in the LSHTM library: https://lshtm.primo.exlibrisgroup.com/permalink/44HYG_INST/1g4gmr9/alma991000315279703736

Read more here: https://www.lshtm.ac.uk/newsevents/news/2019/john-snow-memorial-pump-marking-historic-cholera-outbreak-reinstalled-its ;

Learn more about John Snow at the John Snow pub in Soho, where you can see a replica of the famous hand pump outside: 39 Broadwick St, London W1F 9QJ.

Watch the John Snow Society’s annual Pumphandle Lecture, held every September at LSHTM: https://www.lshtm.ac.uk/newsevents/events/series/annual-lectures, followed by a visit to the John Snow pub.

Question 3

3. In 2019, the Government of Nepal and UNICEF completed the sixth round of the nationally representative Multiple Indicator Cluster Survey (MICS). The questionnaire for women aged 15-49 included measures on social practices relating to menstruation.

   Chhaupadi is a practice observed in Nepal whereby women, girls and people who are menstruating are required to spend their nights in a separate house. Often these houses are unprotected huts, which creates a risk of substantial harm, including death.

1_Nepal MICS Table
Nepal MICS 2019 Fir

Double click on the icon above to download the table (also available on Moodle)

a. Nationally, what is the estimated prevalence of women who had to stay in chhaupadi / chhapro / cowshed due to their last menstruation in the last 12 months?

   3.8% or 3.8 cases per 100 or 38 cases per 1000 women age 15-49 in 2019.

b. Describe the prevalence of women who had to stay in chhaupadi / chhapro / cowshed across characteristics such as geographic region, age, education, disability, and wealth. Describe any patterns you observe.

   While the national prevalence is estimated to be 3.8%, there are notable sub-national variations.

   - The prevalence of chhaupadi among women living in rural areas (6.5%) was higher than in urban areas (2.6%).
   - The prevalence of chhaupadi was low (<3%) in most provinces. However, in Karnali and Sudoorpashchim Province the prevalances were above 20%.
   - By age, there appears to be a slight negative trend, such that the prevalence is higher among younger women.
   - By education, there appears to be a negative trend, such that the prevalence of chhaupadi is higher among women with less education.
   - The prevalence of chhaupadi among women who had functional difficulty (6.2%) was higher than among women who did not have functional difficulty (3.6%).

- The prevalence of chhaupadi was higher among women in the poorest wealth index (15.1%) and lower among women in the other four wealth quintiles (between 0.9 and 2.4%).

c. Repeat Part B, but for the prevalence of women who had to stay away from religious work / temple visits. How do these patterns compare?
The national prevalence of religious exclusion due to menstruation was 92.8%. There was minimal variation in the prevalence figures by geography, age, education, disability, and wealth.

Question 4

4. In 2013, epidemiologists conducted a study of alcohol use in Sehore, a rural district of Madhya Pradesh state in India(3). They enrolled a random sample of 3220 adults from the district and reported the following:

Characteristic	Total n	n who drink alcohol	Prevalence of alcohol use	Prevalence odds of alcohol use
Age (years)				
18-29	905	139	0.154	0.181
30-49	1501	193	0.129	0.148
>=50	814	100	0.123	0.140
Gender				
Female	1444	9	0.006	0.006
Male	1776	423	0.238	0.312

a. What is the estimated prevalence of alcohol use among adults in the district?

Prevalence = 432 / 3220 = 0.134 = 13.4 per 100 = 13.4% in 2013.

b. Calculate (to 3 decimal places) the prevalence and prevalence odds for each row.
See table.

Question 5

5. Sonkin et al (4) analysed the child mortality rate in UK for different modes of transport in 1985 and in 2003. Their findings are tabulated below.

Mode of transport	Mortality rate during use of transport (per 100 million passenger-miles): 1985	Mortality rate during use of transport (per 100 million passenger-miles): 2003
In car	0.4	0.1
On foot	10.8	2.7
On cycle	8.4	5.5

a. What are the (i) comparison groups and the (ii) outcome of interest?

(i) Comparison groups: The different modes of transport- In car, On Foot, On Cycle

(ii) Outcome: Rate of deaths (mortality rate).

b. What is the rationale for using "passenger-miles" as the denominator, rather than "# children who use [car/foot/cycle] for transport"? Can you suggest a better denominator?

"Number of children" doesn't account for the fact that children are likely to be exposed to these different modes of transport at vastly different scales. A child might only walk 1-2 miles a day, whereas a car journey could be hundreds of miles. The opportunity to die in a car in a 100-mile journey is far more substantial than in a 1-mile walk.

A fairer comparison would be the level of risk in 100-mile car journey vs 100 miles of walking (or in this instance, 100 million miles). By using passenger-miles, we get a much more accurate picture of the level of risk by mode of transport. "Passenger-time" could be better, as it accounts for the fact that people travel at different speeds. It is likely more important to consider the amount of time that a person is engaged in a mode of transport (even at a standstill), rather than their distance on that mode. However, it is much more difficult to measure person-time in this case, and so passenger-distance is the next best option.

Note that the analyses by Sonkin et al and Snow are both examples of ecologic studies. As such, the incidence and rate figures are not true incidence and rates. For this exercise though, we ask you to treat these analyses as if they were using individual-level data.

- Sonkin used data from a national survey to estimate the distance travelled by mode of travel for the denominators, and data from a separate register for mortality for the numerators. We don't actually know if the children who died were actually engaged in a given form of transport at the time of death, or how many passenger-miles each child travelled.

- Snow used 1851 census data for the population of each borough as the denominator, and a death registry from 1854 for cholera deaths for numerators. This same estimation method is used to calculate the "maternal mortality ratio" in the present day.

References

1. Snow J. On the mode of communication of cholera. 2nd ed. London, UK: John Churchill; 1855.

2. Central Bureau of Statistics. Nepal Multiple Indicator Cluster Survey 2019, Final Report. Kathmandu, Nepal: Central Bureau of Statistics and UNICEF Nepal; 2019. https://www.unicef.org/nepal/media/11081/file/Nepal%20MICS%202019%20Final%20Report.pdf

3. Rathod SD, Nadkarni A, Bhana A, Shidhaye R. Epidemiological features of alcohol use in rural India: a population-based cross-sectional study. BMJ Open. 2015 Dec;5(12):e009802.

4. Sonkin B, Edwards P, Roberts I, Green J. Walking, cycling and transport safety: an analysis of child road deaths. J R Soc Med. 2006 Aug 1;99(8):402–5.