Introductory session

Aim

This course will introduce students to more complex epidemiological concepts and advanced methods employed in modern epidemiological research.

Objectives

1. To develop a stronger understanding of causation in epidemiology
2. To recognise important biases and understand how these affect interpretation of findings, as well as how such biases can be dealt with through study design and/or statistical analysis
3. To develop a critical understanding of how quantitative methods can be used to apply effect measures to target populations
4. To develop a critical understanding of the principles underpinning specialist areas of epidemiology, such as life-course epidemiology

Learning outcomes

1. Both critique and design epidemiological research informed by an understanding of counterfactual thinking and causal diagrams, including a critical understanding of the limits of these approaches.

2. Recognise important biases and understand how these affect interpretation of findings, understand how such biases can be dealt with through study design and/or statistical analysis and have a critical understanding of the relative strengths and limitations of different methodological approaches.

3. Critically understand how quantitative methods can be used to apply effect measures to target populations, as well as the assumptions such approaches require.

4. Critically understand the major methodological issues in natural experiment studies, administrative data analyses and life-course epidemiology and relate these to major theories across the wider field (i.e. collider bias, confounding etc).

Emphasis of course

- Understanding assumptions
- Making connections
    - *Different statistical approaches*
    - *Different terminologies within epidemiology*
- Interpretation and partnership
- Get a feel for magnitude and importance of biases

Causal notation

Outline

Causes

Counterfactuals

The notation for counterfactual models

Exchangeability

Randomisation

Conditional exchangeability

Standardisation

Causal notation: what we'd like to know

	A (the ice)	Y|A=0	Y|A=1
Fergus *(f)*	1		1
Graeme *(g)*	1		1

1 = yes - factor present, or outcome happened
0 = no – factor absent, or outcome did not happen

$Y_i|A=1$ means the outcome (Y) given that the exposure status for person i was actually 1 (exposed)

$Y_i^{a=1}$ means the outcome (Y) for person i when their exposure status (perhaps counter to the fact) is set to 1 (ie exposed)

Summing up

Counterfactuals help us to be clear about what we mean by saying that something was causal

It’s therefore important to be clear about what counterfactual we are considering

eg “if no-one was obese”, or “if everyone had a BMI of 25” are different counterfactuals when we are thinking about the causal effect of abnormally high weight

Summing up

We can’t observe counterfactual outcomes

However if we assume that groups are exchangeable, then we can use the outcome in the other group to estimate the unobserved counterfactual

Randomisation gives us some assurance that the groups are exchangeable

Summing up

In observational research to draw causal conclusions we have to assume that groups are either exchangeable or at least conditionally exchangeable (conditional on some third factor)

We can deal with this by standardising on that third factor or using other similar approaches to adjust for other factors

Summing up

However when randomisation isn’t involved, we always have to consider whether there might be other factors that threaten exchangeability

In traditional terms, could our group comparison be confounded?

Conclusion

the counterfactual framework is part of everyday speech and being clear about counterfactuals adds rigour and clarity to discussions about causality

the notation may seem complicated

however it gives us a useful mathematical language to discuss causation