Cross-cohort comparative analyses in the British cohort studies: opportunities and challenges

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Housekeeping

- We are recording this session so it will be available online at a later date
- If you have a question, please use the chat function, and please note your question will be visible to all attendees
- Technical issues – please email us: ioe.clsevents@ucl.ac.uk
- We would be grateful for your feedback. Please follow the link in the chat at the end of the event for the short survey – we have also emailed this to you

Thank you for joining us today

Overarching aim

- Discuss opportunities + challenges + possible solutions
- Introduce resources (analysis, data)

Background, motivation and examples

- How has [???] changed across time?
  - Population characteristic - prevalence or association

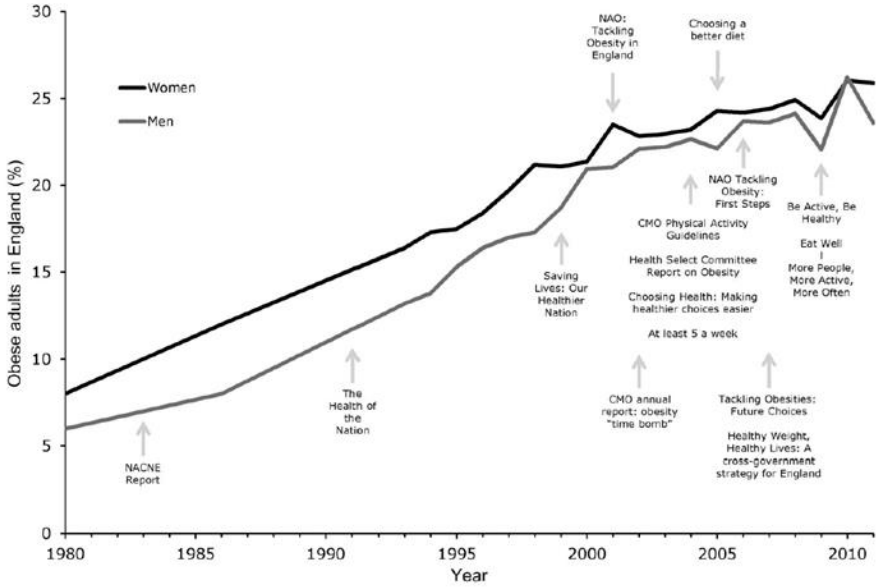
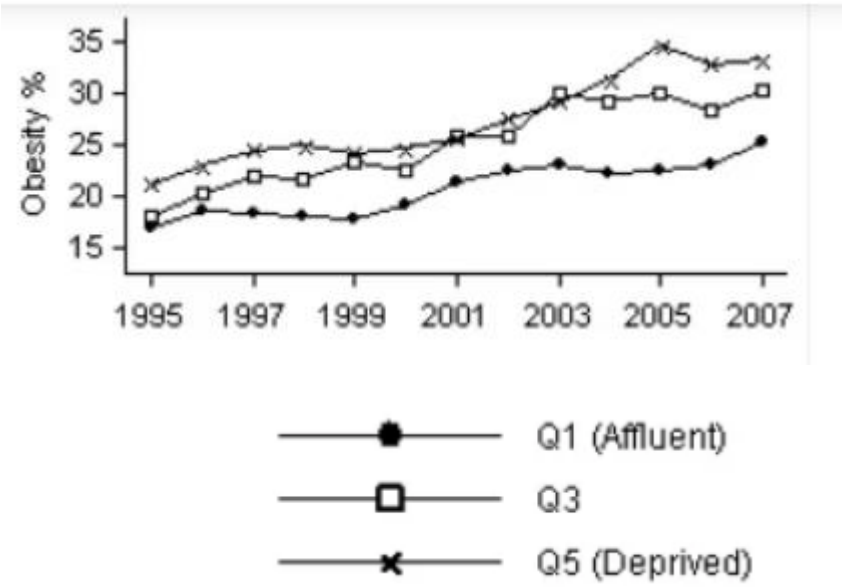
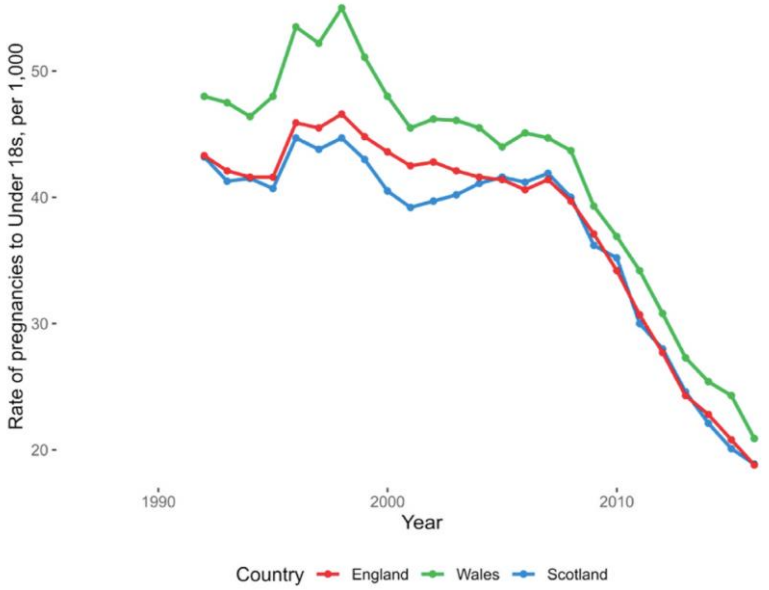


Figure 1 History of obesity policy reports in England and the growing prevalence of obesity in adults.

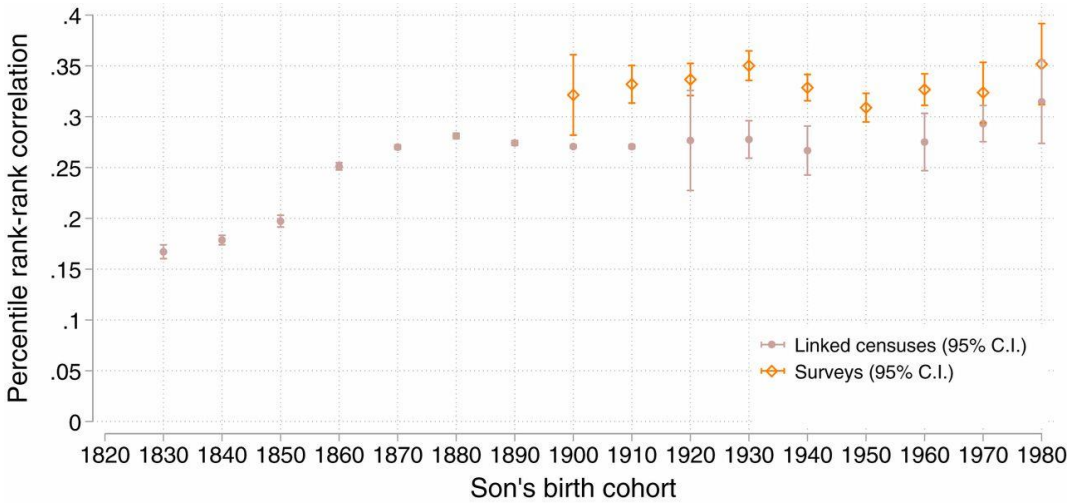
Jebb et al, 2013



Scholes et al 2012



Baxter et al. (2021)



Song et al 2019

- What does this typically involve?
  - Collation + analysis of data from multiple studies, ensure that key data are valid, sources of bias are addressed + inferences are drawn appropriately
    - Multiple decisions -> altered conclusions?

- Most training: analysis of 1 study - all start from scratch
  - Paper to discuss challenges/solutions + checklist + teaching resource
    - Many diverse research questions -> no authoritative rules
    - Targeted at researchers new to this space

David Bann, Liam Wright, et al**.** Investigating change across time in prevalence or association: the challenges of cross-study comparative research and possible solutions. Discover Social Science & Health, 2022. Tutorial+Syntax.

Guidance on different aspects of comparative research workflow:

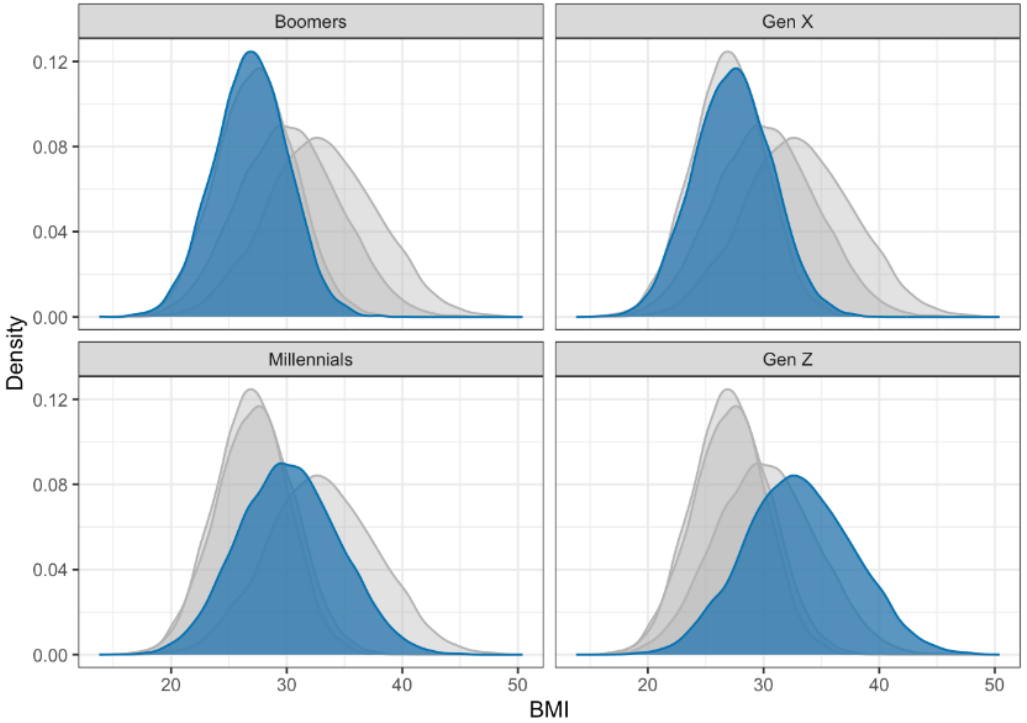
- Descriptive statistics
- Study-specific regressions
- Meta-analysis
- Pooled cohort regressions
- Missing data
- Modelling longitudinal data

In both Stata + R

- Introduction
- Descriptive Statistics
- Study-Specific Regressions
- Meta-Analysis
- Pooled Cohort Regressions
- Missing Data
- Modelling Longitudinal Data
- References

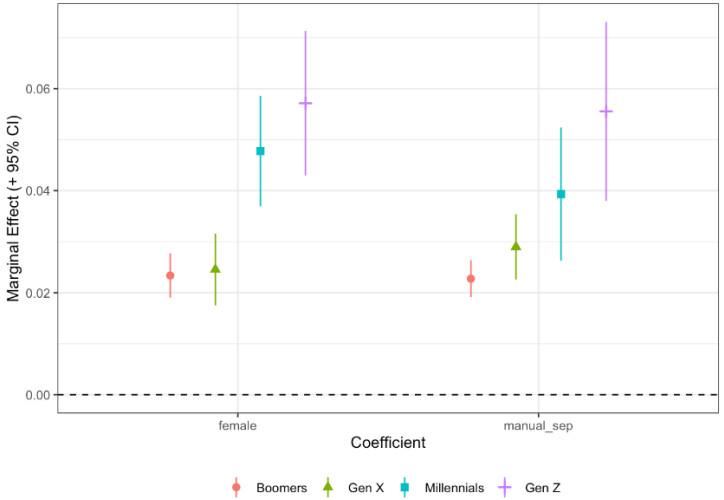

```
                "#F0E442", "#0072B2", "#D55E00", "#CC79A7")

ggplot(df) +
  aes(x = bmi) +
  facet_wrap(~ cohort) +
  geom_density(data = rename(df, cohort_f = cohort),
               aes(group = cohort_f),
               color = "grey70", fill = "grey70", alpha = 0.4) +
  geom_density(color = cbbPalette[6], fill = cbbPalette[6], alpha = 0.7) +
  theme_bw() +
  labs(x = "BMI", y = "Density")
```



- Introduction
- Descriptive Statistics
- Study-Specific Regressions
  - Data Preparation
  - BMI OLS Models
  - Depression Logistic Regression Models
    - Regression Tables
    - Plotting Results
    - Marginal Effects on Absolute Scale
- Meta-Analysis
- Pooled Cohort Regressions
- Missing Data
- Modelling Longitudinal Data
- References


```
mutate(mrg = map(mod, get_mrg)) %>%
select(-mod) %>%
unnest(mrg) %>%
ggplot() +
aes(x = term, y = estimate, ymin = conf.low, ymax = conf.high,
    color = cohort, shape = cohort) +
geom_hline(yintercept = 0, linetype = "dashed") +
geom_pointrange(position = position_dodge(0.6)) +
theme_bw() +
theme(legend.position = "bottom") +
labs(x = "Coefficient", y = "Marginal Effect (+ 95% CI)",
     color = NULL, shape = NULL)
```




```
meta forestplot

Effect-size label:  Effect Size
      Effect size:  beta
        Std. Err.:  se
      Study label:  cohort_lbl
```

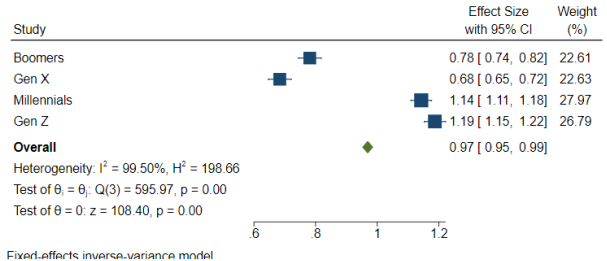


Table 1 Checklist for studies which investigate differences in prevalence or associations across time

Domain Section	Recommendation
Rationale	Explain the scientific background and rationale for the comparative design; give (if any) prespecified hypotheses with supporting evidence where available
	Provide explanation of the basis for study selection/inclusion
Methods	
Study design	Present key elements of each study used, noting key similarities/differences in: (a) Target population (b) Sample recruitment (c) Exposure/outcome measurement (the measures validity and measurement protocols) (d) Covariate availability and specification
	For longitudinal analyses, provide any relevant detail on cross-study alignment in respondent age at assessment (where relevant) and interval lengths between data collections
	Provide sufficient and accurate citation of source data
Statistical methods	Give the rationale for statistical tests undertaken—where either simple or complex models are used
	Consider testing associations in both absolute and relative magnitudes, since conclusions may differ when only one is examined
	Note how cohort differences in association will be compared (e.g., informally by comparing effect estimates, and/or formally via meta-analysis/inclusion of cohort* exposure interaction terms)
	Identify, implement and document an appropriate missing data handling strategy
Estimation	
Results	Provide effect size/s and appropriate indicators of precision (e.g., 95% CI); comment on the size of the cohort difference in association
	Where appropriate consider accounting for confounding variables (common causes of both exposure and outcomes); where included, provide unadjusted and confounder-adjusted effect estimates
	Consider sensitivity analyses to test the robustness of the associations observed; for instance, do conclusions differ when restricted to more comparable target populations (even at the expense of study power)
Inference	
Explanation of findings	Consider, using relevant supporting evidence, the potential explanation for cohort differences/similarities in the association observed: (a) Differences in causal effect of the exposure (b) Alternative explanations, for example differences in confounding/sample composition or measurement
Methodological considerations	Discuss the degree to which analyses are likely to be sufficiently powered to detect differences by cohort (e.g., note in the discussion or where credible a-priori rationale exists for differences in effect size)
	Include a balanced discussion of the strengths and limitations of the work undertaken e.g., whether the number of studies included and the timespan covered are sufficient
Implications	Rationalise the need for future research
	If appropriate give cautious implications for policy, based on the current study and other sources of evidence

Challenges and possible solutions

1. Type and span of study
2. Target sample and population
3. Measurement
4. Missing data
5. Associations (incl. scale, distribution of exposure, methods)
6. Interpretation / causality

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Challenges and possible solutions

1. Type and span of study

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Centre for Longitudinal Studies (CLS) current core studies

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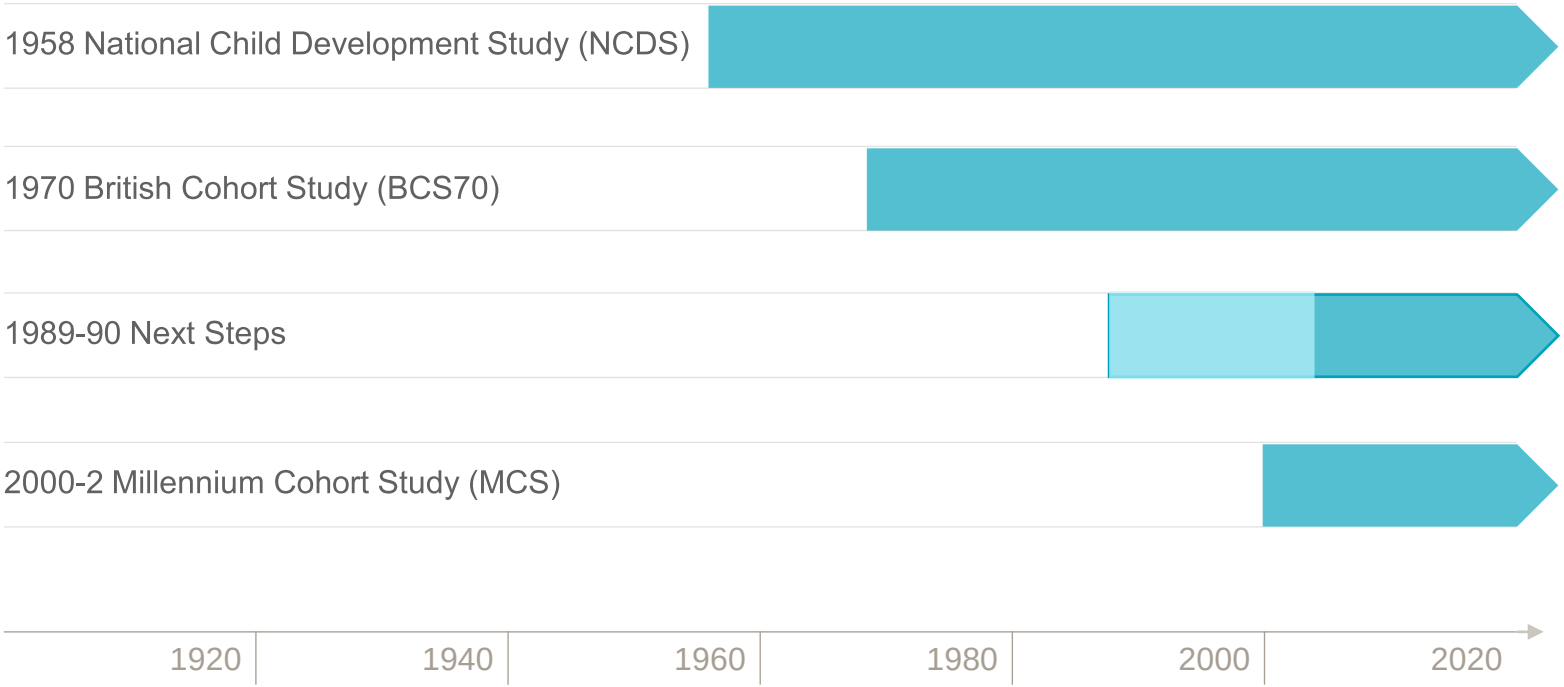

Study timelines and future 2020-2030

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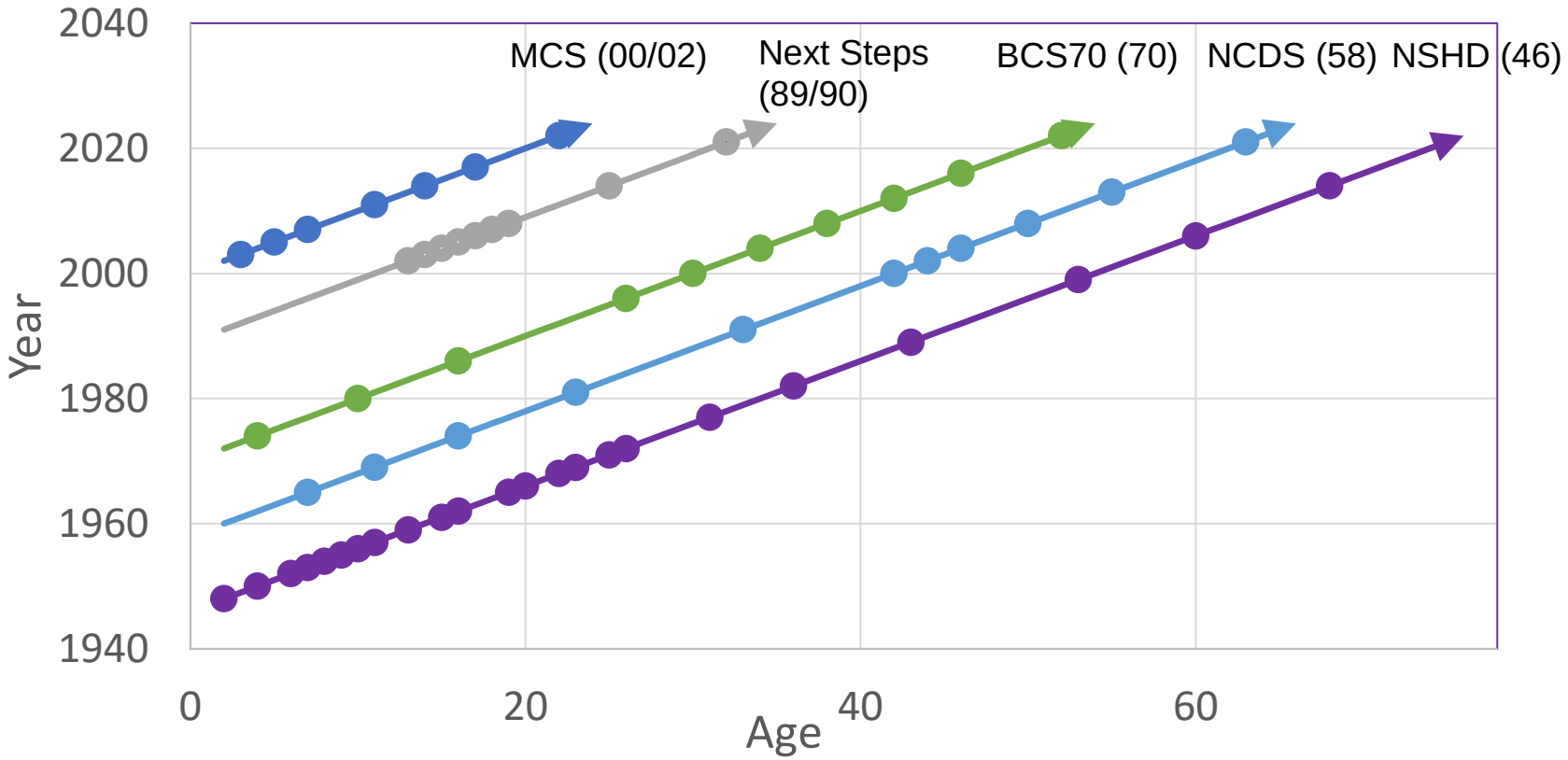
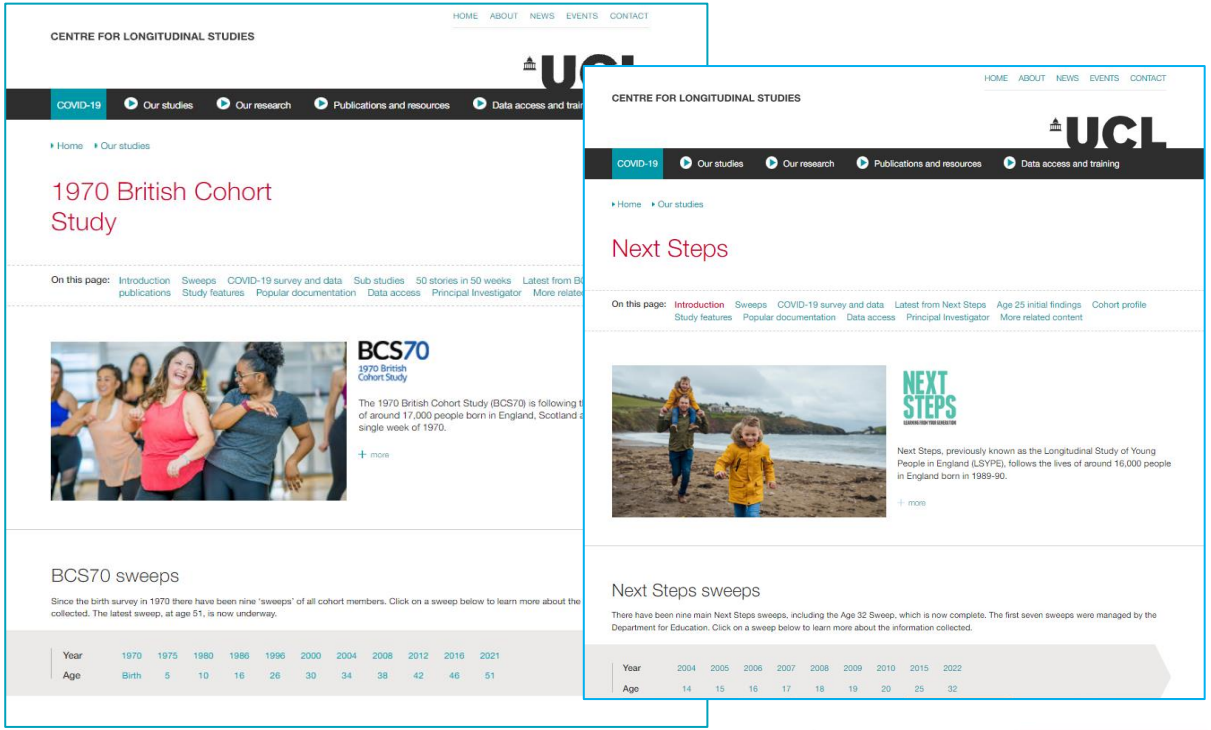


Resources available: CLS website

https://cls.ucl.ac.uk/



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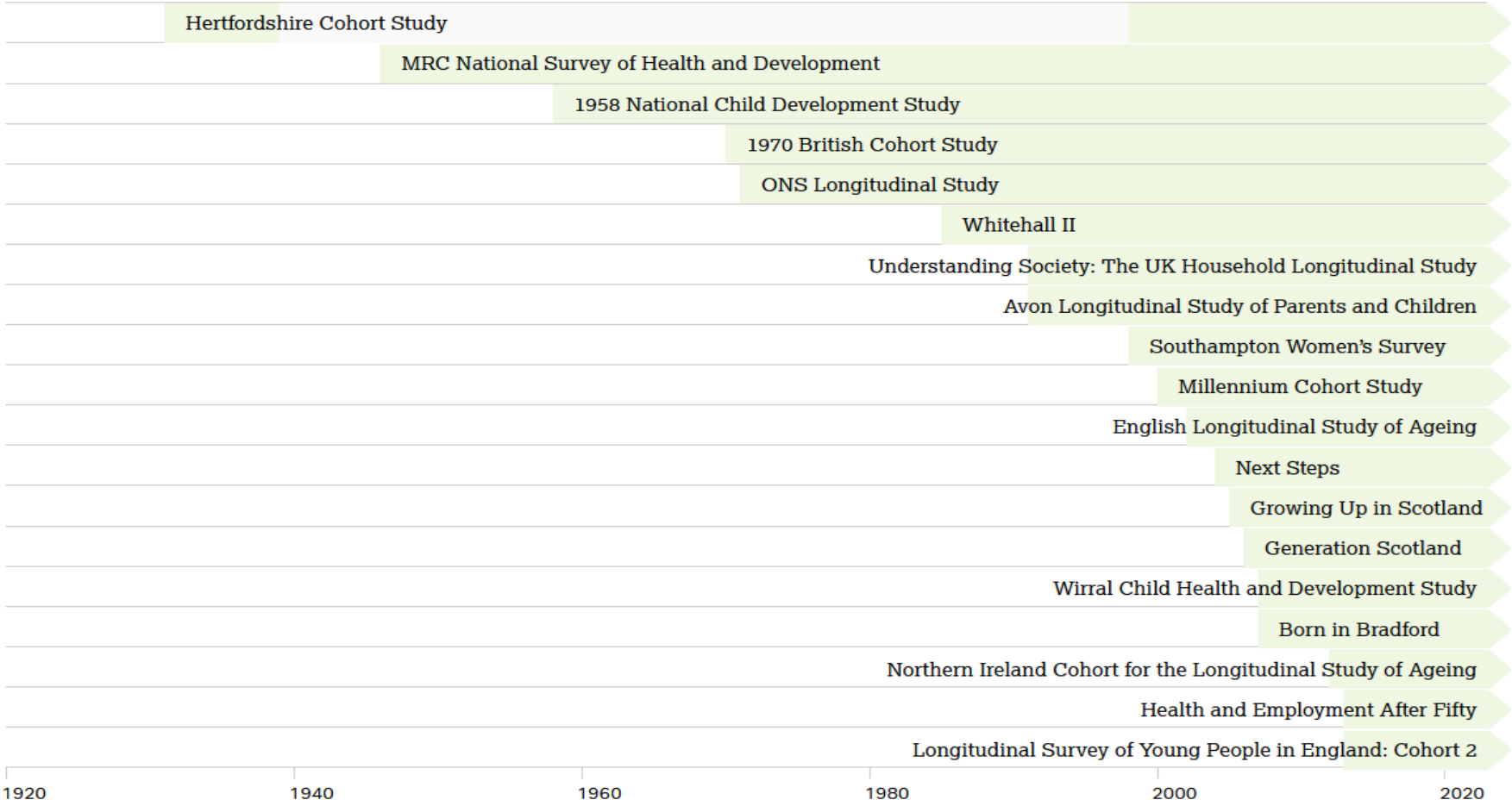
Introduction to the 1958 National Child Development...

Introduction to the 1970 British Cohort Study

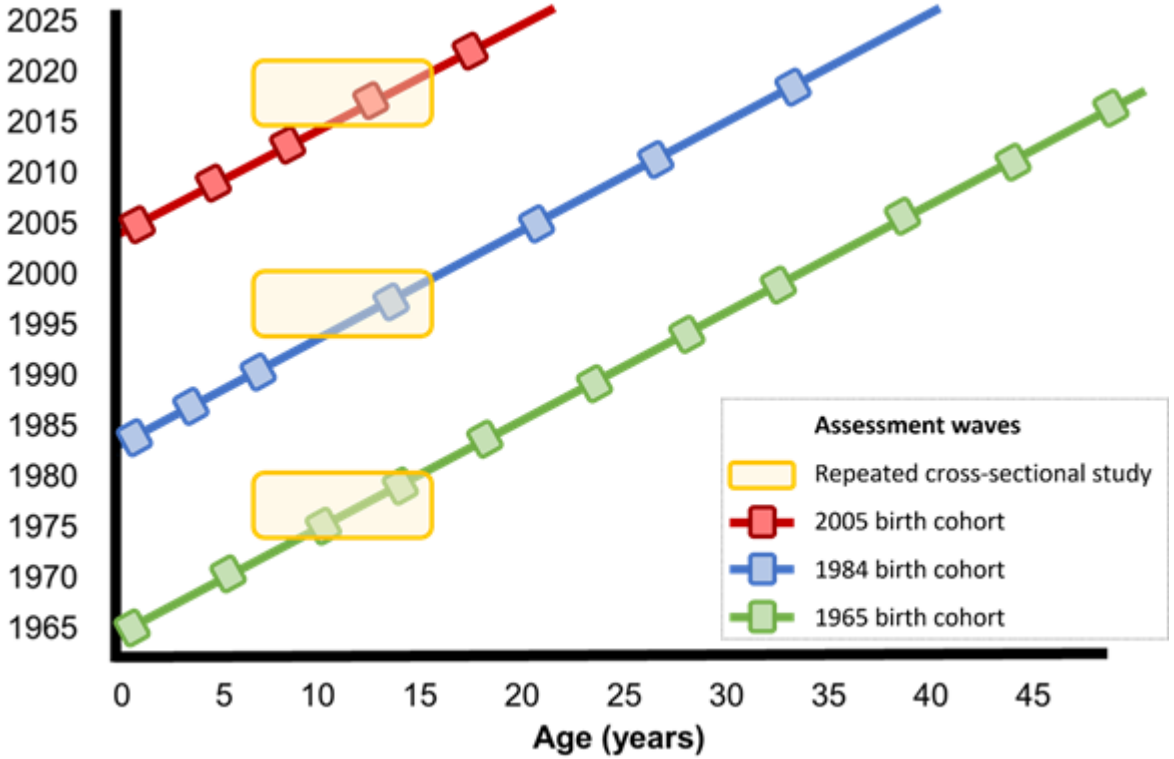
Introduction to Next Steps: a longitudinal study in England

Introduction to the Millennium Cohort Study

Explore the studies



Study/resource type	Name of resource	Location, years	Website
Cross-sectional studies	Europe, e.g. European Social Survey (ESS),	Europe, 2001-	https://www.europeansocialsurvey.org/
	Health-oriented studies, e.g.		
	National Health and Nutrition Examination Survey (NHANES)	USA, 1999-	https://www.cdc.gov/nchs/nhanes/index.htm
	Health Survey for England (HSE)	England, 1994-	http://healthsurvey.hscic.gov.uk
Longitudinal studies	Survey of Health, Ageing and Retirement in Europe (SHARE)	Europe, 2004-	http://www.share-project.org/
	Birth cohort studies	UK, 1946-	https://cls.ucl.ac.uk/cls-studies/
	Household panel studies, e.g.		
	Understanding Society (Usoc)	UK, 1991-	https://www.understandingsociety.ac.uk
	Panel Study of Income Dynamics (PSID)	USA, 1968-	https://psidonline.isr.umich.edu/



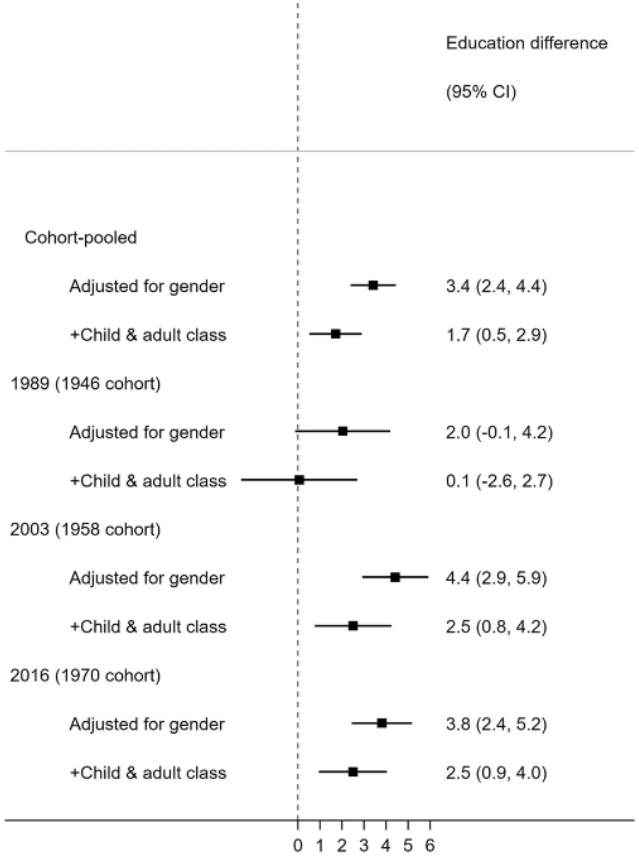
Cohort

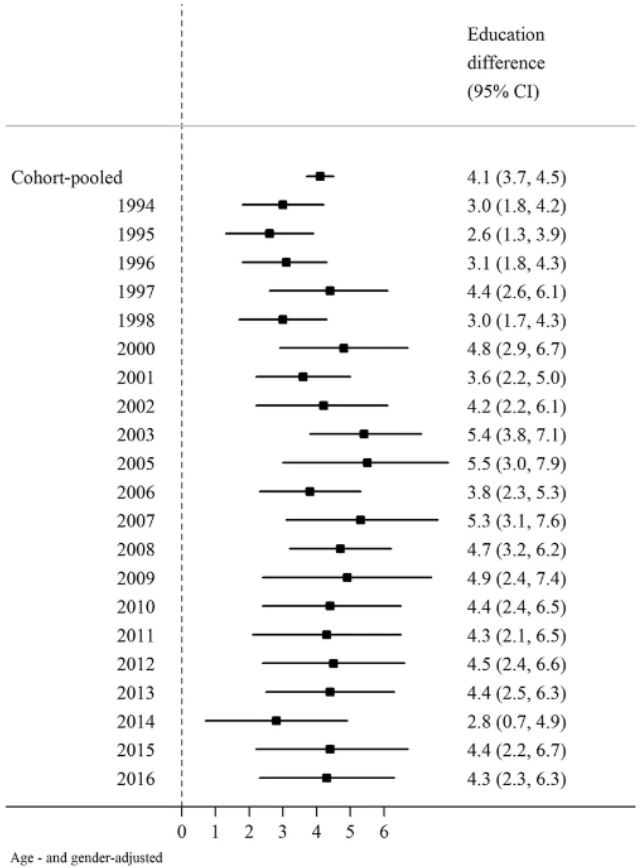
- Temporal ordering… Age-related changes in… exposure or outcome, association
- Large N at specific ages (eg, midlife BP, adolescent MH; power and generalisaility of these ages)

Cross-sectional

- Updatable target population: samples may better reflect demographic changes (eg migration)
- Greater spread of years (chronological precision)
- Spread of ages (aids generalisability)

NB see also panel studies, admin data, RCTs?...





Both: Similar across time i.e., persisted

Cohort: lifetime SEP data, larger N in midlife

HSE: annual data, multiple ages, recent migrants

Bann et al 2020

Life-course body mass index trajectories and blood pressure in mid life in two British birth cohorts: stronger associations in the later-born generation

Leah Li,[1]* Rebecca Hardy,[2] Diana Kuh[2] and Chris Power[1]

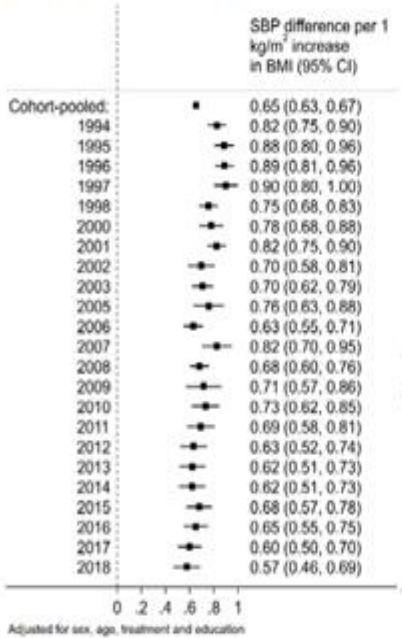
Results: Mean systolic BP (SBP) decreased from the earlier- to later-born cohort by 2.8 mmHg in females, not males; mean diastolic BP (DBP) decreased by 3.2-3.3 mmHg (both sexes). Adult BMI was higher in the later- than the earlier-born cohort by 1.3-1.8 kg/m^2, slopes of BMI trajectory were steeper from early adulthood and associations with adult BP were stronger. Associations between adult BMI and SBP were stronger in the later-born cohort. For males, childhood BMI slope was associated with SBP only in the later-born cohort; the association for adult BMI slope was stronger in the later-born cohort: correlation coefficient $r = 0.28$ [95% confidence interval (CI): 0.25,0.33] versus 0.13 (0.06,0.20). For females, childhood slope was associated with SBP in both cohorts; adult slope was associated with SBP only in the 1958 cohort [$r = 0.34$ (0.31,0.37)]. Patterns of child-to-adult BMI associations were similar in relation to DBP.

Conclusions: BP did not increase between two generations born 12 y apart despite higher BMI levels. A stronger association between BMI trajectory and BP in the later-born cohort suggests that BMI-related effects may have been offset by improvements in other factors linked to BP, such as diet and smoking.

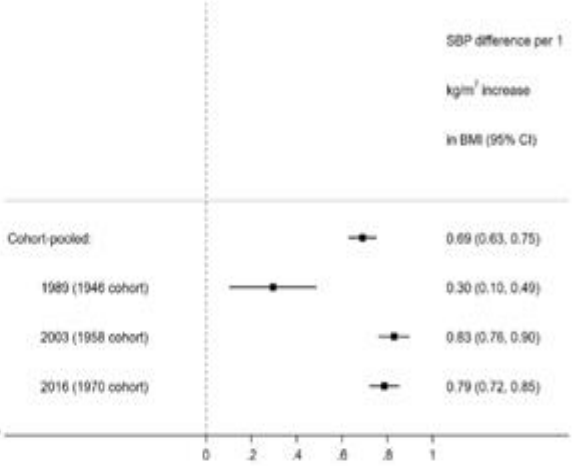
Has this trend continued?

How robust are 2 cohort comparisons?

Health Survey for England:



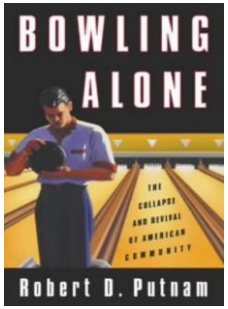
Cohorts:

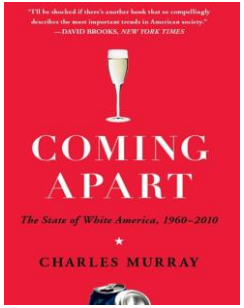


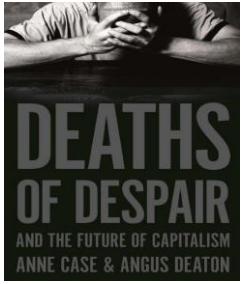
1946c, BMI->BP β 43y 0.34mmHg (0.14-0.53)
53y 1.09mmHg (0.91-1.27)

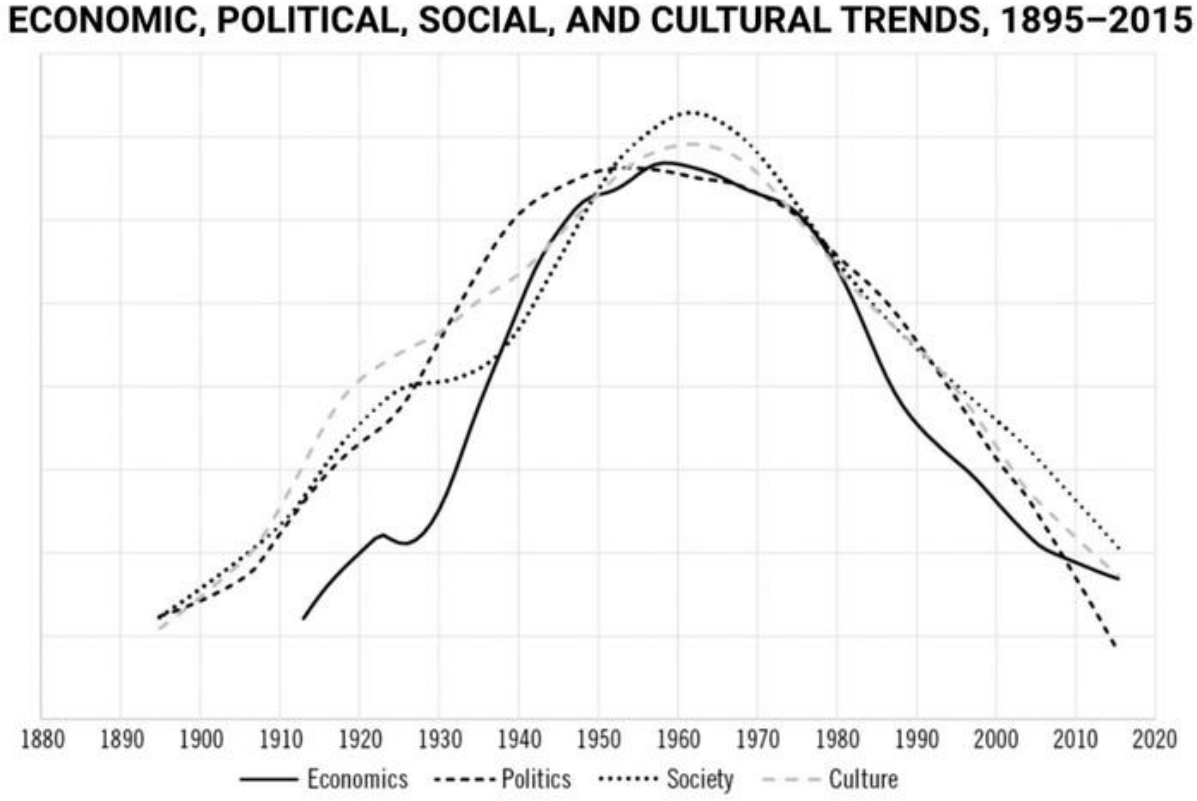
2 timepoint comparisons can get the 'wrong' answer re: longer term trends ~single source of non-differential error, could bias within (longitudinal) and cross-cohort comparisons. More phenotyping detail (eg, imaging) won't help

Bann, Hardy, Scholes, O'Neill 2021

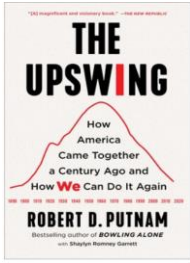








Putnam & Romney Garrett, 2021



Challenges and possible solutions

1. Type and span of study
2. Target sample and population

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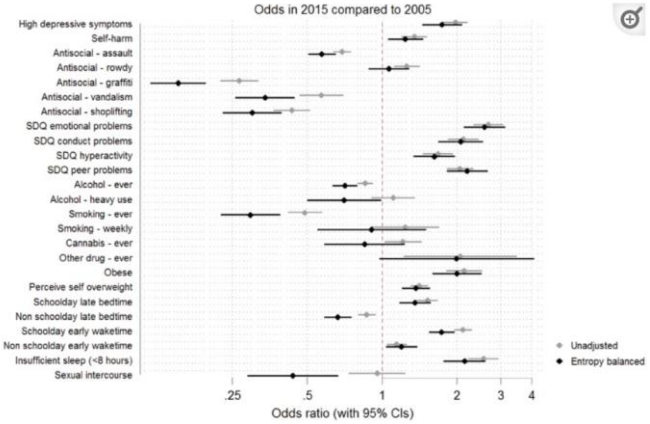
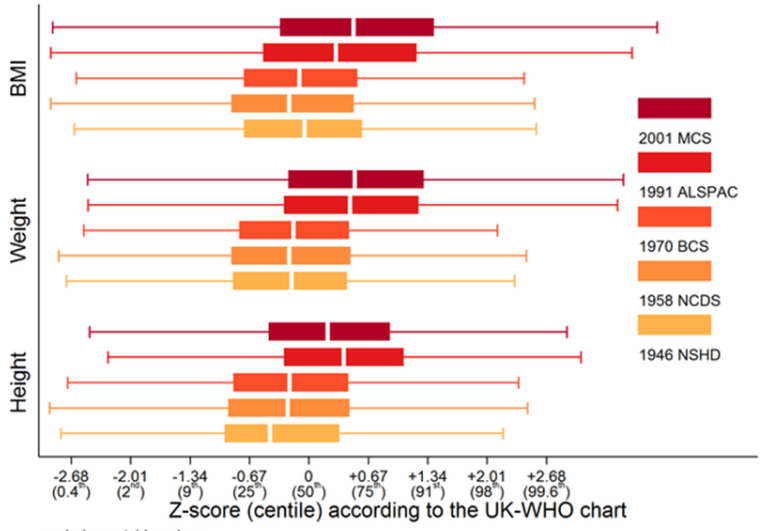
Figure 1.



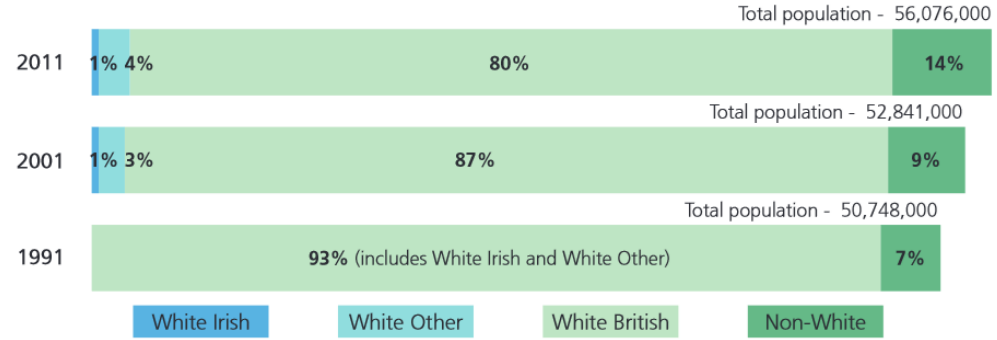
ORs (95% CI) for poorer outcomes in 2015 (MCS) vs 2005 (ALSPAC). Unadjusted estimates and estimates using entropy balancing weights are both presented.

Patalay and Gage, 2019



Johnson et al, 2018

Figure 1. Growth of ethnic diversity in England & Wales, 1991-2001-2011



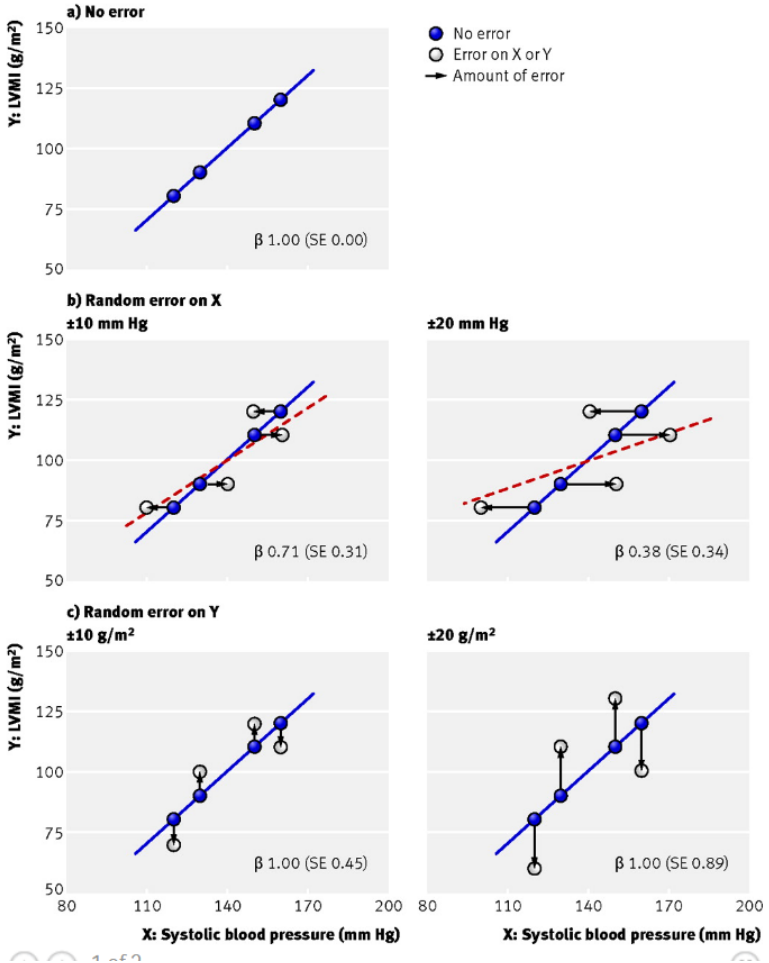
Notes: White Irish includes White Gypsy and Irish Traveller in 2011 (57,680 people).
Figures may not add due to rounding.

Click here for Figure 1 data in Excel

Jivraj, 2012

Challenges and possible solutions

1. Type and span of study
2. Target sample and population
3. Measurement

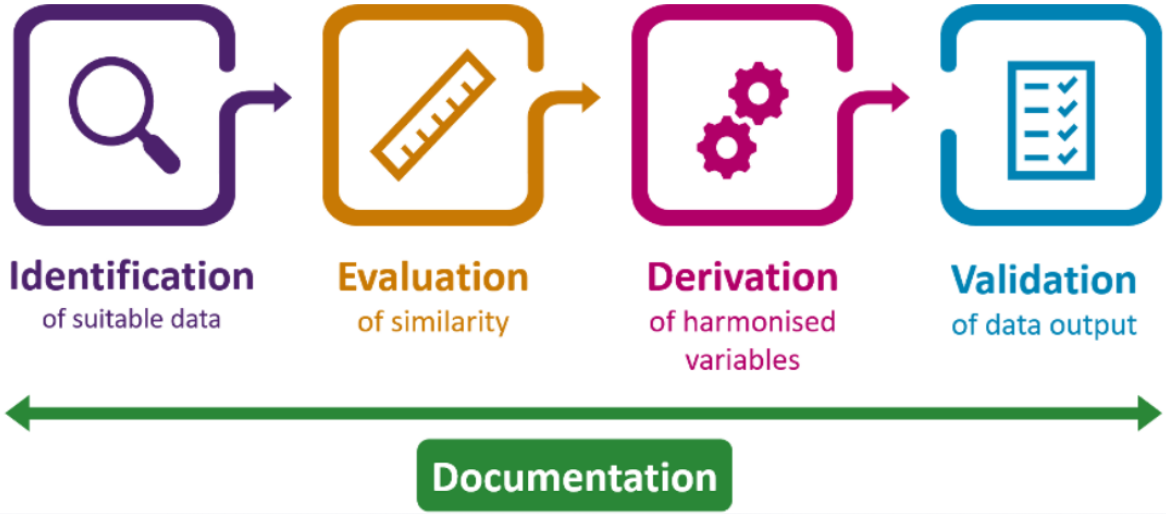


- If studies differ in measurement error, cross study comparisons can be biased
  - Random error (see left)
  - Non-random / differential (can bias in either direction)

Hutcheon et al 2010

- Looking at what data are available,
- Evaluating their comparability and how appropriate and easy it may be to undertake harmonisation,
- Modifying the data to make them more similar and derive harmonised versions of the variables (e.g. recoding categorical variables (such as ethnicity or occupational classifications) so that the data are grouped in the same way for each sweep/study or transforming continuous variables (such as height or weight) so that they are on same scale),
- Validating the output.

Documentation underpins all of this, from accessing sufficient detail about how the variables were defined and collected originally by studies, to capturing the decisions made subsequently during the harmonisation process itself (e.g. how the data were processed and changed).



Lowest common denominator?

Sensitivity analysis

CLOSER learning hub

Resources and Harmonisation initiatives	CLOSER	UK	https://www.closer.ac.uk/ https://closer.ac.uk/training-hub/
	Gateway to Global Aging	International	https://g2aging.org/
	Maelstrom	International	https://www.maelstrom-research.org/
	Cross-National Equivalent File	International, 1970-	https://www.cnefdata.org/
	Multinational Time Use Study	International, 1960-	https://www.timeuse.org/mtus
	Harmonized Learning Outcomes (HLO) database	International 2000-	https://datacatalog.worldbank.org/search/dataset/0038001
	IPUMS	USA/worldwide, 1790-	https://www.ipums.org/
	Harmony	International	https://harmonydata.ac.uk/

Harmonised data sets in our cohorts

Available via the UKDS (EUL)

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Domain	Life-stage	Data set / information
Socio-Economic	Parents Adulthood	• Highest parental social class (RG 1990 version) • CM's social class (RG 1990 version)
Body Mass Index (BMI)	Life-course	• Weight • Height
Mental health	age 11	• Four domains: emotional, peer problems, behavioural and attention / hyperactivity problems
Child environment	Various	• Crowding, Sole use of amenities, Housing tenure, Teen mother and/or father • Child rearing and parenting • Family instability (divorce, separation, moves • Parental and child health • Well-being

Ongoing harmonisation programme:
Coming soon: fertility, health measures

- Triangulation across different data sources (e,g., study type + measurement method; observed + genetic liability?)
- Calibration studies
- For some outcomes (3 or more indicators + underlying latent traits): invariance tests

Challenges and possible solutions

1. Type and span of study
2. Target sample and population
3. Measurement
4. Missing data

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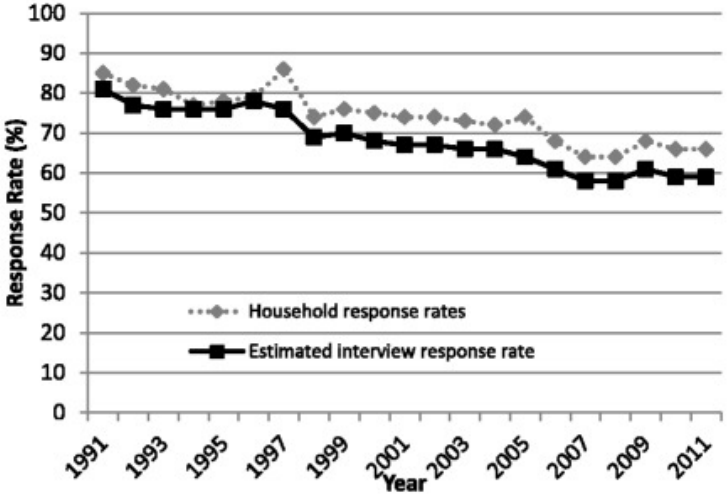
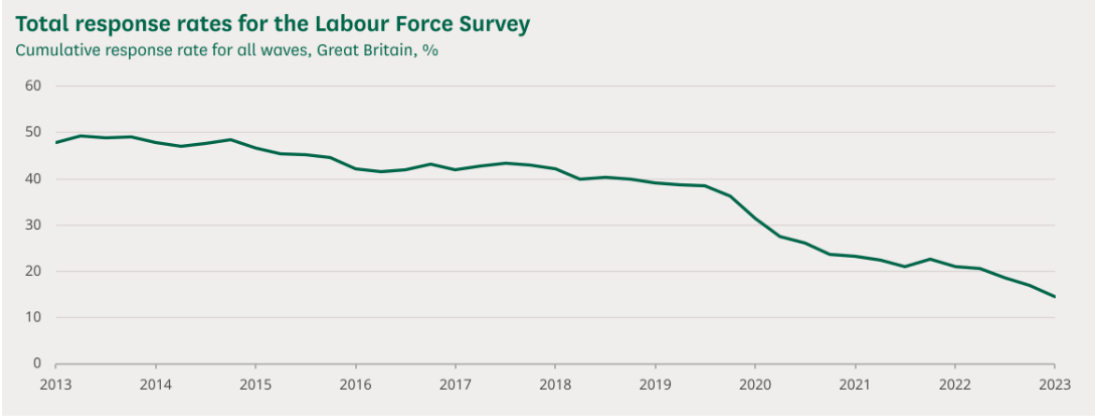
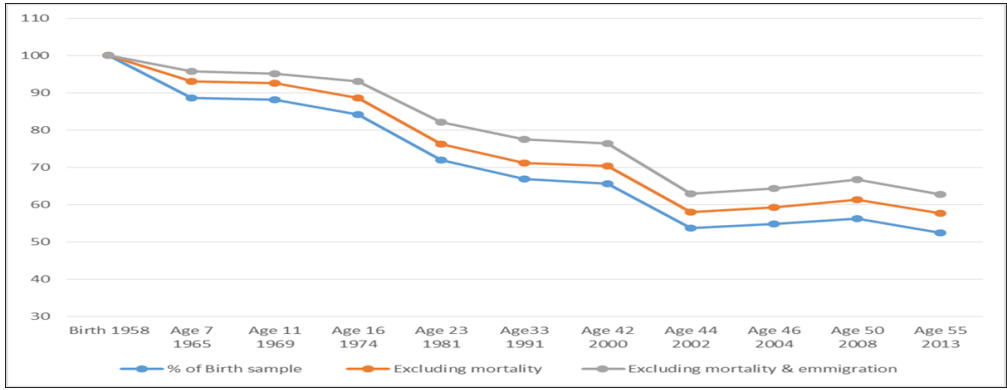


Mindell et al, 2015



Source: Office for National Statistics, Labour Force Survey performance and quality monitoring report, Figure 3, 15 August 2023.



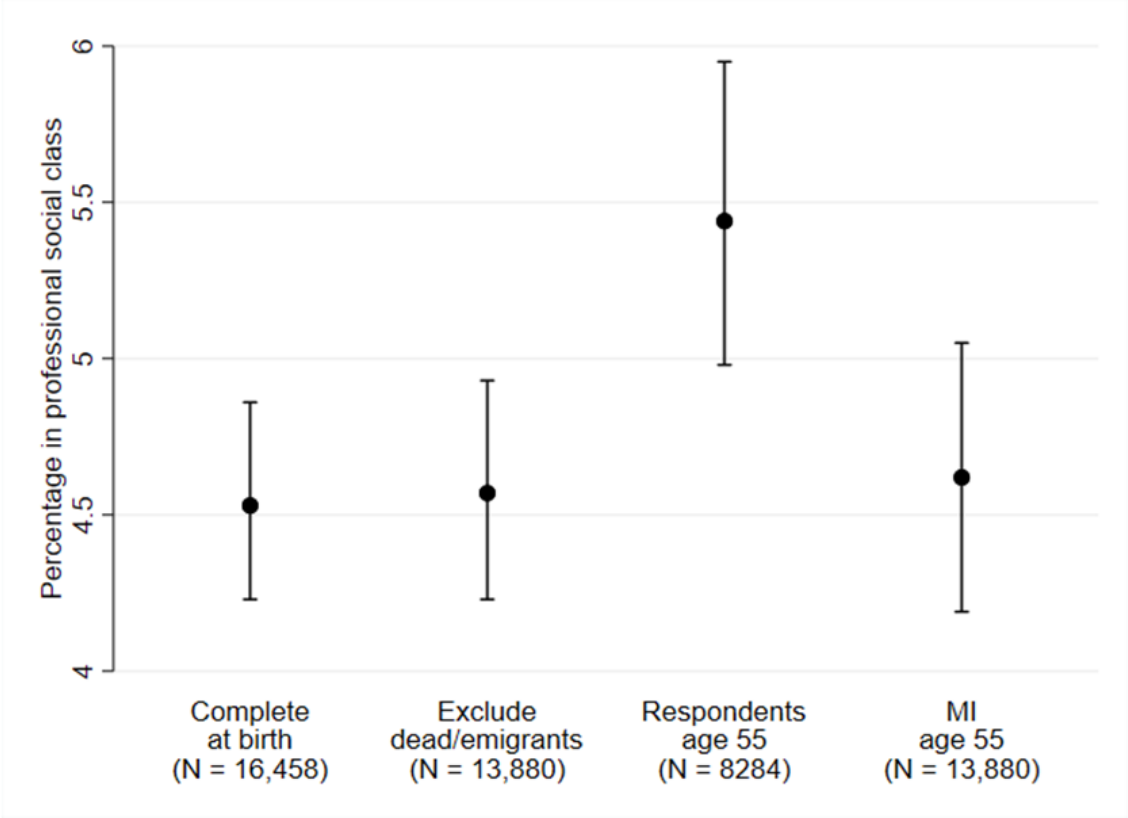
Mostafa et al 2021

More missingness:

- Lower power
- Potential bias
    - Principled approaches to missing data (e.g., use data we do have to inform missing values - multiple imputation, weights, FIML in SEM)

- Cohorts: loss to follow-up, yet early life data to inform plausibility of modelling of missing data

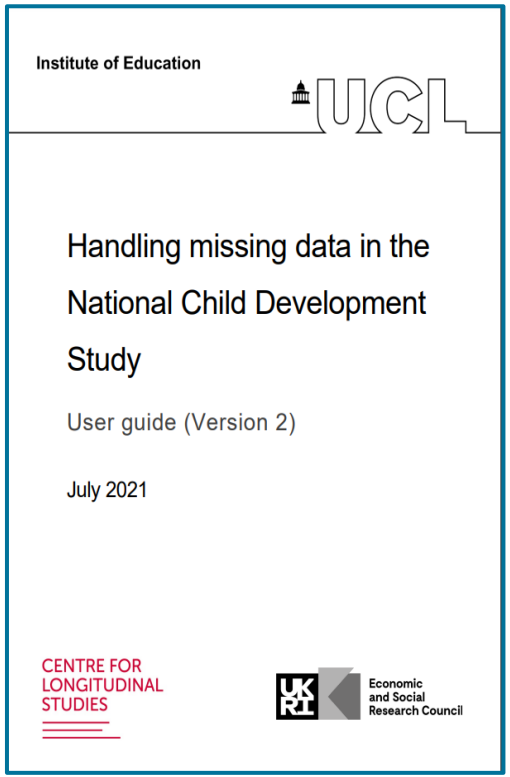
Social class of mother's husband at birth



Mostafa et al 2021

Resources – missing data in CLS cohorts

CLS | Handling missing data (ucl.ac.uk)



Handling missing data webinar (2023)

CLS youtube: Missing data webinar 2023

EVENT **6 June 2024 1:00pm - 2:00pm (UK time)**

Handling missing data in the BCS70

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Mostafa, T., Narayanan, M., Pongiglione, B., Dodgeon, B., Goodman, A., Silverwood, R. J., & Ploubidis, G. B. (2021). Missing at random assumption made more plausible: evidence from the 1958 British birth cohort. *Journal of Clinical Epidemiology*, *136*, 44-54..

Challenges and possible solutions

1. Type and span of study
2. Target sample and population
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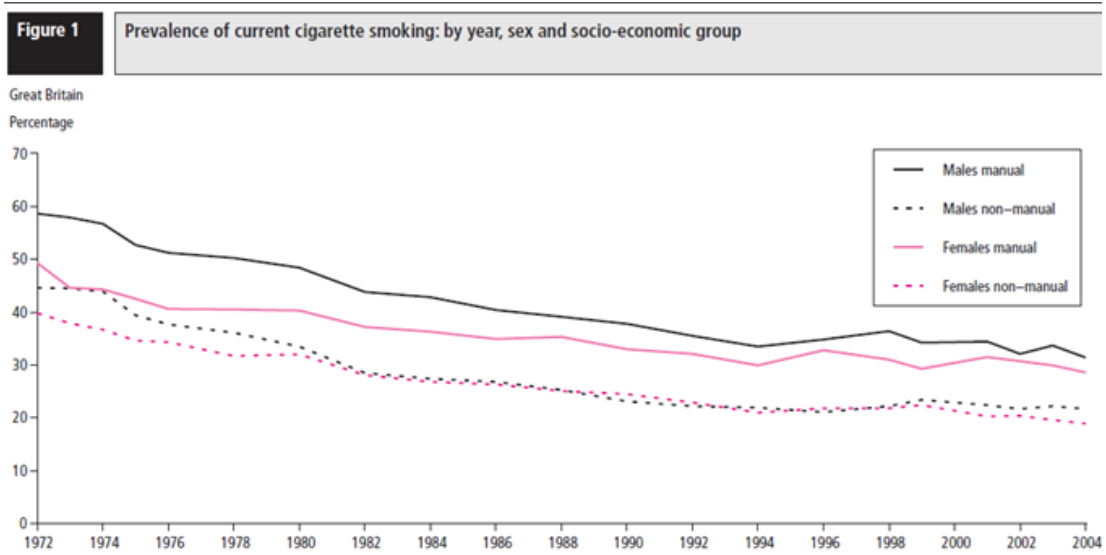
- Trend may differ if in relative (e.g., relative risk) or absolute scales (risk difference)
- Health inequality literature: mortality has declined; absolute difference between SES groups remained the same = increase in relative association

King et al 2012



ONS, 2007

Di Girolamo et al 2021

RelativelyRisky
277 posts
Following

5 113 200

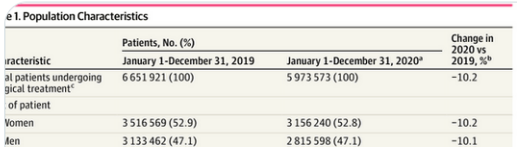
RelativelyRisky @justsaysrisks · 24 Aug
RELATIVE INCREASE: 185%

ABSOLUTE INCREASE: <0.1%

> **NYT Health** @NYTHealth · 24 Aug
> Surprisingly little is known about the number of gender-affirming surgical procedures performed each year. In a new analysis, researchers report that the number tripled from 2016 through 2019 before dipping again as the pandemic arrived. nyti.ms/3YKJQxm

3 20 81 6.8K

RelativelyRisky @justsaysrisks · 24 Aug
Absolute number of 'elective' surgeries estimated from here:



e 1. Population Characteristics

aracteristic	Patients, No. (%) January 1-December 31, 2019	January 1-December 31, 2020[a]	Change in 2020 vs 2019, %[b]
al patients undergoing gical treatment[c]	6 651 921 (100)	5 973 573 (100)	−10.2
of patient			
Vomen	3 516 569 (52.9)	3 156 240 (52.8)	−10.2
Men	3 133 462 (47.1)	2 815 598 (47.1)	−10.1

@Justsaysrisks

Comparing cohort differences in association

- Informally (eye-balling estimates)

- Directly
  - Pooling + testing interaction terms (e.g. exposure * cohort study)
  - Not always possible - studies vary in sample designs or can’t be accessed eg in TREs

- Indirectly
  - Meta-analysis: study specific estimates are outputted and compared

Challenges and possible solutions

1. Type and span of study
2. Target sample and population
3. Measurement
4. Missing data
5. Associations (incl. scale, distribution of exposure, methods)
6. Interpretation

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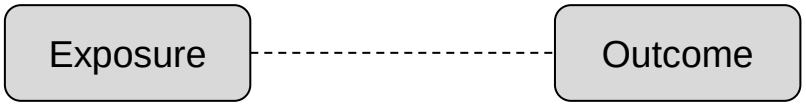
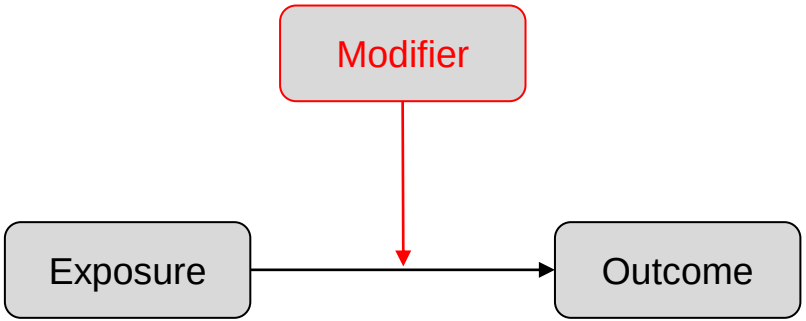
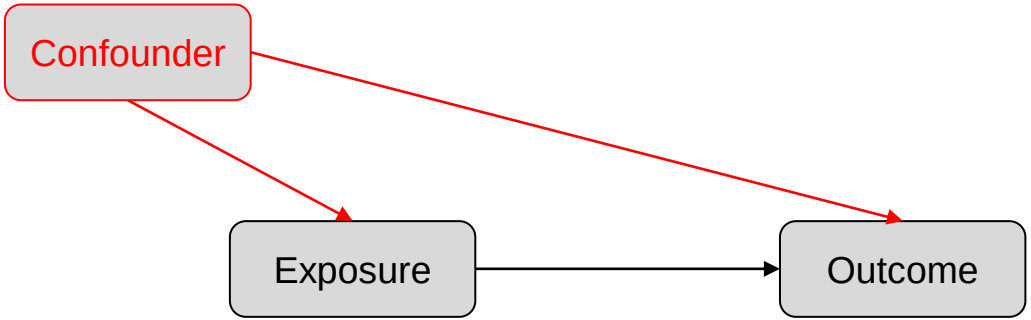
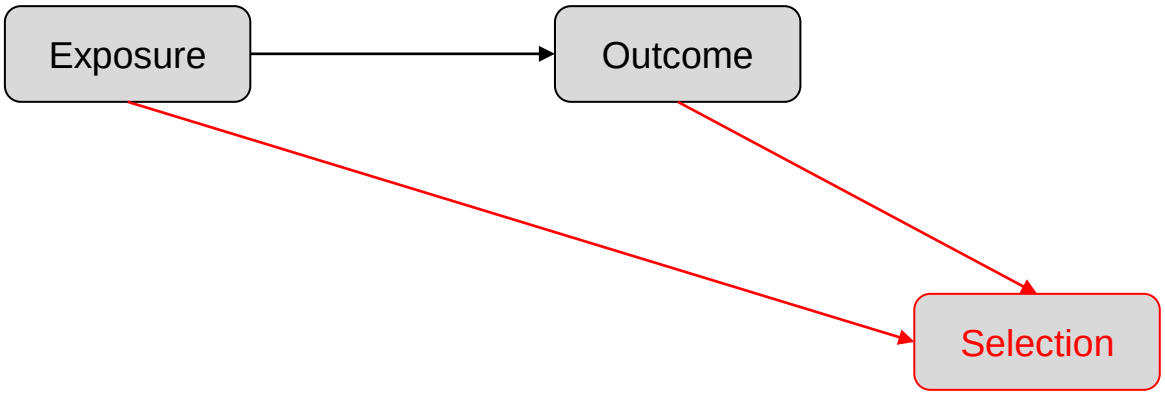
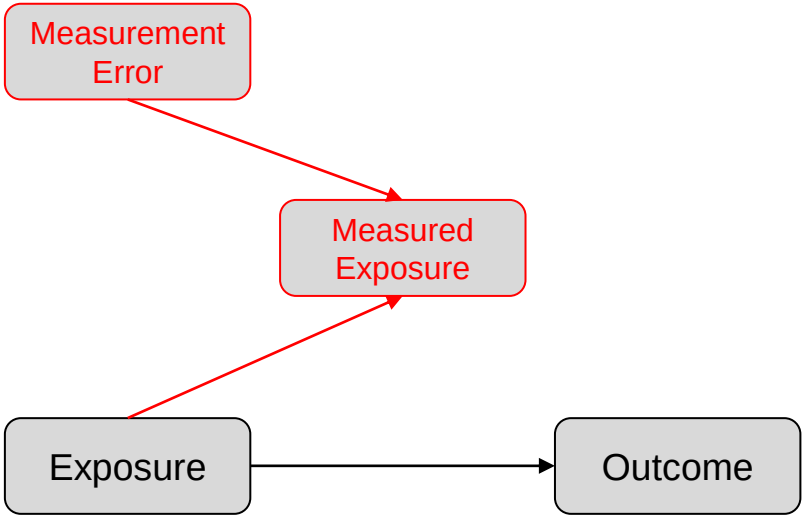
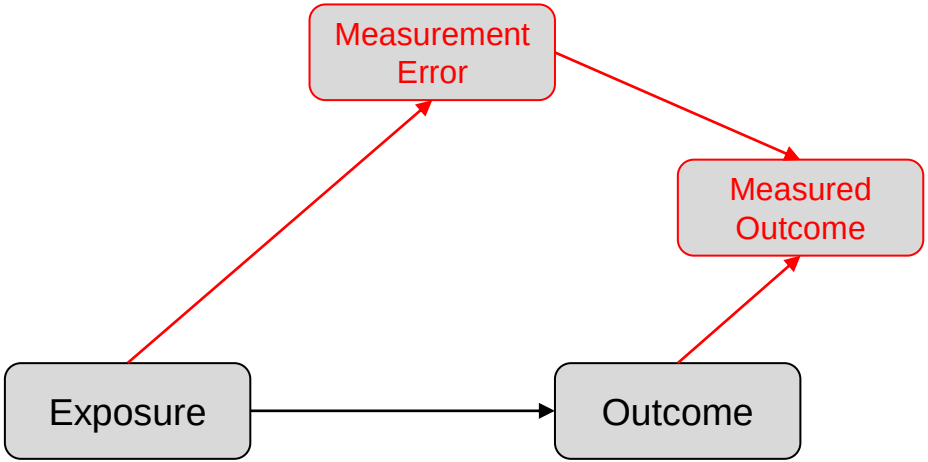

Exposure
Outcome


Modifier
Exposure
Outcome


Confounder
Exposure
Outcome


Exposure
Outcome
Selection


Measurement Error
Measured Exposure
Exposure
Outcome


Measurement Error
Measured Outcome
Exposure
Outcome

Cross-Context Designs for Causal Inference

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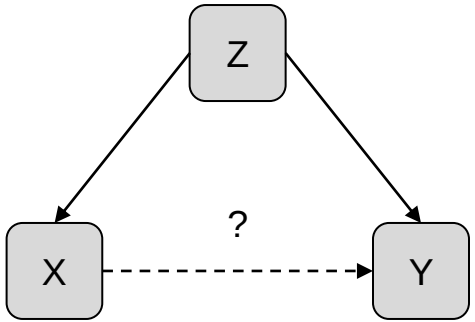
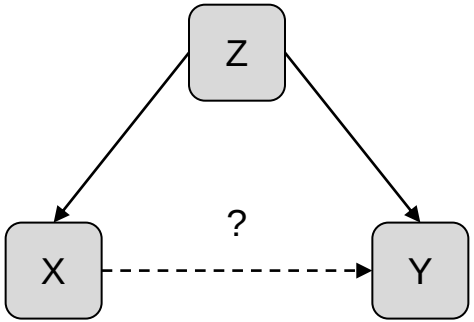
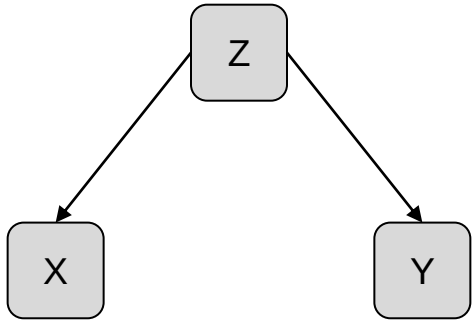
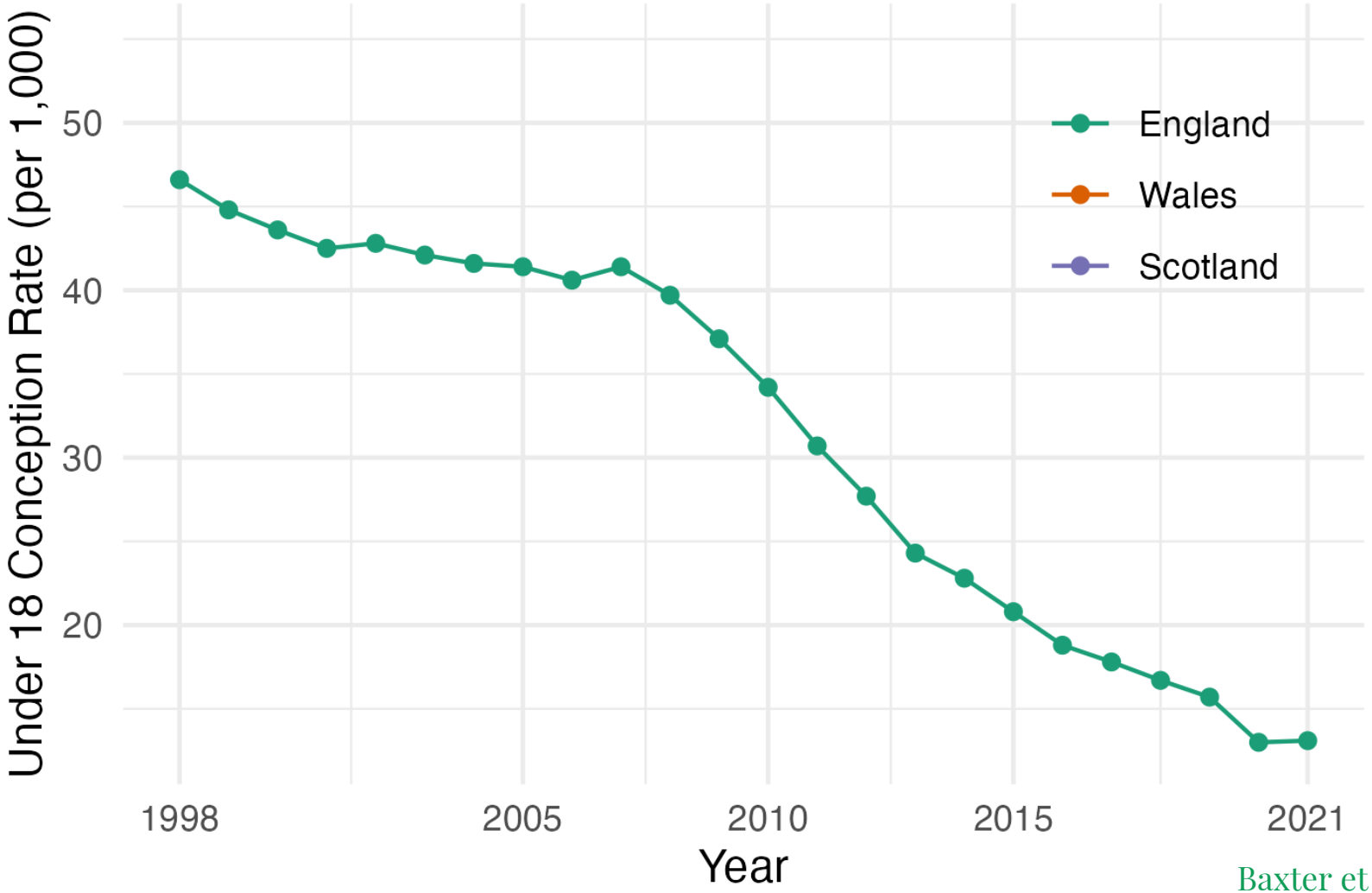

Z
?
X
Y



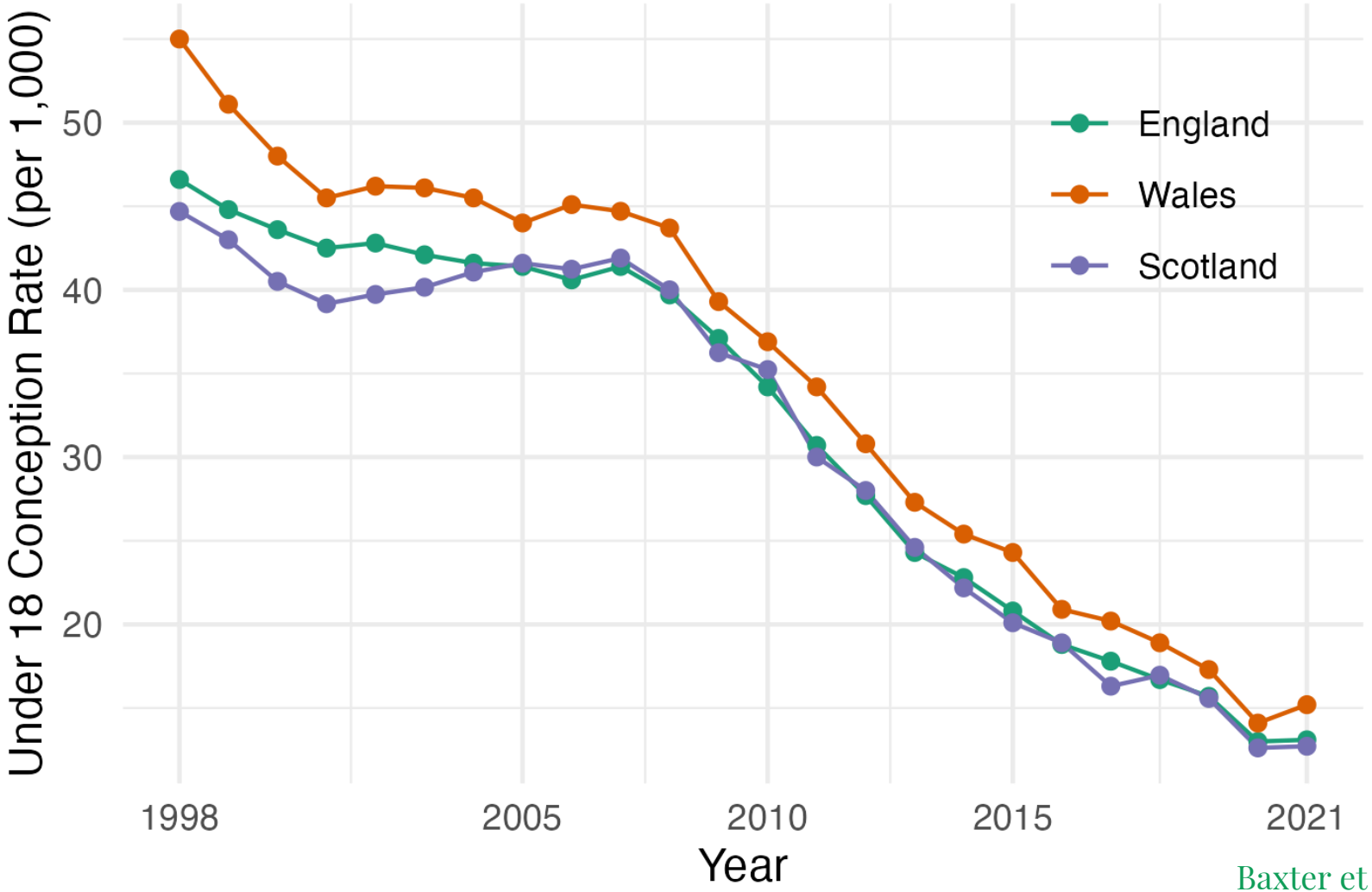
Population A



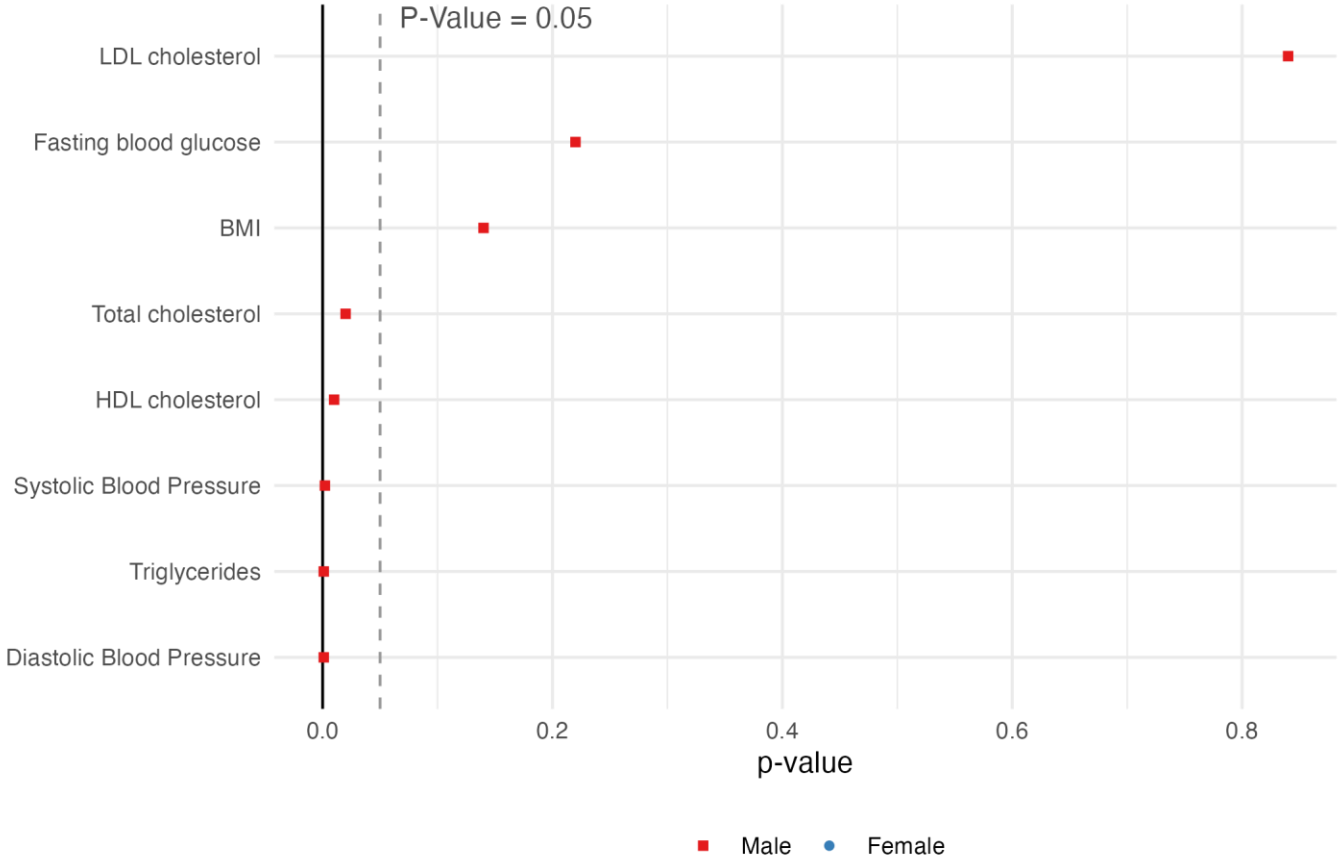
Population B



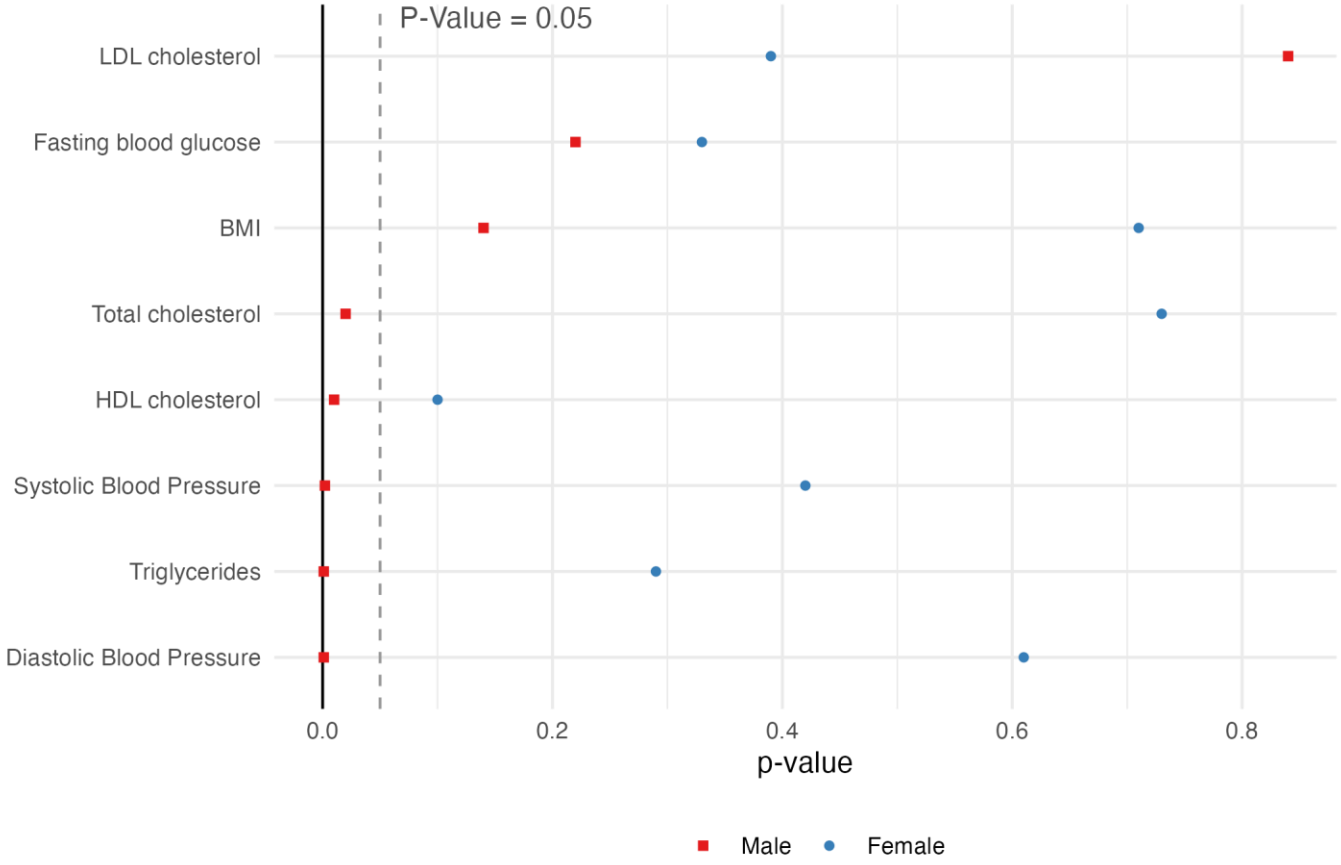
Baxter et al. (2021)



Baxter et al. (2021)



Estimates: Taylor et al. 2015



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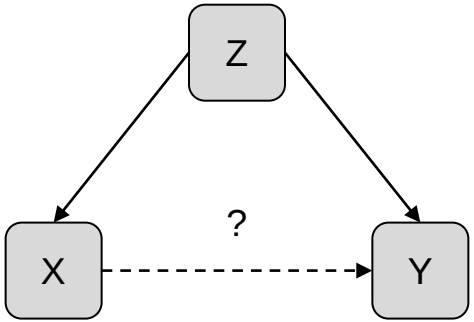
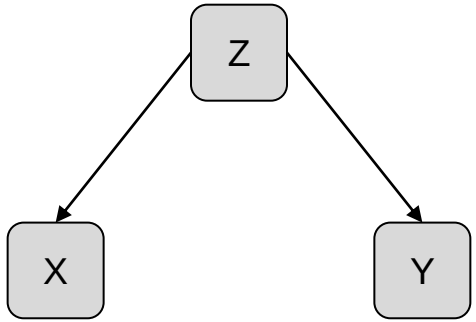
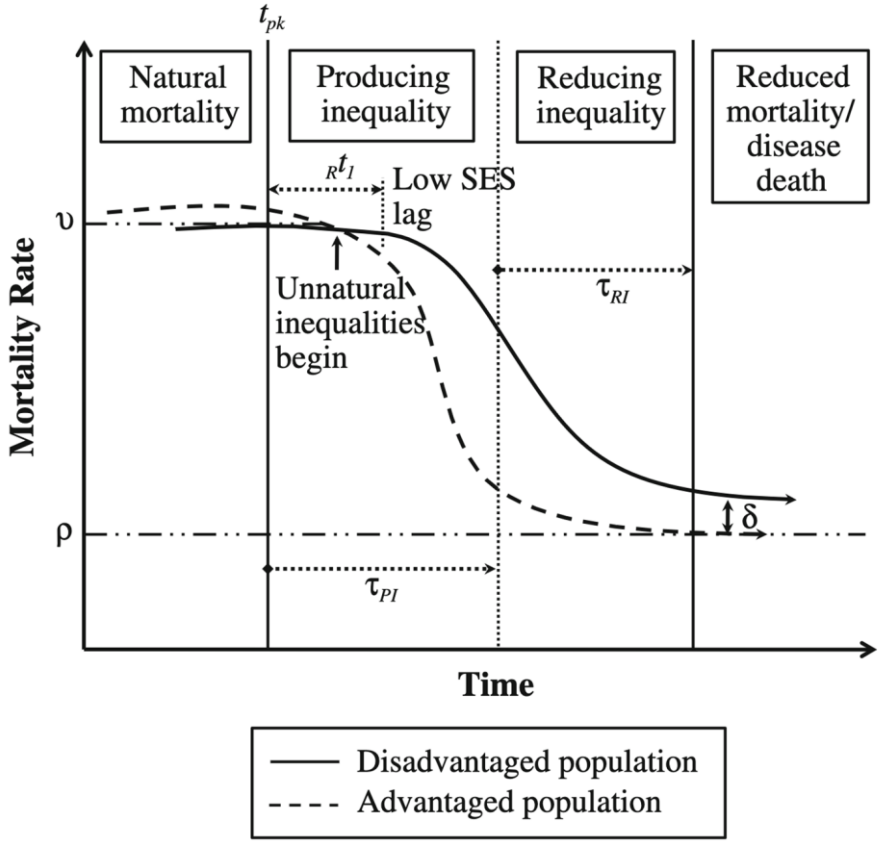


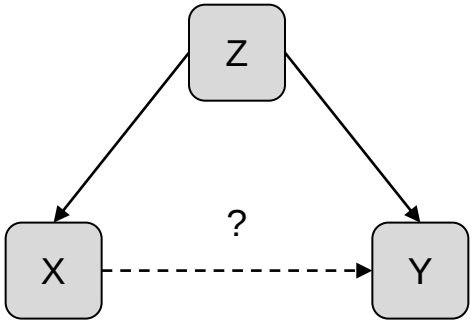
Time A



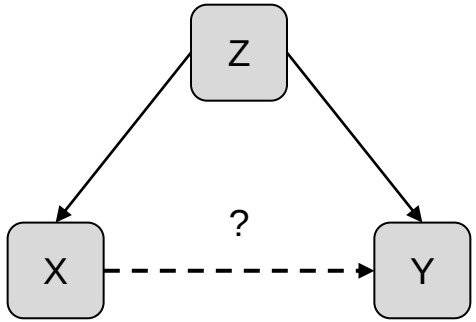
Time B



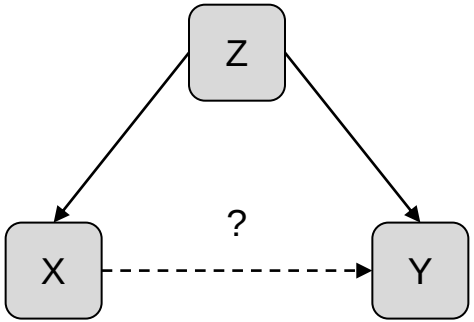
Clouston et al. (2016)



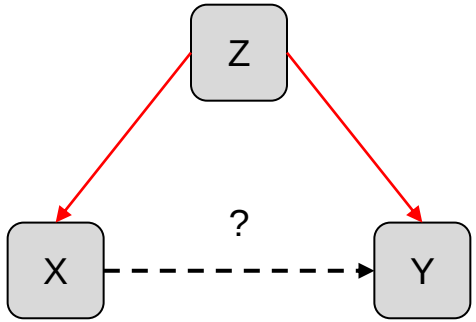
Population A



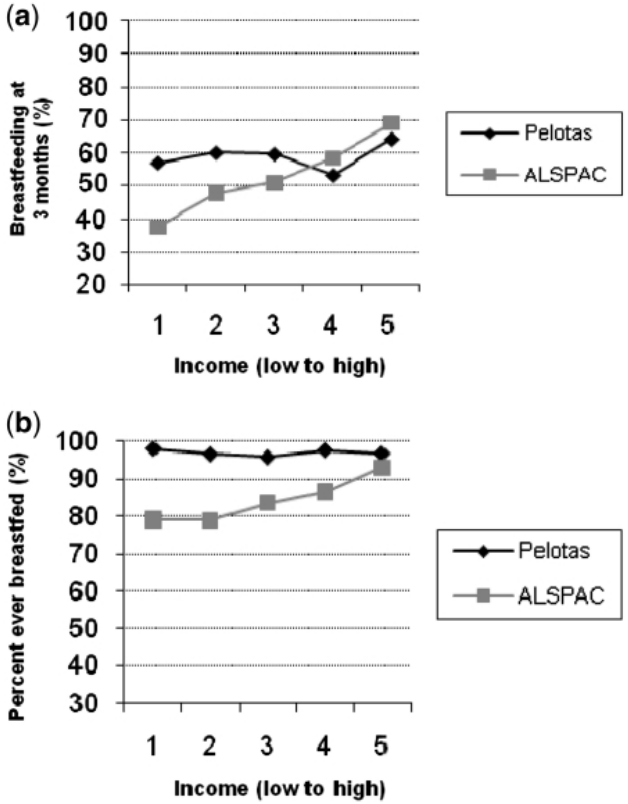
Population B



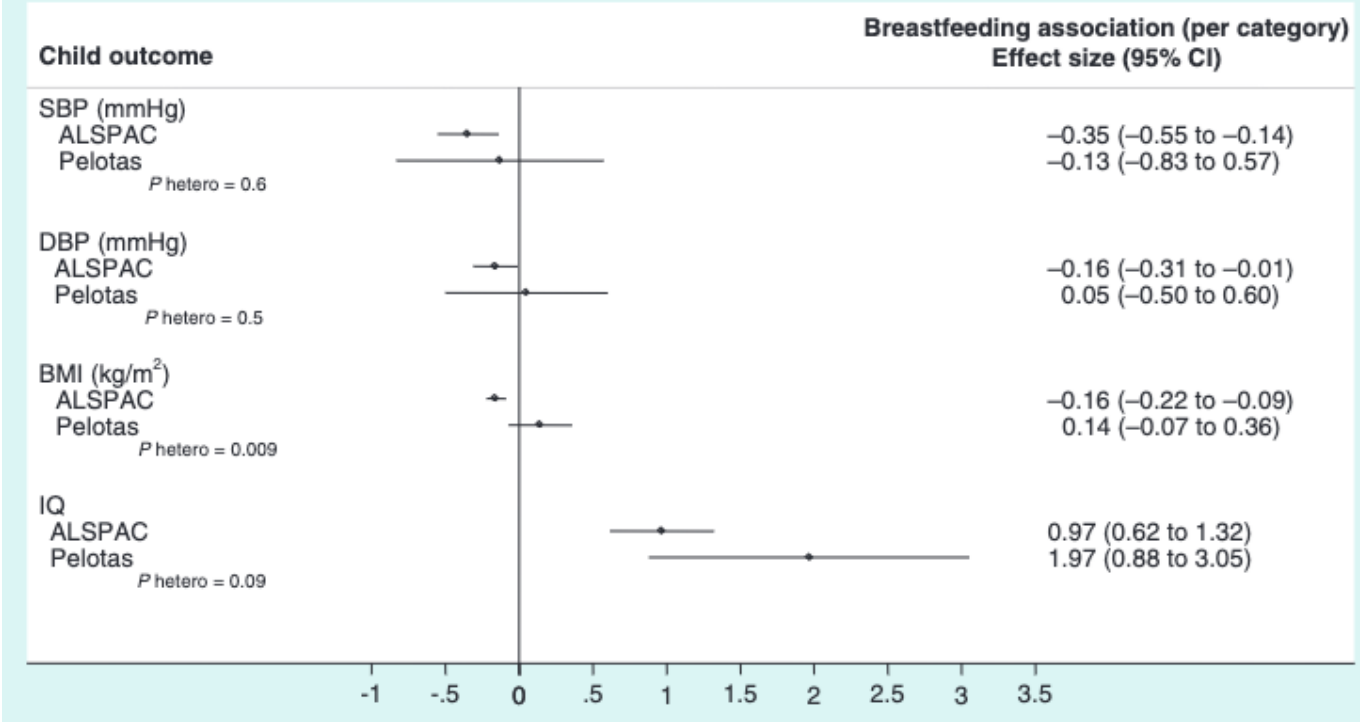
Population A



Population B



Brion et al. (2011)



Brion et al. (2011)

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Thank you!

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David Bann, Liam Wright, Alice Goisis, Rebecca Hardy, William Johnson, Jane Maddock, Eoin McElroy, Vanessa Moulton, Praveetha Patalay, Shaun Scholes, Richard J. Silverwood, George B. Ploubidis & Dara O'Neill. Investigating change across time in prevalence or association: the challenges of cross-study comparative research and possible solutions. Discover Social Science & Health, 2022. Tutorial+Syntax

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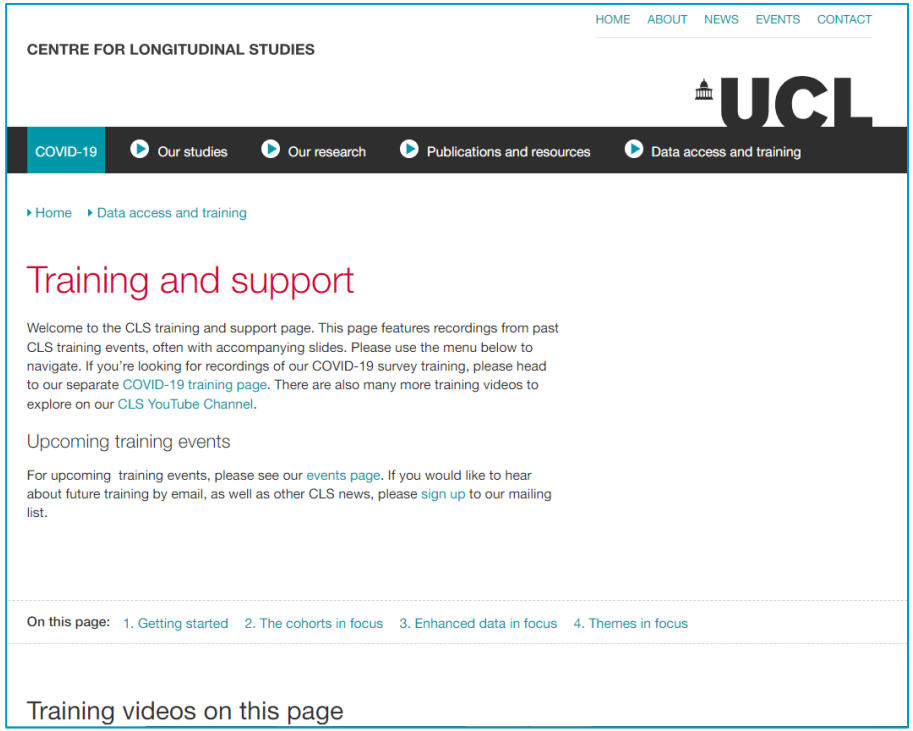
CLS training and support



Upcoming training events	
Handling missing data in the BCS70	6 June 2024
New data: Next Steps age 32	July 2024

https://cls.ucl.ac.uk/events/

https://www.youtube.com/channel/UCUXx6J7PRyhWGf-xKDPW5eA

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https://cls.ucl.ac.uk/data-access-training/training-and-support-2/

Q&A

Please complete the feedback form

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