Conclusion This review contributes to new understandings of health-related community resilience and its measurement. Using rapid review methods limited the scope of the search, and the focus was mainly on European literature. While there is learning from community disaster resilience methods, transferability to population health needs to be tested. Based on review gaps, recommendations are made for future research topics.

Methodological Issues

OP112 USE OF OUTCOME 'CHANGE-SCORES' IN OBSERVATIONAL DATA ARE A POTENTIAL SOURCE OF INFERRENTIAL BIAS

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Background Studies of change are a cornerstone of research in the health sciences. Robust analyses of change are however extremely challenging, especially in observational data.

In simple exposure-outcome scenarios, one common approach is to create and analyse an outcome 'change-score' by subtracting the baseline outcome from follow-up outcome. Tens-of-thousands of articles can be found that have adopted this approach. Unfortunately, this approach fails to capture the (desired) modifiable component of the outcome variable that occurred after baseline. On the contrary, it retains sign-reversed information from the baseline outcome that can create extremely-misleading associations.

Using directed acyclic graphs (DAGs) and illustrative simulations, this study explains why outcome change-scores do not capture the true causal quantity of interest and demonstrates the extent of disagreement between robust analyses and change-score analyses in various circumstances.

Methods DAGs with deterministic nodes are used to explain why change-scores do not capture the (desired) modifiable component of the outcome that occurs after baseline. The implications are then illustrated in simulated data, by analysing outcome change-scores with respect to a baseline exposure under several causal scenarios.

Data were simulated using DAGitty R 0.2–2 to match three broad scenarios, with the baseline outcome as 1) competing exposure, 2) confounder, and 3) mediator for the total causal effect of the exposure on the follow-up outcome. Means, standard deviations, and distributions were informed by data from the US National Health and Nutrition Examination Survey for 2009–2014. The association between the baseline exposure and outcome change-score was estimated by linear regression; and the coefficients compared to the known truth and coefficients obtained from robust analyses.

Results Naïve regression analyses of the outcome change-score (insulin) with respect to the baseline exposure (waist circumference) produced biased causal inferences in all scenarios except where the exposure and outcome were uncorrelated at baseline (as in a randomised experiment). When the baseline outcome (insulin) confounded the effect of the baseline exposure (waist circumference) on the follow-up outcome, the

naïve regression estimate remained confounded. When the baseline outcome (insulin) mediated the effect of the baseline exposure (waist circumference) on the follow-up outcome, the naïve regression estimate had the opposite sign to the total causal effect.

Conclusion Analyses of change-scores should be avoided in observational health research, as they can produce extremely misleading coefficients. Previous observational studies that have naively analysed and interpreted change-score variables should be viewed with extreme caution and any recommendations revisited.

OP113 SEEKING CAUSAL EXPLANATIONS IN POLICY EVALUATION: AN ASSESSMENT OF APPLYING PROCESS TRACING TO THE BARBADOS SUGAR-SWEETENED BEVERAGE TAX EVALUATION

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Background Finding an association between a policy and an effect in an observational study is not enough to prove a causal relationship. Impact evaluations may be strengthened by developing an understanding of the causal explanation(s) behind an association. Here, we assess the feasibility of using process tracing (PT). While PT has been applied to a limited number of programme evaluations, we believe this is the first attempt to apply the method to a public health policy evaluation. Given evidence of a statistical association, can PT be usefully operationalized in a public health policy evaluation?

Methods We used the Barbados sugar-sweetened beverage (SSB) tax as a case study. We previously demonstrated an association between tax introduction and an observed decrease in SSB sales. According to dominant theory, price change is the sole mechanism through which SSB taxes dampen consumer demand. However, SSB taxes may also have a signaling effect, raising awareness and reducing demand. Following PT best-practice, we developed causal theories, pre-specified the evidence we would expect to find under each theory, operationalized tests to identify this evidence, and assessed the probative value of each test. We assessed prior confidence in both theories and described implications of each test.

Results We identified a range of potential tests (8 tests of the price change only theory, 8 separate tests of the signaling effect). For example, one test of the signaling effect could be an assessment of whether the public's perception of 'good' vs. 'bad' drinks matches the pattern of change observed more than a categorization based on taxed vs. untaxed status. In this example, we propose to use print media to qualitatively identify how 'good' and 'bad' drinks were characterized (i.e. were sodas and juices portrayed differently?) and then use this categorization to re-analyze grocery store sales data using an interrupted time series. If this categorization explains the data more fully than an analysis based on taxed/untaxed status, this test would strongly favor signaling over the price change only hypothesis, making this a test with high probative value. We identified methods and data that could be used to empirically assess each test and assessed each test's probative value.

Conclusion Further work will be needed to empirically conduct and critically assess as many of these tests as possible, prioritizing those with greatest probative value. However, this

study has suggested that PT may be able to make a useful contribution to improving public health policy evaluations.

OP114 ASSOCIATION OF DRUG PRESCRIPTIONS WITH INCIDENT DEMENTIA

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Background Recent studies have reported conflicting associations between drug prescriptions and incident dementia. Any association between drug and dementia could be due to the drugs directly causing or preventing dementia; the drugs being associated with a risk factor for dementia; or the drugs being prescribed as a consequence of prodromal dementia. Based on methodology developed for genome-wide association studies, we systematically analyzed the effect of 733 drugs on incident dementia in a population-wide linkage study and clinically reviewed the associations.

Methods Using linked, routinely-collected electronic health records from hospital admissions, mortality records and primary care consultations, we followed-up 574,237 Welsh residents from their 60th birthday onwards to classify exposure (drug prescriptions) and dementia incidence. During follow-up, 13,786 (2.4%) of the study population developed dementia. We used time-dependent Cox proportional hazard models to study the effect of exposure on dementia incidence, controlling for the effects of age, sex, year, deprivation and smoking status. To account for multiple testing, we first analyzed a 50% household-area stratified random sample of the study population (discovery cohort), selected results with a Bonferroni-corrected *p*-value, re-run the analysis of 'significantly' associated drugs in the remaining 50% (validation cohort) and once again selected results with a Bonferroni-corrected *p*-value. We displayed the results (hazard ratio and *p*-value) from the complete cohort in several stratified volcano-plots and clinically reviewed the findings to identify potential pathways of effect.

Results 177/733 (24%) of the analysed drugs were significantly associated with dementia incidence. Of those, 7 were for neurodegenerative conditions that can cause dementia, 14 were for vascular diseases, 13 for diabetes, 16 for depression and 39 for symptoms or complications of dementia. Only four, all travel-related vaccines, were associated with a lower dementia incidence. Some drugs associated with an increased hazard of dementia clustered around several unexpected indications, including: gastro-oesophageal reflux disease, altered bowel habit, lower urinary tract symptoms and infections, anxiety, sleep disturbance, pain and nausea/vertigo.

Discussion By grouping drugs by indication, we identified several drugs with a potential of having a direct association with increased risk of dementia. We also identified drugs which are related to (known) risk factors for dementia, including those prescribed for cardiovascular disease and diabetes. The effect of travel-related vaccines is puzzling and might be more related to a preventative association of travelling with dementia incidence. Most interestingly, we identified several drugs

which might have been prescribed as a consequence of a pre-clinical, non-cognitive syndrome in dementia.

OP115 IMPROVING THE ASSESSMENT OF CAUSALITY IN POPULATION HEALTH: SHOULD BRADFORD HILL BE REVISITED TO INCORPORATE DEVELOPMENTS IN CAUSAL INFERENCE?

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Background Bradford Hill's (BH) guidelines are the traditional approach to causal assessment in population health and epidemiology. However, assessments can be inconclusive; there is no consensus on the thresholds required for components. Some have proposed incorporating more recent developments in causal thinking to BH guidelines to improve assessment of causality. This study aims to understand how traditional approaches to causal assessment can be refined by incorporating alternative causal methods. We will do this by understanding the similarities and differences of these approaches to BH. **Methods** We mapped each BH component against three subsequent, prominent causal inference approaches: directed acyclic graphs (DAGs), grading of recommendations, assessment, development and evaluation methodology (GRADE), and sufficient-component cause models (SCC, also referred to as 'causal pies'), drawing upon existing studies that had assessed the overlap between one or more of these approaches. Existing studies were found through targeted searching and snowballing, with no a priori list of inclusion/exclusion criteria.

Results The approaches can be grouped into two categories: models (DAGs and SCC) and assessment guidelines (BH and GRADE). The literature does not necessarily explicitly make this distinction, but the identified literature largely restricted comparisons within each of these categories.

We found that some components overlap between the guidelines and models, while some are specific to certain approaches. For example, BH causal assessment considers if an increased exposure corresponds with increased incidence of the disease (dose-response). Similarly, GRADE will upgrade evidence from an observational study with evidence of dose-response. However, testing dose-response for DAGs may not be helpful. A dose-response may be demonstrated for different exposure levels due to a confounder that has the same impact on the exposure and the outcome. Thus, it would be the confounder causing the dose-response, not the causal relationship. The SCC model is often drawn with binary exposures and outcomes where dose-response is not considered. However, it can be incorporated by including dose as providing different contributions to the causal pie. Similar comparisons were made for the remaining BH components.

Conclusion Assessing causal relationships is challenging, yet of fundamental importance. There have been limited efforts to incorporate insights from DAGs and SCC into BH guidelines. However, our review did not investigate all potential approaches to assessing causality (e.g. International Agency for Research on Cancer) and the comparisons require further analysis. Nevertheless, this detailed exploration improves the