(SHS). In November 2018 comprehensive restrictions on smoking in Scottish prisons were introduced to protect staff and people in custody from SHS exposure. This study compares SHS exposure assessment results six months after implementation of smokefree policy with levels measured in 2016 before the policy was announced.

Methods Setting: Scotland's 15 prisons

In 2016, 128,431 minutes of $PM_{2.5}$ (as a marker of SHS) concentration data were collected from residential halls and 2,860 minutes for 'task-based' measures; equivalent figures for 2019 were 126,777 minutes (residential halls) and 3,073 minutes (task based).

Six days of fixed-site monitoring were conducted in residential halls in each prison over 6 days commencing 22.5.19. Task-based measurements were also conducted to assess SHS in specific locations (e.g. workshops) and during specific activities (e.g. cell searches). Utilising these monitoring data, typical daily $PM_{2.5}$ exposure profiles were constructed for the prison service and time-weighted average exposure concentrations were estimated for typical shift patterns for residential staff pre- and post-implementation of the smokefree policy. Staff self-reports of exposure to SHS were also gathered using online surveys.

Results Measured $PM_{2.5}$ in residential halls declined markedly; median fixed-site concentrations reduced by more than 91% compared to baseline. The changes in the task-based measurements (89% average decrease for high-exposure tasks) and time-weighted average concentrations across shifts (over 90% decrease across all shifts), provide evidence that prison staff exposure to SHS has significantly reduced. The percentage of staff reporting no exposure to SHS rose between from 19% to 74% among all staff in Phase 3.

Discussion To our knowledge, this study is the first comprehensive international study to objectively measure SHS levels before, during and after implementation of a smokefree policy across a country's prison system. The dramatic reduction in SHS exposures confirmed complementary qualitative data and stakeholder reports of the success of the smoking ban in removing tobacco.

The findings demonstrate that SHS exposures can be effectively eliminated through a well-applied smoking ban in the challenging context of prisons; and are highly relevant for other jurisdictions considering changes to prison smoking legislation.

Wednesday 9 September

Health Inequalities

OP19 | **QUANTIFYING MULTI-MORBIDITY IN AN ETHNICALLY-DIVERSE INNER CITY POPULATION: EXPLORING THE HEALTH BURDEN OF HOUSEHOLDS USING A RETROSPECTIVE E-COHORT**

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Background Multi-morbidity is a growing challenge globally. New insights and approaches into the patterns of, and contributing factors to, multi-morbidity, using large routinely-collected patient data resources, are current research priorities. There is evidence that individuals who live with people with a long-term condition are at increased risk of a long-term condition themselves, however to date there has been no assessment of multi-morbidity at a household level.

General practitioner (GP) Electronic Health Records (EHRs) contain rich demographic and clinical data for research to quantify and explore household multi-morbidity. We investigated this by creating and linking GP-EHRs to a unique household identifier based on the patient address.

Methods GP-EHRs for 1,164,736 patients registered with GP practices in four London boroughs at mid-2018 were extracted to create a retrospective e-cohort. Patient addresses were matched to Unique Property Reference Numbers (UPRNs) using a validated deterministic address-matching algorithm, and pseudonymised into Residential Anonymised Linking Fields (RALFs). GP-EHRs were linked to the RALF. Exclusion criteria were selected using sensitivity analyses as per STROBE guidelines, based on GP registration status and date, property type, and data quality.

The main outcome was multi-morbidity in patients aged ≥18 years in mid-2018 with two or more chronic long-term conditions identified from their GP-EHRs based on diagnostic criteria and their associated READ codesets developed in the Quality and Outcomes Framework. We assigned individuals to their households on the basis of shared RALFs. We calculated age-specific multi-morbidity prevalences and their ratios by individual-level factors, and estimated the number of adults with multi-morbidity in each household. We investigated the characteristics of households with ≥2 adults with multi-morbidity.

Results The e-cohort comprised 923,995 patients (48.6% female, 44.6% Black and Minority Ethnic [BAME] backgrounds, 68% aged 20–64 years) living in 332,661 households (median [IQR] occupancy: 2 [1–3]). Multi-morbidity was identified in 104,082 patients (14%) and was more prevalent in women (53%), those from BAME backgrounds (51%), or those of working age (58% 20–64 years). Overall, 87,889 (26%) households included at least one, and 14,563 (4%) two or more, adults with multi-morbidity. Age-specific prevalence and prevalence ratios will be presented.

Conclusion This is the first time multi-morbidity has been quantified at the household level. We have demonstrated a high burden of multi-morbidity in women, working-age adults and those from BAME backgrounds in a geographically-defined, ethnically diverse, urban population. Factors contributing to multi-morbidity at a household level will be explored and compared to findings from a harmonised dataset for Wales.

OP20 | **USING CROSS-SECTORAL ADMINISTRATIVE DATA LINKAGE TO UNDERSTAND THE HEALTH OF PEOPLE EXPERIENCING MULTIPLE EXCLUSION**

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Background People affected by the intersection of homelessness, drug use, and/or serious mental illness have high rates of mortality and morbidity. However, a recent systematic review found important limitations in the evidence base on this topic,

in particular in relation to people with more than two of these experiences and for health outcomes other than infections. This situation is exacerbated by the under-ascertainment of these populations in routine information sources on population health needs, such as surveys and censuses. In many countries, administrative data are available which could help address these knowledge gaps. We describe the creation and characteristics of a novel virtual cohort using cross-sectoral linkage of administrative datasets, in order to inform policy and practice responses to these co-occurring issues.

Methods Individual-level data from local authority homelessness services (HL), opioid substitution therapy dispensing (OST), and a psychosis case register (PSY) in Glasgow, Scotland between 2011–15 were confidentially linked to National Health Service records, using a mix of probabilistic and deterministic linkage. A de-identified dataset was made available to researchers through a secure analysis platform. Demographic characteristics associated with different exposure combinations were analysed using descriptive statistics.

Results Linkage created a cohort of 24,767 unique individuals with any one of the experiences of interest between 2011–15. Preliminary results suggest that 89.2% of the cohort had one experience; 10.6% two; and 0.2% all three. The most common combination was HL & OST (n=2,150; 8.7%), with other combinations much less frequent (HL & PSY, n=279, 1.1%; OST & PSY, n=188, 0.8%; HL & OST & PSY, n=51, 0.2%). The odds of male gender increased with number of exposures (2 exposures, OR 2.1, 95% CI 1.9–2.2; 3 exposures, OR 4.1, 95% CI 2.3–7.2), but there was little difference in age. Work is ongoing to incorporate into the cohort additional datasets on criminal justice involvement.

Discussion Administrative data linkage is a feasible approach to understanding the health of people affected by multiple exclusionary processes, addressing problems of recruitment and retention affecting traditional cohort studies in this field. As well as improving the validity of descriptive epidemiology for these populations, this study offers a foundation for evaluating future policy or service interventions. In order for the benefits of administrative data research to be realised, robust and timely governance and linkage processes are required.

OP21   INEQUALITIES IN THE PREVALENCE AND DEVELOPMENT OF MULTIMORBIDITY ACROSS ADULTHOOD: FINDINGS FROM THE 1946 NATIONAL SURVEY OF HEALTH & DEVELOPMENT

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Background With increasing life expectancy and aging populations, the prevalence of multimorbidity (two or more conditions in a person) is rising. Multimorbidity is progressively more common in older age, socioeconomically disadvantaged groups and associated with increased mortality and morbidity. Most studies on multimorbidity to date are cross-sectional in design or with limited follow-up.

We studied the development of multimorbidity across adulthood and early old age in a nationally representative birth cohort study.

Methods This study analysed data from the 1946 National Survey of Health and Development (NSHD). The analysis sample included participants who attended the age 36 assessment in 1982 and any one of the follow-up assessments (ages 43, 53, 63 & 69; N=3,723, 51% males). Information on 18 common conditions was based on a combination of self-report, prescribed medications and health records.

Conditions included diabetes, dyslipidaemia, hypertension, obesity, coronary heart disease, stroke, cancer, anaemia, respiratory-, kidney-, gastro intestinal-, skin-disorders, arthritis, Parkinson's disease, epilepsy, depression & psychosis.

For all participants, we calculated a multimorbidity score at each age indicating the number of conditions accumulated over time and was the outcome of interest. Linear-spline mixed-effects modelling was used to study the population-average accumulation of conditions over time in different periods. We also assessed sex and socioeconomic differences in longitudinal trajectories of multimorbidity across the five ages (18,615 data points, mean: 5 data points/participant).

Childhood social class and adulthood educational level were used as socioeconomic indicators. Missing data was addressed using multiple imputation.

Results Proportion of participants with no conditions decreased progressively from 52% at age 36 to 7% at age 69. Multimorbidity (the number of conditions) increased progressively across all 4 periods (0.55, 95% CI [0.5, 0.6] for 1982–89, 0.63 [0.58, 0.7] for 1989–99, 0.70 [0.63, 0.78] for 1999–09 and 1.15 [1.04, 1.25] for 2009–15). Disadvantaged social class in childhood was associated with marginally increased multimorbidity in adulthood (0.08 [0.01, 0.15] for skilled/unskilled and 0.07 [-0.01, 0.15] for manual groups compared to professional/intermediate group). Higher educational attainment was associated with decreased risk for multimorbidity (-0.09 [-0.2, 0.01] for university degree and -0.13 [-0.2, -0.06] for General Certificate of Education (GCE) compared to those without education). Estimates for childhood social class were attenuated and no longer significant when adjusted for educational level. Women had marginally higher risk for multimorbidity compared to men (0.15 [0.09–0.2]).

Conclusion Multimorbidity increases progressively with age, with the socioeconomically more disadvantaged having greater multimorbidity.

OP22   UNDERSTANDING PATHWAYS TO HEALTH INEQUALITIES IN CYSTIC FIBROSIS – A CAUSAL MEDIATION ANALYSIS USING UK REGISTRY DATA

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Background Cystic fibrosis (CF) is an inherited, progressive condition affecting over 10 000 individuals in the UK. Symptoms of CF include poor growth, lung infection, poor lung function and reduced survival. Outcomes are worse for people growing up in disadvantaged circumstances, but it is not clear to what extent inequalities in early growth can explain inequalities in later lung function and survival. Our aim was to assess how the association between socioeconomic circumstances (SECs) and subsequent lung function measured around age 6 is mediated by weight trajectory in early childhood.