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Social and environmental determinants of prostate cancer: The roles of PM2.5 exposure and neighborhood deprivation in men in Baltimore*

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OBJECTIVES/GOALS: The objective of this study was to evaluate whether exposure to air pollution (PM 2.5) and neighborhood deprivation are associated with prostate cancer risk among men in Baltimore and to determine if social and environmental factors jointly influence disparities in prostate cancer occurrence among men. METHODS/STUDY POPULATION: This case–control study was conducted in the Greater Baltimore area between January 2005 and January 2016. Participants included 617 men with prostate cancer and 852 controls without prostate cancer of African and European descent. Individual data on demographics, smoking, BMI, income, and education were collected through chart review. Residential addresses were linked to neighborhood deprivation index (NDI) and average fine particulate matter ($PM_{2.5}$) levels for 2010 using geospatial data. Logistic regression models were used to estimate associations between $PM_{2.5}$, NDI, and odds of prostate cancer, adjusting for race, smoking, income, education, and BMI. All analyses were conducted using complete-case data. RESULTS/ANTICIPATED RESULTS: In complete-case logistic regression of prostate cancer case status (n = 1,856), unadjusted $PM_{2.5}$ (per 1 $\mu g/m^3$) was positively associated with odds of prostate cancer (unadjusted OR for developing prostate cancer per 1 $\mu g/m^3$ = 1.35; p = 0.014). After multivariable adjustment for neighborhood deprivation index (NDI), race, smoking, income, education, and BMI, the association between $PM_{2.5}$ and case status was attenuated and not statistically significant (adjusted OR per 1 $\mu g/m^3$ = 0.78; 95% CI 0.59–1.04; p = 0.088). By contrast, NDI was associated with higher odds of developing prostate cancer in adjusted models: adjusted OR per 1-unit increase in NDI was 1.15 (95% CI 1.09–1.21; $p < 0.001$). Using a standardized effect, the adjusted OR per 1 SD increase in NDI was 1.41 (95% CI 1.23–1.61). DISCUSSION/SIGNIFICANCE OF IMPACT: Neighborhood deprivation was significantly associated with higher odds of prostate cancer, independent of race, smoking, income, education, and BMI. $PM_{2.5}$ showed no independent association after adjustment, suggesting socioeconomic context may underlie observed disparities in prostate cancer incidence.

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From roadwork to research: A controlled laboratory model for asphalt fume exposure

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OBJECTIVES/GOALS: Develop a reliable methodology to deliver and study asphalt emission exposure on lung physiology, enabling the assessment of acute volatile organic compound (VOC) effects with minimal confounding, and test filtration techniques for efficacy. METHODS/STUDY POPULATION: Sixteen healthy adults (18-50 years) visited the Mayo Clinic cardiopulmonary research lab in Scottsdale, Arizona. Subjects wore a mask fitted with a one-way breathing valve connected to a mixing chamber where they would inhale the VOCs that come from a cocktail of chemical compounds captured from heated asphalt. These VOCs were administered by study staff every 5 minutes for a total of 60 minutes of exposure. Pulmonary measures recorded before and after exposure included respiratory oscillometry, exhaled hydrogen peroxide and nitric oxide, diffusion capacity of the lungs for carbon monoxide and nitric oxide, lung ultrasound, basic spirometry, and transcranial Doppler ultrasound. RESULTS/ANTICIPATED RESULTS: The VOCs delivered replicate urban environmental exposure on hot days, consistent with literature linking high VOC exposure to pulmonary disease and cancer. Preliminary findings show acute changes in alveolar-membrane conductance (DM; mean Δ=53.1 mL/min/mmHg) when unfiltered VOCs were administered. This response was accompanied by increased function gas exchange units (DM/Vc; mean Δ=1.027). These early findings confirm successful implementation of the exposure method and suggest reproducible physiologic responses to acute VOC exposure. Completion of this study is expected to reveal additional markers of pulmonary inflammation and validate a controlled, scalable platform for testing VOC exposure in the laboratory setting. DISCUSSION/SIGNIFICANCE OF IMPACT: These methods are the first of their kind to provide a means to study the acute effects of exposure to asphalt in humans in a controlled, laboratory environment. This offers great significance in understanding the environmental exposures that are affecting the health of those that are exposed to asphalt daily.

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Modeling recurrent overdose patterns to guide real-world harm-reduction placement decisions

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OBJECTIVES/GOALS: To quantify the association between proximity to harm-reduction vending machines and recurrent nonfatal overdose using recurrent-event survival models, estimate effects on time to reoverdose and hazard, and identify modifiable predictors to guide machine sitting. METHODS/STUDY POPULATION: Retrospective cohort of Milwaukee County nonfatal overdoses, Jan 2018 to Dec 2023 (28,108 events; 20,300 people). Records were geocoded, deduplicated, linked within person, and tagged as single or recurrent. Exposure: residence or event within a 30 min walk of a harm-reduction vending machine. Recurrence summarized with Kaplan-Meier curves and mean cumulative function. An interrupted time series (ITS) assessed pre- vs post-HRVM expansion. For inference, we compared Andersen-Gill, Prentice-Williams-Peterson, and Cox ML models, selecting AG gap time. Covariates: age, sex, race, jurisdiction, location type, disposition, proximity. Assumptions checked; hazards reported with 95% CIs. RESULTS/ANTICIPATED RESULTS: 2018 to 2023: 28,108 nonfatal overdoses among 20,300 people; 3,803 had repeats (11,611 events). Inter-event times shortened with each recurrence. Kaplan–Meier for first to second overdose showed small, consistent separation favoring those

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within 30 min of HRVMs; mean cumulative functions rose more slowly near HRVMs. The selected Andersen–Gill gap-time model found no meaningful short-term effect of proximity (aHR ≈ 1.03, 95% CI 1.00–1.06). Younger age and public or commercial locations predicted faster recurrence. County ITS suggested stabilization after HRVM expansion without a clear early reduction. DISCUSSION/SIGNIFICANCE OF IMPACT: Early HRVM rollout yields small reductions in cumulative recurrence without a meaningful short-term hazard change. Results support MOUD linkage and mobile outreach targeting younger people and public settings. The recurrent-event and ITS framework is generalizable for sitting and monitoring.

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Environmental survival and inactivation by ultraviolet light of avian and human metapneumoviruses

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OBJECTIVES/GOALS: Quantify environmental persistence and airborne stability of avian (aMPV) and human metapneumovirus (hMPV) and evaluate far-UVC light (at 222 nm) as a safe, non-chemical disinfection method to reduce viral transmission in agricultural and healthcare environments. METHODS/STUDY POPULATION: Subtypes A and B of aMPV and subtype B of hMPV isolates will be propagated in Vero and LLC-MK2 cells, respectively. Viral persistence will be quantified on fomites under varying temperature and humidity. Aerosol stability will be assessed using an environmental chamber and an atomizer system. Once baseline survival is established, samples and aerosols will be exposed to different far-UVC doses, intensities, and durations. The endpoints will be determined by observing cytopathic effects (CPE), virus titers will be calculated by the Karber method, and titers will be expressed as TCID50. RESULTS/ANTICIPATED RESULTS: We anticipate quantifying surface and aerosol stability profiles of aMPV and hMPV across several porous and non-porous materials (fomites) and environmental conditions relevant to poultry and clinical settings. Far-UVC exposure is predicted to achieve rapid viral inactivation on non-porous surfaces and in aerosols without measurable cytotoxicity or material degradation. The findings will establish disinfection thresholds and demonstrate the practicality of far-UVC integration into real-world agricultural and healthcare biosecurity systems. DISCUSSION/SIGNIFICANCE OF IMPACT: This work advances One Health biosecurity by establishing safe far-UVC disinfection protocols to control the spread of both aMPV and hMPV. Findings will inform infection control policies and reduce economic and health burdens in poultry operations and vulnerable human populations.

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Mass incarceration spillover effects: Exploring neighborhood premature mortality through demographic subgroups and spatial relationships

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OBJECTIVES/GOALS: Mass incarceration, i.e., extremely high rates of incarceration concentrated in impoverished racially segregated communities, is associated with poor neighborhood health, but it is unclear if this is due solely to formerly incarcerated individuals. We examine these population health effects through neighborhood premature mortality rates. METHODS/STUDY POPULATION: We calculated census tract-level overall, gender-, and race-specific age-adjusted premature mortality rates using mortality data (2010-2014) from the New York City Department of Health. We excluded tracts with subgroup population <800. Exposure was the NY State imprisonment rate (2010), modeled as quintiles. As covariates, we included % non-Hispanic Black; poverty, education, and violent crime rates; and population density. We used GLM regression models with the census tract as the unit of analysis. To test if spatial clustering of incarceration (i.e., high-incarceration census tracts surrounded by high-incarceration census tracts) was associated with premature mortality rate independent of covariates and tract incarceration rate, we used LISA cluster values and proximity to high-high clusters. RESULTS/ANTICIPATED RESULTS: Across 1985 tracts, incarceration rate ranged from a median of 19 (quintile 1) to 698 (quintile 5) per 100,000 people. In unadjusted models, neighborhoods in Q5 of incarceration rate had 2.4x higher rate ratios of premature mortality versus Q1. In fully adjusted models, Q5 tracts had 62% higher rate ratios (aOR 1.62, 95% CI 1.50-1.75; P<0.001), sex-specific findings were similar for males and females, Black and Hispanic (aOR 1.36; 95% CI 1.04-1.78 and aOR 1.49, 95% CI 1.24-1.79, specifically) rate ratios were both P<0.001 but Asian and White were NS. Being in a high-high cluster was significantly associated with premature mortality independent of covariates and tract incarceration rate (aOR 1.13, 95% CI 1.06-1.20), whereas low-low clusters were protective (aOR 0.90, 95% CI 0.85-0.94), both P<0.001. DISCUSSION/SIGNIFICANCE OF IMPACT: Premature mortality rates are substantially higher in high-incarceration neighborhoods even accounting for confounders. Sex-specific findings suggest spillover to never-incarcerated people, and race-specific findings suggest concentration in social networks of the incarcerated. Spatial analyses suggest true neighborhood-level effects.

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Linking vasomotor symptom severity to physiological health in peri/menopausal women: The role of hormone therapy in menopause treatment

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OBJECTIVES/GOALS: In peri- and postmenopausal women, to determine 1) whether vasomotor symptoms (VMS) reflect underlying vascular and skeletal muscle dysfunction as well as cardiorespiratory fitness (CRF) and 2) to assess the impact of hormone replacement therapy (HRT) on VMS, vascular and muscular function, and CRF. METHODS/STUDY POPULATION: Peri- and postmenopausal women with 1) no/mild, 2) moderate, or 3) severe VMS will be recruited. Muscle and vascular function as well as CRF will be assessed at baseline and after 3 months in women who initiate VMS-specific therapy (HRT vs. SSRIs). Muscle function will be assessed as quadriceps strength (MVC), size (ultrasound), and contraction kinetics (nerve stimulation). Vascular function will be assessed as brachial flow-mediated dilation and carotid artery measures

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