

Office of Research

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COLORADO STATE UNIVERSITY

A Spatiotemporal Prediction Model for Black Carbon in the Denver Metropolitan Area, 2009-2020

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Studies on health effects of air pollution from local sources require exposure assessments that capture spatial and temporal trends. To facilitate intraurban studies in Denver, Colorado, we developed a spatiotemporal prediction model for black carbon (BC). To inform our model, we collected more than 700 weekly BC samples using personal air samplers from 2018 to 2020. The model incorporated spatial and spatiotemporal predictors and smoothed time trends to generate point-level weekly predictions of BC concentrations for the years 2009-2020. Our results indicate that our model reliably predicted weekly BC concentrations across the region during the year in which we collected data. We achieved a 10-fold cross-validation R² of 0.83 and a root-mean-square error of 0.15 $\mu\text{g}/\text{m}^3$ for weekly BC concentrations predicted at our sampling locations. Predicted concentrations displayed expected temporal trends, with the highest concentrations predicted during winter months. Thus, our prediction model improves on typical land use regression models that generally only capture spatial gradients. However, our model is limited by a lack of long-term BC monitoring data for full validation of historical predictions. BC predictions from the weekly spatiotemporal model will be used in traffic-related air pollution exposure-disease associations more precisely than previous models for the region have allowed.

EPIDEMIOLOGY

Factors associated with progression to inflammatory arthritis in first-degree relatives of individuals with RA following autoantibody positive screening in a non-clinical setting

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Annals of the Rheumatic Diseases

Little is known about the likelihood of developing inflammatory arthritis (IA) in individuals who screen autoantibody positive (aAb+) in a non-clinical research setting. This study screened for serum cyclic citrullinated peptide antibody (anti-CCP) and rheumatoid factor isotype aAbs in subjects who were at increased risk for rheumatoid arthritis (RA) because they are a first-degree relative of an individual with classified RA (n=1780). Combinations of aAbs and high titre aAbs, as defined by 2-times (2 x) the standard cut-off and an optimal cut-off, were evaluated as predictors of our two outcomes, aAb+ persistence and incident IA. 304 subjects (17.1%) tested aAb+; of those, 131 were IA-free and had at least one follow-up visit. Sixty-four percent of these tested aAb+ again on their next visit. Anti-CCP+ at levels $\geq 2 \times$ the standard cut-off was associated with 13-fold higher likelihood of aAb+ persistence. During a median of 4.4 years (IQR: 2.2-7.2), 20 subjects (15.3%) developed IA. Among subjects that screened anti-CCP+ at $\geq 2 \times$ or \geq an optimal cut-off, 32% and 26% had developed IA within 5 years, respectively. Both anti-CCP cut-offs conferred an approximate fourfold increased risk of future IA (HR 4.09 and HR 3.95, $p < 0.01$). These findings support that aAb screening in a non-clinical setting can identify RA-related aAb+ individuals, as well as levels and combinations of aAbs that are associated with higher risk for future IA. Monitoring for the development of IA in aAb+ individuals and similar aAb testing approaches in at-risk populations may identify candidates for prevention studies in RA.

BIostatistics & Informatics

Statistical design considerations for trials that study multiple indications

Kaizer, AM; Koopmeiners, JS; Chen, N; Hobbs, BP

Statistical Methods in Medical Research

Breakthroughs in cancer biology have defined new research programs emphasizing the development of therapies that target specific pathways in tumor cells. Innovations in clinical trial design have followed with master protocols defined by inclusive eligibility criteria and evaluations of multiple therapies and/or histologies. Consequently, characterization of subpopulation heterogeneity has become central to the formulation and selection of a study design. However, this transition to master protocols has led to challenges in identifying the optimal trial design and proper calibration of hyperparameters. We often evaluate a range of null and alternative scenarios; however, there has been little guidance on how to synthesize the potentially disparate recommendations for what may be optimal. This may lead to the selection of suboptimal designs and statistical methods that do not fully accommodate the subpopulation heterogeneity. This article proposes novel optimization criteria for calibrating and evaluating candidate statistical designs of master protocols in the presence of the potential for treatment effect heterogeneity among enrolled patient subpopulations. The framework is applied to demonstrate the statistical properties of conventional study designs when treatments offer heterogeneous benefit as well as identify optimal designs devised to monitor the potential for heterogeneity among patients with differing clinical indications using Bayesian modeling.

CENTER FOR HEALTH, WORK & ENVIRONMENT

International Total Worker Health: Applicability to Agribusiness in Latin America

Jaramillo, D; Krisher, L; Schwatka, NV; Tenney, L; Fisher, GG; Clancy, RL; Shore, E; Asensio, C; Tetreau, S; Castrillo, ME; Amenabar, I; Cruz, A; Pilloni, D; Zamora, ME; Butler-Dawson, J; Dally, M; Newman, LS
International Journal of Environmental Research and Public Health

Total Worker Health® (TWH) is a framework for integrating worker and workplace safety, health, and well-being, which has achieved success in European and US settings. However, the framework has not been implemented in Latin America or in agricultural sectors, leaving large and vulnerable populations underrepresented in the implementation and evaluation of these strategies to improve safety and promote health and well-being. This study presents a case study of how a TWH approach can be applied to a multinational Latin American agribusiness. We describe the process and adaptation strategy for conducting a TWH assessment at multiple organizational levels and in multiple countries. We follow this with a description of a TWH leadership training that was conducted based on the results of the assessment. Finally, we describe our methods to make corporate recommendations for TWH policies and programs that were informed by the TWH assessment and leadership trainings. With this case study we aim to demonstrate the importance and feasibility of conducting TWH in Latin America.

ENVIRONMENTAL & OCCUPATIONAL HEALTH

Development and validation of a diabetes risk score among two populations

Schwatka, NV; Smith, DE; Golden, A; Tran, M; Newman, LS; Cragle, D
PLOS One

The purpose of this study was to assess the validity of a practical diabetes risk score amongst two heterogeneous populations, a working population and a non-working population. Study population 1 (n = 2,089) participated in a large-scale screening program offered to retired workers to discover previously undetected/incipient chronic illness. Study population 2 (n = 3,293) was part of a Colorado worksite wellness program health risk assessment. We assessed the relationship between a continuous diabetes risk score at baseline and development of diabetes in the future using logistic regression. Receiver operating curves and sensitivity/specificity of the models were calculated. Across both study populations, we observed that participants with diabetes at follow-up had higher diabetes risk scores at baseline than participants who did not have diabetes at follow-up. On average, the odds ratio of developing diabetes in the future was 1.38 (95% CI: 1.26-1.50, p < 0.0001) for study population 1 and 1.68 (95% CI: 1.45-1.95, p-value < 0.0001) for study population 2. These findings indicate that the diabetes risk score may be generalizable to diverse individuals, and thus potentially a population level diabetes screening tool. Minimally-invasive diabetes risk scores can aid in the identification of sub-populations of individuals at risk for diabetes.

COMMUNITY & BEHAVIORAL HEALTH

Prenatal Stress and Early Childhood Body Mass Index: A Path Analysis Approach

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Maternal and Child Health Journal

Stress experienced by mothers during the prenatal period can have negative impacts on offspring development. Elevated BMI in childhood in response to early stress experience is a particularly critical outcome of interest since high BMI in childhood is associated with diabetes, heart disease and stroke in later life. The primary objective of this study was to analyze pathways between prenatal stress and early childhood BMI at 54-months of age and to begin to explore ethnic variations in these pathways. This study used the Growing Up in New Zealand (GUINZ) dataset, which is a longitudinal, representative birth cohort study that began with recruiting pregnant women in 2009 and 2010 in Auckland, New Zealand. Path analysis modeling was used to explore risk and protective pathways between prenatal maternal stress and early childhood body mass index (BMI) at 54-months of age and differences by ethnicity (n = 5510). Prenatal stress was positively associated with early childhood BMI at 54-months and maternal nutrition behaviors and length of exclusive breastfeeding mediated this direct relationship ($\chi^2(1) = 0.83$, $p = 0.36$; AIC = 50,496). Mediation and moderation paths varied by ethnicity. These findings contribute to the understanding of the intergenerational transmission of stress with respect to early childhood obesity. Reducing early stress exposure and/or addressing mediating and moderating factors linking stress experience with obesity development may prove to be more effective than attempting to alter health behaviors and trajectories in adulthood.

LIFECOURSE EPIDEMIOLOGY OF ADIPOSITY & DIABETES CENTER

Incidence and timing of offspring asthma, wheeze, allergic rhinitis, atopic dermatitis, and food allergy and association with maternal history of asthma and allergic rhinitis

Venter, C; Palumbo, MP; Sauder, KA; Glueck, DH; Liu, AH; Yang, IV; Ben-Abdallah, M; Fleischer, DM; Dabelea, D
World Allergy Organization Journal

Studying the developmental precursors of allergy may help explain the mechanisms (or etiology) of allergic disease. We studied childhood respiratory and allergic diseases in a pre-birth cohort from the United States. We assessed the associations between maternal history of asthma and the development of respiratory and allergic diseases in offspring. We also assessed associations with maternal history of allergic rhinitis. Maternal history of asthma and allergic rhinitis was self-reported during early pregnancy. Offspring respiratory and allergy information was obtained from electronic medical records. Adjusted Cox proportional hazard models assessed the associations between maternal history of asthma and development of respiratory and allergic diseases in the offspring up to 8 years. A similar approach was used for maternal history of allergic rhinitis. Children born to women with a history of asthma had a 77% greater risk of developing asthma, a 45% greater risk of atopic dermatitis/eczema, and a 65% greater risk of wheeze (all $p < 0.01$), but no significantly increased risk of allergic rhinitis or food allergies, compared to children born to women with no history of asthma. Maternal history of allergic rhinitis was not associated with any child allergy outcome, and maternal history of both asthma and allergic rhinitis was associated with child atopic dermatitis/eczema only. Maternal history of asthma was significantly associated with offspring respiratory and allergic diagnoses. The association between maternal history of asthma and offspring asthma and atopic dermatitis is a novel finding. Our findings may guide physicians who counsel families with a history of maternal asthma and allergic rhinitis about their child's risk of developing respiratory and allergic diseases.

HEALTH SYSTEMS, MANAGEMENT & POLICY

National survey of nurse home visitor collaboration with health care and social services

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Public Health Nursing

The objective of this study was to assess the degree to which nurses in a national public health home visiting program collaborate with interprofessional providers to serve families experiencing adversity. A descriptive, cross-sectional survey measured collaborative practices between nurse home visitors, health care, and social service providers. A census of 263 nursing supervisors completed a web-based survey. The survey included the validated 7-item Relational Coordination Scale, adapted items from the Interagency Collaboration Activities Scale on shared resources, and items related to collaboration attitudes and beliefs. Data were analyzed with descriptive statistics. Relational coordination scores, which are relative measures, ranged from 1 to 5; highest with supplemental nutrition for Women, Infants & Children (M = 3.77) and early intervention (M = 3.44); and lowest with housing (M = 2.55). The greatest sharing of resources was with supplemental nutrition (sum = 12.95) and mental health providers (sum = 11.81), and least with housing (sum = 7.26); with a range of 1-30 where higher scores indicated greater resource-sharing. Home visiting nurses collaborate with interprofessional providers with variation in the degree of collaboration between agencies and by provider type within an agency. Collaboration was a function of two interrelated domains: interpersonal relationships supported by organizational and contextual factors at the systems-level.

CENTERS FOR AMERICAN INDIAN & ALASKA NATIVE HEALTH

Adapting a Nutrition Education Curriculum for Spanish-Speaking Adults Experiencing Low-Income: Recommendations from Key Stakeholders

Stotz, S; Habibi, M; Sanville, L; Cotto-Rivera, E; Soler, A; Powell, A; Giraudo, S; Lee, JS

Ecology of Food and Nutrition

The purpose of this study was to understand recommendations of key stakeholders regarding cultural adaptation of an evidence-based nutrition and physical activity education curriculum for Spanish-speaking adults. Findings from focus groups with Spanish-speaking adults (n=43) and telephone interviews with experts in Spanish nutrition and health education (n=9) revealed: 1) emphasis of the heterogeneity of Spanish-speaking communities; 2) importance of including family in nutrition education; 3) importance of addressing cultural differences between Spanish-speaking and general United States culture; and 4) tips for engaging Spanish-speaking adults in health education. These findings were used to inform cultural adaptation of a nutrition education curriculum.