Interdisciplinary Research (IDR) Origination Awards

Cover Page

Project Title: Poverty-related household air pollution: Effects of open-fire cooking vs. liquefied petroleum gas cookstoves on clinical and inflammatory markers of chronic obstructive pulmonary disease

Principal Investigator(s) (full-time faculty)

Name (PI listed first)	Department	College
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Track: Track two

Abstract

Chronic obstructive pulmonary disease (COPD) is a leading cause of death globally. Poverty obliges up to 40% of people worldwide to use low-cost solid fuels (i.e. wood, animal dung, etc.) for cooking, particularly in low and middle-income countries. Inhalation of household air pollution (HAP) from solid fuel cooking is a major risk factor for the development of COPD, particularly among women who spend more time exposed to cooking fires. Evidence suggests chronic inflammation and oxidative stress in the lungs results from inhaling HAP, such as smoke particles ≤ 2.5 μm ($PM_{2.5}$). The progression of COPD can take 30 years or longer to reach a threshold where patients experience clinical symptoms, such as shortness of breath. Thus, having reliable sub-clinical methods for detecting COPD may help identify at-risk individuals during early stages of the disease. Traditional methods for diagnosing lung disease, such as chest CT scan, are not well suited for use in resource-poor settings. Furthermore, the degree to which HAP needs to be lowered to prevent pulmonary-derived inflammation, the precursor to COPD, is unknown. We propose to use a novel method, point-of-care ultrasound (POCUS), to detect lung disease in a low-income population of brick workers in Nepal. We also aim to study biochemical signaling in sputum and blood that orchestrate both lung and systemic inflammation in response to $PM_{2.5}$ exposures. Understanding these sub-clinical markers of COPD progression may help inform future environmental interventions such as cookstove replacement programs, as well as interventions directed at improving lung health in resource-poor settings.

Summary of Plans for External Funding

Our goal for this line of research is to obtain sufficient external funding ($500,000) for clinical trial intervention research to reduce the subclinical (inflammatory) and lung disease progression effects of HAP. Therefore, we have identified the funding pathway below:

1. Apply for a Pilot/Small Projects Research external grant from the Rocky Mountain Center for Occupational and Environmental Health by the May 16, 2022, deadline.
2. Submit an R15 Academic Research Enhancement Award (AREA) through the National Heart, Lung, and Blood Institute by the June 25, 2022, deadline.
3. Apply for R21 Notice of Special Interest (NOSI) – (NOT-ES-20-018) funding through the National Institute of Environmental Health Sciences by the February or June of 2023 deadline.
4. Apply for R01 Notice of Special Interest (NOSI) clinical research grant (NOT-HL-20-788) by October 2024.

PROJECT NARRATIVE

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death globally.[1, 2] It affects an estimated 328 million people, and causes 3.2 million deaths annually, with disproportionately high prevalence in low and middle-income countries (LMIC).[3, 4] COPD is a disease characterized by airflow obstruction, chronic cough, chronic mucous production, wheezing, and peripheral lung inflammation.[5, 6] In addition to smoking, inhalation of household air pollution (HAP) from burning solid fuels (e.g. wood, crop residues, animal dung, coal) is a significant risk factor for developing COPD, particularly among women, who spend more time with direct exposure to smoke from cooking fires (Figure 1).[7, 8] Solid fuels, although highly polluting, are used by approximately 40% of the global population for household energy because they are less expensive and more readily available than cleaner energy sources, such as natural gas or electricity.[9, 10] Thus, in LMICs, poverty-associated fuel use is an underlying and significant risk factor for developing COPD, even more so than smoking.[7, 11] One challenge in identifying COPD is that many adults in the early stages of the disease may not report symptoms.[6] COPD can take 30 years or longer to reach a threshold where patients experience shortness of breath.[12] Thus, having reliable sub-clinical methods for detecting COPD may help identify at-risk individuals during early stages of disease development.

A variety of methods may be used for the detection of lung disease in resource-rich areas. While chest CT scan is the gold-standard for diagnosing many pulmonary conditions, this method is costly, slow, and not widely available, especially in resource-poor settings. Conversely, point-of-care ultrasound (POCUS) is portable, lacks radiation, has high feasibility and reproducibility, and is cost efficient.[13] POCUS measurements take less than five minutes and in some cases can be more accurate than a chest x-ray.[14, 15, 16] POCUS is reliable in detecting COPD,[13] pneumonia,[15] interstitial lung disease,[17] and even COVID-19 lesions.[16]

Figure 1. Household air pollution exposure from solid fuel cooking.

Understanding sub-clinical markers of inflammation resulting from HAP exposure may also be extremely important to guide future interventions to prevent COPD in resource-poor settings. The exact mechanisms by which HAP leads to the development of COPD are not fully understood. Evidence suggests chronic inflammation and oxidative stress in the lungs results from inhaling household air pollutants such as particulate matter (PM) less than or equal to 2.5 microns (μm) in aerodynamic diameter ($PM_{2.5}$).[18] This leads to activation of alveolar macrophages and a cascade of pro-inflammatory mediators that damage the respiratory epithelium, leading to systemic inflammation.[18] Evidence for this pathway is shown by increased influx of neutrophils in bronchial and bronchoalveolar lavage, increased neutrophils in blood samples, and higher local and systemic cytokine levels in individuals exposed to high levels of wood smoke.[19] Chronic exposure to HAP from solid fuels among women in India led to higher levels of nuclear factor erythroid 2 [Nf-E2]-related factor 2 [Nrf2], a protein involved in regulating antioxidants in the body, in women cooking with solid fuels compared to those using liquefied petroleum gas (LPG).[20]

Currently, the leading intervention strategy to reduce HAP globally is to transition people to fuel/cookstove options that result in lower indoor pollution levels; however, many of these interventions are based on improved ventilation (cookstoves with chimneys) while still using solid fuels. Evidence for the effectiveness of these interventions is poor. Several prior interventions using "clean" biomass cookstoves showed low adoption of the new cooking method or limited evidence for effectiveness to improve lung function.[21, 22, 23] It is possible that vented biomass cookstoves, although an improvement over unvented stoves, do not lower HAP levels sufficiently to reduce respiratory inflammation. **Thus, a major gap exists in understanding the degree to which HAP needs to be lowered to prevent pulmonary-derived inflammation and COPD**. Understanding the effects of HAP on sub-clinical measures of lung disease using POCUS and inflammatory markers in blood and sputum may fill this knowledge gap.

Brick kiln housing in Nepal provides a unique natural environment to examine the effects of HAP and type of cooking on COPD. Nepali brick workers have significantly higher prevalence of respiratory symptoms that are consistent with COPD compared to other workers in the same community.[24] We suggest these symptoms are influenced heavily by the type of cooking used in the home. Nepali brick workers almost exclusively use one of two types of cooking: open wood fires or LPG cookstoves. Open wood fires are among the highest polluting cooking methods, and LPG among the lowest, thus allowing us to draw participants from naturally high and low exposure groups. Previous studies by our group show that $PM_{2.5}$ levels are approximately 10 times higher (Figure 2) in brick workers' homes with wood cooking fires compared to homes with LPG cookstoves and outdoor air.[25, 26] Brick workers in Nepal typically live at the brick kiln, and have well-defined jobs with documented occupational exposure profiles.[27] About half of brick workers homes have no smokers. These characteristics will allow us to account for other sources of inflammation and COPD symptoms.

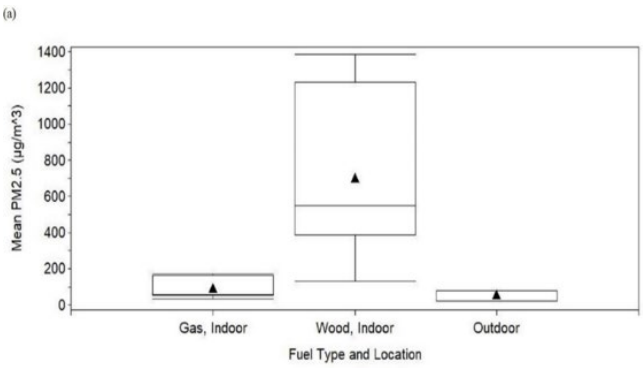

Figure 2. Mean $PM_{2.5}$ by fuel type and location, Bhaktapur, Nepal May 2019. Source: Johnston et al. 2020, *International Journal of Environmental Research and Public Health*, 17, 5681

Study Goals: Our long-term research goal is to reduce HAP exposures and improve lung health in impoverished populations. Before pursuing intervention studies, however, what needs to be answered is whether or not LPG cookstoves reduce HAP sufficient to reduce lung damage. Thus, **the following short-term objectives focus on understanding sub-clinical lung health, and inflammatory markers that serve as indicators of early progression of COPD**. Specifically, this study aims to:

1. Assess and compare the lung condition of brick kiln workers who cook with open wood-burning fires or LPG cookstoves. Lung condition will be objectively determined using the novel approach of point-of-care ultrasound (POCUS).
2. Detect products of biochemical signaling in sputum and blood that orchestrate both lung and systemic inflammation in response to $PM_{2.5}$ exposures from wood-burning fires or LPG cookstoves. The characterization of inflammatory cytokines in sputum will elucidate the status of pulmonary inflammation, while cytokines identified in serum will serve as markers of systemic inflammation.
3. Assess multiple exploratory exposure and health variables among brick kiln workers, including: personal breathing zone $PM_{2.5}$ exposures and $PM_{2.5}$ constituents, lung capacity, self-reported symptoms of COPD, blood oxygenation and heart rate, blood pressure, body weight and composition, sleep quantity and quality, physical activity level, physical strength, and dietary intake.

PROPOSED PLAN (METHODS)

Study Design and Participants. This study will use an observational, cross-sectional, quasi-experimental design with measurements in 40-50 (20-25 per group) participants (sample size calculations below). Participants will be non-smoking adults (18 years or older) and will have lived at the brick kiln for at least five months. We will obtain Institutional Review Board approval from the Karnali Academy of Health Sciences in Jumla, Nepal, and Brigham Young University, prior to initiation.

Procedures. Participants will provide informed consent, obtained in writing and verbally through a translator, prior to participation. Enrolled participants will be fitted with a personal air pollution monitor which they will wear for 24 hrs. We will also collect basic demographic/informational survey data (sex, age, length of time in brick kiln, job classification, home cooking system, number of seasons working in brick kiln, symptoms of COPD). A second air pollution monitor will be placed in the participant's home for 24-hrs. Participants will also be fitted with an accelerometer and asked to wear it continuously for three

days. After 24-hrs, the air pollution monitors will be collected, and the following measurements will be taken: blood oxygenation, heart rate, blood pressure, lung capacity, body weight and composition, physical strength, and dietary intake. Next, each participant will receive a pulmonary ultrasound followed by a blood draw of 10 ml and collection of sputum. Biological samples will be processed immediately after collection and frozen on dry ice. Shipments of biological samples to BYU will be made every two days via FedEx in Kathmandu. Two days after collecting blood and sputum, we will collect the accelerometers. Measurement devices with rechargeable batteries will be charged each night at the hotel, as in our past studies. Participants will receive, in Rupees, the equivalent of $10 USD as compensation for their time.

Assessments/Measurements.

1. *Analyses of personal and household air.* Participants will be fitted with a light-weight vest that holds the air monitoring equipment in the breathing zone (within nine inches of the nose). Indoor samples will be placed on a tripod in the home. $PM_{2.5}$ samples will be collected using RTI International's MicroPEMs V 3.2A (RTI International, Research Triangle Park, NC, USA). $PM_{2.5}$ samples will be collected on 3.0 μm PTFE 25 mm filters, (Zefon International, Ocala, FL, USA). Our collaborators at RTI, International will analyze the filters for 35 carbon and elemental constituents of $PM_{2.5}$.
2. *Pulmonary ultrasound.* POCUS will be performed using the Butterfly IQ device (Butterfly Network, Inc.). This device has a "Lung" preset which has been optimized for detecting the pleural surface and lung sliding, as well as A-lines and B-lines to distinguish pulmonary diseases. The preset has been designed to optimize both near-field lung sliding dynamics and B-lines, as well as A-lines in the mid to deeper field.
3. *Inflammatory markers.* Blood serum will be screened in order to associate systemic inflammation. Leukocyte diapedesis into sputum and serum will be assessed via cytospin approaches. Secreted cytokines will be quantified by conducting a multiplexed Luminex assay with the Bio-Plex 23-Plex Panel Kit (Bio-Rad Laboratories, Inc.). The measured cytokines include eotaxin, G-CSF, GM-CSF, IFN-γ, IL-1α, IL-1β, IL-2, IL-3, IL-4, IL-5, IL-6, IL-9, IL-10, IL-12 (p40), IL-12 (p70), IL-13, IL-17A, KC, MCP-1, MIP-1α, MIP-1β, and RANTES.
4. *Exploratory Measures.* Several exploratory health measures will be collected to evaluate brick workers' health. These measures include blood oxygenation and heart rate (pulse oximeter), blood pressure (automated device), lung capacity (spirometry), body weight and composition (bioelectrical impedance), physical strength (hand-grip dynamometer), sleep quantity and quality (accelerometry), physical activity level (accelerometry), and dietary intake (24-hour, multiple-pass recalls).

Sample Size and Statistical Analyses. Using a significance level of $\alpha = 0.05$ and a power of 0.9, we need a sample size of 32 participants (i.e., 16 participants for each fuel type) to test the association between fuel type (i.e., wood vs. LPG) and $PM_{2.5}$ concentrations. We need a sample size of 28 participants (i.e., 14 participants for each fuel type) to test the association between fuel type and blood and sputum biomarkers (e.g., circulating monocytes) or some spirometry measures. However, we plan to recruit 40-50 total participants (i.e., 20-25 participants for each fuel type) as we plan to use statistical methods which will allow us to adjust for confounders, account for correlations between measurements from participants who live in the same households, and account for missing data (i.e., each of these statistical methods will result in loss of power to detect significant associations, so we are trying to buffer against that loss by recruiting a larger sample size). Statistical analyses for continuous outcomes (e.g., $PM_{2.5}$ concentrations, inflammatory biomarkers, lung capacity, etc.) will use linear or Tobit mixed regression models. For dichotomous outcomes (e.g., pulmonary disease identified via ultrasound, self-reported symptoms of COPD, etc.), we will use unconditional logistic regression models with generalized estimating equations. We will conduct all analyses using SAS version 9.4 (SAS Institute, Inc., Cary, NC).

Current Status of Research and Use of IDR Funds: Our prior body of work documents $PM_{2.5}$ levels in brick workers' homes that exceed World Health Organization guidelines, particularly in homes where solid fuel cooking is used.[25, 26, 28] The Principal Investigator (Johnston) has been to Nepal twice (2018, 2019),

and has ongoing collaborations with the Karnali Academy of Health Sciences (Jumla, Nepal) and Better Brick Nepal, a non-profit organization operating in Kathmandu, Nepal. Thus, we are well positioned to carry out this project. Although our prior studies shed light on the magnitude of $PM_{2.5}$ exposures among brick workers, we lacked the funds and expertise to evaluate health outcomes. The IDR funding mechanism offers us the possibility of working as an interdisciplinary team to collect pilot data on health outcomes that can be used to pursue additional external funding, leading to interventional studies (see External Funding Plan). IDR funds will be used specifically for this purpose as outlined in our assessments/measurements.

Interdisciplinary Team. We have assembled a uniquely qualified team with expertise in air-pollution exposure assessment, pulmonary injury and oxidative stress, occupational epidemiology and statistics, occupational health nursing, chronic disease, and human research design. Members of our team have previous experience in LMICs, including two prior air pollution studies among brick workers in Nepal (2018, 2019).[25, 26, 28] We have existing strong collaborations with scientists, non-profit organizations, and guide/interpreter services in Nepal. Furthermore, the proposed methods of data collection are novel, practical, portable, and have the strong possibility of external grant funding. Therefore, we are confident that this study is feasible with numerous possibilities of future follow-up (see External Funding plan).

Roles and Responsibilities of Interdisciplinary Team

Name	Expertise, Role	Responsibilities
James D. Johnston	Air pollution exposure assessment, Principal Investigator	Team lead, study design, air pollution methodology and exposure monitoring, in-country contacts, grant and manuscript writing
Neil E. Peterson	Occupational health nursing, Co-Investigator	Study design, ultrasound measurements, collection of health outcomes and blood samples, medical oversight, grant and manuscript writing
James D. LeCheminant	Chronic disease, human research design, Co-Investigator	Study design, measurement of obesity, physical activity, and nutrition outcomes, grant and manuscript writing
John D. Beard	Occupational epidemiology and statistics, Co-Investigator	Study design, sample size calculations, data management, statistical analyses, grant and manuscript writing
Paul R. Reynolds	Pulmonary injury and oxidative stress, Co-Investigator	Study design, laboratory analyses for inflammatory biomarkers in blood and sputum samples, grant and manuscript writing

Study Collaborators: We will collaborate with Dr. Seshananda Sanjel (Department of Community Medicine & Public Health, Karnali Academy of Health Sciences, Jumla, Nepal) and Better Brick Nepal, a non-profit organization focused on improving labor conditions in brick kilns. Dr. Sanjel will assist with in-country relations, IRB approval, and manuscript writing. We have successfully collaborated with Dr. Sanjel on multiple previous papers. [24, 25, 27] Jagat Lama, an independent trekking contractor, will serve as our in-country guide and interpreter. Mr. Lama has several years of experience working with BYU faculty and the BYU Kennedy Center. We will collaborate with chemists Frank Weber and Ryan Chartier (RTI International, Research Triangle Park, NC, USA). They will perform carbon and metal analyses of $PM_{2.5}$ filters to identify concentrations of 35 $PM_{2.5}$ chemical components and help with grant and manuscript writing (they will conduct the analyses for free as long as they are included as co-authors of any resulting publications). We have worked with Mr. Weber and Mr. Chartier on multiple previous studies.[25, 28, 29]

Project Milestones

	2022				2023					2024	
Research Activity	Q2	Apply for External Funding (May / June)	Q3	Q4	Q1	Apply for External Funding (February)	Q2	Q3	Q4	Q1	Apply for RO1 (see External Funding Plan)
IRB submissions	x		x								
Team training			x	x	x						
Resource allocation	x		x	x	x						
In-country data collection							x				
Sample analyses								x			
Annual reporting	x						x				
Data analyses								x	x		
Conference presentations									x	x	
Manuscript submission										x	

EXPECTED OUTCOMES

Undergraduate student mentoring. We anticipate a minimum of 20 undergraduate students being mentored through this project, including 12 from BYU, and 8 from the Karnali Academy of Health Sciences in Nepal. Dr. Johnston will train two BYU Public Health students in methods for collecting air pollution samples. Dr. Peterson will train and supervise two BYU Nursing students in POCUS methods. Dr. LeCheminant will train and supervise four students from Exercise Science and/or Nutrition, Dietetics, and Food Science in collecting exploratory health measures (blood oxygenation, lung capacity, etc.). At least two of these students will be phlebotomy certified. Dr. Beard will mentor two Public Health students in statistical analyses, and Dr. Reynolds will mentor two students from Cell Biology and Physiology in laboratory analyses for inflammatory markers. Dr. Sanjel will coordinate having his students participate on a rotating basis during sample collection, as we have done in past studies.

Applications for external funding. Our goal for this line of research is to obtain sufficient external funding ($500,000) for clinical trial intervention research to reduce HAP exposures and improve lung health in impoverished populations. Accordingly, we have identified a funding path ultimately leading to a specific R01 Notice of Special Interest (NOSI). External funding applications will start with a Pilot/Small Projects Research grant from the Rocky Mountain Center for Occupational and Environmental Health (due May 16, 2022). This will be followed by R15 and R21 applications in June 2022 and February 2023, respectively. We will apply for the R01 grant (NOT-HL-20-788) in October 2024.

Scholarly articles and conference presentations. We anticipate publishing four peer-reviewed articles with undergraduate student co-authors from data collected from this IDR. We also anticipate up to six local and/or national conference presentations stemming from this work. Papers will include the following:

1. Application of POCUS for evaluating lung health (Lead author: Neil Peterson)
2. Markers of inflammation in blood and sputum associated with type of cooking (Lead author: Paul Reynolds)
3. Evaluation of air pollution exposures among brick workers using breathing zone sampling methods (Lead author: James Johnston)
4. Respiratory and overall health outcomes of brick workers based on exploratory measures (Lead author: James LeCheminant).

BUDGET AND BUDGET NARRATIVE

Category	Year 1	Year 2	Total
Air pollution measurement supplies	$418	$0	$418
Health effects measurement supplies	$250	$19,750	$20,000
Participant compensation	$500	$0	$500
Travel to and from Nepal	$0	$0	$0
In-country (Nepal) costs	$10,762	$0	$10,762
Undergraduate student wages	$8,320	$0	$8,320
Total	**$20,250**	**$19,750**	**$40,000**

Budget Justification

Air Pollution Measurement Supplies: We (i.e., BYU) already own the instruments that will be used to collect $PM_{2.5}$ samples. We will need $418 in year 1 to purchase consumable materials (filters, tubing, etc.). The $PM_{2.5}$ air filters will be analyzed by our colleagues at Research Triangle Institute (RTI), in Research Triangle Park, NC, for a panel of 35 elements and carbon species. RTI will cover the cost of the chemical analyses. The total cost for supplies to measure air pollution is $418 ($418 in year 1 and $0 in year 2).

Health Effects Measurement Supplies: We (i.e., BYU) already own portable POCUS, spirometry, and bioelectrical impedance machines, thermometers, pulse oximeters, automated blood pressure devices, accelerometers, hand-grip dynamometers, and software needed for analyses of sleep quantity and quality and dietary intake. Blood draw supplies cost ~$5 per person × 50 participants = $250 in year 1, which will cover blood draw kits, biohazard bin, vacutainer tubes, gloves, etc. Multiplexing (i.e., inflammatory biomarkers/cytokines) costs $1,500 for eight samples and we will need 100 samples (i.e., one sputum and one blood sample × 50 participants). Thus, (100/8) × $1,500 = $18,750 in year 2. We will also conduct additional analyses of blood samples for total cell count and differential cell count. We estimate that cost would be ~$1,000 in year 2 for slides, stains, and consumables. The total cost for supplies to measure health effects is ~$20,000 (~$250 in year 1 and $19,750 in year 2).

Participant Compensation: $10 per participant × 50 participants = $500 ($500 in year 1 and $0 in year 2).

Travel to and from Nepal: Faculty members will pay for their own meals and travel costs to and from Nepal from their BYU faculty accounts. Students will pay for their own meals and travel costs to and from Nepal by paying tuition for a global health internship through BYU's David M. Kennedy Center (as done for trips to Nepal in 2018 and 2019). The total cost of travel is $0 ($0 in year 1 and $0 in year 2).

In-Country (Nepal) Costs (per Jagat Lama, our guide for a previous trip to Nepal in 2019): The cost for guides and vans for 12 people (i.e., faculty members and students) is $30 per day for an English-speaking guide and $150 per day for a 14-seat tourist Toyota van, so $180 × 14 days = $2,520 in year 1. The cost for lodging in Bhaktapur is $68 per night at the Peacock Guest House, so $68 × six rooms (assuming two people per room) × 14 days = $5,712 in year 1. The cost for one interpreter at the brick kiln is $30 per day, so $30 × 10 days = $300 in year 1. The cost to transport blood and sputum samples to FedEx at least once every two days for shipment to BYU is the cost of another van and driver, so $150 per day × five days = $750 in year 1. The cost to freeze (dry ice), package and ship blood samples from Kathmandu to BYU by FedEx is $200 per shipment × five shipments = $1,000 in year 1. The cost for transport to and from the airport is $100 each time, so $100 × two times = $200 in year 1. Tips for driver and interpreter are $10 per day/person, so $20 × 14 days = $280. The total in-country cost is $10,762 in year 1 and $0 in year 2.

Undergraduate Students: Eight × $13 per hour × eight hours per day × 10 days = $8,320 ($8,320 in year 1 and $0 in year 2). The four students not traveling to Nepal, but who will be mentored on this project by Dr. Beard (statistics) and Dr. Reynolds (inflammatory marker analyses) will be paid for by faculty 20 accounts.

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PLANS FOR EXTERNAL FUNDING

Overall Goal. Our goal for this line of research is **to obtain sufficient external funding for clinical trial intervention** research to reduce the subclinical (inflammatory) and lung disease progression effects of household air pollution. Accordingly, **we have identified the R01 mechanism and the specific Notice of Special Interest (NOSI) below (NOT-HL-20-788)**. The expiration date of application for this NOSI is September 8, 2025. Therefore, we have identified the pathway to this grant below (including where the IDR fits into this plan).

Internal Interdisciplinary Development Research Grant

1. Should the Interdisciplinary Development Research (IDR) grant be awarded, it will provide us with sufficient funds to collect pilot data for up to 50 participants. This phase of the research will be completed by 2023.

External Grant Progression

1. To supplement the IDR grant, we will apply for a Pilot/Small Projects Research external grant from the Rocky Mountain Center for Occupational and Environmental Health by the May 16, 2022, deadline. Members of our research team have successfully obtained funding from this agency previously.
2. In order to expand our ability to collect data for a larger sample size, we will submit an R15 Academic Research Enhancement Award (AREA) by the June 25, 2022, deadline. An AREA grant is focused on small-scale studies that give students a research experience. Our study fits well with the purpose of the AREA grant. Depending on initial scores, we will resubmit for an AREA grant the following February or June of 2023.
3. To further develop the inflammatory biomarkers aim of our research, we will seek R21 funding through the National Institute of Environmental Health Sciences. The R21 mechanism is for exploratory and developmental research. Specifically, we have identified a NOSI with an expiration date of May 31, 2024 (NOT-ES-20-018). We anticipate submitting for this NOSI by the February or June of 2023 deadline.
4. Lastly, we will seek funding through the R01 (clinical research) mechanism for the specific NOSI listed below (NOT-HL-20-788). Depending on the findings of our research, we anticipate submitting for this grant by the October of 2024, or February or June of 2025 deadline.

Grant Application Due Date	Agency	Program	Amount	Estimated Date of Research Completion
May 16, 2022	Rocky Mountain Center for Occupational and Environmental Health	"Pilot/Small Projects Research"	$15,000 (1 year)	2023
June 25, 2022	National Institute of Environmental Health Sciences or National Heart, Lung, and Blood Institute	R15 "Academic Research Enhancement Awards"	$300,000 (3 years)	2025-2026
February 25, 2023 (Expiration date for applications is May 31, 2024)	National Institute of Environmental Health Sciences	R21 – "Promoting Fundamental and Applied Research in Inflammation Resolution"	$275,000 (2 years)	2025-2026
October, 2024 (Expiration date for this grant is September 8, 2025)	National Heart, Lung, and Blood Institute AND National Institute of Environmental Health Sciences	R01 – "Stimulating Intervention Research to Reduce Cardiopulmonary Impacts of Particulate Matter in Air Pollution among High-Risk Populations"	$500,000 (3 years)	2028

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: James D. Johnston

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Associate Professor, Brigham Young University

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Weber State University, Ogden, UT	BS	05/1998	Microbiology
University of Utah, Salt Lake City, UT	MSPH	05/2000	Public Health
University of Utah, Salt Lake City, UT	PHD	05/2010	Health Promotion

A. Personal Statement

Dr. Johnston is a board certified industrial hygienist (CIH) with 22 years' experience in the field of occupational and environmental health & safety. He is uniquely qualified to lead the proposed project based on prior experience conducting exposure assessment studies in both domestic and international settings. Specific to this proposal, he was the principal investigator on two separate indoor air quality studies among brick workers in Bhaktapur, Nepal in 2018 and 2019. His published works include papers on residential indoor air quality assessments for particle and gas phase pollutants, endotoxins, β-(1→3)-D-glucan, and house dust mite allergens. Several of his publications focus on the elemental composition of particulate matter, and personal monitoring strategies among children and adults. In addition to his work on household air pollution exposures, Dr. Johnston has ongoing projects focused on associations between evaporative cooling in dry climates and its influence on the residential microbiome. Prior to his faculty appointment at Brigham Young University, Dr. Johnston was a Research Assistant Professor in the Department of Pediatrics at the University of Utah, where he managed the Environmental Monitoring team of the National Children's Study in Cache County, Utah. He also has prior work experience as an Industrial Hygienist with the Utah Labor Commission and Bechtel BWTC, Idaho National Engineering & Environmental Laboratory, Idaho Falls, ID.

B. Positions, Scientific Appointments, and Honors

2012 – Present	Associate Professor, Department of Public Health, Brigham Young University
2011 – 2012	Research Assistant Professor, Department of Pediatrics, University of Utah
2010 - 2012	Environmental Monitoring Manager, Cache County Center for the National Children's Study, University of Utah, Department of Pediatrics, Salt Lake City, UT.
2004 - 2010	Research Biosafety Manager/ IBC Administrator, University of Utah, Department of Environmental Health & Safety, Salt Lake City, UT
2001 - 2004	Industrial Hygienist, Utah Labor Commission, Compliance Division, Salt Lake City, UT
2000 - 2001	Industrial Hygienist, Bechtel BWTC, Idaho National Engineering & Environmental Laboratory, Idaho Falls, ID

Academic Honors

2020 - 2023	Ferrin L. Orton Teaching & Learning Faculty Fellowship, Brigham Young University, Provo, Utah.
2019	1st Place Gold, Best in Show Award. What house dust can tell us about indoor air quality: Bioaerosols in low-income homes with evaporative coolers Cowger AE*, Beard JD, Tueller JA*, Weber KS, Johnston JD. American Industrial Hygiene Conference and Exposition (AIHce 2019), Minneapolis, MN.

2019 Distinguished Poster Award. Cowger AE*, Johnston JD, Graul RJ*, Nash R*, Tueller JA*, Hendrickson NR*, Beard J, and Weber KS. Bioaerosols associated with evaporative cooler use in low-income homes in the semi-arid climate of Utah County, Utah, USA. American Society of Microbiology Rocky Mountain Branch Meeting April 13th 2019. Provo Utah.

2010 Robert I Gross Memorial Award, American Biological Safety Association, 53rd Annual Biological Safety Conference, Denver, CO.

C. Contributions to Science

Our research team has published the most comprehensive assessment of Nepali brick workers' occupational and environmental respiratory exposures to date. Nepali brick workers typically live at the kiln where they work. One prior study by our team documented significantly higher rates of respiratory symptoms in this population compared to a control group of workers in the same community (Sanjel et al., 2017*a*). Brick workers' respiratory symptoms were consistent with a diagnosis of chronic obstructive pulmonary disease (COPD). Based on this finding, we followed up with a series of studies to understand their occupational exposures as well as off-duty exposures to household air pollution from cooking. Our body of work thus far shows that brick workers in Nepal experience dangerously high exposures to respirable crystalline silica, as well as significant differences in exposure based on job classification (Sanjel et al., 2017*b*). Furthermore, studies conducted in consecutive years (2018, 2019) evaluated household air pollution exposures (Thygerson et al., 2019; Johnston et al., 2020; Johnston et al., 2021). Collectively, these studies document $PM_{2.5}$ levels in brick workers' homes that far exceed World Health Organization guidelines, particularly in homes where biomass cooking is used compared to liquefied petroleum gas. Several chemical constituents in $PM_{2.5}$ were also identified at levels known to cause adverse health effects. We hope to build on this work by addressing a major gap in the literature, which is understanding the degree to which household air pollution needs to be lowered to prevent sub-clinical and pulmonary-derived inflammation and COPD in this population. The following publications are specific to our prior work in Nepal, in addition to two exposure assessment studies where I had primary oversight of environmental sampling (Chaney et al., 2017; Sloan et al., 2016).

- **Johnston JD**, Beard JD, Montague EJ*, Sanjel S, Lu JH*, McBride H*, Weber FX, Chartier RT (2021). Chemical composition of $PM_{2.5}$ in wood fire and LPG cookstove homes of Nepali brick workers. *Atmosphere*. 12(7), 911; https://doi.org/10.3390/atmos12070911
- **Johnston JD**, Hawks ME*, Johnston HB*, Johnson LA*, Beard JD (2020). Comparison of liquefied petroleum gas cookstoves and wood cooking fires on $PM_{2.5}$ trends in brick workers' homes in Nepal. *International Journal of Environmental Research and Public Health*. 17(16), 5681; https://doi.org/10.3390/ijerph17165681
- Thygerson SM, Beard JD, House MJ*, Smith RL*, Burbidge HC*, Andrus KN*, Weber FX, Chartier R, **Johnston JD** (2019). Air-quality assessment of on-site brick-kiln worker housing in Bhaktapur, Nepal: Chemical speciation of indoor and outdoor $PM_{2.5}$ pollution. *International Journal of Environmental Research and Public Health*. 16:21, 4114; https://doi.org/10.3390/ijerph16214114.
- Sanjel S, Khanal SN, Thygerson SM, Carter WS, **Johnston JD**, Joshi SK (2017*b*). Exposure to respirable silica among clay brick workers in Kathmandu valley, Nepal. Archives of Environmental and Occupational Health. (Published online 12/22/2017).
- Chaney RA, Sloan CD, Cooper VC*, Robinson DR*, Hendrickson NR*, McCord TA*, **Johnston JD** (2017). Personal exposure to fine particulate air pollution while commuting: An examination of six transport modes on an urban arterial roadway. PLoS ONE, 12:11, e0188053. https://doi.org/10.1371/journal.pone.0188053
- Sanjel S, Khanal SN, Thygerson SM, Carter WS, **Johnston JD**, Joshi SK (2017*a*). Respiratory symptoms and illnesses related to the concentration of airborne particulate matter among brick kiln workers in Kathmandu Valley, Nepal. Annals of Occupational and Environmental Medicine. 29:9. doi: 10.1186/s40557-017-0165-0
- Sloan CD, Weber FX, Bradshaw RK*, Philipp TJ*, Barber WB*, Palmer VL*, Graul RJ*, Tuttle SC*, Chartier RT, **Johnston JD** (2016). Elemental analysis of infant airborne particulate exposures. *Journal of Exposure Science & Environmental Epidemiology*. doi:10.1038/jes.2016.77

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Neil E. Peterson, PhD, RN, NP-C, AGACNP-BC

eRA COMMONS USER NAME (credential, e.g., agency login): nep5xnih

POSITION TITLE: Associate Professor & Graduate Program Coordinator, Brigham Young University

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University, Provo, UT	B.S.	12/2007	Nursing
University of Virginia, Charlottesville, VA	M.S.N.	05/2011	Family Nurse Practitioner
University of Virginia, Charlottesville, VA	Post-Master's	05/2013	Acute Care Nurse Practitioner
University of Virginia, Charlottesville, VA	PhD	05/2014	Nursing, Physical Activity and Sedentary Behavior
Harvard Catalyst, Boston, MA	Graduate Certificate	05/2021	Applied Biostatistics

A. Personal Statement

I fully support the BYU IDR submission, "Poverty-related household air pollution: Effects of open-fire cooking vs. liquefied petroleum gas cookstoves on clinical and inflammatory markers of chronic obstructive pulmonary disease." My role in the study is as Co-Investigator. My contribution to the research is in both clinical and research expertise. I will be the lead for our pulmonary assessments (Aims 1 and 3) and assist with accelerometry (Aims 1 and 3). I have over 10 years' experience as a nurse practitioner in family practice and I specialize in physical activity and healthy lifestyle research. I have prior experience using ultrasound and will receive additional training in pulmonary assessments to support this study. Additionally, as a health care practitioner, I will provide medical oversite for the study.

B. Positions and Honors

Academic Positions

2013-2014 Clinical Instructor, School of Nursing, University of Virginia, Charlottesville, VA
2014-2020 Assistant Professor, College of Nursing, Brigham Young University, Provo, UT
2020-Present Associate Professor, College of Nursing, Brigham Young University, Provo, UT
2020-Present Graduate Program Coordinator, College of Nursing, Brigham Young University, Provo, UT

Professional Experience

2008-2009 Registered Nurse, Cardiothoracic ICU, Cleveland Clinic Foundation, Cleveland, OH
2009-2012 Registered Nurse, Employee Health & Same Day Clinic, University of Virginia Medical Center, Charlottesville, VA
2011-2013 Research Assistant, Department of Cardiovascular Medicine, University of Virginia Medical Center, Charlottesville, VA
2012-2014 Nurse Practitioner, Employee Health & Same Day Clinic, University of Virginia Medical Center, Charlottesville, VA
2014-2018 Nurse Practitioner, Pace Clinic, Springville, UT
2015-Present Nurse Practitioner, OnSite Care Clinics, Salt Lake City, UT

Recent Honors and Awards

2015 Best Research Methods Paper for 2015 by the Editorial Board of *Research in Nursing & Health*

2017 Excellence in Research Award, Sigma Theta Tau International, Iota Iota Chapter
2018 SBRN Paper selected for Springer Nature's Change the World 2018 initiative
2019 Excellence in Mentorship Award, Sigma Theta Tau International, Iota Iota Chapter

C. Contributions to Science

1. Measurement and use of accelerometry for sedentary behavior and physical activity: Sedentary behavior and physical activity have had wide variability in measurement standards and definitions. During my NIH funded F31 pre-doctoral grant through NINR, I concluded that inclinometry, or body position, is not well suited for measuring sedentary behavior above and beyond what actigraphy already provides. Furthermore, the standard for measuring sedentary behavior using actigraphy should include triple axis measurements from actigraphy. My work with the Sedentary Behavior Research Network includes official position statements, with evidence, for the proper measurement and definitions of sedentary behavior and other levels of activity. This standardization should greatly enhance the replication and comparability of research in this area.
    a. **Peterson, N. E.**, Sirard, J. R., Kulbok, P. A., DeBoer, M. D., & Erickson, J. M. (2015). Validation of accelerometer thresholds and inclinometry for measurement of sedentary behavior in young adult university students. *Research in Nursing & Health, 38*(6), 492-499. http://dx.doi.org/10.1002/nur.21694.
    b. **Peterson, N. E.**, Sirard, J. R., Kulbok, P. A., DeBoer, M. D., & Erickson, J. M. (2018). Sedentary behavior and physical activity of young adult university students. *Research in Nursing & Health, 41*(1), 30-38. doi:10.1002/nur.21845
    c. Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S. F. M., Altenburg, T. M., Chinapaw, M. J. M., Aminian, S., Arundell, L., Atkin, A. J., Barone Gibbs, B., Bassett-Gunter, R., Belanger, K., Biddle, S., Biswas, A., Chaput, J. P., Chau, J., Colley, R., Coppinger, T., Craven, C., Cristi-Montero, C., de Assis Teles Santos, D., del Pozo Cruz, B., del Pozo-Cruz, J., Dempsey, P., Ekelund, U., Ellingson, L., Ezeugwu, V., Fitzsimons, C., Florez-Pregonero, A., Friel, C. P., Fröberg, A., Giangregorio, L., Godin, L., Gonçalves, R. F., Gunnell, K., Halloway, S., Hinkley, T., Hnatiuk, J., Husu, P., Kadir, M., Karagounis, L. G., Koster, A., Lakerveld, J., Lamb, M., Larouche, R., LeBlanc, A. G., Lee, E. Y., Lee, P., Lopes, L., Manns, T., Manyanga, T., Martin Ginis, K., McVeigh, J., Meneguci, J., Moreira, C., Murtagh, E., Patterson, F., Pereira da Silva, D. R., Pesola, A. J., **Peterson, N. E.**, Pettitt, C., Pilutti, L., Pinto Pereira, S., Poitras, V., Prince, S., Rathod, A., Rivière, F., Rosenkranz, S., Routhier, F., Santos, R., Smith, B., Theou, O., Tomasone, J., Tucker, P., Umstattd Meyer, R., van der Ploeg, H., Villalobos, T., Viren, T., Wallmann-Sperlich, B., Wijndaele, K., Wondergem, R.. (2017). Sedentary Behavior Research Network (SBRN) – Terminology consensus project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 75. doi:10.1186/s12966-017-0525-8.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: James D. LeCheminant

eRA COMMONS USER NAME (credential, e.g., agency login): jlechem

POSITION TITLE: Professor, Brigham Young University

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University	B.S.	08/1999	Health Promotion
Brigham Young University	M.S.	08/2001	Exercise Physiology
University of Kansas	Ph.D.	08/2005	Exercise Science and Public Health

A. Personal Statement

I can contribute substantial expertise to this project. I have had 9 years of experience directing or coordinating clinical treatment programs that includes physical activity/exercise and over 20 years involved in research projects of human health. As a result, I've been privileged to be a co-author over 77 peer-reviewed publications. Along with physical activity and diet, I have had research experience in obesity and weight management, chronic disease, and sleep. For the current project, I can contribute research expertise in design, human data collection, phlebotomy, health evaluation, program planning, program evaluation, research assistant training, and data analysis.

B. Positions, Scientific Appointments, and Honors

08/99 – 08/01 - Y-Be-Fit Co-Director (BYU Wellness), Brigham Young University, Provo, UT
08/01 – 08/05 - Weight Control Research Project (WCRP) coordinator, University of Kansas, Lawrence, KS
08/05 – 08/08 - Assistant Professor, Southern Illinois University Edwardsville, Edwardsville, IL
08/06 – 08/08 - Weight Management Program Director, Edwardsville, IL
09/08 – 08/11 - Assistant Professor, Brigham Young University, Provo, UT
09/11 – 08/18 - Associate Professor, Department of Exercise Sciences and the Department of Nutrition, Dietetics, and Food Science (2018), Brigham Young University, Provo, UT
09/19 – Present - Professor, Department of Nutrition, Dietetics, & Food Science, Brigham Young University, Provo, UT

Other:

1999 – Present - American College of Sports Medicine, Member
2001 – Present - The Obesity Society, Member
2006 – Present – Ad Hoc reviewer for 26 peer-reviewed journals
2009 – Present - American College of Sports Medicine, Fellow
2010 – 2012 - Utah Council for Worksite Health Promotion, Member
2012 – Present - American Heart Association, Member
2014 – 2017 - Ferrin L. Orton Teaching and Learning Fellowship ($30,000) – Brigham Young University
05/2017 – 9/2017 - Special Volunteer (National Institutes of Health, National Institute of Diabetes, Digestive, and Kidney Disorders)
2018 – Present – American Society of Nutrition, Member
2021 – Skaggs Distinguished Mentoring Award ($20,000), College of Life Sciences, Brigham Young University

C. Contributions to Science

For a full list of peer-reviewed, scientific publications (n=77), please see the link below to google scholar.

https://scholar.google.com/scholar?hl=en&as_sdt=0%2C45&q=lecheminant+j&oq=

D. Additional Information: Recent Research (2017-Present) Support and/or Scholastic Performance

American Diabetes Association ($365,000) (In Review) 2022-2025
Title: Utilizing Individual Response to Three Dietary Approaches for Body Weight Management
Role: Primary investigator

Alliance for Potato Research and Education ($53,190) 2021-2023
Title: The effect of potatoes on vegetable consumption
Role: Co-Investigator

The Community Foundation of Utah; Association for Utah Community Health ($129,363) 2019 – 2022
Title: Homeless Health and Wellness
Role: Co-PI

Gerontology Research Grant ($5,000) 2019 - Present
Brigham Young University
Title: Geriatric Obesity: What Role Does the Brain Play? An Event-Related Potential Investigation of Food-Related Cognition in Older Adults
Role: Co-investigator

Private Donor – ($161,020) 08/2017- Present
Title: A Mentored-Learning Experience and Computational Training in Human Electrophysiology
Role: Co-Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Beard, John D.

eRA COMMONS USER NAME (credential, e.g., agency login): JDBEARD

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University, Provo, UT	BS	04/2008	Statistics
Brigham Young University, Provo, UT	MPH	04/2010	Public Health
University of North Carolina at Chapel Hill, Chapel Hill, NC	PHD	05/2015	Epidemiology

A. Personal Statement

Dr. Beard is an occupational and environmental epidemiologist with several years of experience using the proposed methods—including cross-sectional studies and various types of regression models—and conducting research about air pollution. Dr. Beard has published on exposure assessment studies of air pollution concentrations at brick kilns in Nepal, health effects of occupational carbon nanotube and nanofiber exposure, and radon concentrations in public schools in Utah. He has worked on epidemiological studies of associations between military service, deployments, and exposures, blood trace metals, body mass index, occupation, blood lead, and bone turnover and amyotrophic lateral sclerosis (ALS) etiology, mortality, and survival. He has published on relationships between diet and occupation and Parkinson's disease, pesticides and depression and suicide, and temperature inversions and emergency department visits for asthma. Before starting at BYU in 2017, he worked for two years as a Lieutenant in the Commissioned Corps of the United States (U.S.) Public Health Service during which time he was assigned to be an Epidemic Intelligence Service Officer and a Research Officer in the Industrywide Studies Branch of the National Institute for Occupational Safety and Health in Cincinnati, OH. Before that he worked for six years as a Summers of Discover Intern, Special Volunteer, and Pre-Doctoral Fellow in the Epidemiology Branch of the National Institute of Environmental Health Sciences in Research Triangle Park, NC. He also worked for nine months as an Epidemiologist in the Environmental Epidemiology Program of the Utah Department of Health in Salt Lake City, UT.

- Johnston JD, **Beard JD**, Montague EJ, Sanjel S, Lu JH, McBride H, Weber FX, Chartier RT. Chemical composition of $PM_{2.5}$ in wood fire and LPG cookstove homes of Nepali brick workers. Atmosphere. 2021 Jul 15;12(7):911.
- Johnston JD, Hawks ME, Johnston HB, Johnson LA, **Beard JD**. Comparison of liquefied petroleum gas cookstoves and wood cooking fires on $PM_{2.5}$ trends in brick workers' homes in Nepal. Int J Environ Res Public Health. 2020 Aug 6;17(16):5681. PubMed Central PMCID: PMC7460176.
- **Beard JD**, Erdely A, Dahm MM, de Perio MA, Birch ME, Evans DE, Fernback JE, Eye T, Kodali V, Mercer RR, Bertke SJ, Schubauer-Berigan MK. Carbon nanotube and nanofiber exposure and sputum and blood biomarkers of early effect among U.S. workers. Environ Int. 2018 Jul;116:214-28. PubMed Central PMCID: PMC5970999.
- Schubauer-Berigan MK, Dahm MM, Erdely A, **Beard JD**, Birch ME, Evans DE, Fernback JE, Mercer RR, Bertke SJ, Eye T, de Perio MA. Association of pulmonary, cardiovascular, and hematologic metrics with carbon nanotube and nanofiber exposure among U.S. workers: a cross-sectional study. Part Fibre Toxicol. 2018 May 16;15(1):22. PubMed Central PMCID: PMC5956815.

B. Positions, Scientific Appointments, and Honors

Current Positions and Employment

2017 - Assistant Professor, Department of Public Health, College of Life Sciences, Brigham Young University, Provo, UT

Other Experience While in Current Position

2019 - Faculty Affiliate, Gerontology Program/Minor, BYU

2019 - 2019	Peer-Reviewer for Office of Health Assessment and Translation, Division of the National Toxicology Program, National Institute of Environmental Health Sciences. Draft NTP Monograph on Systematic Review of Long-Term Neurological Effects Following Acute Exposure to the Organophosphate Nerve Agent Sarin. Research Triangle Park, NC: Office of Health Assessment and Translation, Division of the National Toxicology Program, National Institute of Environmental Health Sciences; 2018
2019 – 2019	Chair, Concurrent Contributed Session: Occupational Epidemiology, 52nd Annual Meeting of the Society for Epidemiologic Research, Minneapolis, MN, 2019
2020 – 2021	Member, Scientific Committee, 28th International Symposium on Epidemiology in Occupational Health, EPICOH
2021 – 2021	Co-Chair, Concurrent Session D2: Aging Workforce, 28th International Symposium on Epidemiology in Occupational Health, EPICOH

Honors While In Current Position

2018 – 2018	Veterans Disability & Rehabilitation Research Channel Anniversary Prize (for Beard et al. 2017a), Public Library of Science (PLOS)
2019 – 2019	2018 AJE Reviewer of the Year, AJE and SER
2019 – 2019	2019 Alice Hamilton Award for Excellence in Occupational Safety and Health, Epidemiology and Surveillance Category, NIOSH, CDC (for Beard et al. 2018; Dahm et al. 2018; Schubauer-Berigan et al. 2018)
2019 – 2019	Distinguished Poster Award, American Society of Microbiology Rocky Mountain Branch Meeting, Provo, UT (for Cowger et al. 2019)
2019 – 2019	Radon Champion Award, U.S. Environmental Protection Agency Region 8 Radon Stakeholders' Meeting, Utah Department of Environmental Quality
2019 – 2019	1st Place Gold, Best in Show Awards (Student Poster Winner), American Industrial Hygiene Conference and Exposition 2019, Minneapolis, MN (for Cowger et al. 2019)

C. Contributions to Science

Risk and prognostic factors, especially those related to military service, for ALS. I have published seven journal articles on risk and prognostic factors for ALS. The risk factors described in these articles were military service, deployments, and exposures, blood trace metals, body mass index, occupation, blood lead, and bone turnover. Previous studies, reviewed in Beard and Kamel (2015), found positive associations between military service and ALS, but explanations for the positive association remain elusive. We conducted some of the largest, most comprehensive studies of military-related factors and ALS etiology and survival and identified positive associations between several military related factors (e.g., deployment to World War II or the Korean War, mixing and application of burning agents, exposure to Agent Orange in the field, etc.) and ALS etiology and survival (Beard et al. 2016, 2017a). These papers have spawned additional research and were cited by a National Academies of Sciences, Engineering, and Medicine publication called *Veterans and Agent Orange: Update 11* (2018). We received an award for Beard et al. (2017a; listed under "Honors"). We also found ALS mortality was higher among occupations associated with higher socioeconomic status (e.g., architecture and engineering, computer and mathematical, education, training, and library, legal, etc.) (Beard et al. 2017b).

- **Beard JD**, Engel LS, Richardson DB, Gammon MD, Baird C, Umbach DM, Allen KD, Stanwyck CL, Keller J, Sandler DP, Schmidt S, Kamel F. Military service, deployments, and exposures in relation to amyotrophic lateral sclerosis survival. PLoS One. 2017a;12(10):e0185751. PubMed Central PMCID: PMC5634564.
- **Beard JD**, Steege AL, Ju J, Lu J, Luckhaupt SE, Schubauer-Berigan MK. Mortality from amyotrophic lateral sclerosis and Parkinson's disease among different occupation groups - United States, 1985-2011. MMWR Morb Mortal Wkly Rep. 2017b Jul 14;66(27):718-722. PubMed Central PMCID: PMC5687590.
- **Beard JD**, Engel LS, Richardson DB, Gammon MD, Baird C, Umbach DM, Allen KD, Stanwyck CL, Keller J, Sandler DP, Schmidt S, Kamel F. Military service, deployments, and exposures in relation to amyotrophic lateral sclerosis etiology. Environ Int. 2016 May;91:104-15. PubMed Central PMCID: PMC4876822.
- **Beard JD**, Kamel F. Military service, deployments, and exposures in relation to amyotrophic lateral sclerosis etiology and survival. Epidemiol Rev. 2015;37:55-70. PubMed Central PMCID: PMC4325667.

A complete list of all my contributions can be found at:
https://www.ncbi.nlm.nih.gov/myncbi/john.beard.2/bibliography/public/

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: **Paul R. Reynolds**

eRA COMMONS USER NAME (credential, e.g., agency login): **paulrreynolds**

POSITION TITLE: **Professor, Department of Cell Biology and Physiology**

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University; Provo, UT, USA	BS	1999	Human Biology
Brigham Young University; Provo, UT, USA	MS	2001	Human Biology
University of Cincinnati; Cincinnati, OH, USA	PhD	2004	Mol. And Dev. Biology
University of Utah; Salt Lake City, UT, USA	Post-Doc	2006	Pulmonary Biology

A. Personal Statement

I am a principal investigator trained in the areas of molecular and developmental pulmonary biology. My long-standing interests center on mechanisms of lung morphogenesis and the molecular impact of genetic misregulation. A key interest also focuses on the consequences of particulate exposure and the progression of pulmonary diseases. A dynamic, accomplished team has been assembled that are positioned to delineate the proposed research objectives identified I have published research that uses techniques in histology/immunohistology, molecular biology, biochemistry, genetic mouse models, and immunology. My training in clinical environments emphasizing molecular biology, organogenesis, and disease is well suited for the dissection of scoring toxicity, oxidative stress, and inflammation as described in the proposal.

B. Positions and Honors

Positions

2018-present Professor, Brigham Young University, Department of Cell Biology and Physiology
2013-2018 Associate Professor, Brigham Young University, Department of Cell Biology and Physiology
2007-2013 Assistant Professor, Brigham Young University, Department of Cell Biology and Physiology
2006-2009 Assistant Professor, University of Utah School of Medicine, Department of Internal Medicine
2004-2006 Post-doc, University of Utah Health Sciences Center, Department of Internal Medicine

Honors

2017 Ferrin L. Orton Teaching and Learning Faculty Fellowship
2016 APS-TPS Joint Meeting Award
2015 American Physiological Society Research Career Enhancement Award
2012 APS Respiratory Section New Investigator Award
2008-2012 National Institutes of Health LRP Award: NHLBI Extramural Clinical Researcher
2011 American Physiological Society Research Career Enhancement Award
2007-2012 Flight Attendant Medical Research Institute Young Clinical Scientist Award
2006-2009 Parker B. Francis Foundation Fellowship in Pulmonary Research

C. Contribution to Science Google Scholar H-index = 27

1. I am the principal investigator of a research laboratory that focuses on the molecular aspects of lung development and disease. Our laboratory has attracted over two million dollars in support aimed at

answering questions related to the developmental role of autocrine/paracrine signaling in the lung during branching morphogenesis, pulmonary remodeling induced by interactions between mesenchymal/epithelial compartments, and mechanisms of pulmonary injury and disease related to environmental tobacco or oxidative stress. Undergraduate co-authors are underlined.

a) Bodine BG, Bennion BG, Leatham E, Jimenez FR, Wright AJ, Jergensen ZR, Erickson CJ, Jones CM, Johnson JP, Knapp SM, and **Reynolds PR** 2014. Conditionally induced RAGE expression by proximal airway epithelial cells causes lung inflammation. *Respir Res,* 15(1):133. PubMed PMID: 25359169
b) Winden DR, Ferguson NT, Bukey BR, Geyer AJ, Wright AJ, Jergensen ZR, Robinson AB, Stogsdill JR, and **Reynolds PR** 2013**.** Conditional over-expression of RAGE by alveolar epithelium compromises the respiratory membrane and impairs differentiation. *Respir Res* 14(1):108. PubMed PMID: 24134692
c) Stogsdill JA, Stogsdill MP, Porter JL, Hancock JM, Robinson AB, and **Reynolds PR** 2012. Embryonic over-expression of RAGE induces an imbalance between proliferation and apoptosis. *Am J Resp Cell Mol Biol.* 47(1):60-6. PubMed PMID: 22343220
d) **Reynolds PR**, Stogsdill JA, Stogsdill MP, and Heimann NB 2011. RAGE influences cytodifferentiation and causes severe lung hypoplasia. *AJRCMB* 45(6): 1195-202. PubMed PMID: 21685154

2. I have been instrumental in identifying the effects of RAGE in the orchestration of combusted environmental particulate exposure. The following discoveries identify a central axis for RAGE in cellular responses to aged particulates abundantly suspended in the atmosphere. Undergraduate co-authors are underlined.

a. **Reynolds PR**, Wasley KM, and Allison CH 2010. Diesel Particulate Matter Induces RAGE Expression in Pulmonary Epithelium and RAGE Signaling Influences NF-κB-Mediated Inflammation. *Environ Health Per* 119(3):332-9. PubMed PMID: 21087909
b. Barton DB, Betteridge BC, Earley TD, Curtis CS, Robinson AB, and **Reynolds PR** 2014. Primary alveolar macrophages exposed to diesel particulate matter increase RAGE expression and activate RAGE signaling. *Cell Tissue Res* 358(1):229-238. PubMed PMID: 24859220
c. Rao NV, Argyle B, Xu Z, **Reynolds PR**, Walenga JM, Prechel M, Prestwich GD, Hoidal JR, and Kennedy TP 2010. Low Anticoagulant Heparin Targets Multiple Sites in Inflammation, Suppresses Heparin-Induced Thrombocytopenia and Inhibits Interaction of RAGE with its Disparate Ligands. *Am J Physiol Cell Physiol* 299(1):C97-110. PubMed PMID: 20375277
d. Wood TT, Winden DR, Marlor DR, Wright AJ, Jones CM, Chavarria M, Rogers GD, and **Reynolds PR** 2014. Acute secondhand smoke-induced pulmonary inflammation is diminished in RAGE knock out mice. *AJP: Lung Cell Mol Physiol.* 307(10):E919-27. PubMed PMID: 25260756

3. I have expanded my expertise in the field of RAGE biology by identifying compelling evidence that RAGE also functions in systemic responses to exposure. Obesity and smoking are two of the largest causes of preventable deaths worldwide, increasing the risk of multiple illnesses such as heart disease, stroke, airway infections and diabetes. Undergraduate co-authors are underlined.

a. Nelson MB, Swensen AC, Winden DR, Bodine JS, Bikman BT, and **Reynolds PR.** Receptor for advanced glycation end-products (RAGE) signaling reduces cardiomyocyte mitochondrial function in a ceramide-dependent manner.*AJP: Heart and Circulation Physiology* PubMed PMID: 25957215
b. Tippetts TS, Winden DR, Swensen AC, Saito RR, Condie TB, Simmons KJ, Judd AM, **Reynolds PR**, and Bikman BT. 2014. Cigarette smoke increases cardiomyocyte ceramide accumulation and inhibits mitochondrial respiration. *BMC Cardiovasc Disord,* 14(1):165. PubMed PMID: 25416336
c. Thatcher MO, Tippetts TS, Nelson MB, Swensen AC, Winden DR, Hansen ME, Anderson MC, Johnson IE, Porter JP, **Reynolds PR**, and Bikman BT 2014. Ceramides mediate cigarette smoke-induced metabolic disruption in mice. *AJP: Endocrine Metabolism,* 307(10):E919-27. PubMed PMID: 25269485
d. Larkin DJ, Kartchner JZ, Doxey AS, Hollis WR, Rees JL, Wilhelm SK, Draper CS, Peterson DM, Jackson GG, Ingersoll C, Haynie SS, **Reynolds PR**, Kooyman DL 2013. Inflammatory markers associated with osteoarthritis after destabilization surgery in young mice with and without Receptor for Advanced Glycation End-Products (RAGE). *Frontiers in Integ Physiol* **4**: 121. PibMed PMID: 23755017

Complete listing of published works (70 peer-reviewed publications) in MyBibliography:
https://www.ncbi.nlm.nih.gov/sites/myncbi/1TGdffTeZ4hQw/bibliography/48212744/public/?sort=date&direction=ascending

CURRENT AND PENDING SUPPORT

James D. Johnston

No current and pending support

John D. Beard
Title: College of Life Sciences new faculty start-up research funding second of three years
Source: Ira and Mary Lou Fulton Gift Fund, College of Life Sciences, BYU, Provo, UT
Role: Principal Investigator, Department of Public Health, College of Life Sciences, BYU, Provo, UT, 2021-2022
Amount: $20,000

Neil E. Peterson
Title: What Women Want: Motivating Factors of Activity Trackers for Women
Source: Dr. Elaine Dyer Research Endowment Award, College of Nursing, BYU, 2021-2022
Amount: $5,000

Title: Long-term Impact of Mental Wellness Courses on College Student Mental Health
Source: Small Grant, Spencer Foundation, Chicago, IL, 2022
Amount: $49,950 [SUBMITTED—UNDER REVIEW]

Title: Piloting an mHealth Stress Management App for Millennial Caregivers
Source: Dr. Elaine Dyer Research Endowment Award, College of Nursing, BYU, 2022
Amount: $5,000 [SUBMITTED—UNDER REVIEW]

Title: Developing an mHealth Stress Management Intervention for Millennial Caregivers
Source: Myrtie Fulton Award, College of Nursing, BYU, 2022
Amount: $5,000 [SUBMITTED—UNDER REVIEW]

James D. LeCheminant

Title: The effect of potatoes on vegetable consumption
Source: Alliance for Potato Research and Education, 2021-2022
Amount: $53,190

Title: Homeless Health and Wellness
Source: The Community Foundation of Utah; Association for Utah Community Health, 2019 – 2022
Amount: $129,363

Title: Geriatric Obesity: What Role Does the Brain Play? An Event-Related Potential Investigation of Food-Related Cognition in Older Adults
Source: Gerontology Research Grant, BYU, 2019 - Present
Amount: $5,000

Paul R. Reynolds
Title: RAGE targeting attenuates smoke-induced inflammation Research Award
Source: NIH: Heart Lung and Blood Institute 8/1/2020 – 7/31/2023 1R15HL152257
Amount: $450,000.00

Title: Characterizing the effects of chlorophyll in diminishing the inflammatory responses induced by environmental diesel particulates as they relate to oxidative stress
Source: Performance Labs, LLC
Amount: $58,272.00 [PENDING]

Title: RAGE signaling underpins basic mechanisms of inflammatory health effects of electronic nicotine delivery system (ENDS) Exposure
Source: National Institutes of Health R01, National Institute of Environmental Health Sciences
Amount: $1,125,000.00 [PENDING, *Current status: Initial impact score was near the pay line; a resubmission in planned].*

OVERLAP
There is no scientific overlap between the IDR application under consideration and the current/expiring awards.