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ALPHA FOUNDATION FOR THE IMPROVEMENT OF MINE SAFETY AND HEALTH

Final Technical Report

Project Title: Mental Illness in US Coal Miners: A collaborative approach to understand risk factors and prevalence

Grant Number: AFCTG22R2-158

Organization: University of Illinois Chicago
School of Public Health
Division of Environmental and Occupational Health Sciences

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Period of Performance: 16 January 2023 – 15 October 2025

1.0 Executive Summary

Background and Problem Statement: Coal mining remains one of the most hazardous occupations in the U.S., with well-documented risks for injury and chronic respiratory disease. Mental health among miners, in contrast, has received far less attention despite evidence of high psychological burden. Stressors such as traumatic workplace events, chronic pain, declining industry employment, and socioeconomic instability contribute to elevated risks of depression, anxiety, PTSD, and substance misuse. Prior studies of mental health in coal miners have been limited in scope and geography, leaving a critical gap in understanding national prevalence and determinants of mental illness in this population. Since the start of our study, an additional study of the prevalence of depression and anxiety among coal miners has been published, but limited exploration of risk and protective factors was explored.

Methods: In this project, we implemented a mixed-methods design across seven federally funded Black Lung Clinics from 2023 to 2025. We screened 668 coal miners using validated tools (PHQ-9 for depression symptoms, GAD-7 for anxiety symptoms, PC-PTSD-5 for post-traumatic stress disorder symptoms, and AUDIT for problematic alcohol use) to estimate prevalence of mental health symptoms and identify associated risk and protective factors using multivariable regression modeling. We then performed 34 semi-structured in-depth interviews with coal miners which provided rich context on occupational stressors, coping strategies, and barriers to care. Additionally, we analyzed historical clinical datasets from Dr. Donald Rasmussen's estate to explore associations between physical health indices and antidepressant/anxiolytic medication use.

Results: Overall, 19% of miners reported depression (either a diagnosis or moderate/severe symptoms), 22.5% anxiety, 6.7% PTSD, and 1.3% problematic alcohol use. Chronic pain was nearly universal (91%), with 46% reporting moderate to severe pain. PTSD symptoms, adverse childhood experiences, chronic pain, unmet social needs, low social connectivity, and work-related injuries leading to job loss or task changes were strongly associated with poor mental health. Qualitative analyses revealed and reinforced findings that traumatic experiences were commonplace in coal mining, as were injury and chronic pain. We identified strong social ties, particularly the bonds between workers, as buffers against psychological distress. Radiographic lung disease and other clinical measures of lung function showed limited association with mental health outcomes, underscoring the importance of trauma, pain, and social determinants.

Conclusions: This study provides a comprehensive assessment of mental health among U.S. coal miners seen across seven Federal Black Lung Clinics, expanding scientific understanding and informing practical interventions. Depression and anxiety were common among the miners we screened, and the trauma and pain sustained from work-related injuries in coal mining were major risk factors for poor mental health. Our findings support integrating mental health screening and services into trusted clinical settings such as Black Lung Clinics. Some clinics currently provide these services, but they remain limited in scope and availability (e.g., providers only available specific days, small number of behavioral health providers). These results offer a foundation for policy development and future intervention studies aimed at promoting mental health and well-being among miners and within their communities.

2.0 Contents

3.0 Problem Statement and Objective

Background Information: Coal mining is a hazardous occupation,[1] with well-established elevated risks of injury,[2] respiratory disease,[3,4] and cause-specific mortality.[5] While the physical health hazards of coal mining have been well-described, there is a paucity of research on mental health in the industry. Yet coal mining involves multiple stressors that could result in poor mental health or substance misuse, including work-, health-, and socioeconomic-related stressors (See Conceptual Model, Figure 1).

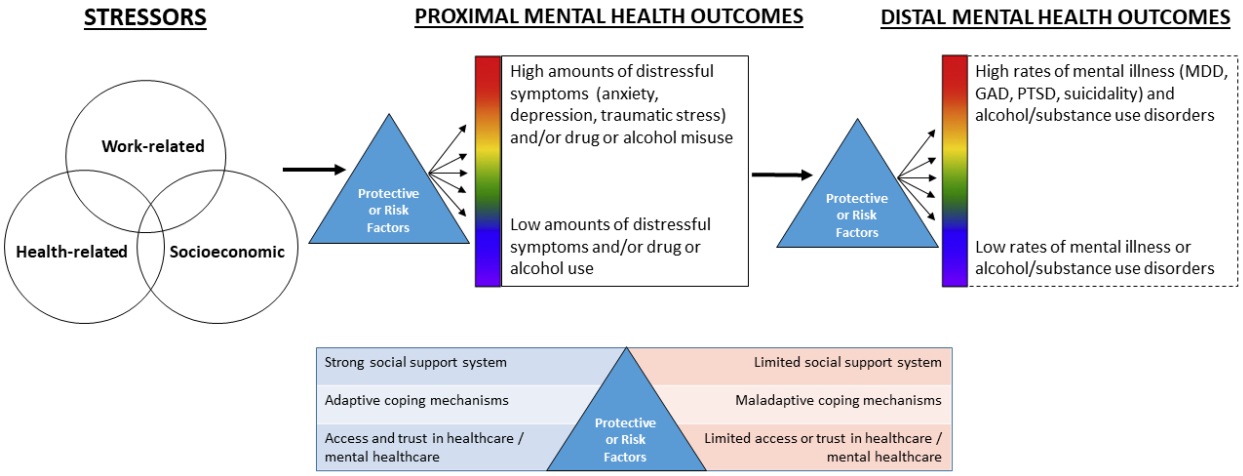

Figure 1. Conceptual model of the relationship between stressors, risk and protective factors, mental health outcomes. MDD = major depressive disorder. GAD = Generalized anxiety disorder. PTSD = Post-traumatic stress disorder.

A. Stressors in the Coal Mining Industry

The physical and psychological health impacts of stress are substantial.[6,7] This study will be the first to comprehensively measure stressor exposure among miners, which will allow us to gauge the relative importance of different sources of stress as they are associated with mental health. What follows are three broad categories of stressors in coal miners which will be further studied in this study.

Work-related stressors Coal miners face a wide range of work-related stressors including long working hours, shiftwork, physical trauma and job insecurity. Long working hours, defined as shifts exceeding eight hours, are associated with increased risk of occupational injury and death in the coal mine industry.[8] Shift work, which is highly prevalent in coal mining[9] increases the risk of physical and mental health problems including cardiovascular disease[10] and depression.[11–14] Additionally, given the hazardous nature of coal mining, coal miners have a high likelihood of experienced (primary) or witnessed (secondary) trauma. Explosions, slope failures, equipment malfunction/mishaps, and roof collapses are constant threats in coal mines that can lead to hypervigilance, serious injury, or death. Although experienced and witnessed traumas are known to lead to higher rates of mental illness in other occupations such as military or healthcare workers,[15] the impact of trauma on the mental health of coal miners is unknown.

Socioeconomic Stressors Socioeconomic factors unique to US coal mining communities are also important to consider in relation to mental health. The vast majority of coal miners in the US reside in rural communities that experience wide economic and health disparities.[16] Many of these disparities are driven by the decline of the coal industry. Coal mine employment in the US has declined precipitously in the last 30 years[17] with far-reaching socioeconomic impacts, due in part to a lack of economic diversification of communities surrounding coal fields. As an example, the coalfield communities of Central Appalachia now are experiencing some of the highest rates of unemployment and poverty in the US.[18] Downstream effects of unemployment and poverty, such as low healthcare access and high rates of substance misuse,[19,20] are likely to widen disparities of mental illness in US coal miners.[21] Multiple studies have shown that unemployment is associated with early cause-specific mortality, specifically from suicide.[22,23] Most coal miners served by the US Health Resources and Services Administration (HRSA) Black Lung Clinics Program are former miners, near or around retirement age. More broadly, the proportion of individuals nearing or at typical retirement age who report current or likely financial insecurity is growing. This results in an economic vulnerability for the retirement age individual and their family that can create or exacerbate psychological distress.[24] Financial insecurity in populations served by HRSA Black Lung Clinics (e.g., middle-aged individuals on the threshold of retirement) is associated with adverse health outcomes, including substance abuse.[25]

Health-related stressors While impaired health is often considered a consequence of exposure to stressors, chronic illness can also be a source of stress. Chronic illness can impair one's lifestyle, impact finances, and place other demands on one's resources.[26] Coal miners suffer excess morbidity from chronic cardiopulmonary diseases in part due to occupational exposures. Occupational exposure to respirable coal mine dust can cause a broad spectrum of coal mine dust lung diseases (CMDLD), including pneumoconiosis, dust related diffuse fibrosis, lung function impairment,[27,28] and chronic obstructive pulmonary disease (COPD).[29] Prevalence rates of CMDLD in the US, and especially coal workers' pneumoconiosis (CWP) and its most severe form, progressive massive fibrosis (PMF), have risen to levels not seen since the 1970s.[30–33] The association between chronic lung disease and mental illness is well established. Numerous publications describe the interconnectedness between morbidity from COPD or interstitial lung diseases and mental health conditions including depression, anxiety and PTSD.[34–41] In our study of current and former coal miners, the prevalence of anxiety, depression, and suicidal ideation was significantly higher among miners using supplemental oxygen, suggesting severe comorbid pulmonary illness is a risk factor for mental illness.[42] Treatment of mental illness is known to improve outcomes for those with chronic lung diseases.[43] It is widely recommended to screen for mental illness in those suffering with chronic lung diseases.[44]

In addition, coal miners suffer higher morbidity and mortality from heart disease, even after accounting for other risk factors such as smoking and obesity.[45] Mental health may be causally linked to biological processes and behaviors that contribute to and cause cardiovascular disease; hence, interventions to improve psychological health can have a beneficial impact on cardiovascular health.[46] Occupational injuries, particularly musculoskeletal injuries and injuries that permanently inhibit activities of daily living, are associated with symptoms of depression and anxiety after injury across a wide array of industries.[47–51] While the injury research literature is vast, there is a dearth of research on the relationship between mental health and work injuries

in the coal mine industry.[52] Chronic pain is highly prevalent among coal miners and is associated with increased psychological distress.[53] Chronic pain, regardless of its occupational relatedness, is associated with higher rates of depression[54,55] and suicide.[56–58] Furthermore, chronic pain and substance misuse, particularly opioids and alcohol, are complex and a concern for our population of primarily former coal miners where disability levels are high.[59,60]

B. Risk and Protective Factors

As depicted in Figure 1, various factors external to coal mining may hasten the onset or worsen the severity of a mental health disorder (risk factors) or may delay its onset or prevent it altogether (protective factors). Social support, including interpersonal connectedness and community engagement, may protect against mental health disorders, notably depression[61], particularly among older adults.[62–64] This is an especially salient point for the HRSA Black Lung Clinics population of coal miners in which the mean age is 65 years. Coping behaviors are strategies that individuals employ in response to stressors and can either be adaptive (positive) or maladaptive (negative). For example, substance use, self-blame, and avoidance are examples of maladaptive coping mechanism, whereas behavioral techniques such as mindfulness or exercise are examples of adaptive coping strategies.[65]

As access to mental healthcare is a protective factor in the development of mental illness, it is important to consider the unique barriers to seeking and obtaining treatment for mental health or substance use disorders in the coal mining population. A study in Appalachia, where most US coal miners reside, found barriers to accessing mental health and substance misuse services related to cost, lack of insurance, self-efficacy (e.g., belief that individuals could handle the problem on their own), and stigma.[66] Additional barriers to seeking mental healthcare in US coal mining communities are rooted in a long history of corporate behavior that has not prioritized health promotion /protection or healthcare delivery for its workforce. This has fostered a lingering skepticism of "outsiders", extending to providers of medical and mental healthcare.[67] Furthermore, prior studies suggest that patients prefer to be screened for mental illness within familiar medical facilities and with their usual medical providers available to assist.[68] Our study brings together a network of clinics with established and trusted relationships with miners seeking black lung benefits, primary care and subspecialty care. Utilizing these trusted relationships to break down these barriers was paramount to the success of this study.

C. Mental Health Symptoms among Coal Miners (Proximal Outcomes)

This study would be the first to estimate the prevalence of symptoms of depression, anxiety, PTSD, and substance misuse among coal miners across all regions of the US. This study would build on our prior prevalence study of coal miners seeking care in Virginia[42] and a recent publication by Blanc et al. that demonstrated that clinically significant symptoms of depression and anxiety were common (23% and 16%, respectively) among Appalachian coal miners.[69] Few studies describe rates of mental health disorders in international coal mining populations, and these studies are difficult to apply to US coal miners due to study limitations (e.g., small sample sizes, mental health assessment tools not commonly used in the US) and differences in study populations. For example, two recent studies of Australian coal miners indicate that coal miners have higher levels of psychological distress than their age- and gender-weighted non-miner employed counterparts. However, 68% of the miners included in these studies were younger than age 45 and more than half had a mining tenure of less than 10 years.[53,70] A study of 89 Brazilian

coal miners found low rates of anxiety (13%) and depression (<3%), but the mean age of participants was 33.[71] By comparison, the mean age of miners seen in the HRSA Black Lung Clinics Program in the last year was 65 years, with a mean coal mining tenure of 26 years, a demographically different population than has been represented in existing research.

While mental health data for US coal miners, including substance misuse, is lacking, we have regional data that can inform our research. The majority of the coal miners in this study will be residents of Appalachia. A recent report from the Appalachian Regional Commission found that there are higher rates of mental health diagnoses, including depression, among residents of Appalachia compared to the rest of the US. Alcohol is the predominant substance of misuse within Appalachia and remains a primary reason for substance misuse treatment in the region.[66] Opioid misuse is higher in Appalachia than the rest of the US, and has the highest rates of hospital admissions for opioid overdose in coal mining regions.[66] Further, West Virginia has led the country in opioid overdose deaths over the last decade.[72,73] As previous work has identified strong relationships between mood and anxiety disorders and substance misuse,[74,75] it is probable that these problems in Appalachia are related as well. These findings also suggest we may expect to see regional differences in prevalence rates of mental health conditions and substance misuse across our study population.

D. Distal/Long-Term Outcomes

This study was focused on the proximal outcome (Figure 1) of symptoms of mental health disorders. Performing diagnostic clinical interviews to establish true rates of mental illness according to the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-V) is beyond the scope of this project, but distal measures are included in the model (Figure 1) to fully represent how we would expect these disorders to develop over time in relation to the study variables measured.

Problem Statement: It is widely recognized that mental and physical health are closely related and both important components of overall health. Poor mental health increases the risk of morbidity from many chronic physical diseases including heart disease, chronic obstructive pulmonary disease, and stroke. Furthermore, those suffering from chronic illness are at increased risk of developing poor mental health[76] and vice versa.[77] Despite this knowledge, the vast majority of research and clinical care for coal miners has historically focused on physical health, with far less attention paid to mental health.

A study conducted by our team in 2021 suggests an urgent need to expand screening for mental illness to coal miners throughout the United States (US). In our study of 2,808 current and former coal miners seeking care in one clinic in Virginia, symptoms of depression (37%), suicidality (11%), anxiety (39%), and post-traumatic stress disorder (PTSD) (26%) were highly prevalent.[42] Since the inception of this work, Dr. Paul Blanc and his team published their findings from a cross-sectional random-digit dialing survey of mental health symptoms among miners and non-miners in Appalachia.[69] Their study estimated prevalence of moderate to severe depression among miners in Appalachia at 23% and of clinically significant anxiety at 16%. 56% of miners in the Blanc et al. study reported experiencing a traumatic event. There are no other published studies that have estimated the prevalence of mental health disorders in any other US coal mining population, despite miners being at particular risk for mental health issues due to the

confluence of stressors that they experience. In particular, there is a lack of research on potential risk and protective factors for mental health in this occupational group.

The specific aims of the proposed study align with the request for proposals as issued by Alpha Foundation for the Improvement of Mining Safety and Health, Inc. for this specific topic.

Aim 1/Objective 1: Estimate prevalence of symptoms of depression, anxiety, suicidal ideation, PTSD, and substance misuse among US coal miners and their non-mining counterparts.

Aim 2/Objective 2: Using a multivariable regression model, establish and describe the demographic, socioeconomic, occupational, and clinical variables that are either protective of or risk factors for mental health disorders in coal miners.

Objective 3: Collect qualitative follow-up interview data from up to 100 miners, employing a semi-structured interview guide designed to capture detailed information about miners' occupational history, exposures to psychosocial stressors at work, socioeconomic stressors, perceptions of health and health-related stressors, childhood experiences, and coping strategies.

Objective 4: Identify and characterize factors that may be relevant to and predictive of mental health symptoms, problematic substance use, and/or the absence of such states.

4.0 Research Approach

Aim 1/Objective 1: Estimate prevalence of symptoms of depression, anxiety, suicidal ideation, PTSD, and substance misuse among US coal miners and their non-mining counterparts.

Task 1.1: Train clinic staff to collect high-quality and consistent data using the mental health screening tool developed for this study. Train all staff administering the screening tool using the Mental Health First Aid Training Course.[78]

All questions in the study screening packet (Appendix A) were derived from validated measures. We aligned our screening questions with those of Dr. Paul Blanc's study team prior to the start of the project in such a way that ensured comparison of most of our primary study outcomes. Both projects used the Patient Health Questionnaire (PHQ)-9, Generalized Anxiety Disorder (GAD)-7, and the Primary Care – Post-traumatic Stress Disorder (PC-PTSD)-5 tools. All clinic staff who were engaged in participant screening completed an interactive short course in which they learned the risk factors, warning signs, and strategies to assist patients in both crisis and non-crisis mental health situations. We partnered with Dr. Richard Merkel from the University of Virginia Department of Psychiatry to deliver this training in July 2023. Sessions included practice with responding to participants that may require behavioral health intervention based on screening results.

We developed a detailed "Field Handbook" for each participating clinic site which included all study documents and standard operating procedures for protocol implementation. The study P.I.s and the project coordinator trained staff from each clinic in these procedures - including recruitment, consent, and screening procedures. This training aimed to provide consistency in study implementation across study sites.

Task 1.2: Screen coal miners (n = 750) with screening packet. This task has been updated to reflect the revised sampling target discussed in January 2025.

Participating clinics recruited 718 coal miners. Our study included seven clinic sites which collectively saw 5,966 individual miners between January 2023 and December 2024. These clinics included four clinics based in Appalachia, one in the Midwest, one in the West, and one that serves miners from the Midwest and Appalachia based in Western Kentucky. This distribution is consistent with the distribution of black lung clinics nationally (n = 25), in which ~76% are located in Appalachia; 8% in the Midwest, and 16% in the West.

Based on our preliminary data, as well as prevalence estimates published by Dr. Harris and his colleagues at Stone Mountain and Dr. Blanc's recent publication on the psychological morbidity of coal miners, the prevalence of these symptoms range from approximately 10-40%, depending on the outcome of interest. Using this range of prevalence estimates, and our population size of 5,966, while allowing for a 5% margin of error (alpha value), we need to sample between 136 and 348 miners to ensure a sufficiently representative sample.

Task 1.3: Using publicly available data, calculate analogous prevalence estimates of depression, anxiety, and other mental health outcomes of non-miners.

Due to feasibility issues in recruiting non-miners through our participating sites, we pursued the approach discussed in January of using representative data sources in order to be able to contextualize the findings we have from our coal mining participants. The most important dataset is the National Health Interview Survey (NHIS) which publishes data on the prevalence of depression, anxiety, and chronic pain, by sex, age group, and region. We examined two other data sources: the Household Pulse Survey (HPS), administered by the National Center for Health Statists and the U.S. Census Bureau, and Substance Abuse and Mental Health Services Administration (SAMHSA) data. The HPS uses the PHQ-2 and GAD-2 to estimate prevalence of depression and anxiety symptoms in the U.S. population.

Task 1.4: Review screening data on a monthly basis.

We reviewed our study screening data on a monthly basis throughout the project period, which allowed us to: (1) ensure timely progression of the protocol; (2) characterize demographics of study participants to ensure proper frequency matching; (3) classify coal miner participants according to scheme of severity for selection in Objective 3 for participation in the qualitative component of this study; (4) monitor any differences between miners who consent to participate in a follow-up interview (Objective 3) and those who did not.

Task 1.5: Estimate prevalence of mental health disorders among coal miners and non-coal miners in the study, including depression, anxiety, suicidal ideation, PTSD, and substance misuse. Compare prevalence of mental health disorders in US coal miners to non-coal mining populations.

Depression, anxiety, PTSD, and substance misuse are the primary mental health outcomes in this study. We used well-validated screening tools with established cutoff scores to estimate prevalence of symptoms of these mental health disorders in this population. We used the Patient Health Questionnaire-9 (PHQ-9) to measure depressive symptoms and the Generalized Anxiety Disorder-7 (GAD-7) tool to measure anxiety. We screened for PTSD using the Primary Care PTSD for DSM 5 (PC-PTSD-5) tool. We will assess occupational-related PTSD using a modified version of the Life-Events Checklist for DSM-5. Any relevant events identified in the checklist will be indexed to the PC-PTSD-5 tool. We measured alcohol and substance misuse via the Alcohol Use Disorders Identification Test (AUDIT) and Drug Abuse Screening Test (DAST-10), respectively. In addition to these screening tools, we asked targeted questions about the effect of the COVID-19 pandemic on each participant's mental health. Participants were asked about previous diagnosis of major depressive disorder, generalized anxiety disorder, and substance use disorders prior to completing the screening questionnaires (See Appendix A for full screening tool). Where possible, we compared the prevalence of these symptoms in our study population to results from two other studies of mental health symptoms in coal miners and estimates of mental health symptoms among non-miners from nationally-representative data sources.

We report the overall prevalence of symptoms of depression, anxiety, suicidal ideation, PTSD, and substance misuse among coal miners using standard cutoff scores for each survey employed. Prevalence estimates were calculated using both incident and prevalent cases (self-reported

previous diagnosis). All analyses were conducted using SAS 9.4 and R. Statistical significance was defined as $p < 0.05$.

Expanded Mental Health Analyses of Data originating from Grant #AFCTG20-102 ("Continued Epidemiologic Analyses of Large Data Sets of Health Data on U.S. Coal Miners")

In addition to the original scope of work outlined in the current grant, we expanded our analyses of occupational, medical history, and clinical data collected from coal miners seen by Dr. Donald Rasmussen between 2004 and 2015 which was obtained under grant #AFCTG20-102. Dr. Rasmussen's data included systematic assessment of both self-reported mental health symptoms and current medication use in addition to demographic, clinical, and occupational information about these miners. Demographic data included age, race/ethnicity, and sex. Data from occupational history narratives were extracted and included total years of coal mine employment and mining occupations. The disability evaluations included pre-bronchodilator spirometry, diffusing capacity of the lungs for carbon monoxide (DLCO) testing, and chest radiograph. Percent predicted (PP) values and lower limits of normal (LLN) for pre-bronchodilator forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), and DLCO were calculated using the Global Lung Function Initiative reference equations.[79] FEV_1 impairment was defined as FEV_1 <LLN. The classification for severity of FEV1 impairment, as described by Pellegrino et al.[80] was used to characterize FEV_1 of <70% predicted as 'moderate to severe' impairment. Chest radiographs were classified according to the International Labour Office (ILO) system by B Readers certified by the U.S. National Institute for Occupational Safety and Health.[81]

All miners reported a list of their current medications to the examining physician as part of their medical history, including antidepressants and/or anxiolytic medications. A study physician coded all unique medications listed in the data set with up to three primary indications (e.g., hypertension, angina, depression, diabetes) and pharmacological categories (e.g., analgesic, corticosteroid, opioid) based on clinic guidelines. All medications with a treatment indication of depression and/or anxiety were included in the outcome definition. No attempt was made to classify these medications into separate antidepressant and anxiolytic categories given that many of these drugs are used to treat both conditions. Clinical diagnoses of depression and/or anxiety were not available in Dr. Rasmusen's data.

We examined selected demographic, occupational, and clinical variables in relation to antidepressant/anxiolytic medication use including BMI, hypertensions, cardiovascular disease, cancer, post-traumatic stress disorder, hearing loss, chronic pain, sleep problems, mining tenure, and age. Associations between indices of physical health, covariates, and antidepressant and/or anxiolytic medication use were assessed first through bivariate analyses and then through multivariable logistic regression models. Results from this work are briefly summarized below, but are detailed in our recent publication of this work.[82]

Aim 2/Objective 2: Using a multivariable regression model, establish and describe the demographic, socioeconomic, occupational, and clinical variables that are either protective of or risk factors for mental health disorders in coal miners.

Task 2.1: At the time of mental health screening (Task 1.2), simultaneously collect participant information related to demographics, socioeconomic variables, comorbidities, occupational history, social determinants of health (SDOH), social connectivity, and adverse childhood events.

At the time of mental health screening (Aim 1), we simultaneously collected participant characteristics including demographics, educational attainment, household income and smoking status. We assessed the presence of health-harming social needs (e.g., unmet social determinants of health) as well as social connectivity via the PRAPARE Questionnaire. We additionally screened for adverse childhood experiences (ACEs) and military service history.

In order to determine mining-related risk factors for mental health disorders, we obtained a detailed occupational history including: coal mining tenure (start/end years, breaks in coal mining work); primary coal mining method (underground vs surface); primary coal mine job held; state of longest coal mining tenure; reason for leaving mining (layoff or mine closure, disability, retirement, or other); and federal black lung benefits claim status (e.g., not applied, pending, denied, withdrawn, awarded). We also asked miners a brief series of questions about any occupational injuries they may have sustained in coal mining and assessed their average pain.

Finally, initial assessments characterized participants' medical and mental health histories including any previous diagnosis of mental illness and associated medication use. We asked for self-reported diagnoses of CWP, PMF, COPD, hypertension, obesity, diabetes mellitus, hearing loss, sleep apnea, all cancers, lung cancer specifically, and chronic pain (using PEG screening tool).

Task 2.2: Link participating miners with their existing occupational and health data in the Black Lung Data and Resource Center (BLDRC) REDCap database, including information related to respiratory health such as lung function tests and chest x-rays (CXRs) with International Labour Organization (ILO) classifications of pneumoconiosis.

In total, 97% of the miners screened in this study were linked to their respective data in the BLDRC REDCap database. Miners were linked through a combination of clinic site, first name, last name, and date of birth or age. The addition of the BLDRC database allowed us to examine clinical data including results from spirometry, diffusion capacity, blood gases, International Labor Office (ILO) chest x-ray classification, and other pulmonary diagnoses from existing Black Lung Clinic data.

Task 2.3: Perform statistical analyses to identify associations between patient factors (Tasks 2.1 and 2.2) and symptoms of mental health disorders in US coal miners.

We described the study population through univariate data analysis, using percentages, means, and median values for demographic, occupational, and clinical factors based on variable type (e.g., continuous vs. categorical) and distribution (e.g., normal vs nonparametric). Multivariable logistic regression models were developed to identify which demographic, occupational,

socioeconomic and clinical variables are most strongly associated with symptoms of depression, anxiety, PTSD, and substance misuse. All analyses were conducted using SAS 9.4 and R. Statistical significance was defined as $p < 0.05$.

Objective 3: Collect qualitative follow-up interview data from up to 100 miners, employing a semi-structured interview guide designed to capture detailed information about miners' occupational history, exposures to psychosocial stressors at work, socioeconomic stressors, perceptions of health and health-related stressors, childhood experiences, and coping strategies.

Task 3.1: Select miners for participation in an individual qualitative interview based on the following broad categorizations: (1) positive screening for symptomatic distress (i.e., symptoms of anxiety and/or depression); (2) witnessed occupational trauma; (3) alcohol consumption and problems; (4) drug use and problems; (5) absence of positive screening for aforementioned categories.

We used the electronic database in Task 1.2 to identify miners who (1) meet criteria for inclusion in one of the five broad categorizations listed above and (2) gave consent to participate in a follow-up interview. The PI and study personnel developed a SAS program that we used to identify potential participants for the follow-up interview. This program automated the process of identifying those who have consented to the interview while also categorizing each potential participant into one of the five categories described above. Miners who were identified as possible candidates for an interview were removed from the pool of eligible miners before random samples of ~5-10 miners were selected for the study personnel who performed the interviews. This process allowed the interviewers to remain blinded to the screening results of the miner they interviewed.

At each of the partnering clinics, we recruited a purposive sample of current or former miners who consent for interviews and whose screeners (Aim 1) identify:
(1) symptoms of severe anxiety and/or depression, or current physician-diagnosed anxiety or major depressive disorder as indicated by self-report or medical records review;
(2) witnessed occupational trauma;
(3) alcohol consumption and problems;
(4) drug use and problems; or
(5) absence of aforementioned attributes.

Ultimately, we had few participants with illicit drug use, and alcohol use was also rare. Consequently, our three robust interview pools are among those with exposure to trauma and those with symptoms of moderate to severe depression or anxiety.

Task 3.2: Conduct telephone interviews with a random sample of up to 50 miners who consented to participate in a follow-up interview.

Guided by the preliminary quantitative analysis, we refined the qualitative interview guide detailed in Appendix B to further understand the risk and protective factors (e.g., occupational, social, cultural, economic and medical) that may be associated with participants' mental health, including those that participants perceive to be relevant to their mental health. We

explored how and why particular occupational factors (e.g., experienced or witnessed trauma, physical injury, shift work, union membership, job tasks) might differentially impact mental health in this population. Specifically, we asked miners about work precarity in the coal mine industry as well as in subsequent employment. We explored the relationship between job displacement and mental health of former coal miners, which is especially relevant given the decline of coal mine employment across the U.S. and miners' transition to other, non-mining occupations. Finally, we characterized the barriers and facilitators that participants experience in regard to receiving mental health care.

In total, we interviewed 34 miners. Interviews lasted, on average, approximately 60 minutes, and all interviews were audio recorded and professionally transcribed. Participants received a $40 incentive upon completion of the qualitative interview. A preliminary review of interviews early in 2025 suggested that we were reaching saturation in qualitative responses to interview questions (i.e., as we were collecting additional data, those data were no longer yielding new information relevant to our research questions). This was further confirmed during the inductive coding procedures employed in the construction of our codebook (detailed in Task 4.1, below), thus we concluded interviews on March 5, 2025.

Task 3.3: Write and aggregate procedural and analytic memos of all interviews to prepare for analysis.

Following each interview, the interviewer recorded, in written memo form, their immediate reactions and reflections to the interview, including questions that brought about particularly salient responses from interviewees and constructs that may have emerged through the interview process. These memos were used in conjunction with transcribed interviews to build the codebook for analysis, which include primarily emergent (inductive) codes in addition to literature-based *a priori* codes (further described in Task 4.1, below).

Objective 4: Identify and characterize factors that may be relevant to and predictive of mental health symptoms, problematic substance use, and/or the absence of such states.

Task 4.1: Finalize codebook and code interviews using a two-passthrough, dual-coder approach.

Upon completion of interviews, a subset of the research team (DR, TB, DH, AD) read through all 34 interview transcripts and prepared summative notes including: a brief summary of each transcript (i.e., a linear summary of what participant discussed, without interpretations of relevance to study questions); reflections and interpretations of discussion, including but not limited to initial impressions, emerging patterns, tentative propositions, theoretical insights, and/or questions for further exploration; and any connections to other transcripts or quantitative data from this study or others. The team met for a semi-structured discussion of each member's notes, which informed the development of the initial codebook. In this discussion, the team also decided to exclude two interview transcripts from further analysis: one transcript in which a miner did not meet inclusion criteria for occupational tenure in mining (i.e., too few years in mining) and another transcript in which the interviewee described a history of psychosis and paranoia (schizophrenia diagnosis, history of psychiatric

hospitalization). The latter was excluded due to concerns about appropriate recall. The team subsequently reviewed and refined the codebook before applying it to a test transcript (coded by DR, TB, and AD). After initial application of the codebook, the team revised the codebook and completed another test application, after which the codebook was finalized. The final, agreed upon codebook was then used in subsequent rounds of dual coding (i.e., two separate reviewers each code the same transcript) using Atlas.TI qualitative coding software. Atlas.TI was used to perform an initial intercoder reliability assessment for each dual coded transcript. When the Atlas.TI intercoder reliability assessment was below 80%, one coder reviewed instances of divergent coding and summarized discrepancies. The team discussed these discrepancies and resolved them such that coding was consistent across transcripts.

Task 4.2: Construct themes from coded transcripts.
Aggregate theme construction is complete; however, this task is iterative and will remain underway as additional analyses are performed, as stratifications of codes based on quantitative parameters outlined in objectives 1 and 2 may allow for more nuanced interpretation of coded segments. For aggregate theme construction, a subset of the research team (TB and DR) read and organized coded segments into clusters with similar characteristics. We employed a triaging approach to this clustering, starting with codes that emerged as particularly salient and recurrent in Task 4.1. We summarized similar experiences and feelings described by miners, without stratification by screening status outlined in Task 3.1, and aggregated into codes. As notable opportunities for stratification emerge from quantitative objectives, we will construct more nuanced themes; this is a process that remains as iterative as secondary data analyses in the quantitative dataset.

Task 4.3: Complete qualitative analysis.

Like Task 4.2, this task is iterative and will remain underway as additional analyses are performed. At this stage, all required preliminary steps are complete to allow for continued, iterative analyses of qualitative data using a mixed-methods approach (i.e., with the inclusion of quantitative metrics for individual miners who participated in both quantitative and qualitative data collection elements for this project). This will allow us to conduct robust mixed methods analyses of both the quantitative and qualitative data to better describe occupational and non-occupational contributors to poor mental and behavioral health.

5.0 Research Findings and Accomplishments

Aim 1/Objective 1: Estimate prevalence of symptoms of depression, anxiety, suicidal ideation, PTSD, and substance misuse among US coal miners and their non-mining counterparts.

In total, 764 individuals were screened under the study protocol across seven black lung clinic sites. Of these, 46 were non-coal miners. Of the 718 coal miners screened, 42 either withdrew or were lost to follow up; and additional 8 were removed due to poor data reliability, leaving 668 miners for analysis. Below we report on the summary findings from the major mental health outcomes in this study including symptoms of depression, anxiety, PTSD, substance use, and chronic pain (Table 1).

The regional distribution of where miners were screened generally aligned with the distribution of participating clinics and the distribution of clinics nationally. Approximately 77% (531) miners were screened in clinics located in Appalachia; 14% of miners screened were done so at clinics serving miners from the Midwest and western Kentucky; and 6.5% were served by the participating clinic in the West. The only region with sampling below the regional proportion of clinics was the Western region.

Depression Screening
We employed the Patient Health Questionnaire (PHQ-9) to screen for symptoms of depression in our study population. Additionally, we identified participants who have a prior diagnosis of depression and current medication use for depression. Of the 643 coal miners with complete PHQ-9 data, 9% (n = 60) reported symptoms consistent with moderate to severe depression (PHQ-9 score of ≥10). Forty-three percent of miners reported at least one symptom of depression, and of these 29% reported that these symptoms made life more difficult. A majority of miners reporting depression symptoms (n = 152, 54%) said these pre-dated COVID and had largely stayed the same after the pandemic (n = 131, 86%). Eight percent of miners reported their depression symptoms worsened after the start of the pandemic. A previous diagnosis of depression was reported by 14.5% of coal miners (n=93), of which 71% (n = 66) reported current use of antidepressants. Of those taking antidepressants, 92% (n = 61) still report at least one symptom of depression, with 38% (n = 25) reporting moderate to severe symptoms of depression. In total, 123 (19%) of participants either had a diagnosis of depression or reported moderate to severe symptoms of depression.

Anxiety Screening
We used the Generalized Anxiety Disorder (GAD-7) screening tool to assess symptoms of anxiety. Similar to the PHQ-9, we added two questions regarding previous diagnosis of anxiety and current medication use for anxiety to this screening tool. Eleven percent of coal miners (n = 74 scored ≥10 on the GAD-7, indicating symptoms consistent with moderate to severe anxiety). Forty-six percent of miners (n = 307) reported at least one symptom of anxiety. A majority of miners reporting anxiety symptoms (n = 173, 56%) said these pre-dated COVID and had largely stayed the same after the pandemic (n = 165, 84%). Twelve percent of miners reported that their anxiety symptoms worsened after the start of the COVID-19 pandemic. Nineteen percent (n = 124) reported a previous diagnosis of anxiety, of which 75% (n = 93) reported current medication use for anxiety. Forty-one percent of miners currently

taking medication for anxiety (n = 38) continue to experience moderate to severe anxiety symptoms, with 90% (n = 84) reporting at least one symptom of anxiety. In total, 150 (22.5%) of miners screened reported a diagnosis of anxiety or symptoms of moderate to severe anxiety.

PTSD Screening and Occupational Trauma

We used a combination of screening tools to assess symptoms of PTSD as well as a novel examination of occupational trauma. We used the validated Primary Care Post-Traumatic Stress Disorder (PC-PTSD-5) to assess symptoms of PTSD. This questionnaire begins by giving examples of traumatic events (e.g., a serious accident or fire; a war; physical or sexual assault or abuse; an earthquake or flood; having a loved one die through homicide or suicide; seeing someone be killed or seriously injured) and asking if the individual being screened has ever experienced an event like this. Forty-three percent of coal miners (n = 286) report experiencing a traumatic event, and 16% (n = 109) have reported at least one PTSD symptom. Only 3.9% (n = 26) of all coal miners in our sample have a score of 4 or more on the PTSD screener, the recommended scoring for likely PTSD; however it may be more accurate to examine PTSD scores among those reporting any traumatic event (n = 286). In this group, 9% (n = 26) had a PTSD score of 4 or higher. To compare our findings best to those published by Blanc et al (2025), we also calculated those scoring 3 or higher on the PTSD-screener. Approximately 7% of miners screened met this criterion for PTSD (n = 45); although among those reporting experiencing a traumatic event, 15.7% had a PTSD-PC5 score of 3 or higher.

We concluded our PTSD evaluation by asking what type of traumatic event had been recalled when responding to the PC-PTSD-5. Sixty-seven percent (n = 191) reported it was a traumatic event that occurred while coal mining; 8% (n = 23) reported the event happened at work, but not in coal mining; and 31% (n = 88) reported the event in question occurred outside of work altogether. Participants can select more than one response.

We used two questions to assess exposure to primary (experienced) and secondary (witnessed) traumatic occupational events. We asked participants “While you were working, did you experience a serious accident without injuries?” In response to this question, 15% (n = 99) of coal miners reported experiencing such an event themselves while coal mining; 15% (n = 103) reported witnessing such an event while coal mining; and 8% (n = 53) reported hearing about such an event from co-workers while coal mining. We then asked participants “While you were working, did you experience a serious or life-threatening injury or death?” In response, 12% (n = 80) of coal miners reported experiencing such an event themselves while coal mining; 18% (n = 117) reported witnessing such an event while coal mining; and 10% (n = 66) reported hearing about such an event from co-workers while coal mining.

Chronic Pain

We used the Pain Enjoyment and General Activities (PEG) screening tool to assess chronic pain in our study population. This questionnaire assesses three domains of pain: average severity of pain in the past week; the extent to which pain has interfered with the enjoyment of life; and the extent to which pain has interfered with one’s general activity. All three questions specifically ask about these issues over the past week. Each item is rated on a scale from 0 to 10, with 0 indicating no pain or interference and 10 indicating pain as “bad as you can imagine”/“completely interferes.” The overall average PEG score, indicating overall level of

pain and its interference with life, was 4.0 (sd 2.7). The average extent to which pain interfered with enjoyment of life or general activities was 3.8 (sd 2.9) for both measures, reflecting mild-moderate interference. Ninety-one percent (n = 606) of miners reported pain over the previous week, with 46% (n = 308) of all miners reporting moderate to severe pain (score of 5-10). This overall frequency of any reported pain is consistent with what we have observed in Dr. Rasmussen's clinic data, in which 94% of miners reported chronic pain.[82]

Substance Use Screening
Using the Alcohol Use Disorders Identification Test (AUDIT) screening tool to assess symptoms of alcohol use disorder, we found that the coal miners in our study to date have a median score of 0 (range 0 – 29), reflecting low likelihood of harmful or problematic alcohol use (range of possible scores 0 – 40). Only 1.3% of miners (n = 9) scored ≥8, indicating harmful or hazardous drinking behaviors.

Comparison of Study Findings with Other Data Sources
We compared the findings from our study to date with the study of mental health symptoms among coal miners published by Paul Blanc et.al.[83] They used many of the same screening tools and found a higher prevalences of moderate to severe symptoms of depression (23% vs 9%) and of clinically significant anxiety (16% vs. 12%) among Appalachian miners. Miners in Dr. Blanc's sample reported experiencing any traumatic more frequently than in our sample (56% vs 40%). The discrepancy in prevalence estimates of moderate to severe depression symptoms may be explained by several factors largely relating to study design. Our survey was administered by clinic staff at black lung clinics across the country which have trusted relationships with the miners they treat. This familiarity is both an asset for participant recruitment, but may also prohibit full disclosure of mental health struggles as a result of stigma. It is likely that those with the most severe mental health symptoms declined participation more often than those without severe mental health symptoms, introducing potential selection bias into our study. We would expect this type of selection bias, however, to bias our findings towards the null. Using our combined outcome definition of depression diagnosis or moderate to severe depression symptoms, our prevalence of 19% is closer to that published by Dr. Blanc's team.

We used NHIS data from 2019-2023 to further contextualize our findings. During this time period, the national prevalence of reported depression for non-Hispanic males aged 62-72, which most closely aligns with our study sample, was 13%. We found a reported history of depression in 14.5% of our miners. The prevalence of anxiety among the NHIS sample was 10% from 2019-2023, compared to 19% of our sample reporting an anxiety diagnosis. Of those reporting these diagnosis, similar proportions report medication use for these conditions in the NHIS data compared to our data (71% reporting antidepressant use in both; 75% reporting anxiolytic medications in our sample, 69% in NHIS). This comparison helps to validate our findings from the screening survey, but additionally help bolster our assumption that the majority of miners reporting the use of antidepressants/anxiolytics have a diagnosis of either depression or anxiety. This was a foundational assumption of the analysis we performed on the Rasmussen data, which is validated by both our sample and the NHIS data.

Data from the Household Pulse Survey reveal that 18.5% of men aged 65 and older reported mental health symptoms of depression or anxiety in 2020, which dropped to 17% in 2023. These

data are not readily available by race/ethnicity and age, therefore there is some caution when comparing these data to our own. The Household Pulse Survey also used only two-measure items for depression and anxiety symptoms, rather than the 9- and 7-item questionnaires employed in our study. Notably, these estimates are similar to those reported by Blanc et al.

Table 1. Demographic and mental health screening results for coal miners participating in the "Mental Illness in US Coal Miners" study (n=668).

Screening Component	**N**	**%**
Demographics		
Mean age (sd)	66.5	10.1
Race/Ethnicity		
Non-Hispanic white	634	94.9
Non-Hispanic black/African American	6	0.9
Hispanic	26	3.9
Other/Unknown	2	0.3
Sex		
Male	661	99.0
Female	7	1.0
Appalachian State of Residence	587	88.1
Mental Health Screening Results		
Depression Screening (PHQ-9)		
Prior diagnosis of depression	93	14.5
Taking medication for depression	66	71.0
Scoring with moderate to severe depression	60	9.3
Anxiety Screening (GAD-7)		
Prior diagnosis of anxiety	124	18.6
Taking medication for anxiety	93	75.0
Scoring with moderate to severe anxiety	74	11.1
Post-traumatic stress disorder Screening (PC-PTSD-5)		
Experienced any traumatic event	286	42.8
Experienced any PTSD symptom	109	16.3
PTSD Score ≥3	45	6.7
Event in mind when responding to this screening tool:		
Experienced event as a coal miner	191	66.8
Experienced event NOT as a coal miner	23	8.0
Experienced event outside of work	88	30.8
Occupational Trauma		
Experienced a serious accident without injuries		
Happened while coal mining	99	14.8
Witnessed while coal mining	103	15.4
Heard from others while coal mining	53	7.9
Experienced a serious injuries or death		
Happened while coal mining	80	12.0
Witnessed while coal mining	117	17.5
Heard from others while coal mining	66	9.9

Chronic Pain		
Average pain, mean (sd)	4.0	2.7
No Pain (PEG score 0)	62	9.3
Mild Pain (PEG score 1-4)	298	44.6
Moderate Pain (PEG score 5-6)	150	22.5
Severe Pain (PEG score 7-10)	158	23.7
Extent to which pain interferes with enjoyment of life, mean (sd)	3.8	2.9
Extent to which pain interferes with general activity, mean (sd)	3.8	2.9
Substance Use Screening Results		
Alcohol Use Disorder Identification Test (AUDIT)		
AUDIT score, median (range)	0	0 – 29
Moderate to severe symptoms of AUD (score >8)	9	1.3

Analyses of Mental Health in Dr. Rasmussen's Black Lung Clinic Data
We reported extensively on the findings from Dr. Rasmussen's data in prior progress reports. As this was a secondary exploration of the grant, and not part of the original proposal, we will keep our summary of these findings brief in this final technical report. Full results can be found in our recent publication of this work (See Publication Record and Dissemination Efforts). This population of miners (n = 5,463) was overwhelmingly male (>99%) and non-Hispanic white (>98%). Mean age was 62 years with mean coal mine employment of 27 years. Thirty-three percent were taking antidepressant and/or anxiolytic medications and 39% reported current prescription opioid use. Multivariable logistic modeling demonstrated a significant inverse relationship between diffusion capacity and use of anxiolytics and/or antidepression medication, controlling for age, pack years of cigarette smoking, radiographic severity of CWP, length of coal mine employment, and opioid use. Opioid use was a strong predictor of use of anxiolytics and/or antidepression medication.

This examination of Dr. Rasmussen's data reveals high rates of depression and/or anxiety medication usage among this population of former US coal miners. The prevalence of antidepressant and anxiolytic use likely underestimates the true burden of depression and anxiety in this population, as not all those experiencing symptoms of these conditions will receive a diagnosis and treatment. The rate of prescription opioid use among this cohort is higher than the opioid dispensing rate among US men aged 55 years and older from a similar time period (32% in 2008 and 25% in 2018),[84] reflecting a high level of chronic pain and regional marketing campaigns for opioid pain medications among former coal miners. This study demonstrates that pulmonary health and chronic pain are important risk factors for poor mental health outcomes in this population.

Objective 2: Using a multivariable regression model, establish the demographic, socioeconomic, occupational, and clinical variables that are either protective of or risk factors for mental health disorders in coal miners.

At the time of mental health screening, our study team simultaneously collected participant information related to demographics, socioeconomic variables, comorbidities, occupational history, social determinants of health (SDOH), social connectivity, and adverse childhood events.

This study sample of 668 miners with data sufficient for inclusion was nearly all male (99%) and non-Hispanic white (95%; Table 1). The mean age of this population was 66 years old. Most miners screened were from Central Appalachia (n = 581, 87%), with an additional six miners from other Appalachian states. Mean age was significantly lower among those with moderate to severe symptoms of either depression (63 vs 67, $p< 0.01$) or anxiety (62 vs 67, $p<0.01$) compared to those with mild or no symptoms, but no other demographic characteristics were associated with our primary mental health outcomes.

In general, this study population of coal miners had stable housing (99%) and reported not having problems meeting their needs (97%, Table 2). Among those reporting unmet needs, medicine, food, and utilities were most commonly reported. Twenty-seven percent reported having less than a high school degree, 55% reported a high school degree/GED, and 18% reported more than that. A majority of miners in this sample reported that they saw or talked to people that they cared about and felt close to 5 or more times a week (n = 454, 68%), reflecting a high level of social connectedness.

The majority of these miners were not working (86%, Table 3) consistent with the occupational characteristics of the black lung clinics more broadly that serve primarily former miners. Seventy-nine percent of miners in this study had underground coal mining experience, and 44% had surface mining experience (23% had both). For those who were not currently working in the mines, the most left mining due to disability and/or injury (41%) or had retired (32%). Nearly 20% of these miners left coal mining due to mine closure, lay-offs, or being fired. Many miners in this dataset performed job duties that are high-risk for dust exposure such as continuous miner operator and roof bolter (90% and 75% of underground miners, respectively). Few miners had other mining experience (6%). Among the subset of miners who were asked about military service (n = 234), 16% had served in the military, the majority of whom had been deployed (62% of those who served).

Adverse childhood events (ACEs) were reported by 14% (n = 95) of coal miners screened (Table 4). The most commonly reported ACE was having lived with an alcoholic (9%), followed by experiencing physical (7%) and verbal (7%) abuse. Reporting at least one ACE was significantly associated with a higher likelihood of reporting a prior diagnosis of either depression or anxiety; reporting moderate to severe symptoms of depression or anxiety; experiencing a traumatic event; and reporting at least one symptom of PTSD (Table 5).

Miners reported a high prevalence of black lung disease (54%) with approximately 9% reporting progressive massive fibrosis (Table 6). Reflecting this population, which has a high burden of occupational disease, many miners have applied for state workers' compensation benefits (33%). Most of those applying for these benefits have been awarded state workers' compensation benefits (61% of those who applied). The majority of these miners have applied for Federal Black Lung Program (FBLP) benefits (56%), however unlike the state workers' compensation data, relatively few of these miners (14%) are receiving federal benefits. Half of these miners are never smokers (50%). The miners in this study report a high prevalence of COPD (29%), hypertension (65%), diabetes (29%),

and cancers (16%). In bivariate analyses of these medical conditions and moderate to severe symptoms of either depression or anxiety, the only significant associations found were that diabetes, hypertension, and cancers were positively associated with having moderate to severe symptoms of anxiety. No associations with depression symptoms were found.

Table 2. Distribution of social determinants of health, as survey using the PRAPARE questionnaire, among U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668).

Variable	**N**	**%**
Housing		
Have housing	663	99.3
Do not have housing	1	0.1
Declined to answer	4	0.6
Worried about losing housing		
Yes	10	1.5
No	658	98.5
Educational attainment		
Less than a high school degree	178	26.6
High school degree or GED	368	55.1
More than High school	119	17.8
Declined to answer/ Missing	3	0.4
Work Status		
Unemployed and seeing work	8	1.2
Part time or temporary work	18	2.7
Full time work	73	10.9
Other, not seeking work	563	84.3
Declined to answer/ Missing	6	0.9
Unmet needs		
I do not have problems meeting my needs	645	96.6
Any unmet need	20	3.0
Frequency of close social contact		
Less than once a week	13	1.9
1 or 2 times a week	44	6.6
3 to 5 times a week	153	22.9
more than 5 times a week	454	68.0
Declined to answer	4	0.6
Low Social Contact (< 1-2x/week)	57	8.5
Safe where live		
Yes	641	96.0
No	24	3.6
Unsure; Unknown/Missing	3	0.4

Table 3. Occupational history of U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668).

Variable	N	%
Employment Status		
Yes	96	14.4
No	571	85.5
Missing	1	0.1
Coal Mining Experience		
Currently working in coal mining	85	12.7
Previously worked in coal mining	583	87.3
Coal Mining Type		
Underground	373	55.8
Surface	141	21.1
Both	153	22.9
Circumstance in which left coal mining (n = 583)		
Retired	184	31.6
Lay-off or fired	40	6.9
Mine Closure	70	12.0
Disability and/or injury	236	40.5
Changed careers	32	5.5
Other or Unknown	20	3.3
Underground Mining Experience (n=526)		
Room & Pillar		
Yes	468	89.0
No	58	12.6
Pull pillars/retreat	401	85.7
Driller/Shooter	228	48.7
Continuous miner	419	89.5
Unsupported top	184	39.3
Longwall Mining		
Yes	144	27.4
No	382	72.6
Shearer foreman/operator/helper	81	56.3
Shield/jack setter	85	59.0
Roof Bolter		
Yes	394	74.9
No	131	24.9
Surface Mining Experience (n = 294)		
Drilling/Blasting	114	38.8
Heavy Equipment	219	74.5
Highwall/Continuous Miner	54	18.4
Other Mining Experience (non-coal)		
Yes	40	6.0
No	623	93.3
Military Service Subset (n = 234, 35%)		
Yes	37	15.8
Ever deployed?	23	62.2
No	197	84.2

Table 4. Distribution of adverse childhood events (ACEs) among coal miners screened for mental health symptoms at Black Lung Clinics, 2023-2025.

Adverse Childhood Event	**N**	**%**
Physical Abuse		
Yes	48	7.1
No	624	92.6
Declined to Answer	2	0.3
Verbal Abuse		
Yes	44	6.5
No	628	93.2
Declined to Answer	2	0.3
Lived with an alcoholic		
Yes	57	8.5
No	616	91.4
Declined to Answer	1	0.1
Sexual Abuse		
Yes	12	1.8
No	659	97.8
Declined to Answer	2	0.3
Number of ACEs reported		
0	579	85.9
1	56	8.3
2 or more	39	5.8

Table 5. Associations between adverse childhood experiences (ACEs) and mental health symptoms and diagnoses among miners screened at BLCPs, 2023-2025 (n = 667*).

	No ACES (n = 572)		**At least one ACE (n = 95)**		
Mental Health Screening Results	**N**	**%**	**N**	**%**	**p-value**
Depression Screening (PHQ-9)					
Prior diagnosis of depression	62	10.8	30	31.6	<0.0001
Taking medication for depression	44	71.0	21	73.3	n.s
Scoring with moderate to severe depression	36	6.3	22	23.2	<0.0001
Anxiety Screening (GAD-7)					
Prior diagnosis of anxiety	91	15.9	32	33.7	<0.0001
Taking medication for anxiety	67	73.6	25	78.1	n.s
Scoring with moderate to severe anxiety	53	9.3	20	21.1	0.0001
Post-traumatic stress disorder (PC-PTSD-5)					
Experienced any traumatic event	224	39.2	62	65.3	<0.0001
Reporting at least one symptom of PTSD	68	11.9	40	42.1	<0.0001
Alcohol Use Disorder Identification Test (AUDIT)					
Moderate to severe symptoms of AUD (score >8)	5	0.9	2	2.1	not sig

*Denominator for these tables is 667; one miner was missing responses for half of the ACEs questionnaire.

Table 6. Self-reported medical history of U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668).

Variable	N	%
Small opacity coal workers' pneumoconiosis	300	44.9
Progressive massive fibrosis	59	8.8
Applied for State Workers' Compensation Benefits	217	32.5
Receiving State Workers' Compensation Benefit	132	19.8
Applied for Federal Black Lung Benefits	376	56.3
Receiving Federal Black Lung Benefits	54	8.1
Denied Federal Black Lung Benefits	66	9.9
Diagnoses		
COPD	191	28.6
Emphysema	37	5.5
Asthma	58	8.7
Hypertension	437	65.4
Diabetes Mellitus	193	28.9
Lung Cancer	6	0.9
Other Cancer	102	15.3
Silicosis	37	5.5
Smoke		
Never Smoker	329	49.6
Current Smoker	73	22.2
Former Smoker	256	77.8

Work-related injury was common (66%) among coal miners in this study (Table 7), and those who had a work-related injury had significantly higher mean pain scores than those who did not (4.2 vs 3.5, $p = 0.0007$). Nearly all (97%) of those having experienced a work injury reported their injury occurred in coal mining. The majority of workers with work-related injuries went to the ER due to coal-mining injuries. Injuries from coal mining frequently resulted in emergency visits (85%), days away from work (68%) and hospitalization (38%) in this population. In comparison, relatively few participants reported work-related injuries from their non-coal mining jobs (n = 14; 2%). This small group of miners with non-mining work-related injuries sustained relatively severe injuries resulting in emergency room care (11/14) or hospitalization (9/14). The frequency of injuries sustained by workers in their coal mining tenures far exceeded the frequency of injuries sustained in non-coal mining work. About a fifth of those with work-related injuries from coal mining reported having to either stop working or change jobs, or reduce their work or change tasks as a result of their injuries.

Table 7. Work-related (WR) injury experience of U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668).

Variable	**n**	***% of Total N (668)***	***% of those with WR-Injury (438)***
Ever injured at work?			
Yes, in coal mining	424	63.5	
Yes, not in coal mining	14	2.1	
No	230	34.4	
Ever visited an ER for a work-related injury?			
Yes, in coal mining	370	55.4	84.5
Yes, not in coal mining	11	1.6	2.5
No	56	8.4	12.8
Ever hospitalized for a work-related injury			
Yes, in coal mining	165	24.7	37.7
Yes, not in coal mining	9	1.3	2.1
No	258	38.6	58.9
Missed days of work due to injury			
Yes, in coal mining	296	44.3	67.6
Yes, not in coal mining	11	1.6	2.5
No	125	18.7	28.5
Stopped Working/Changed jobs due to work-related injury			
Yes, in coal mining	100	15.0	22.8
Yes, not in coal mining	7	1.0	1.6
No	330	49.4	75.3
Reduce work or changed tasks due to a work-related injury			
Yes, in coal mining	97	14.5	22.1
Yes, not in coal mining	6	0.9	1.4
No	331	49.6	75.6

We linked participating miners with their existing occupational and health data in the Black Lung Data and Resource Center (BLDRC) REDCap database, including information related to respiratory health such as lung function tests and chest x-rays (CXRs) with International Labour Organization (ILO) classifications of pneumoconiosis. In total, 97% (n = 646) of the miners screened in this study were linked to their respective data in the BLDRC REDCap. Not all miners in the BLDRC database will have complete data on CXRs and PFTs. Approximately 86% of miners screened had CXR and/or spirometry data for analysis (Table 8). We found no associations between radiographic or spirometric indices and severity of depressive symptoms (Table 9), consistent with our findings in the Rasmussen data. We found that a higher proportion of miners with mild or no symptoms of anxiety had radiographic black lung compared to those with moderate to severe symptoms of anxiety (68% vs 51%, p =0.009). Similarly, we found that obstructive pattern of impairment and lower mean FEV1/FVC ratio were found among those with less severe anxiety symptoms compared to those with more severe anxiety symptoms.

Table 8. Lung function and radiographic disease category of U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668). Clinical data from the BLDRC database are represented in this table.

Variable	**N**	**%**
Miners with CXR ILO classification	574	85.9
Coal Workers' Pneumoconiosis Category		
None	196	34.1
Small Opacity CWP	311	54.2
PMF	67	11.7
Use of Home Oxygen		
Currently prescribed or recommended	117	17.5
Not prescribed and not recommended	480	71.9
Unknown	71	10.6
Miners with Spirometry	572	85.6
Any Abnormal Spirometric Pattern, n (%)	218	38.1
Restrictive, n (%)	115	20.1
Obstructive, n (%)	67	11.7
Mixed, n (%)	36	6.3
Any Obstruction[a], n (%)	103	18.0
FEV_1 impairment, n (%)	208	36.4
Moderate to Severe FEV_1 Impairment, n (%)	96	16.8
Mean FEV_1 pp, mean (std)	79.7	20.5
Mean FVC pp, mean (std)	85.9	17.9
Mean FEV_1/FVC pp, mean (std)	92.4	14.5

[a] Any obstruction includes those with an obstructive and mixed pattern of spirometric impairment.

Table 9. Lung function and radiographic disease category of U.S. coal miners screened for mental health symptoms at Black Lung Clinics nationally, 2023-2025 (n = 668). Clinical data from the BLCP are represented in this table.

	Moderate/ Severe Depression Symptoms		**Mild to No Depression Symptoms**			**Moderate/Severe Anxiety Symptoms**		**Mild to No Anxiety Symptoms**		
Variable	**n**	**%**	**n**	**%**	**p-value**	**n**	**%**	**n**	**%**	**p-value**
Coal Workers' Pneumoconiosis										
None	24	45.3	168	33.3	0.08	30	49.2	166	32.4	0.009
Small Opacity CWP or PMF	29	54.7	337	66.7		31	50.8	347	67.6	
Use of Home Oxygen										
Currently prescribed or recommended	10	17.9	101	19.5	0.77	10	14.9	107	20.2	0.31
Not prescribed and not recommended	46	82.1	418	80.5		57	85.1	423	79.8	
Unknown										
Any Spirometric Obstruction, n (%)	7	13	91	18.3	0.33	5	7.6	98	19.3	0.02
FEV_1 impairment, n (%)	17	31.5	183	36.8	0.44	19	28.8	189	37.2	0.18
Mean FEV_1 pp, mean (std)	80.5	17.4	79.6	20.6	0.77	83.3	17.7	79.3	20.8	0.13
Mean FVC pp, mean (std)	86.2	14.4	85.9	18.1	0.91	85.9	16	85.8	18.1	0.97
Mean FEV_1/FVC pp, mean (std)	92.8	11.9	92.2	14.2	0.76	96.7	12.2	91.9	14.7	0.01

Multivariable model findings

We explored the main predictors of depression and anxiety, defined as reported symptoms alone or in combination with prior diagnoses of these conditions in four separate multivariable logistic models.

In models predicting odds of moderate to severe depression symptoms, the strongest predictors were PTSD, low social connectivity, and having had an injury at work that resulted in reduced hours or cessation of work (Table 10). Additional significant predictors included pain and adverse childhood experiences. Age was inversely related to odds of moderate to severe symptoms of depression, although the clinic significance of this is unclear. This same trend was observed in our analyses of the Rasmussen data. Importantly, no clinical measures of respiratory health were associated with moderate to severe depressive symptoms. Self-reported COPD was associated with higher odds of this outcome, although the finding was not significant.

In models predicting odds of depression defined as moderate to severe depression symptoms or a prior diagnosis of depression, the strongest predictors were having unmet needs pertaining to social determinants of health, PTSD, and having had an injury at work that resulted in reduced hours or cessation of work (Table 11). Additional significant predictors included pain, ACEs, and self-reported COPD. While not reaching significance, low social connectivity and having witnessed, hearing about or experiencing a life-threatening injury or death on the job were also associated with higher odds of depression. Age was inversely related to odds of moderate to severe symptoms of depression, although the clinic significance of this is unclear. This same trend was observed in our analyses of the Rasmussen data. Importantly, no clinical measures of respiratory health were associated with depression in this model.

Table 10. Association between severity of depression symptoms and selected demographic, occupational, clinical, and health indices of miners screened at seven black lung clinics between 2023-2025 (n = 668).

Variable	**Adjusted OR (95% CI)[a]**
Age (10 year increase)	0.80 (0.56, 1.14)
PTSD (PTSD-PC-5 ≥ 3)	3.61 (1.51, 8.52)
Pain level[b]	1.35 (1.19, 1.54)
Low social connectivity[c]	3.65 (1.51, 8.54)
Changed or stopped work due to work injury[d]	3.22 (1.64, 6.29)
COPD[e]	1.84 (0.94, 3.56)
Total ACEs[f]	1.63 (1.13, 2.35)

[a] Adjusted odds ratios (Ors) and 95% confidence intervals (CI) are derived from a multivariate logistic regression model that includes all covariates listed in the table.
[b] Mean pain score derived from the PEG screening tool.
[c] Defined as seeing or talking to people that they care about and feel close to ≤2 times/week.
[d] Defined as those who either had to stop working, change jobs, reduce work or changed tasks as a result of a work injury.
[e] Self-reported diagnosis of chronic pulmonary obstructive disease (COPD)
[f] Total number of adverse childhood events (ACEs)

Table 11. Association between depression, defined as prior diagnosis of depression or moderate to severe depression symptoms) and selected demographic, occupational, clinical, and health indices of miners screened at seven black lung clinics between 2023-2025 (n = 668).

Variable	Adjusted OR (95% CI)[a]
Age (10 year increase)	0.60 (0.46, 0.78)
PTSD (PTSD-PC-5 ≥ 3)	3.81 (1.68, 8.95)
Pain level[b]	1.35 (1.23, 1.50)
Low social connectivity[c]	1.69 (0.74, 3.79)
Changed or stopped work due to work injury[d]	2.12 (1.21, 3.68)
Secondary trauma from serious injury/accident[e]	1.64 (0.97, 2.75)
COPD[f]	1.84 (1.09, 3.07)
Total ACEs[g]	1.85 (1.30, 2.66)
Having unmet SDOH needs[h]	5.13 (1.31, 24.38)

[a] Adjusted odds ratios (ORs) and 95% confidence intervals (CI) are derived from a multivariate logistic regression model that includes all covariates listed in the table.
[b] Mean pain score derived from the PEG screening tool.
[c] Defined as seeing or talking to people that you care about and feel close to 2 or fewer times in a week.
[d] Defined as those who either had to stop working, change jobs, reduce work or changed tasks as a result of a work injury.
[e] Witnessing, hearing about, or experiencing a serious or life-threatening injury or death.
[f] Self-reported diagnosis of chronic pulmonary obstructive disease (COPD)
[g] Total number of adverse childhood events (ACEs)
[h] Reporting any unmet needs on the PRAPARE questionnaire.

In models predicting odds of moderate to severe anxiety symptoms, the strongest predictors were again PTSD, low social connectivity, and having had an injury at work that resulted in reduced hours or cessation of work, and pain (Table 12). Of note, the confidence interval around the PTSD odds ratio was wide, although still significant in this model. Increased lung function, as measured by increased FEV_1 percent predicted, was associated with increased odds of moderate to severe anxiety symptoms, although the strength of association was modest (OR for a 10% change in FEV_1 percent predicted 1.17, 95%CI 1.01 - 1.37). The FEV_1 finding is contrary to our hypothesis, and may suggest that the primary risk factors for anxiety symptoms in this population are not related to lung function. Age was inversely related to odds of moderate to severe symptoms of anxiety, as it was for symptoms of depression.

In models predicting odds of anxiety defined as moderate to severe anxiety symptoms or a prior diagnosis of anxiety, the strongest predictors were PTSD and having unmet social determinants of health needs as assessed on the PRAPARE questionnaire (Table 13). Additional significant predictors included pain; having witnessed, hearing about or experiencing a life-threatening injury or death on the job; and self-reported COPD. While not reaching significance, low social connectivity and were also associated with higher odds of anxiety. Age was inversely related to anxiety.

Table 12. Association between severity of anxiety symptoms and selected demographic, occupational, clinical, and health indices of miners screened at seven black lung clinics between 2023-2025 (n = 668).

Variable	Adjusted OR (95% CI)[a]
Age (10 year increase)	0.69 (0.50, 0.96)
PTSD (PTSD-PC-5 ≥ 3)	12.20 (5.32, 29.05)
Pain level[b]	1.22 (1.09, 1.38)
Low social connectivity[c]	2.77 (1.14, 6.40)
Changed or stopped work due to work injury[d]	2.02 (0.99, 3.96)
FEV_1 percent predicted[e]	1.17 (1.01, 1.37)

[a] Adjusted odds ratios (Ors) and 95% confidence intervals (CI) are derived from a multivariate logistic regression model that includes all covariates listed in the table.
[b] Mean pain score derived from the PEG screening tool.
[c] Defined as seeing or talking to people that they care about and feel close to ≤2 times/week.
[d] Defined as those who either had to stop working, change jobs, reduce work or changed tasks as a result of a work injury.
[e] FEV_1 percent predicted values calculated using GLI predictive equations; OR reflects a change in 10 units

Table 13. Association between anxiety, defined as prior diagnosis of anxiety or moderate to severe anxiety symptoms) and selected demographic, occupational, clinical, and health indices of miners screened at seven black lung clinics between 2023-2025 (n = 668).

Variable	Adjusted OR (95% CI)[a]
Age (10 year increase)	0.53 (0.43, 0.68)
PTSD (PTSD-PC-5 ≥ 3)	13.19 (5.35, 37.84)
Pain level[b]	1.23 (1.13, 1.34)
Low social connectivity[c]	1.65 (0.76, 3.46)
Secondary trauma from serious injury/accident[d]	2.20 (1.40, 3.46)
COPD[e]	1.80 (1.12, 2.90)
Having unmet SDOH needs[f]	4.18 (1.01, 20.47)

[a] Adjusted odds ratios (Ors) and 95% confidence intervals (CI) are derived from a multivariate logistic regression model that includes all covariates listed in the table.
[b] Mean pain score derived from the PEG screening tool.
[c] Defined as seeing or talking to people that you care about and feel close to 2 or fewer times in a week.
[d] Witnessing, hearing about, or experiencing a serious or life-threatening injury or death.
[e] Self-reported diagnosis of chronic pulmonary obstructive disease (COPD)
[f] Reporting any unmet needs on the PRAPARE questionnaire.

In general, there were few clinical measures of respiratory health that were significantly associated with diagnoses or symptoms of depression or anxiety. In particular, radiographic coal workers' pneumoconiosis was not associated with either outcome, which was surprising, but consistent with our examination of the Rasmussen data. Radiographic severity of disease was not associated with use of antidepressant and/or anxiolytic medications in that analysis. Similarly, Dr. Harris found no association between radiographic disease or lung function measures and depression or anxiety symptoms in his earlier study of mental health among coal miners at the Stone Mountain Health System black lung clinic.[42] That study did, however, report that anxiety and depression symptoms were significantly higher among those with supplemental oxygen use, which we did not find in the current study. These findings remain counterintuitive, perhaps, but

also underscore that the primary drivers of depression and anxiety symptoms in this population arise from other exposures, particularly trauma and injury.

Objective 3: Collect qualitative follow-up interview data from up to 100 miners, employing a semi-structured interview guide designed to capture detailed information about miners' occupational history, exposures to psychosocial stressors at work, socioeconomic stressors, perceptions of health and health-related stressors, childhood experiences, and coping strategies.

During the grant period, the research team successfully interviewed a total of 34 former miners by telephone. 75.6% of the miners interviewed had worked the majority of their careers in Central Appalachia (KY, VA, WV; n = 26). Of the 34 miners interviewed, 20.6% (n = 7) scored positive for PTSD; 8.8% (n = 3) for mild-moderate problematic alcohol use; 44.1% (n = 15) either reported a depression diagnosis or reported moderate to severe depression symptoms; and 38.2% (n = 13) either reported an anxiety diagnosis or reported moderate to severe anxiety symptoms. Importantly, comorbid occurrence of these symptoms across domains was common. We interviewed 13 miners without prior diagnoses or symptoms of moderate to severe depression or anxiety, without problematic drinking behaviors, and without PTSD symptoms as a comparison group.

Individuals who participated in follow-up qualitative interviews were highly engaged and forthcoming: their openness resulted in rich, detailed accounts that strengthened the overall quality of the dataset and provided insights that would not have been visible through quantitative screening alone. Our interview guide proved highly effective in eliciting comprehensive information about former miners' work histories, traumatic workplace events (individual experiences, witnessed or relayed traumatic experiences), mental and physical health stressors, social supports during and post-mining, and other risk factors throughout the life course. More broadly, our qualitive inquiry approach allowed us to capture nuances of lived experience that help contextualize patterns emerging in clinical screening data (i.e., the scale-based measures collected in clinics per objective 1). In our aggregate analyses of interview transcripts, we identified several overarching themes:

- **Mining careers shaped participant identity, family life, and community**. Throughout interviews, participants described mining as a defining part of their identity. Most miners we interviewed grew up in mining families or communities and entered the mines in early adulthood.

  "There was a lot of miners here because if you wanted to stay in the area, that's all there was around here." – Participant A9

  "So I mean, coal was king of everything in the seventies and I started in '78, so I mean, like I said earlier, if you're going to make any money, I mean, there wasn't no GE or no places like that around here. If you're going to make any money and have any benefits, you went in the coal mine." – Participant A27

  "Well, the reason I went to go mine, just for more money. I had no schooling, no education, nothing, and had a baby and I was making $5.25 an hour. I got paid every two

weeks. One week we'd go to Sonic and eat, the next week we were broke. I'd go to my dad to borrow $20 to get milk money to feed my baby. I said I got to do something different and the coal mines was my only option." – Participant A12

Notably, most participants described mining as the best of very few employment options in their communities, and when mines closed or miners were forced to stop work due to injuries or illness participants described feelings that there were no realistic employment alternatives to adequately support themselves and their families. When mines closed, participants described the economic impacts as devastating to their communities, with no viable industries to replace this loss.

"Everybody around that part of the country thought [mining company], we'd all retire, and our kids would retire, and everything, was what they told us when we went to work, which they had been there for a long time, and when they shut down, it hurt a lot of people, and then, after that, yeah, you already always had that in the back of your mind, but a lot of the little companies, you didn't know whether they was going to make it or not, you worked for. You just hoped it would. If they didn't, you hoped you'd find another job real quick." – Participant A26

- **Mines were hazardous and this risk became normalized**. All participants described dangerous conditions in the mines, regardless of the positions that they worked, including ever-present high levels of dust, risks of roof falls (for underground miners), and risks related to operating heavy machinery. One miner described the dust at work and the knowledge that it wasn't good for his health:

"When I would come out of the cold mines, when I first started in mines, of course this is talking about coal dust, you couldn't see your hand in front of your face. The coal dust could be so bad at times, and you'd have to stop, spray with water and spray the dust down to see where you were at. And so that was a part that was, I knew that wasn't going to be great for me…But it's just one of them things that you just do it." – Participant A13

Participants described these risks as 'part of the job', noting that they became accustomed to the risks, even if they recognized that there were potential acute and long-term risks associated with the hazards on the job.

"*I worried about the environment underground, particularly respiratory issues. Not only that, but the danger of a cave-in or something like that happening, and not only for me, but for my co-workers too. There were some times when I'd be underground, it'd be pretty dusty and dirty, and you think, "Jeez, I'm not sure this is really good to be breathing all this," type of thing."* – Participant A21

- **Frequent injury and physical wear led to long-term deterioration**. Many participants described chronic pain, back injuries, arthritis, and respiratory challenges. Most participants clearly linked their declining health to mining exposure, as illustrated by this miner's quote:

"Well, I guess the fatigue of your body, I mean, it just wears you out. You talking dog-tired, when you boat top all day long, you wore out, kindly. It just drains you. It just takes a toll on your body. The thing about it is, once you get old, it breaks you down. You probably lose 10 or 15 years of your life because you worked so hard." – Participant A2

- **Trauma was commonplace, both individually experienced trauma and witnessed trauma**. Many miners had first-hand or direct witnessed experience with serious accidents, injuries, or even deaths underground. Participants who did not report personal or witnessed experiences reported hearing about such incidents from colleagues or friends. These stories were vivid and emotional, as depicted by these participants' quotes:

  "Before the safety got going real good, we would lose at least one guy a year. "I've seen rocks fall on people and break your back. I've seen, this is personal, what I think, there's a lot more went on with [inaudible 00:31:23]. A guy running a loader got mashed on a rib, he turned the corner too tight. He didn't die right away, but eventually, he did. A lot of people, minor injuries, cuts, bruises, and got to go out for go to a doctor and get patched up and come back. But there was a couple serious ones that I was aware of, but a lot of people where I worked got hurt pretty bad over the years." – Participant A4

  "Because as a young guy... Well, any young guy, I'd say you don't pay too much attention to things because you're trying to do what's right, and you're trying to make a live for your family. But as time goes on, you begin to watch things. You understand you're there for that reason, for your family, but you're also... Because I was around these guys, and I'm sure if you've talked to other men with this same survey, they've told you the same. I was around guys that got killed underground, the same place that I would've rode to go in underground or come home, to come out, they were sitting in the same places, and died because the same rocks, or when I say rocks, the same mountain, or the slabs of stuff that was in between the pins fell on them and killed them." – Participant A14

- **Strong bonds with coworkers created family-like support**. Social support from fellow miners emerged as a strong theme from our interviews. Many miners described coworkers as "family" and emphasized loyalty and shared responsibility. Several miners also described the ways in which this social connectedness from the mines impacted the broader community.

  "...[the mines]'ve done a lot of great things for the community. The town up here had a tornado, and it tore up quite a bit of the town, well the mine went down to a skeleton crew, and sent everybody to town to help with the tornado. We cleaned the town and helped put it back together." – Participant A1

- **Chronic stress persisted throughout and after mining**. An overarching theme from our interviews was that many participants had experienced, and most continued to experience, some degree of chronic stress related to their mining work. This manifested primarily in (a) the ways participants described the dangers of their work and the stress that arose from the need for constant vigilance or from worry about the inevitability of adverse health impacts related to their work tasks, and (b) the economic insecurity that came from needing to retire

sooner than desired, either due to mine closures or ill health, or from inadequate retirement benefits (e.g., absence of a pension, insufficient savings). These perceptions are exemplified in these quotes:

> *"The whole time you're there, you had to be alert and on your toes, and you couldn't do anything wrong that was going to jeopardize somebody else's life."* – Participant A14

> *"The danger of natural hazards or unnatural hazards, like cave-ins on the surface, worried about the equipment not being seen, getting backed over by some piece of equipment that was literally the size of a two or three-story house and those type of things. It's a very dangerous environment. You've got to pay attention to everything constantly. You can't relax."* – Participant A21

> *"When you're used to getting up and providing for your family and you can no longer do that anymore and don't see any hope for doing it again in the future. It weighs on me. Now, everybody else may not be like that, but now it did weigh heavy on me. It did."* – Participant A27

Objective 4: Identify and characterize factors that may be relevant to and predictive of mental health symptoms, problematic substance use, and/or the absence of such states.

Across qualitative interviews and linked screening data, the project identified a constellation of factors that appear relevant to mental health outcomes among former miners, including many that align with existing literature and some that may be distinct to this population. Consistent with prior research, participants described exposure to chronic physical pain, disability-related activity limitations, economic insecurity following mine closures, and experiences of trauma or near-miss events as key contributors to stress, anxiety, and low mood. For example, miners frequently reported decades of high-risk work environments, cumulative injuries, and forced exits from the industry due to declining physical health. Limited employment options in rural coal-producing regions further compounded financial strain and feelings of loss of purpose or identity following retirement. These narratives align closely with documented risk factors for poor mental health from broader sociological and occupational research, strengthening confidence in the validity of our qualitative dataset. Several themes emerged with nuances that offer new insight into risk and resilience in this particular population. Retirement was experienced very differently depending on access to disability benefits, union protections, and financial security. Some miners described smooth transitions supported by pensions, health coverage, or stable post-mining employment; others described prolonged challenges with Black Lung benefit approval, loss of income, and worsening health symptoms before receiving benefits. This variability appears relevant to mental health, as individuals with prolonged uncertainty or financial instability more frequently endorsed stress, depressed mood, and interpersonal strain. As we continue with our mixed-methods analyses, we will be able to examine these associations with more nuance.

Trauma: As noted in the themes listed above, participants described witnessing traumatic events underground, such as serious injuries, fatalities, and catastrophic equipment failures, as well as the ongoing psychological impact of these memories. While trauma exposure has been

documented in mining literature, the depth of first-person accounts in this dataset provides rich contextual detail for understanding downstream risk of PTSD symptoms and hypervigilance as a coping strategy. While there are many examples of this in our qualitative dataset, here is one such quote that highlights common experiences reported by miners:

> *"Well, it impacted my sleep for a while when my buddy got killed. I had a hard time sleeping there for a while, but I got over it. But especially my other guys [inaudible 00:37:14] 10 guys got killed. I think it was 10 but anyway. When that happened, I had a hard time sleeping for a while. It would bother you. You had bad dreams, but I eventually got over it."* – Participant A3

Protective factors: Preliminary findings also highlighted sources of resilience in this population. Strong coworker relationships, a sense of shared identity, and ongoing social connectedness after retirement appeared to buffer stress and support positive mental health. Several miners described coworkers as "family", as noted in the themes described above, and several described post-retirement connectedness that suggests more positive transitions out of work than reported by those with fewer close connections. For some, family engagement, community involvement, or faith-based groups seemed to serve a similar protective role.

6.0 Publication Record and Dissemination Efforts

We have made considerable efforts to disseminate our research findings to all relevant stakeholders, including federal agencies, the scientific community, miners, and the general public. The results of these efforts are presented below.

6.1 Published and planned manuscripts

1. Friedman LS, Go LHT, Dang N, et al. The Association Between Employment in Coal Mining and History of Injury, Current Pain, and Prescription Opioid Use. *Am J Ind Med.* 2025;68(1):76-88. doi:10.1002/ajim.23679

2. DeVaughn A, Go LHT, Bonney T, Cohen RA, Shannon B, Friedman LS, Richardson D, Yan R, Almberg KS. Association of Physical Health Indices with Antidepressant and/or Anxiolytic Use in Former US Coal Miners. J Occup Environ Med. Published online July 15, 2025. doi:10.1097/JOM.0000000000003505

3. Almberg KS, Harris D, Bonney T, et al. Prevalence and Determinants of Mental Health Symptoms among U.S. Coal Miners (working title). JAMA. (*in progress)*

4. Bonney T, Harris D, Richardson D, et al. Major risk and protective factors associated with mental health symptoms among U.S. coal miners, a mixed-methods approach. (*planned)*

6.2 Peer reviewed presentations at national and international scientific conferences

1. Devaughn A, Shannon B, Friedman L, et al. Impaired Pulmonary Function and Severe Pain are Associated with Mental Health Disorders among Former US Coal Miners. American Thoracic Society International Conference Abstracts. Am J Respir Crit Care Med 2024; 209:A2873.

2. Almberg KS, Devaughn A, Shannon B, et al. Antidepressant and/or anxiolytic medication use, mental health symptoms, and their association with physical health indices among former U.S. coal miners. Work, Stress, and Health Conference. 2025; Seattle, WA.

3. Almberg KS, Bonney T, DeVaughn et al. Prevalence and Determinants of Mental Health Symptoms among U.S. Coal Miners. American Public Health Association Annual Conference 2026, *Planned submission*

6.3 Invited presentations at national and international meetings

1. Almberg KS. "Rasmussen Research Forum, Part 2 – Mental Health and Future Directions." The National Coalition of Black Lung & Respiratory Disease Clinics Conference. Pipestem, WV. June 5, 2024.

2. Almberg KS. “Approach to Studying Behavioral Health in Coal Miners.” The National Coalition of Black Lung & Respiratory Disease Clinics Conference. Pipestem, WV. May 11, 2023.

7.0 Conclusions and Impact Assessment

This project represents a significant advancement in understanding mental health among U.S. coal miners, a population historically overlooked in behavioral health research. This study systematically assessed the prevalence and determinants of depression, anxiety, PTSD, and substance misuse among this population of workers.

Conclusions: The burden of poor mental health is substantial and measurable among U.S. coal miners. In this study of coal miners from seven Black Lung Clinics spread across the Appalachian, Midwestern, and Western region of the U.S., 19% either had a diagnosis of depression or reported moderate to severe symptoms of depression and 22.5% of miners screened reported a diagnosis of anxiety or symptoms of moderate to severe anxiety. The prevalence of a depression diagnosis among miners in our study (14.5%) is similar to, albeit slightly higher than, the prevalence of depression reported among U.S. men aged 62-73 from 2019-2023 reported by the NHIS (13%). When using the combined outcome of a depression diagnosis or reporting moderate to severe depression symptoms, the prevalence of depression and its symptoms are substantially higher among our population of miners (19% vs 13%) compared to their counterparts in the U.S. population. The prevalence of anxiety among the NHIS sample was 10% from 2019-2023, compared to 19% of our sample reporting an anxiety diagnosis. Of those reporting these diagnosis, similar proportions report medication use for these conditions in the NHIS data compared to our data.

We also compared our findings to those from the Household Pulse Survey, which found that between 17% - 18.5% of men aged 65 and older reported mental health symptoms of depression or anxiety in between 2020 and 2023. Our estimates of depression (19%) and anxiety (22.5%) are slightly higher than these national estimates, however substantial methodological differences in mental health assessment between the Household Pulse Survey and our study limit the comparison.

PTSD symptoms were present in 16% of miners, with traumatic occupational events frequently cited. This is perhaps of the most important and unique contributions of our study – occupational injury, primary and secondary trauma, and certain work-related health conditions such as COPD significantly contribute to poor mental health among coal miners. These findings confirm that mental health challenges are pervasive and warrant targeted intervention.

In our exploration of the Rasmussen data, we were primarily interested in examining the relationship between physical health and mental health, with limited ability to examine other factors. With the data collected in this study, we were able to elucidate risk factors for poor mental health that extend beyond physical disease. Our multivariable analyses demonstrated that psychosocial and socioeconomic stressors - such as unmet social needs, low social connectivity, adverse childhood experiences, and work-related injuries - are stronger predictors of poor mental health than radiographic lung disease or spirometric impairment. This underscores the need for holistic approaches that address both occupational and social determinants of health.

We also identified important protective factors that offer pathways for improved mental health and well-being among coal miners. Social connectedness and trusted clinical relationships

emerged as key buffers against psychological distress, suggesting that interventions leveraging these strengths may be particularly effective. In particular, the comradery among miners reported by coal miners while working was a striking example of the importance of social cohesion among this population.

Impact: Our study has demonstrable impacts for research and intervention development to improve mental health and well-being in the coal mine industry. We developed and deployed validated mental health screening tools across seven Black Lung Clinics, creating a replicable model for routine behavioral health assessment in mining communities. In fact, our findings support embedding mental health services within federally funded Black Lung Clinics which are trusted access points for miners as a means to enhance feasibility and uptake of care. We identified modifiable risk factors for mental health which provides a foundation for targeted interventions aimed at reducing symptoms of poor mental health and improving overall well-being. Our study can inform federal and state agencies on resource allocation for behavioral health programs, with potential to reduce morbidity, improve quality of life, and mitigate safety risks linked to untreated mental illness among U.S. coal miners.

8.0 Recommendations for Future Work

We believe that the results of this study provide compelling data that suggest federally-funded Black Lung Clinics are ideal sites for an intervention study to address the burden of depression, anxiety, trauma, and pain in this population of workers. Through our partnerships in this work, we have identified barriers to meeting the behavioral health needs of the coal miners seen at HRSA-funded BLCPs. Among the clinics we partnered with for this work, behavioral health services were varied and ranged from full-service behavioral health providers on site at the BLCP, to referral to the ER if suicidality is reported. Most clinics are lacking comprehensive behavioral health services either due to a lack of mental health staff, limiting funded for such programs, and/or geographic isolation resulting in gaps in care. Currently, all clinics face funding and capacity issues in expanding services beyond those required of the BLCP grant.

And yet, the BLCP clinics represent a trusted access point for miners and an opportunity to integrate mental health interventions. Many of these clinics are trusted community hubs for miners and their families. The BLCP clinics have outreach and education infrastructure could support mental health programming. HRSA's emphasis on comprehensive care creates an opportunity for integrated behavioral health interventions. In fact, our BLCP project officer is enthusiastic about this idea of leveraging additional research dollars to expand services provided at BLCPs nationally.

We are in the early planning stages of a multi-site intervention study proposal to promote mental health and well-being among current and former coal miners by leveraging federally-funded Black Lung Clinics as intervention sites. The intervention would consist of structured group therapy sessions designed to address depression, anxiety, trauma, and social isolation commonly experienced in this population. Each group will include 8–10 miners and meet weekly for 8–10 weeks, facilitated by licensed mental health professionals trained in trauma-informed. The group format will foster peer support, normalize mental health challenges, and build coping strategies tailored to the unique experiences of miners. Outcomes will include changes in psychological distress, perceived social support, and quality of life, measured pre- and post-intervention. We would use a pre-post evaluation framework to assess outcomes like depression/anxiety symptoms; psychological distress; chronic pain; perceived social support, and quality of life. Such a study would also include the goal of assessing feasibility for scaling-up in other settings.

9.0 References

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10.0 Appendices

Appendix A: Mental Illness in U.S. Coal Miners: Screening Survey

1

UNIVERSITY OF ILLINOIS CHICAGO

Mental Health Disorders in U.S. Coal Miners: A collaborative approach to understand risk factors and prevalence

Before you get started, the following are some example phrases to provide neutral feedback throughout the interview:

- "Thank you for sharing that with me"
- "Thank you for answering those questions"
- "I see, that's useful information to know"
- "Yes, I understand"

These responses show that you are actively listening and care about the information that they are sharing while also keeping your responses neutral and consistent. Even if participants are expressing difficulties that may be concerning to you, it is important to remain brief and non-judgemental during the screening.

Note to interviewer: participants can decline to answer any question provided. If they decline, be sure to document this response.

Pre-Screening Script

"This survey focuses on your occupational history and your physical and mental well-being. Please remember that your participation in this study is completely voluntary. All of the answers you give me today will be kept confidential. We will not share what you say with anyone without your permission. The only exceptions are if you tell me you're thinking of harming yourself or others, or, if you tell me about child, elder, and/or disabled adult abuse or neglect. Then I am obligated to activate the appropriate emergency response plan or call the appropriate authorities, depending on the situation. The interview will take about 30 minutes. As we go through the interview, you don't have to answer any questions you don't want to. If you don't understand something, please ask me to explain it."

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Demographics and Contact Information

FOR INTERNAL USE ONLY: **Please select if this survey was self-administered (completed by participant) or staff administered (completed by study personnel with participant)**

☐ **Self-administered** ☐ **Staff administered**

First name: **Last name:**

Middle name (optional):

Age at date of screening: _____ years

State of Residence: _____

Zip Code of Residence: _____

Phone Number: (_____) _____

Secondary Phone Number (optional): (_____) _____

What is your gender, please select one:

☐ Male
☐ Female
☐ Another gender not listed
☐ I choose not to respond to this question

What is your RACE, please select one:

☐ White/Caucasian
☐ Black/African American
☐ American Indian/Alaska Native
☐ Asian
☐ Native Hawaiian/Other Pacific Islander
☐ More than one race
☐ Unknown
☐ I choose not to respond to this question

What is your ETHNICITY, please select one:

☐ Hispanic/Latino
☐ Not Hispanic/ Not Latino
☐ Unknown
☐ I choose not to respond to this question

3

Occupational History

Please select only one response, except where selecting all applicable responses is indicated.

1. Are you currently employed for pay, either full time or part time?
   - ☐ Yes
   - ☐ No

2. What is your experience working in the coal mine industry?
   - ☐ Currently working in coal mining
   - ☐ Previously worked in coal mining
   - ☐ Never worked in coal mining ***(skip to Question 23)***

If the participant has coal mine employment experience answer questions 3 – 6:

3. What type of coal mining employment have you ever worked in?
   - ☐ Underground
   - ☐ Surface
   - ☐ Both

4. What was the **first** year you worked in coal mining? _____
   - ☐ Don't know / Can't recall

5. What was the **last** year you worked in coal mining? _____
   - ☐ Don't know / Can't recall

6. **If you are no longer working as a coal miner**, what was the circumstance in which you left the coal mining industry?
   - ☐ Retirement
   - ☐ Lay-off or fired
   - ☐ Mine closure
   - ☐ Disability and/or injury
   - ☐ Other; please provide response: _____

If you worked as an <u>underground coal miner</u>, please answer Questions 7 – 18:

7. Did your underground mining experience ever include room and pillar mining?
   - ☐ Yes
   - ☐ No ***(Skip to Question 13)***

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8. **If your coal mine experience includes room and pillar mining,** did you ever pull pillars or do retreat mining?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know / Can't recall
9. **If your coal mine experience includes room and pillar mining,** was the room and pillar mining done by conventional mining?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know / Can't recall

10. **If your coal mine experience includes room and pillar mining,** were you ever a driller or shooter?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Can't recall

11. **If your coal mine experience includes room and pillar mining,** was the room and pillar mining done with a continuous miner?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Can't recall

12. **If your coal mine experience includes room and pillar mining,** did you ever have to cut or work beneath unsupported top?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Can't recall

13. Did your underground mining experience ever include longwall mining?
    - ☐ Yes
    - ☐ No ***(Skip to Question 16)***

14. **If your work experience included longwall mining,** were you ever a longwall sheer foreman, operator, or helper?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Can't recall

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15. **If your work experience included longwall mining,** were you ever a longwall shield or jack setter?
    ☐ Yes
    ☐ No
    ☐ Don't know / Can't recall

16. Were you ever a roof bolter?
    ☐ Yes
    ☐ No
    ☐ Don't know / Can't recall

17. How long did you work in underground coal mining? _____ years
    ☐ Don't know / Can't recall

18. What percentage of these years, or the total time you worked underground, did you work at the coal face or inby? _____ %
    ☐ Don't know / Can't recall

If you worked as a surface coal miner, please answer Questions 19 – 22:

19. In your surface mining experience did you do drilling or blasting?
    ☐ Yes
    ☐ No
    ☐ Don't know / Can't recall

20. In your surface mining experience, did you operate heavy equipment such as bulldozer, end loader, dragline, or scraper?
    ☐ Yes
    ☐ No
    ☐ Don't know / Can't recall

21. In your surface mining experience, were you a high wall continuous miner or auger operator or helper?
    ☐ Yes
    ☐ No
    ☐ Don't know / Can't recall

22. How long did you work in surface coal mining? _____
    ☐ Don't know / Can't recall

6

23. **For all participants:** Do you currently work, or have you ever worked, in mining OTHER than coal mining (for example: uranium, gold, stone, or gravel)?
    - ☐ Yes
    - ☐ No

24. **If you have OTHER mining experience,** how many years in total have you worked in non-coal mining?
    - ☐ Less than one year
    - ☐ More than one year; please specify number of years: _____
    - ☐ Don't know / Can't recall

Please proceed to the Occupational Injury Questionnaire

7

Occupational Injury

Please select only one response, except where selecting all applicable responses is indicated.

During any point in your career:

1. Did you have an injury at work?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No ***(Skip remaining questions in this section)***

2. Have you ever visited an ER for a work-related injury?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No
   - ☐ Don't know / Can't recall

3. Have you ever been hospitalized for a work-related injury?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No
   - ☐ Don't know / Can't recall

4. Were a number of workdays missed due to a work-related injury?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No
   - ☐ Don't know / Can't recall

5. Have you ever stopped working or changed jobs due to a work-related injury?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No
   - ☐ Don't know / Can't recall

6. Did you reduce work or changed tasks due to a work-related injury?
   - ☐ Yes, in coal mining
   - ☐ Yes, but not in coal mining
   - ☐ No
   - ☐ Don't know / Can't recall

Please proceed to the Medical/Health History Questionnaire

8

Medical/Health History

Please select only one response, except where selecting all applicable responses is indicated.

1. Have you EVER been diagnosed by a doctor with black lung?
   - ☐ Yes
   - ☐ No ***(Skip to Question 3)***
   - ☐ Don't know / Can't recall

2. **If you have been diagnosed with black lung,** have you ever been told that you have complicated black lung, or progressive massive fibrosis?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know / Can't recall

3. Have you applied for **state** black lung benefits?
   - ☐ Yes
   - ☐ No ***(Skip to Question 5)***
   - ☐ Don't know / Can't recall

4. **If you have applied for state black lung benefits,** did you receive benefits from your state black lung claim?
   - ☐ Yes
   - ☐ No

5. Have you applied for **federal** black lung benefits?
   - ☐ Yes
   - ☐ No ***(Skip to Question 9)***

6. **If you have applied for federal black lung benefits,** did you receive benefits from your federal black lung claim?
   - ☐ Yes, I currently receive benefits
   - ☐ No, I am awaiting a decision on my claim
   - ☐ No, I was denied benefits

7. **If you have applied for federal black lung benefits,** was your application for federal benefits ever denied?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know / Can't recall

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8. **If any of your federal black lung claims have been denied**, how many times has your federal black lung application been denied?
_____ times

9. Please indicate if you've been diagnosed with any of the following conditions by a doctor, nurse practitioner, or other healthcare provider:
☐ Silicosis
☐ COPD
☐ Emphysema
☐ Asthma
☐ Hypertension
☐ Diabetes mellitus
☐ Lung cancer
☐ Other cancer (if other, please provide response): _____

10. Have you smoked at least 100 cigarettes (~5 packs) in your entire lifetime?
☐ Yes
☐ No ***(Skip remaining questions in this section)***
☐ Don't know / Can't recall

If you have smoked at least 100 cigarettes in your lifetime, please answer questions 11 – 16:

11. About what age were you when you started smoking cigarettes?

_____ years old
☐ Don't know / Can't recall

12. How many cigarettes did you smoke a day on average over the years you smoked?

_____ cigarettes a day
☐ Don't know / Can't recall

13. Do you still smoke cigarettes?
☐ Yes ***(Skip to Question 15)***
☐ No
☐ Don't know / Can't recall

14. **If you no longer smoke cigarettes,** about what age were you when you stopped smoking cigarettes altogether?

_____ years old
☐ Don't know / Can't recall

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15. During the time you smoked cigarettes, did you ever stop for 6 months or more?
    ☐ Yes
    ☐ No ***(Go to next section)***

16. **If you stopped for 6 months or more,** about how many years did you stop smoking out of the total time you have smoked?

    _____ years
    ☐ Don't know / Can't recall

Please proceed to the Generalized Anxiety Disorder Questionnaire

11

GENERALIZED ANXIETY DISORDER (GAD-7)

Please select only one response, except where selecting all applicable responses is indicated.

1. Have you ever been diagnosed by a doctor or other health professional with any type of anxiety?
   - ☐ Yes
   - ☐ No ***(Skip to Question 3)***
   - ☐ Decline to respond

2. **If you have ever been diagnosed with any type of anxiety,** are you currently using medication for anxiety?
   - ☐ Yes
   - ☐ No
   - ☐ Decline to respond

3. ***Over the last 2 weeks***, how often have you been bothered by any of the following problems?	Not at all	Several days	Over half the days	Nearly every day	Decline to respond
a. Feeling nervous, anxious, or on edge	☐	☐	☐	☐	☐
b. Not being able to stop or control worrying	☐	☐	☐	☐	☐
c. Worrying too much about different things	☐	☐	☐	☐	☐
d. Trouble relaxing	☐	☐	☐	☐	☐
e. Being so restless that it's hard to sit still	☐	☐	☐	☐	☐
f. Becoming easily annoyed or irritable	☐	☐	☐	☐	☐
g. Feeling afraid, as if something awful might happen	☐	☐	☐	☐	☐

4. Did you have any of these problems prior to the start of the COVID-19 pandemic in March 2020?
   - ☐ Yes
   - ☐ No ***(Skip to Next Section)***
   - ☐ Don't know / Can't recall
   - ☐ Decline to respond

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5. **If you did have any of these problems prior to the start of the COVID-19 pandemic**, have any of these problems:
   - ☐ Gotten worse
   - ☐ Gotten better
   - ☐ Stayed the same
   - ☐ Decline to respond

Please proceed to the Occupational Trauma Questionnaire

13

PC-PTSD-5 Occupational Trauma

Please select only one response, except where selecting all applicable responses is indicated.

1. Sometimes things happen to people that are unusually or especially frightening, horrible, or traumatic. Such as a serious accident or fire, a war, a physical or sexual assault or abuse, an earthquake, having a loved one die through homicide or suicide, or seeing someone be killed or seriously injured.

   Have you ever experienced this kind of event?
   ☐ Yes
   ☐ No ***(Skip to Next Section)***

In the past month, have you:

2. Had nightmares about the event(s) or thought about the event(s) when you did not want to?
   ☐ Yes
   ☐ No
   ☐ Decline to respond

3. Tried hard not to think about the event(s) or went out of your way to avoid situations that reminded you of the event(s)?
   ☐ Yes
   ☐ No
   ☐ Decline to respond

4. Been constantly on guard, watchful, or easily startled?
   ☐ Yes
   ☐ No
   ☐ Decline to respond

5. Felt numb or detached from people, activities, or your surroundings?
   ☐ Yes
   ☐ No
   ☐ Decline to respond

6. Felt guilty or unable to stop blaming yourself or others for the events(s) or any problems the event(s) may have caused?
   ☐ Yes
   ☐ No
   ☐ Decline to respond

7. What kind of traumatic event were you thinking of when you responded to this measure? (you may select multiple)
   - ☐ Something that happened on the job as a coal miner
   - ☐ Something that happened on the job NOT as a coal miner
   - ☐ Something that happened outside of my work

Please proceed to the Occupational Trauma Checklist

15

Occupational Trauma Checklist

Please select only one response, except where selecting all applicable responses is indicated.

Listed below are a number of difficult or stressful things that sometimes happen to people while they are working. For each event, select the option that most accurately describes your experiences with these events. **Check all that apply.**

1. While you were working, did you experience a serious accident ***without*** injuries?

   ☐ This happened to me while I was working in coal mining
   ☐ This happened to me, but not while I was working in coal mining
   ☐ I witnessed this happen while I was working in coal mining
   ☐ I witnessed this happen, but not while I was working in coal mining
   ☐ I heard about this happening to my coworkers while I was working in coal mining
   ☐ I heard about this happening to my coworkers, but not while I was working in coal mining
   ☐ I haven't experienced this in my work

2. While you were working, did you experience a serious or life-threatening injury or death?

   ☐ This happened to me while I was working in coal mining
   ☐ This happened to me, but not while I was working in coal mining
   ☐ I witnessed this happen while I was working in coal mining
   ☐ I witnessed this happen, but not while I was working in coal mining
   ☐ I heard about this happening to my coworkers while I was working in coal mining
   ☐ I heard about this happening to my coworkers, but not while I was working in coal mining
   ☐ I haven't experienced this in my work

Please proceed to the Alcohol Use Disorder Identification Test

16

Alcohol Use Disorder Identification Test (AUDIT)

Please select only one response, except where selecting all applicable responses is indicated.

Please select the answer that is correct for you.

1. How often do you have a drink containing alcohol?
   - ☐ Never ***(Skip to Question 9)***
   - ☐ Monthly or less
   - ☐ 2-4 times a month
   - ☐ 2-3 times a week
   - ☐ 4 or more times a week

2. How many standard drinks containing alcohol do you have on a typical day when drinking?
   - ☐ 1 or 2
   - ☐ 3 or 4
   - ☐ 5 or 6
   - ☐ 7 to 9
   - ☐ 10 or more

3. How often do you have six or more drinks on one occasion?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

4. During the past year, how often have you found that you were not able to stop drinking once you started?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

5. During the past year, how often have you failed to do what was normally expected of you because of drinking?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

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6. During the past year, how often have you needed a drink in the morning to get yourself going after a heavy drinking session?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

7. During the past year, how often have you had a feeling of guilt or remorse after drinking?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

8. During the past year, have you been unable to remember what happened the night before because you had been drinking?
   - ☐ Never
   - ☐ Less than monthly
   - ☐ Monthly
   - ☐ Weekly
   - ☐ Daily or almost daily

9. Have you or someone else been injured as a result of your drinking?
   - ☐ No
   - ☐ Yes, but not in the past year
   - ☐ Yes, during the past year

10. Has a relative or friend, doctor, or other health worker been concerned about your drinking or suggested you cut down?
    - ☐ No
    - ☐ Yes, but not in the past year
    - ☐ Yes, during the past year

11. Has your alcohol use pattern changed since the start of the COVID-19 pandemic in March 2020?
    - ☐ Yes
    - ☐ No ***(Skip to Next Section)***
    - ☐ Don't know / Can't recall

12. **If your alcohol use pattern has changed since the start of the COVID-19 pandemic,** has it:
- ☐ Increased – drinking more at one time or drinking more often
- ☐ Decreased – drinking less at one time or less often
- ☐ Stayed the same

Please proceed to the PRAPARE Questionnaire

19

PRAPARE Questionnaire

Please select only one response, except where selecting all applicable responses is indicated.

1. What is your current housing situation?
   - ☐ I have housing
   - ☐ I do not have housing (staying with others, in a hotel, in a shelter, living outside on the street, on a beach, or in a park)
   - ☐ I choose not to answer this question

2. Are you worried about losing your housing?
   - ☐ Yes
   - ☐ No

3. What is the highest level of school that you have finished?
   - ☐ Less than a high school degree
   - ☐ High school diploma or GED
   - ☐ More than high school
   - ☐ I choose not to answer this question

4. What is your current work situation?
   - ☐ Unemployed and seeking work
   - ☐ Part time or temporary work
   - ☐ Full time work
   - ☐ Otherwise unemployed, but not seeking work (ex. Student, retired, disabled, unpaid primary caregiver)
   - ☐ I choose not to answer this question

5. In the past year, have you or any family members you live with been unable to get any of the following when it was really needed? Check all that apply
   - ☐ Food
   - ☐ Clothing
   - ☐ Utilities
   - ☐ Child care
   - ☐ Medicine or any health care (medical, dental, mental health or vision)
   - ☐ Phone
   - ☐ Other (Please provide response) _____
   - ☐ I do not have problems meeting my needs
   - ☐ I choose not to answer this question

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6. Has the lack of transportation kept you from medical appointments, meetings, work, or from getting things needed for daily living?
   - ☐ Yes, it has kept me from medical appointments or from getting my medications
   - ☐ Yes, it has kept me from non-medical meetings, appointments, work, or getting things needed for daily living
   - ☐ No
   - ☐ I choose not to answer this question

7. How often do you see or talk to people that you care about and feel close to? (For example: talking to friends on the phone, visiting friends or family, going to church or club meetings)
   - ☐ Less than once a week
   - ☐ 1 or 2 times a week
   - ☐ 3 to 5 times a week
   - ☐ I choose not to answer this question

8. How stressed are you? Stress is when someone feels tense, nervous, anxious, or can't sleep at night because their mind is troubled.
   - ☐ Not at all
   - ☐ A little bit
   - ☐ Somewhat
   - ☐ Quite a bit
   - ☐ Very much
   - ☐ I choose not to answer this question

9. In the past year have you spent more than 2 nights in a row in a jail, prison, detention center, or juvenile correctional facility?
   - ☐ Yes
   - ☐ No
   - ☐ I choose not to answer this question

10. Are you a refugee?
   - ☐ Yes
   - ☐ No
   - ☐ I choose not to answer this question

11. What country are you from?
   - ☐ United States
   - ☐ Country other than the United States
   - ☐ I choose not to answer this question

12. Do you feel physically and emotionally safe where you currently live?
- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ I choose not to answer this question

13. In the past year, have you been afraid of your partner or ex-partner?
- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ I have not had a partner in the past year
- ☐ I choose not to answer this question

Please proceed to the Adverse Childhood Experience Questionnaire

22

Adverse Childhood Experience (ACE) Questionnaire

Please select only one response, except where selecting all applicable responses is indicated.

1. Before age 18, were you ever physically punished or beaten by a parent, caretaker, or teacher so that you were very frightened or thought you would be injured, or you received bruises, cuts, welts, lumps, or other injuries?
   ☐ Yes
   ☐ No

2. Before age 18, did parents or adults in your home swear at you, insult you, or put you down more than once?
   ☐ Yes
   ☐ No

3. Before age 18, did you live with anyone who was a problem drinker or alcoholic?
   ☐ Yes
   ☐ No

4. Has anyone ever made or pressured you into having some type of unwanted sexual contact?
   ☐ Yes
   ☐ No ***(Go to next section)***

5. **If anyone has ever made or pressured you into having some type of unwanted sexual contact,** how old were you when this first happened?
   ☐ Younger than 18
   ☐ Older than 18
   ☐ Both

Please proceed to the Chronic Pain Questionnaire

23

Chronic Pain

Please select only one response, except where selecting all applicable responses is indicated.

1. What number best describes your pain on average in the past week? *Circle only one number on the following scale.*

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

2. What number best describes how, during the past week, pain has interfered with your enjoyment of life?

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

3. What number best describes how, during the past week, pain has interfered with your general activity?

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

Please proceed to the Patient Health Questionnaire

24

Patient Health Questionnaire (PHQ-9)

Please select only one response, except where selecting all applicable responses is indicated.

1. Have you **EVER** been diagnosed by a doctor or other health professional with any type of depression?
   ☐ Yes
   ☐ No ***(Skip to Question 3)***

2. **If you have ever been diagnosed with depression,** are you currently using medication for depression?
   ☐ Yes
   ☐ No

3. Over the last 2 weeks, how often have you been bothered by any of the following problems?	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**	**Decline to respond**
a. Little interest or pleasure in doing things	☐	☐	☐	☐	☐
b. Feeling down, depressed, or hopeless	☐	☐	☐	☐	☐
c. Trouble falling/staying asleep, sleeping too much	☐	☐	☐	☐	☐
d. Feeling tired or having little energy	☐	☐	☐	☐	☐
e. Poor appetite or overeating	☐	☐	☐	☐	☐
f. Feeling bad about yourself or that you are a failure or have let yourself or your family down	☐	☐	☐	☐	☐
g. Trouble concentrating on things, such as reading the newspaper or watching television	☐	☐	☐	☐	☐
h. Moving or speaking slowly that other people could have noticed. Or the opposite; being so fidgety or restless that you have been moving around a lot more than usual	☐	☐	☐	☐	☐
i. Thoughts that you would be better off dead or hurting yourself in some way	☐	☐	☐	☐	☐

4. **If you have checked off any of these problems we just talked about in the past 2 weeks**, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?
   - ☐ Not difficult at all
   - ☐ Somewhat difficult
   - ☐ Very difficult
   - ☐ Extremely difficult

5. Did you have any of these problems prior to the start of the COVID-19 pandemic in March 2020?
   - ☐ Yes
   - ☐ No
   - ☐ Decline to respond

6. **If you had any of these problems prior to the start of the COVID-19 pandemic**, have they:
   - ☐ Gotten worse
   - ☐ Gotten better
   - ☐ Stayed the same
   - ☐ Decline to respond

Thank you for taking the time to share this important information with us. We appreciate your full participation! Please return this packet to clinic staff.

FOR INTERNAL USE ONLY:

Study staff: please review results of the PHQ-9 before the participant leaves the site to determine if the participant should receive C-SSRS screener.

Appendix B: Semi-Structured Interview Guideline

Semi-Structured Interview Guide (Alpha 6)

Notes about the interview guide: *Miners will be asked introductory questions in each section to ensure that all topics are discussed. Interviewers will skip questions that respondents have answered in response to earlier, broader questions; because of this, not all respondents will be asked all questions. Interviews will be kept to 90 minutes.*

- **Bolded questions** are asked of all miners.
- Non-bolded questions are asked if information does not come up in prior responses and if interviewer deems question appropriate based on miner's prior responses.
- *Italicized language* is typically not read aloud but is available to help prompt the interviewer to probe respondent further if answers to questions are vague or non-specific.

Participant ID	*Date of Interview*	*Time of Interview*	*Interviewer*	*Note-taker (if applicable)*

Semi-Structured Interview Guide

(*After consent protocol*): Thank you for agreeing to participate in an interview with our team. My name is ____, and I am a member of the research team for this project at the University of Illinois at Chicago. We are conducting this interview to learn more about some of your work experiences and experiences that you may have had outside of work over the course of your life. Our interview will include questions about your work as a miner, questions about other work that you may have had outside of mining, general questions about your home and family life, and questions about your health. All of the answers you give me today will be kept confidential. The only exceptions are if you tell me you're thinking of harming yourself or others, or, if you tell me about child, elder, and/or disabled adult abuse or neglect. Then I am obligated to activate the appropriate emergency response plan or call the appropriate authorities, depending on the situation.

I. *Mining History*

To start out, I'd like to hear a bit about how you got a job as a miner and what your mining job or jobs were like.

- **Can you start off by telling me why you chose to work as a miner and how you first got a job in mining?**
    - How old were you when you got your first mining job?
    - When you were growing up, were there people that you knew who worked in mining jobs or in jobs related to mining?
      Probes:
        - *Were many people in your community employed in mining or in jobs related to mining when you were growing up?*
        - *Did you have other family members who were miners?*

Semi-Structured Interview Guide (Alpha 6)

  - *Did you have other close friends or acquaintances who were miners?*
  - *Did this/these family member(s) or close acquaintance(s) help you get a job in mining? (If yes) Can you describe this?*

- **Do you currently work as a miner?**

  - *If yes*: How long have you worked as a miner and where have you worked?
  - *If no:* How long did you work as a miner? Where did you work?
    Probes:
    - *Counties / Companies?*
    - *Surface / Underground?*

- **Can you describe what a typical day looks like/looked like for you when you were mining? For example, the types of jobs/tasks that you did, how long you worked on different tasks, whether those tasks were things that you did by yourself or with others, etc.**

I'd like to learn more about the work that you did in the mine and how that work was structured.

- **Can you describe the different kinds of tasks that you performed in the mine, and how often you did those tasks, generally?**
  Probes:
  - *What did you do the most of? For how long?*
  - *Did you rotate from task to task?*
  - *What was your 'downtime work', or work when you weren't doing your regular job tasks?*

  - How were your job tasks assigned?
    Probes:
    - *Were you able to decide what you would work on, did someone else tell you what to work on, or was it some combination of the two?*
    - *Could you choose when to work on certain tasks?*

  - How did your work change over the course of your employment in the mine?
    Probes
    - *[If jobs changed] Why did you change jobs?*
    - *Did your workload change over time? The intensity/speed/difficulty of your work?*

  - How did these changes impact your work? Your life?

I'd like to hear a bit about what your employment situation was like while you were mining.

- **Can you describe what your job arrangement(s) was/were like while you were mining? For example, did you work full-time or part-time, did you work a regular weekday schedule, were you ever paid "under the table"** (*if yes, follow up with why*)?

  - What kind of employment benefits did you have while mining?
    Probes:
    - *Pension or retirement plan, insurance (health, dental, life), paid sick leave, paid vacation.*

Semi-Structured Interview Guide (Alpha 6)

- Were you in a labor union?
  Probes:
  - *Why or why not?*
  - *Did you change from a union to a non-union job? Or opposite?*

- **Did your employment situation, like your union status or benefits, change at all over the time that you were mining?**

  - How did these changes impact your work? Your life?
    Probes:
    - *Health and safety?*
    - *Benefits?*
    - *Wages and hours?*
    - *Stability/protection from termination?*

- **Did you ever feel like your work tasks were particularly dangerous to your health or to the health of your coworkers?**

  - Can you share an example of a time where you felt that your work was particularly dangerous?
    Probes:
    - *Were there specific work tasks that felt more dangerous than others?*
    - *How did you feel about the dangers of your work tasks/other miners' work tasks?*
    - *[If miner brings up specific situation that was dangerous] What happened when (specific situation) occurred in the mine?*

II. <u>*Non-Mining Employment*</u>

- [*If no longer mining*] **Can you describe why you stopped mining, and what it was like to stop working as a miner?**

- **Have you held non-mining jobs?**

  - *If yes:* Can you briefly describe the type or types of job(s) that you have held?

  - What were some of the biggest differences in this/these job(s) compared to your job(s) as a miner?
    Probes:
    - *What kinds of employment benefits did/do you receive?*
    - *Are/were you in a labor union?*

  - *If no*: Did you try to work in other jobs, either before or after you worked in the mines?

- **Did you ever serve in the military?**
  - *If yes:* Can you tell me a bit about your experience in the military?
    - *Probe for (briefly): duration of service, main roles/duties, challenges/difficulties experienced during service, positive elements of service.*

Semi-Structured Interview Guide (Alpha 6)

III. *Mining and Stress, Mental health, and Trauma*

Now I'd like to talk a bit about your feelings about coal mining.

- **How did you feel about mining growing up? Do you feel the same about mining now?**
    - What do/did you like the best about coal mining?
    - What do/did you dislike about coal mining?
      Probes:
        - *What was the hardest part about coal mining?*
        - *What did you worry about most when you were working as a coal miner?*
- **Were you ever worried that you would lose your job or the mine would close?**
  Probes:
    - *If yes*, why?
    - *How did you deal with that?*
    - *Did that worry impact how you conducted yourself at work?*
- **Can you describe the relationships that you had with your coworkers? With your supervisor(s)?**
    - Did you ever observe others who were singled out or treated unfairly at work?
    - Can you think of a time when you were singled out or treated unfairly at work?
    - Did you ever witness or experience any violence or aggressive behavior at work?

  Probes for this section:
    - *When you experienced or witnessed these incidents, what typically led up to the incident, and what happened afterwards?*
    - *Can you tell me about how these sorts of incidents shaped your experience in the mine, if at all?*
- **Was there a time that you didn't alert someone about a safety concern or didn't tell your supervisor about something unfair that happened at work because you feared for your job?**
    - *If yes*: Can you describe the situation and why you were concerned for your job?
- **I know that mining can be very physically demanding. Were there times when you or miners you worked with weren't able to keep up with the physical demands of the work?**
    - *Probes:*
        - *What did you and others do when you saw someone else struggling?*
        - *What did you do if you struggled to keep up?*
-

Semi-Structured Interview Guide (Alpha 6)

- *[If support of co-workers described and respondent has/had subsequent non-mining job(s)]* Have you found the same levels of supports from coworkers in your non-mining work?

- **Did you ever know anyone who was seriously injured or killed in a mine?**

  - *If yes*, I know that it can be really difficult talking about topics like this. If you are willing, can you tell me a bit more about what happened right before, during, and after the accident or incident?
    Probes:
    - *Was this someone you worked with?*
    - *Was this something you heard about, but not someone you worked with?*
    - *What was going on around the time that (the accident/incident) occurred?*

    Can you walk me through what happened immediately after (the incident)?
    Probes for specific injuries/illnesses:
    - *Black lung*
    - *Injuries that prevented someone from working in the mine again*
    - *Roof collapse*

  - *If yes*: Can you tell me a bit about what happened in the mine after (the accident/incident)?
    Probes:
    - *How did management/supervisors respond?*
    - *How did other miners respond?*

  - *If yes*: How did/do you deal with or cope the stress of experiencing or witnessing [above]
    Probes:
    - *Who did you talk to about it?*
    - *Did your supervisors help you cope?*
    - *Other coping mechanisms (alcohol, drugs, exercise*)?

  - *If no*: Did/do you worry that something bad would happen to you or your coworkers in the mines?

  - How have the things that happened to you, things you witnessed, or things you worried about in the mines impact your life?

  - *Probes:*
    - *Impact your relationships?*
    - *Sleep?*
    - *Interests?*
    - *Health?*

IV. <u>*Health*</u>

Now I'd like to shift topics and talk some about health.

Semi-Structured Interview Guide (Alpha 6)

- **How do you think your work as a coal miner impacted the physical health of the miners you worked with?**

- **How do you feel that mining has impacted your physical health, if at all?**

  - *If this hasn't come up:* Did you experience an injury on the job while mining?
    Probe for:
    - *(If details not shared) Can you tell me a bit more about (the injury) and how (the injury) happened?*
    - *(If acute injury):*
      - *What was going on around the time that (the accident/incident) occurred?*
      - *Can you walk me through what happened immediately after (the incident)?*
      - *How did other folks respond to (the accident/incident)? (probe for supervisors, other miners)*

  - *If occupational injury*: Did you see a doctor for [describe injury]?
    Probes:
    - *Did you need surgery?*
    - *Were you prescribed pain medications for your injury? Are you still taking these medications? For how long have you/did you take these medications?*

  - Have you experienced mining-related illnesses?

  - Is this/are these something that has fully resolved or does this injury/illness still bother you today?
    Probes:
    - *(If resolved)*
      - *How long did you have (illness)?*
      - *Can you tell me a bit about how (the illness) impacted your day-to-day life?*
      - *How and when did (illness) resolve?*
    - *(If still bothersome)*
      - *How long have you had (illness)?*
      - *How does (the illness) impact your day-to-day life?*
      - *Are there things that you do to help you cope with troublesome symptoms of (illness)?*

- **When you think about your health today, generally, what do you feel is going well? What are you most worried about, health-wise?**

- **How often do you typically get a health checkup or visit a doctor?**

  - If you wanted to see a doctor for a physical health concern, would it be easy for you to do so? Why or why not?

  - If you wanted to see a doctor for a mental health concern, would it be easy for you to do so? Why or why not?

Semi-Structured Interview Guide (Alpha 6)

- **How do you think your work as a coal miner impacted the mental health of the miners you worked with?**

- **How do you think your work as a coal miner impacted your mental health?**

  - *If substance abuse:* Have you received treatment for [alcohol/drug] use?

  - *If mental health concern*: Have you sought treatment for [mental health concern]? Do you feel that treatment was helpful?

  - How did/do you deal with [above]?
    Probes:
    - *Who do/did you turn to for help? Pastor? Friend? Doctor? Family?*

V. Home Life

I have a couple of questions about your life growing up.

- **Can you tell me a bit about your parents or guardians, and what they did for work while you were growing up?**

  - Do you remember times when your dad/parents were laid off, or on strike, or any other hard times?
    Probes:
    - *How often*?
    - *How did this impact your life/your family's life at the time*?

  - Do you remember particularly good times for your family? Can you tell me about those?

- **When you were a child, what did you think you'd do when you grew up?**

- **How is your life now like that of your parents? How is it different?**

  - Would you say that your life is easier than that of your parents? Why or why not?

I'd like to hear a bit about your home life now.

- **What does your typical day look like now? How is it different from your daily routines in the past?**

- **Can you describe who currently lives or spends time in your household and what your relationships are with those individuals?** (*Examples – grandchildren, children, siblings, etc.*).

  - [*If others reside in household*] Can you share whether other members of your household are employed, and if there are members of your household who depend on you for care or for financial support?

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- Are there individuals outside of your household who depend on you for care or for financial support?

- **Can you describe any things about your home life currently that you think are going particularly well?**

- **How about things that you find to be particularly stressful?**
  Probes:
  - *Issues with drug abuse (family/friends)*
  - *Disabilities/handicaps (self/family)*
  - *Raising grandchildren*
  - *Retirement income, health insurance, other financial stressors*

- **How do you typically cope with challenges that arise in your day-to-day life?**

- [*If no longer mining*] **How has your home life changed, if at all, since you stopped working as a miner?**

  - How did you feel about leaving mining? [*If retired*] About stopping working?
    Probes:
    - *Did you leave before you wanted to?*
    - *What impacts has this had on your life?*
    - *What is different now than before?*
    - *How did this change how you feel about yourself, if at all?*

- **How do you feel about growing older? What are you most excited for? Most worried about?**

- **What do you feel have been important frustrations in your life?**

- **What do you feel have been important successes in your life?**

This brings us to the end of our questions. Is there anything else that you'd like to share, or anything that you think we did not ask about that is important for us to know? [*pause for response, once all questions have been addressed, **stop recording before proceeding to collect mailing address***].

You will receive $40 for completing today's interview. Your interview payment will be mailed to you, which you will receive in the next 2-4 weeks. What is the best mailing address to send this payment to you?"

Thank you very much for your time. We really appreciate your participation in this conversation. If you have any questions for us, you can reach us at this phone number (*provide study number*) or via email (*provide study email*).