

**Exploratory Research Projects Regarding Mining-Related Health Problems  
(AFC618)**

**ALPHA FOUNDATION FOR THE IMPROVEMENT OF MINE SAFETY AND HEALTH**

**Final Technical Report**

**Project Title:** Coal Mining Risk of Arthritis, Including Auto-Immune Rheumatologic Disease

**Grant Number:** AFC618-04

**Organization:** University of California, San Francisco

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## 2. Executive Summary

“Coal Mining Risk of Arthritis, Including Auto-Immune Rheumatologic Disease,” proposed two principal aims. The first was to delineate risk factors for any form of arthritis (hereafter referred to as “arthritis”) in a population survey of adult males in geographic areas manifesting a high burden of coal worker’s pneumoconiosis (CWP). The second was to delineate the risk factors for autoimmune rheumatologic disease, the most common of which is rheumatoid arthritis (hereafter referred to as “RA”) in a population survey of adult males in geographic areas manifesting a high burden of CWP. The research hypothesis underpinning these related aims is that coal mining would be associated with increased risk of arthritis and, specifically, RA as well. This takes into account other known risk factors for arthritis, for example age, ergonomic exposures and cigarette smoking. Specifically for RA, we hypothesized that coal and silica dust would be key work-associated risk factors for disease.

We carried out a random digit dial population-based telephone survey of men aged 50 and over with a history of labor force participation and residing in coal mining areas. We specifically targeted persons living in Appalachia (selected counties in Kentucky, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia) with historically high mortality rates from coal workers’ pneumoconiosis (CWP) based on data previously analyzed by the National Institute for Occupational Safety and Health (NIOSH). We developed a telephone survey instrument, working closely with our survey contractor, Davis Research, to refine and field test this instrument. After preliminary analysis of descriptive data distributions, we used multivariable logistic regression analysis to model separately the risk of arthritis and RA in association with coal mining employment. Our metric of risk was the odds ratio (OR), which estimates the odds of an outcome (e.g., RA) among those with the risk factor (e.g., coal mining work) relative to those without. The associated confidence interval (CI) assesses the confidence that the observed OR is unlikely to be due purely to chance. Based on the OR and the proportion of cases at risk, we also estimated the population attributable fraction (PAF). This estimates the proportion of preventable disease if the risk factor were to be eliminated.

We completed 1,003 surveys, consistent with our target of 1000 (from among 4965 active numbers: 2066 landline and 2899 cell lines). We had a 37% cooperation rate and 10% success among survey-eligible contacts. Of the respondents, 888 (91%) were white; ever smokers comprised 87% of participants. More than one in four respondents (27%) reported employment in coal mining, of whom 50% had worked underground. Over half (54%) of those with any current or past employment reported employment for one year or more that involved “regular exposure to breathing dusty air.” Of these, 41% reported at least one of seven work duties likely to involve silica exposure. Of 14 work-related, adverse ergonomic factors we surveyed, those with 10 or more comprised 30% of the entire group but characterized more than half of the coal and other silica exposures, while only 12% of all others. Over half of the respondents reported having received a health care provider’s diagnosis of arthritis; 12% reported a diagnosis of RA with corticosteroid treatment; corticosteroid treatment increases the diagnostic reliability of self-reported RA.

Coal mining work was associated with more than double the odds of arthritis (OR 2.2; 95% CI, 1.6, 3.1), taking into account smoking, ergonomic factors, and age. The PAF for arthritis in relation to coal mining was 19% (95% CI 14-24%). We estimated RA risk excluding those with other arthritis. The OR of RA associated with coal mining was increased more than three-fold (OR 3.5; 95% CI (2.0, 6.0). The PAF was 33% (95% CI 26-40%). Our findings met our primary study aims, supporting our underlying study hypotheses. We found that arthritis overall and specifically RA are prevalent in this population and are associated with coal mining employment. Based on the observed PAF, one out of three cases of RA in this study population appears to be due to coal mining employment.

### **3. Problem Statement and Objective**

Our solicitation focus area was “Musculoskeletal Disorders.” This award, “Coal Mining Risk of Arthritis, Including Auto-Immune Rheumatologic Disease,” proposed two principal aims and related hypotheses:

Aim 1: Delineate risk factors for arthritis in a population survey of adult males in geographic areas manifesting a high burden of CWP. Research Hypothesis: Coal mining employment is associated with increased risk of arthritis, taking account other known risk factors for arthritis, for example age, ergonomic exposures beyond those from mining occupations, and cigarette smoking.

Aim 2: Delineate the risk factors for autoimmune rheumatologic disease in a population survey of adult males in geographic areas manifesting a high burden of CWP. Research Hypothesis: Coal mining employment is associated with increased risk of auto-immune rheumatologic conditions, taking account of risk associated with non-coal mining occupational mineral dust exposures (such as those linked to construction or metal foundry work) and including the covariates, age and cigarette smoking. Further, the magnitude of this risk will be greater than for arthritis overall.

The rationale for this project is that occupational exposure to mineral dust in multiple independent studies is strongly associated with markedly elevated risk of autoimmune disease with arthritis manifestations. Of these, rheumatoid arthritis (RA) has been the condition most strongly implicated in association with mineral dust. Despite suspicion of an increased prevalence of arthritis in coal mining populations, the collocation of regions in which coal mining is concentrated and where there is a high prevalence of arthritis in males has been studied only to a limited extent and not in recent decades. The impetus for this study was to examine whether the etiologic connection between these two factors (the prevalence of arthritis, including autoimmune disease, and being a male in Appalachia) is likely to be coal mining itself. This association, if established at the regional level, would be important in the delivery of health care services relevant to individual case attribution and compensation. For example, treatment guidelines for RA indicate that a disease-modifying agent should be started soon after onset of disease that could be detected by targeted surveillance recognizing coal miners as an at-risk group. The association could also lead to preventive measures in coal mining, for example through stricter standards and enforcement to reduce dust levels.

### **4. Research Approach**

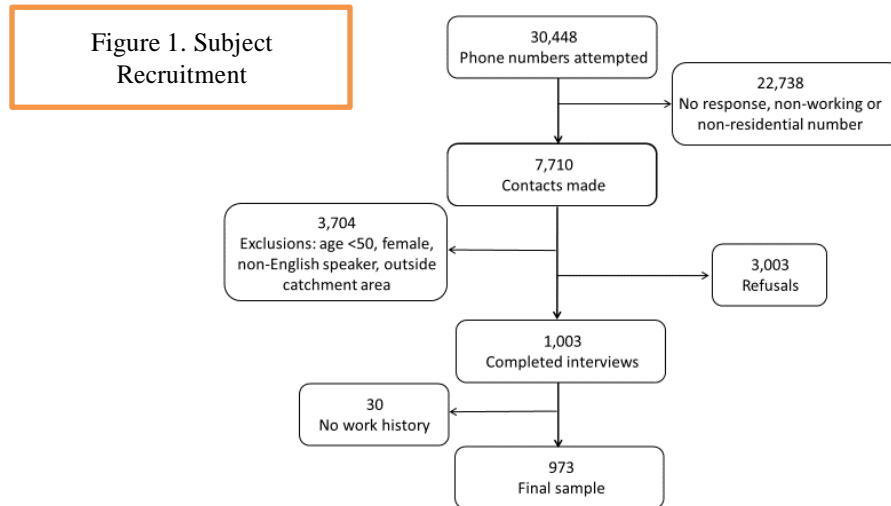
We carried out a random digit dial population-based telephone survey of men aged 50 and over with a history of labor force participation and residing in coal mining areas. We specifically targeted persons living in Appalachia (selected counties in Kentucky, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia) with historically high mortality rates from coal workers’ pneumoconiosis (CWP) based on data previously analyzed by the National Institute for Occupational Safety and Health (NIOSH). Meeting our proposed study timeline, the research team developed a telephone survey instrument in the first three months of the award (July through September 2017). We worked closely with Davis Research (our interviewing contractor) to refine and then field test this instrument in September 2017, insuring that skip patterns functioned as designed, that subjects’ responses were consistent with item intent, and that the overall length of the interview conformed to our specifications. The interviews went into the field in October and sampling was complete by early November 2017 (study months four-five). In study month six, we carried out data cleaning. Study months seven through twelve were devoted to data analysis. After preliminary analysis of descriptive data distributions, we used multivariable logistic regression analysis to model separately the risk of arthritis and RA in association with coal mining employment.

Our metric of risk was the odds ratio (OR), which estimates the odds of an outcome (e.g., RA) among those with the risk factor (e.g., coal mining work) relative to those without. For example, an OR of 1.0 would indicate no increased risk of RA associated with coal mining; an OR of 2.0 indicates and increased risk with a doubling of the odds of RA associated with coal mining. The confidence interval (CI) assesses the confidence that the observed OR, even if 2.0, differs statistically from 1.0. Based on the OR and the proportion of cases at risk, we also estimated the population attributable fraction (PAF). This is an estimate of the overall proportion of preventable disease if the risk factor were to be eliminated. A PAF of 33 percent for RA associated with coal mining suggests that, absent that risk, one out of three cases of RA would not have occurred.

## 5. Results, Summary of Accomplishments, Conclusions and Impact Assessment

### Results

We completed 1,003 surveys, consistent with our target of 1,000 (from among 4,965 active numbers: 2,066 landline and 2,899 cell lines). We had a 37% cooperation rate and 10% success among survey eligible contacts. The target interview length was 12.45 minutes on average, within our target specifications. After minimal exclusions, our analysis is based on 973 participants (by design, all male).



Frequency data for employment status and related exposures are shown below in Table 1. More than one in four respondents (27%) reported employment in coal mining; 50% of whom reported work underground. The mean duration of coal work employment was 21±13 years (60 miners had worked 30 years or more). Over half (54%) of those with any current or past employment, independent of their response to the survey item eliciting coal mining work status, reported employment for one year or more that involved “regular exposure to breathing dusty air,” with a mean duration of 21.5±14 years. Of all 973 surveyed, 400 (41%) responded positively to at least one of the following seven categories of exposure: silica, sand, or concrete dust; sandblasting; rock drilling or roof bolting; rock crushing or quarry work; foundry work; concrete finishing, cutting, or drilling; or masonry work or tip-pointing. Among the 133 underground coal miners, 78 (59%) reported rock drilling or roof bolting work.



| Ergonomic Factor                  | All Respondents (n=973) | Coal Mining (n=266) | Other Silica (n=189) | Neither (n=518) |
|-----------------------------------|-------------------------|---------------------|----------------------|-----------------|
| Lifting/carrying >30 lbs.         | 69.8                    | 83.1                | 93.7                 | 54.2            |
| Arms overhead                     | 55.3                    | 64.3                | 77.8                 | 42.5            |
| Knee bend/squat/kneel             | 69.3                    | 82.7                | 91.0                 | 54.4            |
| Back bend/twist                   | 68.1                    | 81.6                | 88.4                 | 53.9            |
| Hand grip/wrist bend              | 71.8                    | 85.0                | 89.9                 | 58.5            |
| Shaking/vibrating equip           | 36.3                    | 57.1                | 58.7                 | 17.4            |
| Hammer/chisel/saw/drill           | 50.5                    | 71.1                | 80.4                 | 29.0            |
| Stoop over                        | 71.1                    | 82.7                | 91.0                 | 57.9            |
| Pneumatic tools                   | 32.7                    | 51.5                | 56.1                 | 14.5            |
| Pedal/treadle                     | 37.3                    | 53.0                | 46.0                 | 26.1            |
| Push/pull >50 lbs                 | 55.5                    | 71.1                | 80.4                 | 38.4            |
| Neck twist/bend                   | 51.7                    | 73.3                | 66.7                 | 35.1            |
| Stand > 8 hrs./day                | 65.6                    | 73.3                | 83.6                 | 55.0            |
| High level exposure (>10 factors) | 30.4                    | 50.8                | 53.4                 | 11.6            |

\* All measures differed at  $p < 0.001$  across the 3 occupational groups.

The frequencies of osteoarthritis and other arthritic conditions are shown in Table 4. The survey queried report of a condition diagnosed by a health care provider (Stem question: Has a doctor, nurse, or other health professional ever told you that you have arthritis?). Over half of the respondents reported having received a health care provider's diagnosis of arthritis; of these, the majority (34% of all those surveyed) did not identify RA. A diagnosis of RA was reported by 188 (19%), but restricting this to a more conservative case definition of RA with corticosteroid treatment at any point yielded a disease prevalence of 12%. Three percent of those surveyed reported at least one non-RA autoimmune condition. The prevalence of these autoimmune conditions were as follows: systemic lupus erythematosus (SLE), 5 (two of whom did not report concomitant arthritis); systemic sclerosis, 5; and psoriatic arthritis, 20. Among these, 11 also were in the RA with corticosteroids group.

| Condition                                     | N   | %   |
|---|-----|-----|
| Any arthritis                                 | 517 | 53% |
| Arthritis, excluding rheumatoid arthritis     | 329 | 34% |
| Any rheumatoid arthritis                      | 188 | 19% |
| Rheumatoid arthritis, without corticosteroids | 76  | 8%  |
| Rheumatoid arthritis, with corticosteroids    | 112 | 12% |

Table 5 presents the risk for all arthritis, RA, and arthritis without RA. These risks are estimated from multivariable logistic regression models taking into account smoking status (current and former, with never smoking as the referent category), occupational ergonomic factors (11-13 factors with less than that as the referent category), and age.

| Table 5. Multivariate analysis: Risk of arthritis and rheumatoid arthritis associated with coal and silica exposure adjusted for smoking, ergonomic factors, and age |                              |                                      |                                   |
|--|------------------------------|--------------------------------------|-----------------------------------|
|  | All arthritis<br>Model n=973 | Rheumatoid Arthritis<br>Model n=566* | Non-RA Arthritis<br>Model n=861** |
| Risk Factor  | OR (95% CI)                  | OR (95% CI)                          | OR (95% CI)                       |
| Coal and Silica exposure   |                              |                                      |                                   |
| Coal mining work   | 2.2 (1.6, 3.1)               | 3.5 (2.0, 6.0)                       | 2.0 (1.3, 2.8)                    |
| Silica, no coal exposure   | 1.7 (1.2, 2.4)               | 1.9 (1.01, 3.6)                      | 1.6 (1.1, 2.4)                    |
| Smoking  |                              |                                      |                                   |
| Current  | 1.2 (0.8, 1.9)               | 2.0 (1.0, 3.8)                       | 1.1 (0.7, 1.7)                    |
| Former   | 1.1 (0.8, 1.4)               | 1.2 (0.7, 1.9)                       | 1.1 (0.7, .5)                     |
| Ergonomic exposure   |                              |                                      |                                   |
| 11-13 factors  | 1.5 (1.1, 2.0)               | 1.8 (1.1, 3.0)                       | 1.4 (0.99, 2.0)                   |
| Age (per year)   | 1.03 (1.01, 1.04)            | 1.04 (1.01, 1.05)                    | 1.03 (1.01, 1.04)                 |
| For coal and silica, referent category=neither exposure; for smoking, referent=never smoker; for ergonomic exposure, referent category= 0 to 10 factors.             |                              |                                      |                                   |
| *Excludes 407 reporting arthritis or selected autoimmune diseases without concomitant RA.  |                              |                                      |                                   |
| **Excludes 112 participants reporting RA and glucocorticoid treatment  |                              |                                      |                                   |

Coal mining work was associated with more than double the odds of all arthritis (OR 2.2; 95% CI, 1.6, 3.1). The coal mining population attributable fraction (PAF) for all arthritis was 19% (95% CI 14-24%). Silica exposure, exclusive of coal mining, was also associated with significantly increased odds of arthritis (OR 1.7; 95% CI 1.2, 2.4) with a lower PAF (9%; 95% CI 4-13%). For all arthritis, exposure to 11 to 13 ergonomic factors (present in 30 percent of respondents) was associated with 50 percent increased odds of disease (OR 1.5; 95% CI 1.1-2.0). Smoking was not associated with statistically increased odds of arthritis.

We estimated RA risk excluding those with arthritis or other rheumatic autoimmune diseases (SLE, systemic sclerosis, or psoriatic arthritis) without concomitant RA (407 excluded). Compared to all arthritis, the estimated risk of RA associated with coal mining was higher (OR 3.5; 95% CI 2.0, 6.0) as was the PAF (33%; 95% CI 26-40%). For silica exclusive of coal work, the risk estimate was similar to that for arthritis overall (OR 1.9; 95% CI 1.01- 3.6), as was the PAF (9%; 95% CI 2-16%). We also estimated the risk of non-RA arthritis (excluding RA from the model). Coal mining was associated with double the odds of disease (2.0; 95% CI 1.3, 2.8). The ergonomic risk estimate was also elevated but attenuated to 1.4 and not statistically significant (95% 0.99, 2.0; p=0.056).

To further examine the potential interactions between ergonomic factors and coal/silica exposure for arthritis risk, we carried out an analysis stratified by level of ergonomic factors. In the entire group (adjusted ergonomics, smoking, and age), the risk of arthritis associated with coal work or silica exposure was OR 2.0 (95% 1.5-2.7). Among those reporting 10-13 ergonomic factors (n=296), the coal/silica association risk was not statistically significant (OR 1.5; 95% CI 0.8-2.7). Among the stratum with a lower ergonomic burden (n=677), the risk was higher and was statistically significant (OR 2.2; 95% CI 1.6, 3.1). A formal test of an interaction term, however, was not statistically significant (p=0.24)

## Summary of Accomplishments

Meeting our timeline and work plan, we successfully: designed, refined and field tested our survey instrument; carried out the survey as proposed; achieved our targeted participation numbers; confirmed that key exposures and outcomes were sufficiently frequent in the study population to adequately power our analysis; and carried out the analyses we had proposed. Our findings meet our primary Study Aims and support our underlying Study Hypotheses. We found that both arthritis overall and, specifically, RA are prevalent among the population sampled and are associated with coal mining employment. In our study, coal mining was associated with double the odds of arthritis and a more than three-fold increased odds of RA. This risk was present after taking into account ergonomic factors as well as smoking history and age. The PAF for RA, that is, the amount of RA attributable to coal mine work, was 33%. Stated in other terms, one out of three cases of RA appear to be due to this risk factor.

## Impact Assessment

Our findings have limitations that should be taken into account when assessing their potential impact. The diagnosis of RA we used was based on respondent report of a health care provider's diagnosis. This is the approach used in many questionnaire-based studies, most notably the U.S. National Health Interview Survey. Nonetheless, self-reported disease can be subject to random misclassification or reporting bias. Random misclassification of disease can only result in a reduced association between an exposure and outcome, because persons with and without true disease under- or over-report the condition, thus cancelling out an effect. In contrast, systematic reporting bias could lead persons with coal mining histories to be more likely to report disease, thus leading to a false association. We did not have access to medical records, serologic data (e.g., for rheumatoid factor), or physical examinations, sources of confirmatory data that mitigate against reporting bias. Our finding of a 53% prevalence of arthritis overall, although high, is consistent with estimated rates in Appalachia: the total prevalence of arthritis in West Virginia based on 2015 data was 50% among those aged 44-64 and among those 65 and older was 60% overall. (1) It is probable that some persons with osteoarthritis but not autoimmune disease misreport their condition as RA. In particular, the term "rheumatism" as commonly used may manifest geographic regional differences that magnify this problem in the counties from which we recruited.(2) We attempted to address this, in part, by using a conservative definition of disease that also included reported corticosteroid use. In addition, the higher coal mining associated OR that we observed for RA as compared to arthritis (3.5 vs. 2.2) argues against selective over-reporting of arthritis as RA amongst coal miners. Were preferential over-reporting to be the case, the estimated OR should have been similarly elevated for arthritis. Further, the association with current smoking for RA (2.0), but not all arthritis (1.2), is consistent with previous observations specific to RA. (3)

We hypothesized that, independent of dust inhalation, ergonomic exposures in coal mining would also be a risk factor for arthritis. This was, in fact, the case (OR 1.5 for all arthritis, 1.7 for RA, and 1.4 for arthritis excluding RA ). Ergonomic factors with established relationships to osteoarthritis include: kneeling, bending, squatting, crawling, whole body vibration, lifting heavy loads, and repetitive motion.(4-9) For osteoarthritis of the knee, data specific to coal mining has established a strong link to disease.(10-16) It is reasonable to assume that this can be generalized to other body parts. Thus, the arthritis that we observed is consistent with the pattern of ergonomic factors reported by the coal (and silica) exposed participants in our study, but ergonomics alone does not account for all the risk, because our multivariable modelling of coal mining risk for arthritis and RA took into account these factors. Indeed, the association of a high ergonomic load with RA was of a similar magnitude as that for arthritis overall (without the step up in risk for coal mining with RA compared to arthritis). This observation of a lack of step-up in risk may be explained by some osteoarthritis being mislabeled as RA. We did not identify a significant interaction between ergonomic exposures and coal or silica for arthritis risk, although study power was limited, with fewer than 300 in the stratum with a heavy ergonomic load.



Our findings are consistent with other observations in coal and silica exposure. In the early 1950s, there were nearly simultaneous observations that both silica dust (nearly pure silica “flour”) and coal mining work were associated with RA. These observations were made by Colinet in Belgium and Caplan in the UK. (17-19) By the 1990s, researchers identified mineral dust as a factor in a range of autoimmune diseases. (20-23) Although much of the biomedical literature focuses on silica, there is emerging recognition that silica co-exposure in coal mining represents an important factor in what has come to be recognized more broadly as “coal mine dust lung disease.”(24-25)

Despite this, there has been relatively little study focused on RA among U.S. coal miners. Nearly fifty years ago, a 1969 study of rheumatism in 560 miners and 546 non-miners in Marion County, West Virginia observed that rates of positive rheumatoid factor in miners aged 50-69 (9%) were only modestly higher than non-miners in that age group (7.4%). That study also found that radiographic hand changes consistent with RA were present in 5.7% of miner in that age range compared with 3.9% of non-miners (rate 1.5). (26) Another rheumatoid factor prevalence study was carried out among Pennsylvania and West Virginia coal miners and published in 1973. (27) That study concluded that there was little evidence of elevated rheumatoid factor among the miners (the serologic marker for SLE, ANA, did manifest increased prevalence). In contrast, contemporaneous clinical studies of coal miners from the same region suggested that exposure-related RA was more common than appreciated.(28,29) Only one other study of rheumatologic disease in Appalachian coal miners has appeared since that time, published in 1981.(30)

In summary, our findings of increased risk of arthritis and RA among coal miners in Appalachia are robust, unlikely explained by biased reporting or confounding, and are consistent with other studies, primarily of silica exposure outside of coal mining. We already presented preliminary findings at the 2018 American Thoracic Society International meeting in May 2018 (“Occupational exposure to coal and silica dust and risk of rheumatoid arthritis in Appalachia”).(31) We also have submitted an abstract to the 2018 American College of Rheumatology/ Association of Rheumatology Health Professionals annual meeting for October 2018 (“Occupational exposure to coal and silica dust is associated with elevated risk of rheumatoid arthritis in coal mining areas of US”; under review). A full manuscript for peer-review publication is currently in preparation. We anticipate submitting this by September 2018. We also wish to build on the success of this exploratory research. To do so, we intend to seek support from the Alpha Foundation, if invited to do so, in its upcoming cycle intended to fund competitive follow-on proposals from projects demonstrating promise based on convincing evidence from the exploratory efforts. This proposal will use a case referent approach, recruiting patients with well-characterized RA from specialists’ practices in the region matched with persons with health conditions unlikely to be causally associated with coal mining employment.

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## **7.0 Appendices**

I. Study survey instrument, screening questions

Davis Research  
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090517  
Final

2017 UCSF Alpha Survey  
– Screening Questions –

Hello, my name is \_\_\_\_\_, and I am calling from Davis Research, an independent public opinion research organization. We are conducting an important survey for the University of California, School of Medicine about some work and health-related issues. This is a legitimate public opinion survey – we are not selling anything. It will not take long, only about 10 or 12 minutes for most people.

- S1. We are only conducting this survey in certain states and counties in the U.S. In what state do you live?
- KENTUCKY .....1
  - OHIO .....2
  - PENNSYLVANIA .....3
  - TENNESSEE .....4
  - VIRGINIA .....5
  - WEST VIRGINIA .....6
  - ALL OTHER STATES...7 ✍️ END
  - REFUSED ..... 8 ✍️ END

S2. And, in what county do you live?

- | <u>IF KENTUCKY</u>     | <u>IF OHIO</u>          | <u>IF PENNSYLVANIA</u> |
|------------------------|-------------------------|------------------------|
| BELL .....01           | ATHENS .....01          | ARMSTRONG ..... 01     |
| CLAY .....02           | BELMONT .....02         | BEDFORD..... 02        |
| FLOYD .....03          | GALLIA .....03          | CAMBRIA..... 03        |
| HARLAN .....04         | JEFFERSON .....04       | CARBON ..... 04        |
| HOPKINS .....05        | LAWRENCE.....05         | CENTRE ..... 05        |
| JOHNSON .....06        | MEIGS.....06            | CLARION ..... 06       |
| KNOTT .....07          | MUSKINGUM .....07       | CLEARFIELD ..... 07    |
| KNOX .....08           | PERRY .....08           | COLUMBIA..... 08       |
| LAUREL .....09         | TUSCARAWAS.....09       | DAUPHIN..... 09        |
| LESLIE ..... 10        | ALL OTHER ... 10 ✍️ END | ELK ..... 10           |
| LETCHER..... 11        | REFUSED ... 11 ✍️ END   | FAYETTE..... 11        |
| MCCREARY..... 12       |                         | GREENE..... 12         |
| MARTIN ..... 13        |                         | INDIANA ..... 13       |
| MUHLENBERG..... 14     |                         | JEFFERSON..... 14      |
| PERRY ..... 15         |                         | LACKAWANNA..... 15     |
| PIKE ..... 16          |                         | LUZERNE ..... 16       |
| PULASKI..... 17        |                         | MONTOUR ..... 17       |
| UNION..... 18          |                         | NORTHUNMBERLAND18      |
| WHITLEY ..... 19       |                         | SCHUYLKILL ..... 19    |
| ALL OTHER .. 20 ✍️ END |                         | SOMERSET..... 20       |
| REFUSED .. 21 ✍️ END   |                         | SUSQUEHANNA ..... 21   |
|                        |                         | WASHINGTON..... 22     |
|                        |                         | WAYNE ..... 23         |
|                        |                         | WESTMORELAND .... 24   |
|                        |                         | WYOMING ..... 25       |
|                        |                         | ALL OTHER .. 26 ✍️ END |
|                        |                         | REFUSED .. 27 ✍️ END   |

IF TENNESSEE

ANDERSON.....01  
CAMPBELL.....02  
CLAIBORNE .....03  
GRUNDY.....04  
HAWKINS.....05  
MARION.....06  
MORGAN .....07  
ROANE .....08  
SCOTT .....09  
ALL OTHER .. 10 ✍ END  
REFUSED ....11 ✍ END

IF VIRGINIA

BUCHANAN .....01  
DICKENSON .....02  
FAUQUIER .....03  
LEE.....04  
NORTON CITY .....05  
RUSSELL .....06  
SCOTT .....07  
TAZEWELL .....08  
WASHINGTON .....09  
WISE.....10  
ALL OTHER .. 11 ✍ END  
REFUSED ....12 ✍ END

IF WEST VIRGINIA

BARBOUR ..... 01  
BOONE ..... 02  
BRAXTON ..... 03  
CLAY..... 04  
FAYETTE ..... 05  
GREENBRIER ..... 06  
HARRISON ..... 07  
KANAWHA..... 08  
LINCOLN..... 09  
LOGAN ..... 10  
MCDOWELL..... 11  
MARION..... 12  
MARSHALL..... 13  
MERCER..... 14  
MINERAL ..... 15  
MINGO..... 16  
MONONGALIA..... 17  
MONROE ..... 18  
NICHOLAS..... 19  
PRESTON ..... 20  
RALEIGH..... 21  
RANDOLPH ..... 22  
SUMMERS..... 23  
TAYLOR..... 24  
UPSHUR ..... 25  
WAYNE..... 26  
WEBSTER ..... 27  
WYOMING ..... 28  
ALL OTHER ..29 ✍ END  
REFUSED.....30 ✍ END

S3. RECORD GENDER: (INTERVIEWER: IF YOU HAVE ANY DOUBT AS TO RESPONDENT'S GENDER, SAY: Because it is sometimes difficult to determine over the phone, I am asked to confirm whether you are male or female.)

MALE..... 1  
FEMALE ..... 2

LANDLINE SAMPLE

IF MAN IS ON THE TELEPHONE, SAY:

S4a. For this interview I need to speak to a male age 50 or older. Does a male age 50 or older live in your household? (IF YES, ASK) Is that you or someone else? (IF SOMEONE ELSE, ASK TO SPEAK TO THAT PERSON) (IF MORE THAN 1 MALE AGE 50 OR OLDER LIVING IN HOUSEHOLD, SAY: I'd like speak with the youngest male age 50 or older who is at home now.)

|                                 |   |                                      |
|---------------------------------|---|--------------------------------------|
| SPEAKING TO ELIGIBLE MALE       | 1 | CONTINUE WITH S5A                    |
| ELIGIBLE MALE COMES TO PHONE    | 2 | REPEAT INTRO, THEN CONTINUE WITH S5A |
| ELIGIBLE MALE NOT AVAILABLE NOW | 3 | CALLBACK                             |
| NO MALES AGE 50+ IN HOUSEHOLD   | 4 | END                                  |
| REFUSED.....REF                 |   | END                                  |

IF WOMAN IS ON THE TELEPHONE, SAY:

S4b. For this interview I need to speak to a male age 50 or older. Does a male age 50 or older live in your household?. (ASK TO SPEAK TO THAT PERSON) (IF MORE THAN 1 MALE AGE 50 OR OLDER AT HOME NOW, SAY: I'd like to speak with the youngest male age 50 or older who is at home now.)

|                                |   |                                      |
|--------------------------------|---|--------------------------------------|
| SPEAKING TO ELIGIBLE MALE      | 1 | CONTINUE WITH S5A                    |
| ELIGIBLE MALE COMES TO PHONE   | 2 | REPEAT INTRO, THEN CONTINUE WITH S5A |
| ELIGIBLE MALE IS NOT AVAILABLE | 3 | CALLBACK                             |
| NO MALES AGE 50+ IN HOUSEHOLD  | 4 | END                                  |
| REFUSED.....REF                |   | END                                  |

S5a. What is your age?

\_\_\_\_\_ IF AGE 50+, GO TO S6  
 IF UNDER AGE 50 ..... X ✎ END  
 REFUSED..... XX ✎ ASK S5B

IF REFUSED, ASK:

|   |                   |             |
|---|-------------------|-------------|
| S5b. I don't need to know exactly, but can you tell me if you are under age 50, age 50-54, 55-59, 60-64, 65-69, 70-74 or 75 or older? | UNDER AGE 50..... | 1 ✎ END     |
|   | 50-54.....        | 2 CONTINUE  |
|   | 55-59.....        | 3 CONTINUE  |
|   | 60-64.....        | 4 CONTINUE  |
|   | 65-69.....        | 5 CONTINUE  |
|   | 70-754.....       | 6 CONTINUE  |
|   | 75 OR OLDER.....  | .7 CONTINUE |
|   | REFUSED.....      | 8 ✎ END     |

S6. You are eligible to participate in an important study about the potential impact of work on health. The survey is completely voluntary and you can stop at any point. Upon completing the survey, we will send you a \$5 gift card to Amazon or Starbucks.

YES, PROCEED ..... 1 ✎ CONTINUE WITH Q1  
 YES, BUT CALL BACK LATER 2 ✎ CALLBACK  
 NO ..... 3 ✎ END  
 NOT SURE..... 9 ✎ READ TEXT BELOW

(IF NECESSARY): The survey will only take about 10-12 minutes.

- The study's principal investigator is Dr. Paul Blanc at the University of California, School of Medicine. If you have any questions, we can give you the telephone number of Dr. Blanc's office or for the Office of Research Affairs at the University.
- Dr. Blanc's research office telephone number is 415-476-7377
- The University Office of Research Affairs telephone number is 415-476-1814

IF CALLBACK, ASK:

|      |  |                                 |
|------|--|---------------------------------|
| S7a. | When would be a good time for us to call back?   | RECORD DAY AND TIME OF CALLBACK |
| S7b. | So our interviewer can ask to speak to (that person) (you) by name, what is (his) (your) first name? | RECORD FIRST NAME FOR CALLBACK  |

CELL PHONE SAMPLE

- IF MALE FROM S3, GO TO S8A
- IF FEMALE FROM S3, END

|      |                   |   |
|------|-------------------|---|
| S8a. | What is your age? | _____ IF AGE 50+, GO TO S9<br>IF UNDER AGE 50.....X ✎ END<br>REFUSED ..... XX ✎ ASK S8b |
|------|-------------------|---|

IF REFUSED, ASK:

|      |  |   |
|------|--|---|
| S8b. | I don't need to know exactly, but can you tell me if you are under age 50, age 50-54, 55-59, 60-64, 65-69, 70-74 or 75 or older? | UNDER AGE 50 ..... 1 ✎ END<br>50-54.....2 CONTINUE<br>55-59.....3 CONTINUE<br>60-64.....4 CONTINUE<br><br>65-69.....5 CONTINUE<br>70-74.....6 CONTINUE<br>75 OR OLDER..... .7 CONTINUE<br>REFUSED ..... 8 ✎ END |
|------|--|---|

|     |   |   |
|-----|---|---|
| S9. | You are eligible to participate in an important study be about the potential impact of work on health. The survey is completely voluntary and you can stop at any point. Upon completing the survey, we will send you a \$5 gift card to Amazon or Starbucks. | YES, PROCEED .....1 ✎ CONTINUE, ASK S10a<br>YES, BUT CALL BACK LATER 2 ✎ CALLBACK<br>NO .....3 ✎ END<br>NOT SURE .....9 ✎ READ TEXT BELOW |
|-----|---|---|

(IF NECESSARY): The survey will only take about 10-12 minutes.

- The study's principal investigator is Dr. Paul Blanc at the University of California, School of Medicine. If you have any questions, we can give you the telephone number of Dr. Blanc's office or for the Office of Research Affairs at the University.
- Dr. Blanc's research office telephone number is 415-476-7377
- The University Office of Research Affairs telephone number is 415-476-1814

|       |  |   |
|-------|--|---|
| S10a. | For your safety, are you currently driving a motor vehicle, operating heavy equipment or in a place that is unsafe to do the survey? | YES.....1 CALLBACK<br>NO, CONTINUE.....2 CONTINUE WITH Q1 |
|-------|--|---|

IF CALLBACK, ASK:

|       |   |                                 |
|-------|---|---------------------------------|
| S11a. | When would be a good time for us to call back?  | RECORD DAY AND TIME OF CALLBACK |
| S11b. | So our interviewer can ask for you to speak to (that person) (you) by name, what is (his) (your) first name | RECORD DAY AND TIME OF CALLBACK |

2017 UCSF Alpha Survey  
 – Questionnaire –

Before we begin, I need to tell you that my supervisor sometimes monitors these interviews to ensure quality and courtesy.

The first questions concern work and employment.

1. Are you currently employed for pay or profit either full or part time? YES..... 1 (ASK Q2)  
 NO ..... 2 (GO TO Q3)  
 NO ANSWER/REFUSED ..... DK (GO TO Q3)

IF Q1=YES, ASK:

2. Do you work in coal mining? YES.....1 (ASK Q2A)  
 NO .....2 (GO TO Q4)  
 NO ANSWER/REFUSED .....DK

IF Q2=YES, ASK:

- 2a. Including your current and all past jobs, for how many years have you been working in coal mining? \_\_\_\_\_ YEARS  
 NO ANSWER/REFUSED .....DK
- 2b. Does this include surface or strip mining? YES .....1  
 NO.....2  
 NO ANSWER/REFUSED.....DK
- 2c. Does this include underground mining? YES .....1  
 NO.....2  
 NO ANSWER/REFUSED.....DK

IF Q1=NO OR DK, ASK:

3. Did you ever work for pay or profit for one year or longer, including civilian and military duties? YES.....1 (ASK Q4)  
 NO .....2 (GO TO Q5)  
 NO ANSWER/REFUSED.....DK (GO TO Q5)

IF (Q2=NO OR DK) OR (Q3=YES), ASK:

4. Did you ever work in coal mining? YES ..... 1  
 NO..... 2  
 NO ANSWER/REFUSED ..... DK

IF Q4=YES, ASK:

- 4a. For how many years did you work in coal mining? \_\_\_\_\_ YEARS  
 NO ANSWER/REFUSED..... DK
- 4b. Did this include surface or strip mining? YES ..... 1  
 NO..... 2  
 NO ANSWER/REFUSED ..... DK
- 4c. Did this include underground mining? YES ..... 1  
 NO..... 2  
 NO ANSWER/REFUSED ..... DK



IF Q3=NO OR DK, ASK:

|    |  |                         |    |
|----|--|-------------------------|----|
| 5. | Did you ever work without salary or pay on a farm or family business for one year or more? | YES .....               | 1  |
|    |  | NO.....                 | 2  |
|    |  | NO ANSWER/REFUSED ..... | DK |

- IF (Q1=NO OR DK) AND (Q3=NO OR DK) AND (Q5=NO OR DK), GO TO Q9

IF Q1=YES OR Q3=YES OR Q5=YES, ASK:

|    |   |                  |                          |
|----|---|------------------|--------------------------|
| 6. | Thinking about all of the types of work that you have done for <u>one year or more</u> during your career, did any job involve regular exposure to breathing dusty air? | YES .....        | 1 (GO TO Q6a)            |
|    |   | NO.....          | 2 ( GO TO Q8 )           |
|    |   | NO ANS/REF ..... | DK (SKIP Q6a AND ASK Q7) |

IF Q6=YES, ASK:

|     |  |  |                        |               |
|-----|--|--|------------------------|---------------|
| 6a. | For how many years did your job regularly expose you to breathing dusty air?   | _____ YEARS                                    | NO ANSWER/REFUSED..... | DK            |
| 7.  | Did you ever have regular contact on the job with any of the following? (READ ITEMS IN RANDOM ORDER, MULTIPLE YES ANSWERS ALLOWED) |  |                        |               |
|     |  | <u>YES</u>                                     | <u>NO</u>              | <u>DK/REF</u> |
| [ ] | a  | Coal dust or powder.....                       | 1 .....                | 2 .....DK     |
| [ ] | b  | Silica, sand, or concrete dust .....           | 1 .....                | 2 .....DK     |
| [ ] | c  | Sandblasting .....                             | 1 .....                | 2 .....DK     |
| [ ] | d  | Welding or flame cutting .....                 | 1 .....                | 2 .....DK     |
| [ ] | e  | Blasting or explosive fumes.....               | 1 .....                | 2 .....DK     |
| [ ] | f.   | Rock drilling or roof bolting .....            | 1 .....                | 2 .....DK     |
| [ ] | g  | Rock crushing or quarry work.....              | 1 .....                | 2 .....DK     |
| [ ] | h  | Foundry work .....                             | 1 .....                | 2 .....DK     |
| [ ] | i.   | Concrete finishing, cutting, or drilling ..... | 1 .....                | 2 .....DK     |
| [ ] | j.   | Masonry work or tip-pointing .....             | 1 .....                | 2 .....DK     |
| [ ] | k  | Metal grinding or polishing.....               | 1 .....                | 2 .....DK     |

8. Thinking about all of the types of work that you have done for one year or more during your career . . . did any job include the following manual activities on a daily or almost daily basis? (READ ITEMS IN RANDOM ORDER, MULTIPLE YES ANSWERS ALLOWED)

|     |    |  |           |               |
|-----|----|--|-----------|---------------|
|     |    | <u>YES</u>   | <u>NO</u> | <u>DK/REF</u> |
| [ ] | a. | Lifting or carrying objects weighing more than 30 pounds ..... | 1 .....   | 2 .....DK     |
| [ ] | b. | Overhead use of the arms .....                                 | 1 .....   | 2 .....DK     |
| [ ] | c. | Knee bending, squatting, or kneeling .....                     | 1 .....   | 2 .....DK     |
| [ ] | d. | Back bending or twisting .....                                 | 1 .....   | 2 .....DK     |
| [ ] | e. | Gripping with the hands or wrist bending .....                 | 1 .....   | 2 .....DK     |
| [ ] | f. | Use of shaking or vibrating power equipment .....              | 1 .....   | 2 .....DK     |
| [ ] | g. | Use of tools to hammer, chisel, saw, or drill .....            | 1 .....   | 2 .....DK     |
| [ ] | h. | Stooping over .....  | 1 .....   | 2 .....DK     |
| [ ] | i. | Using a pneumatic drill or compressed air power tool .....     | 1 .....   | 2 .....DK     |
| [ ] | j. | Applying pedal or treadle pressure with the foot .....         | 1 .....   | 2 .....DK     |
| [ ] | k. | Pushing or pulling objects weighing more than 50 pounds .....  | 1 .....   | 2 .....DK     |
| [ ] | l. | Neck twisting or bending back the neck .....                   | 1 .....   | 2 .....DK     |
| [ ] | m. | Standing or walking 8 hours or more a day.....                 | 1 .....   | 2 .....DK     |
| [ ] | n. | Sitting 6 hours or more a day.....                             | 1 .....   | 2 .....DK     |

Now I want to ask about your health.

9. In general, would you say your health is excellent, very good, good, fair, or poor?
- |  |                           |    |
|--|---------------------------|----|
|  | EXCELLENT .....           | 1  |
|  | VERY GOOD .....           | 2  |
|  | GOOD .....                | 3  |
|  | FAIR.....                 | 4  |
|  | POOR.....                 | 5  |
|  | NO ANSWER/DON'T KNOW..... | DK |
- 
- 10a. Has a doctor, nurse, or other health professional EVER told you that you have arthritis?
- |  |                         |    |
|--|-------------------------|----|
|  | YES.....                | 1  |
|  | NO .....                | 2  |
|  | DON'T KNOW/REFUSED..... | DK |

(IF Q10a = YES, ASK:)

|   | <u>YES</u> | <u>NO</u> | <u>DK/REF</u> |
|---|------------|-----------|---------------|
| 10b. Was this osteoarthritis (os-tee-oh-arth-right-us), which is sometimes called degenerative arthritis? ..... | 1          | 2         | DK            |
| 10c. Was this rheumatoid (rue-ma-toyed) arthritis? .....  | 1          | 2         | DK            |
| 10d. Was this arthritis due to psoriasis (sor-eye-ah-sis)? .....  | 1          | 2         | DK            |
| 10e. Was this arthritis due to gout?.....   | 1          | 2         | DK            |
| 10f. Was this another type of arthritis? .....  | 1          | 2         | DK            |

(IF Q10f = YES, ASK:)

10g. What type was this?

DON'T KNOW/REFUSED.....DK

10h. At what age did your arthritis first start? AGE: \_\_\_\_\_

(IF MORE THAN ONE TYPE, ENTER YOUNGEST AGE FOR ANY) NO ANSWER/REFUSED ..... DK

IF Q10a =NO, ASK:

|  |                        |    |
|--|------------------------|----|
| 11. Even though a health professional never said so, do you believe that you have arthritis or rheumatism (rue-ma-tiz-em)? | YES .....              | 1  |
|  | NO .....               | 2  |
|  | NO ANSWER/REFUSED..... | DK |

12. Has a medical doctor ever told you that you have any of the following medical conditions? (READ IN ORDER)

- |   | <u>YES</u> | <u>NO</u> | <u>DK/REF</u> |
|---|------------|-----------|---------------|
| a. Systemic lupus (loop-us) or SLE? ..... | 1          | 2         | DK            |
| b. Scleroderma (sklare-oh-derm-ah)? ..... | 1          | 2         | DK            |
| c. Autoimmune disease?.....               | 1          | 2         | DK            |

(IF Q12c = YES, ASK:)

d. What is the name of this autoimmune disease?

DON'T KNOW/REFUSED ..... DK



Finally, some questions about yourself for classification purposes.

15. What is the highest level of school that you have completed or the highest degree that you have received?
- 4 GRADE OR LESS ..... 1  
 5<sup>TH</sup>-8<sup>TH</sup> GRADE ..... 2  
 9<sup>TH</sup>-12<sup>TH</sup> GRADE (NO HIGH SCHOOL DEGREE)..... 3  
 HIGH SCHOOL GRADUATE ..... 4  
 SOME COLLEGE / NO DEGREE ..... 5  
 ASSOC. DEGREE / TRADE OR VOCATIONAL SCHOOL..... 6  
 COLLEGE GRADUATE/BACHELOR'S DEGREE..... 7  
 MASTERS DEGREE ..... 8  
 PROFESSIONAL DEGREE ..... 9  
 DOCTORATE / PH.D. .... 10  
 NO ANSWER/REFUSED ..... DK
16. Are you married, separated or divorced, widowed, never been married, or are you a member of an unmarried couple?
- MARRIED..... 1  
 SEPARATED/DIVORCED..... 2  
 WIDOWED ..... 3  
 NEVER BEEN MARRIED..... 4  
 UNMARRIED COUPLE ..... 5  
 NO ANSWER/REFUSED ..... DK
17. For classification purposes, are you Latino or of Hispanic origin or descent?
- YES..... 1  
 NO ..... 2  
 NO ANSWER/REFUSED ..... DK
18. What is your racial background? Are you white, black or African-American, Asian or Pacific Islander, or are you a member of another race? (ANSWER CAN BE A MULTIPLE)
- WHITE/CAUCASIAN..... 1  
 BLACK/AFRICAN-AMERICAN..... 2  
 ASIAN/PACIFIC ISLANDER ..... 3  
 LATINO/HISPANIC (VOLUNTEERED) ..... 4  
 OTHER (SPECIFY) \_\_\_\_\_ 5  
 NO ANSWER/REFUSED ..... DK
19. About how tall are you without shoes?
- \_\_\_\_\_ FEET  
 \_\_\_\_\_ INCHES  
 NO ANSWER/REFUSED ..... DK
20. About how much do you weigh without shoes?
- \_\_\_\_\_ LBS.  
 NO ANSWER/REFUSED ..... DK
21. We don't need to know exactly, but just roughly could you tell me if your annual household income from all sources before taxes in 2016 was less than \$20,000, \$20,000 through \$40,000, \$40,000 through \$60,000, \$60,000 through \$80,000, \$80,000 through \$100,000, or \$100,000 or more?
- LESS THAN \$20,000..... 1  
 \$20,000 – \$39,999 ..... 2  
 \$40,000 – \$59,999 ..... 3  
 \$60,000 – \$79,999 ..... 4  
 \$80,000 – \$99,999 ..... 5  
 \$100,000 OR MORE ..... 6  
 NO ANSWER/REFUSED ..... DK

IF LANDLINE SAMPLE LISTING, ASK:

- 22a. Do you regularly make and receive personal calls from a cell phone? YES ..... 1  
NO ..... 2  
DON'T KNOW/REFUSED ..... DK

IF CELL PHONE SAMPLE LISTING, ASK:

- 22b. Is there a telephone inside your home that you use to make and receive calls that is not a cell phone? YES ..... 1  
NO ..... 2  
DON'T KNOW/REFUSED ..... DK

- 23a. These are all the questions I have. To thank you for your participation, we would like to send you a \$5 gift card from Amazon or Starbucks. What email address should we send that to? PROVIDES EMAIL ADDRESS ..... 1  
NO EMAIL/REFUSES EMAIL ..... 2  
REFUSES GIFT CARD ..... REF – END

IF PROVIDES EMAIL ADDRESS, ASK:

- 23b. ENTER EMAIL ADDRESS (READ BACK SLOWLY TO CONFIRM) EMAIL: \_\_\_\_\_  
DON'T KNOW/CAN'T RECALL ..... DK

IF (Q23a=2) OR (Q23b= DK), ASK:

- 23c. Then we'll need to mail you your \$5 gift card. What is your name and mailing address? (ENTER ADDRESS, AND READ BACK SLOWLY TO CONFIRM)

NAME: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_  
 CITY: \_\_\_\_\_  
 (CATI DISPLAYS STATE FROM S1)  
 ZIP CODE: \_\_\_\_\_

- 23d. Which would you prefer, an Amazon or a Starbucks gift card? AMAZON ..... 1  
STARBUCKS ..... 2  
REFUSES GIFT CARD ..... REF

Thank you very much for participating in this important survey.

**8.0 Disclaimer**

This study was sponsored by the Alpha Foundation for the improvement of Mine Safety and Health, Inc. (ALPHA FOUNDATION). The views, opinions, and recommendations expressed herein are solely those of the authors and do not imply any endorsement by the ALPHA FOUNDATION, its Directors and staff.