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Final Closeout Report
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List of Terms and Abbreviations

U.S. Bureau and Labor Statistics	BLS
U.S. Census	CENSUS
Chronic Obstructive Pulmonary Disease	COPD
Dictionary of Occupational Titles	DOT
U.S. Department of Labor, Labor/Employment and Training Administration	DOL/ETA
Healthy Worker Effect	HWE
Mean Intensity Level	MIL
National Longitudinal Survey of Youth, 1979	NLSY79
Occupational Information Network	O*NET
Standard Occupational Classification	SOC

Abstract

In this study, a generalizable process was developed for estimating the relationship between long-term work history in a particular occupation and the likelihood of developing a chronic disease later in life. This process can be applied very broadly to many occupational classifications and a variety of common chronic diseases. The process was based on using surrogate indicators of occupational exposure from the Occupational Information Network (O*NET) sponsored by the U.S. Department of Labor/Employment and Training Administration (DOL/ETA), together with assessments of long-term chronic disease outcomes utilizing 32 years of data from the National Longitudinal Survey of Youth,1979 (NLSY79), administered by the U.S. Bureau of Labor Statistics.

Within the O*NET database, each of 974 job classifications is characterized by a uniform, measurable set of 277 variables called "descriptors" that describe and rate job requirements, worker activities, workplace conditions, and worker perspectives within each of those occupational classifications. Ratings are assigned to each descriptor (on a standardized scale of 0 to 100) for a particular occupational classification. The ratings are based on accumulated empirical data collected and analyzed by DOL/ETA, and its processor, the Dictionary of Occupational Titles, since 1939.

Our research strategy involved creating job histories over a 32-year period (1978 through 2009) for 12,686 men and women in the NLSY79 cohort and then matching those job histories with O*NET ratings of work exposures for each job held by every cohort member during that period.

To test the efficacy of this process, several analyses were conducted using a variety of predictor variables from O*NET. For example, in one study, six O*NET job descriptors were used as surrogate measures of physical work demands. Logistic regression measured the association between those demands and arthritis occurrence after 32 years. We found that the risk of osteoarthritis was significantly associated with several O*NET descriptors including handling and moving objects, kneeling, crouching, and crawling, bending and twisting, working in a cramped or awkward posture, and performing general physical activities.

In another similar study, we utilized O*NET job indicator ratings to show that the risk of contracting asthma and COPD was significantly associated with long-term work in very hot or cold temperatures, performing physically demanding activities, working outdoors exposed to weather, and workplace exposure to contaminants. We used that same methodology to demonstrate significant associations between occupational psychosocial exposures (e.g., decision latitude, interpersonal relationships, etc.) and three major workers' compensation outcomes (lost work days, total indemnity costs and total medical costs per claim).

Utilizing O*NET indicators as measures of exposure provides a different, but complementary and potentially informative, framework for investigating potential predictors of chronic disease. The primary advantage of using O*NET is its ability to provide a general approach for estimating risk, even in the absence of direct measurements. Because resources are scarce, extensive on-site exposure assessment may not always be feasible. The approach we describe here, based on O*NET, can provide a relatively easy and accessible screening device to help identify general patterns of chronic disease risk and indicate whether more in-depth assessment appears to be warranted.

Closeout Document 1: The Final Progress Report

Section 1 of the Final Report (2-page limit)

Significant (Key) Findings

The main aims of this research project were to; 1) develop a process to estimate the association between long-term history of working in a particular occupation and the likelihood of contracting a chronic disease later in life, and 2) develop a process for determining whether cumulative exposure to particular hazards (e.g., handling and moving heavy objects) is associated with the onset of a chronic disease (e.g., arthritis) later in life. The study also showed that O*NET can successfully serve as a surrogate measure for occupational exposure when no actual exposure data is available

We had hypothesized that the more intensity of work exposure there was in a particular classification, as measured by the O*NET descriptor ratings, the greater likelihood there would be for a specific chronic disease occurrence later in life. Also, we had speculated that the duration of exposure may also be an independent determinant of chronic disease risk (or there might also be an interaction effect). These scientific considerations led to us to develop a new combination measure of exposure risk, the "Mean Intensity Level" (MIL), which reflects both the intensity of exposure and the cumulative duration of exposure, as was applied in our 2014 publication, "Using O*NET to Estimate the Association between Work Exposures and Chronic Diseases."

Here is an itemization of our key findings:

1. In general, all of our various studies performed from this project demonstrated provided evidence of significant relationships between some O*NET indicators of job exposure and long term chronic disease occurrence over a long period of time (decades).

2. A generalizable process was developed to test the feasibility and efficacy of the O*NET measures as surrogate measures of job classification risk, that can help predict long-term chronic disease occurrence over a range of different disease conditions.

3. Significant effects were observed for a variety of exposures indicating that the job descriptor indicators developed by the U.S. Department of Labor over a 70-year period, were useful and potentially valid indicators of exposures based on the O*NET job classification ratings.

4. The O*NET descriptor variables were easy to apply and appeared to be relative sensitive indicators of exposure, even in the absence of direct exposure measurement.

5. There were three main studies conducted. The first O*NET analysis found that the risk of arthritis later in life was significantly associated with handling and moving objects, kneeling, crouching, and crawling, bending and twisting, working in a cramped or awkward posture, and performing general physical activities.

6. In the second O*NET analysis using O*NET as a surrogate measure of true exposure, the risk of contracting COPD was significantly associated with long-term work in very hot or cold temperatures, performing physically demanding activities, working outdoors exposed to weather, and workplace exposure to contaminants. In general, the effects of these exposures were greater for COPD than for asthma. With respect to contracting asthma, only exposure to work in very hot or cold temperatures and performing physically demanding activities were statistically significant.

7. Using seven O*NET indicators of psychosocial job exposure (freedom to make decisions, time pressure, work schedules, establishing and maintaining interpersonal relationships, communicating with supervisors, peers, or subordinates, scheduling work and activities, and time management), we found that every psychosocial job characteristic we analyzed was significantly associated with lower total indemnity costs, except for time pressure, which was associated with higher costs.

8. In another study that we have completed but not yet published, we analyzed how the relationship between the O*NET job descriptors and the various disease outcomes varies within

particular industries and occupations. We have completed the statistical analysis and are now preparing to publish the results. The findings of this study indicate that the relationship between lifetime exposure to long work hours and chronic disease occurrence is relatively insensitive to variations among particular occupations and industries. Some of the data suggest that production (blue collar) workers with long-term exposure to long hours work have an elevated propensity to contract chronic disease compared to workers in other non-production (white-collar) occupations.

9. As a spin-off result of these studies, we decided to examine the general relationship between various forms of long work-hour schedules over a working lifetime, and the eventual onset of chronic disease later in life, including heart disease, non-skin cancer, arthritis, diabetes, chronic lung disease, asthma, depression and hypertension. The study found that working long hours (e.g., 41-50, 51-60 and over 60 compared to 35-40 hours per week) was significantly associated with an elevated risk of four chronic diseases: heart disease, non-skin cancer, arthritis and diabetes over a 32-year follow-up period. The adverse effect was much larger among women than among men. Long working hours were also associated with prevalence of chronic lung disease and asthma among women over that period. These results have been submitted for publications and are currently under review.

Translation of Findings

The various studies we have conducted suggest that O*NET exposure indicators can be a valuable tool to employ when actual direct exposure measurement cannot be obtained. These studies also suggest that long-term exposure to various occupational exposures, as represented by the O*NET exposure categories, can potentially predict chronic disease later in life. If these results hold up to further examination, then the results are potentially quite significant. They indicate that long-work hours may contribute to chronic disease through years of exposure, and thus support the idea that workplace-based screening programs for chronic-disease occurrence might be useful from a public health standpoint. Additionally, these results support the idea of targeting facilities/workers as being at high risk for eventual chronic disease, even if not evidenced by direct exposure assessment. That suggests that surveillance systems based on O*NET indicators could be used as a basis for identifying risk in those situations.

Outcomes/Impact

The rising prevalence of chronic disease among people over 45 years old is perhaps the greatest health challenge facing America. Insufficient attention has been paid to investigating possible connections between long-term job history in specific occupations and the risk of eventual chronic disease. This study will greatly advance knowledge in this field, and help target and apply appropriate interventions (e.g., workplace surveillance for chronic conditions) in high-risk occupations. This constitutes an important potential outcome of this study.

Additionally this study helps to validate the efficacy of using the O*NET job classifications descriptions and associated descriptor ratings, as surrogates of workplace exposure when conventional exposure measurement has not or cannot be done. This provides new opportunities for employers to gauge the effect of workplace exposure, over an extended period of time, with only a modest investment for the employer. Developing this new methodology constitutes an important intermediate outcome from the project

Because resources are scarce, researchers must be cognizant of the need to conduct studies in an efficient manner. This new methodology could be used as a “screening” device to provide an indication of the situations in which it might be useful to conduct more detailed exposure assessment. In that respect, the approach could help make epidemiology studies most cost effective, and thus constitute another important potential outcome from this study.

Section 2 of the Final Report

Scientific Report

Background:

This study aimed to develop a generalizable process to study the relationship between long-term job exposures and the onset of chronic disease later in life. Because measurement of long-term job exposures is usually unfeasible, we tested the feasibility and efficacy of using O*NET surrogate exposure indicators to quantify the relationship between lifetime job demands and eventual chronic disease onset. As chronic disease prevalence in the U.S. continues to expand, it becomes more important to understand the contribution of long-term job history to the onset and progression of chronic disorders such as arthritis, diabetes, asthma, COPD, and chronic heart disease. The novel approach we developed provided a useful tool for examining these questions.

Although O*NET and its predecessor, the Dictionary of Occupational Titles, have been collecting occupational data for more than 70 years, there has been only limited use of O*NET for analyzing long-term chronic disease risks. The long-term longitudinal nature of NLSY79 data allowed for consideration of early employment experiences and developments during a person's entire life course as potentially important determinants of eventual chronic conditions and illness-predicated retirement. Few sources of data in the U.S. are available for studying these long-term effects.

Our finding of a positive and consistent relationship between O*NET ratings of physical job demands and arthritis risk lends credence to the putative benefit of using O*NET descriptors as surrogate indicators of long-term workplace exposures, in situations where conventional direct exposure assessment is not feasible. Our findings help to validate the program established more than 70 years ago by the U.S. Department of Labor to collect empirical information using field raters (and, more recently, survey responders) to continually update and refine specific information about the activities and demands faced by workers in hundreds of distinct occupations. This study adds to the growing body of evidence indicating the convergent validity of using O*NET indicators as measures of occupational exposure.

This study went beyond previous research in three important ways: 1) the study used 32 years of longitudinal work history data to quantify and estimate the level of association between aggregated occupational exposure to physical work demands and the relative risk of contracting arthritis, 2) it provided new evidence about how long-term composite exposure to multiple physical work demands might elevate the risk of contracting osteoarthritis later in life, and 3) the study demonstrated the feasibility of using O*NET data linked to national occupational and employment data (from NLSY) to estimate the strength of these associations that can be applied to many other occupational hazards and chronic conditions. This research has provided a framework for facilitating a whole range of new research opportunities for investigating the connections between long-term job history and chronic disease occurrence in older workers and retirees.

Besides the results reported, we also performed comparative analyses using other analytical approaches, for example, measuring the time sequencing of exposures across the 32-year time frame, and calculating the cumulative severity scores across the total number of weeks worked during the study period. Some researchers have suggested that physical demands ought to be accumulated over time to better estimate occupational exposure in osteoarthritis studies.

Specific Aims

The project's initial aims were as follows:

1. Development of a process to estimate the association between long-term history of working in a particular occupation and the likelihood of contracting a chronic disease later in life.

The proposed process can be applied very broadly to many occupational classifications and a variety of common chronic diseases. The project produced a new generalizable tool for identifying possible connections between occupational history and chronic disease occurrence.

2. A secondary aim was to develop a process for determining whether cumulative exposure to particular hazards (e.g., handling and moving heavy objects) is associated with the onset of a chronic disease (e.g., arthritis) later in life.

3. This project went beyond previous research in three important ways: 1) the project used 32 years of longitudinal work history data to quantify and estimate the level of association between cumulative work history in various occupational classifications and the relative risk of contracting any of several common chronic conditions (e.g., arthritis, diabetes, asthma, hypertension, heart disease, non-skin cancer, chronic lung disease, emotional and psychiatric disorders, and general health limitations).

4. The process developed and tested in this project utilized publicly available de-identified data from two federal sources: a) the National Longitudinal Survey of Youth,1979 (NLSY79), administered by the U.S. Bureau of Labor Statistics, and b) the Occupational Information Network (O*NET), sponsored by the U.S. Department of Labor/Employment and Training Administration. O*NET contains a continually updated database on the skill requirements and job characteristics of 974 occupational classifications, based on empirical data collected over several decades. Each occupation was characterized by a standardized, measurable set of 277 variables called "descriptors" that describe and rate job requirements, worker activities, workplace conditions, and worker perspectives.

The NLSY79 cohort was comprised of 12,686 men and women who were 14 to 22 years of age when first surveyed in 1979. Follow up interviews with NLSY79 respondents have been conducted annually from 1979 to 1994, and biannually since 1996. The latest year of complete data for this study was drawn from the 2010 survey, when cohort members were 46 to 54 years old. As of 2008, there were still 9,577 eligible cohort members and 7,757 survey respondents. Subjects for the survey were selected based on the results of 57,000 household screening interviews conducted by the National Opinion Research Center at the Univ. of Chicago. NLSY79 provides sampling weights for each response to reflect the national distribution of Americans in this age range.

The NLSY79 collected information on respondents' sociodemographic characteristics, household composition, education, training, detailed work histories, job and employer characteristics, income and assets, health insurance status, incidence of work-related injuries and illnesses, episodes of work disability, and social and domestic functioning. In each survey year, respondents provided information on all jobs held during that period. Each job record contained extensive self-reported information about the characteristics of the job including the date of beginning work in the job, the end date (if applicable), job responsibilities and activities, occupational category, job location, customary work schedule, usual daily job starting and ending times, and commuting time. Beginning in 1998, a series of health status questions were added to NLSY79 for cohort members who were at least 40 years old. The 40+ health module included as assessment of general health (using the SF-12 scale), depression (using the CES-D scale), parents' health status, and information about the last time that the respondent had seen a health professional and received a physical examination. A similar health module for respondents aged 50 years and over was added to the NLSY79 in 2008. The 40+ and 50+ modules collect information on the respondents' health conditions, including arthritis or rheumatism, hypertension, diabetes, non-skin cancer, lung disease or chronic bronchitis, heart disease, general health limitations, and emotional, nervous, or psychiatric problems. Condition status is based on the respondent's answer to the question, "Has a doctor ever told you that you have ___?" Respondents answering affirmatively to any of the above conditions were asked the month and year in which the condition was first diagnosed.

The project was able to achieve all of its primary aims. In each of the major studies performed (arthritis, asthma/COPD, and psychosocial factors), a variety of statistically significant associations between the predictor variables and the chronic disease outcomes

Methodology

In the NLSY79, occupational categories were coded according to the three-digit 1970 U.S. Census Occupation Coding System. In this system, there are 441 individual occupation codes grouped into thirteen broad occupational classifications. For analytical purposes in this study, we collapsed these into ten categories as follows: 1) professional and technical workers [codes 001-196], 2) managers and administrators [201-246], 3) sales workers [260-296], 4) clerical workers [301-396], 5) craftsmen [401-586], 6) operatives [601-696], 7) transportation workers [701-726], 8) laborers [740-796], 9) service workers [901-976], and 10) a miscellaneous category of "other" workers (which includes farmers and farm managers [801-806], farm laborers [821-846], private household workers [980-986], and others not classified elsewhere [000, 991-995]). The NLSY began also using 1980 Census Codes in 1983 (along with maintaining 1970 Census Codes for all jobs for all survey years) and adopted 2000 Census Codes as of 2002. There are various publicly-available services including the University of Minnesota Census Research Data Center that maintain standardized crosswalks for maintaining a synthesized single coding system across U.S. Census Code periods (e.g. to map the 503 codes from the 1980 system onto the 441 codes from the 1970 system). A job record was created for each position held by an individual during each survey period, with a ''job'' defined as a cohort member being employed in a particular position for a specific employer with a position start date and (if applicable) end date provided. If an individual held more than one position at a time (for example, for different employers), another job record was created to reflect the individual's experiences in the positions held concurrently. A new record was created when a worker changed positions (for example, a machinist becoming a supervisor).

We applied these approaches to a variety of studies using a relatively common methodology featuring the use of O*NET job descriptors as indicators of potential chronic disease risk. To test the efficacy and utility of this new approach, we conducted several demonstration studies.

One of the studies study utilized O*NET data to classify and rate job characteristics in diverse occupational categories, using data from the NLSY79 to determine the prevalence of chronic disease among cohort members.

The ONET database contains continually updated information on the skill requirements and job characteristics of 974 occupational classifications Within O*NET, each occupation is characterized by a uniform, measurable set of 277 variables called "descriptors" that describe and rate job requirements, worker activities, workplace conditions, and worker perspectives. Ratings are assigned to each descriptor (on a scale of 0 to 100) for a particular occupational classification. A mixed methods approach was used to collect the occupational data from trained occupational analysts and from workers ("incumbents") in the job to be described. O*NET normalized the raw rating scores (originally collected using scales of 1-5 and 1-7) to a standardized 0-100 scale for each job. .

NLSY79

The NLSY79 is sponsored by the U.S. Bureau of Labor Statistics and administered by the Ohio State University Center for Human Resource Research [BLS, 2005]. The NLSY79 cohort is comprised of 12,686 men and women who were 14 to 22 years of age when first surveyed in 1979. Follow-up interviews with NLSY79 respondents have been conducted annually from 1979 to 1994, and biannually since 1996. The latest year of complete data for this study was drawn from the 2010 survey when cohort members were 45 to 53 years old. As of 2010, there were 7,565 survey respondents, approximately 75.9% of the remaining 9,964 cohort members.

The NLSY79 collects information on respondents' sociodemographic characteristics, household composition, education, training, detailed work histories, job and employer characteristics, income and assets, health insurance status, incidence of work related injuries and

illnesses, episodes of work disability, and respondents' social and domestic functioning. The survey's sampling strategy is designed to be representative of the non-institutionalized civilian segment of young people living in the United States in 1979 and born between January 1, 1957 and December 31, 1964. Additionally, NLSY79 over-sampled civilian Hispanic, black, and economically disadvantaged white youth to help detect variations in employment and health conditions according to respondents' race, ethnicity, and socioeconomic status. NLSY79 provided sampling weights for each response to reflect the national distribution of Americans in this age range.

Beginning in 1998, a module to the NLSY79 survey questionnaire was added to assess health status and prevalence of chronic conditions in cohort members who were at least 40 years old. A similar health module for those at least 50 years old was added in 2008. In both of the 40+ and 50+ modules, respondents were asked whether a doctor had ever diagnosed them with one of several chronic conditions including: asthma, hypertension, diabetes, heart disease, non-skin cancer, chronic lung disease, arthritis or rheumatism, and emotional problems (emotional, nervous, or psychiatric problems).

O*NET uses the Standard Occupational Classification (SOC) system to classify occupations. However, NLSY79 uses U.S. Census (Census) occupation codes. In order to assign O*NET job exposures to the respondents in NLSY79, we used existing crosswalks provided by National Crosswalk Service Center (NCSC) to link Census occupation codes to SOC codes. NLSY79 used three versions of Census occupation codes: 1970 Census codes (used from 1979 to 2000), 2000 Census codes (used in 2002), and 2002 Census codes (used from 2004 onward). There is no direct crosswalk between 1970 Census codes and SOC codes, so we first linked 1970 Census codes to DOT codes, and then used the crosswalk between DOT and SOC codes to link the 1979 Census codes to the SOC codes. For the 2000 and 2002 Census codes, there are existing crosswalks to the SOC systems available from the NCSC.

Study Design

To evaluate the utility and efficacy of the this process, we examined the relationship between the following job descriptors and the associated chronic diseases. In each case, logistic regression analysis was employed to assesses the association between the independent variables and the outcome variables.

Study #1:

Predictor variables for physical job demands: 1) handling and moving objects, 2) spending time bending or twisting the body, 3) spending time kneeling, crouching, stooping, or crawling, 4), working in cramped work spaces and awkward positions, 5) and performing general physical activities. The disease outcomes we chose to study was "arthritis and rheumatism."

Study #2:

Predictor variables for environmental conditions: 1) exposure to contaminants, such as pollutants, gases, dust or odors; 2) working indoors, in non-controlled environmental conditions, (e.g., a warehouse without heat); 3) working outdoors, exposed to weather conditions; 4) working in very hot (above 90 F degrees) or cold (below 32 F degrees) temperatures; 5) working in an enclosed vehicle or equipment; 6) performing general physical activities (such as climbing, lifting, balancing, walking, stooping, and handling of materials); and 7) working under time pressure. The disease outcomes we chose to study were asthma and COPD.

Study #3

Predictor variables for psychosocial stressors in the workplace:: 1) freedom to make decisions, 2) time pressure, 3) work schedules, 4) establishing and maintaining interpersonal relationships, 5) communicating with supervisors, peers, or subordinates, 6) scheduling work and activities, and 7) time management. The disease outcomes we chose to study were total indemnity costs, total medical costs, and lost work days.

Study #4

Predictor variables for occupation and industry:: 1) professional and technical, 2) managers, officials, proprietors, 3) sales workers, 4) clerical, 5) craftsmen, foremen 6) operatives, 7) laborers, except farm, 8) service workers, and 9) other miscellaneous workers. The disease outcomes we chose to study included seven types of chronic disease including arthritis, diabetes, asthma, hypertension, heart disease, non-skin cancer, chronic lung disease, emotional and psychiatric disorders, and general health limitations

Covariates for the regression analyses included age (as of 2010), gender, and education level. We also controlled for co-occurring health conditions, such as heart disease, non-skin cancer, diabetes, affective and mental disorders, and hypertension. Respondents completed the 40+ module in the survey year closest to their 40th birthday and completed the 50+ module in the survey year closest to their 50th birthday. Cohort members over 50 thus had two opportunities to report arthritis, and those under 50 only had one opportunity. We therefore controlled for whether people were in the older (who had two reporting opportunities) or the younger segment of the cohort.

To investigate potential dose-response trends, we conducted two additional analyses. A linear trend was estimated using MIL as a continuous predictor in the model. Additionally, non-linear trends were investigated by considering quartiles, using the lowest quartile as the referent category. The analytical process described above was repeated, each time using one of the other O*NET descriptor variables. Multivariable logistic regression was performed to calculate a point estimate of the mean odds ratio, along with 95% confidence intervals and associated p-values. To assess the combination effects that may exist when multiple specific exposures are considered concurrently, we performed a primary factor analysis. Correlations were measured among all five O*NET job descriptors to determine factor loadings. All calculations were performed using SAS Statistical Software, Version 9.2. In order to account for the complex survey design, survey weights from the 2010 NLSY79 dataset were applied in the logistic regression to calculate the weighted results.

In these studies we needed to consider both the potential effect of the intensity of the exposure, as measured by the O*NET descriptor ratings in each occupational classification, as well as the potential duration of exposure. Originally, we had intended to create an “Aggregated Demand Score” (ADS) which would reflect exposure based on a formula involving both the intensity of an exposure, as measured by the O*NET rating (on the 0-100 scale) for that particular descriptor variable as well as the duration of work in that occupation (in years). However, that provided to be difficult for various technical reasons, related to measuring periods in which individuals did not work full time. To better assess exposure, we created what we called a “Mean Intensity Level” (MIL). Calculation of the MIL is based upon the entire 32-year work history for all individuals, both those contracting a particular chronic disease during the study and those not contracting a chronic disease during the study. We adopted this simple method to ensure that that MIL exposure is potentially equivalent for all individuals. We recognize that this approach could result in some misclassification (i.e., even after the date of diagnosis, some weeks of job exposure might count towards calculation of the MIL). We chose to adopt this conservative approach because the resulting misclassification would tend to bias the results towards the null. If we had truncated MIL exposure after diagnosis, then other forms of bias could have been introduced (e.g., only exposure from the early “more demanding” years would be considered rather than the “less demanding” work which often occurs as workers age).

To investigate potential dose-response trends, we conducted two additional analyses. A linear trend was estimated using MIL as a continuous predictor in the model. Additionally, non-linear trends were investigated by considering quartiles of MIL, using the lowest quartile as the referent category. Multivariable logistic regression was performed to calculate a point estimate of the mean odds ratio, along with 95% confidence intervals and associated p-values. To assess the combination effects that may exist when multiple specific exposures are considered concurrently, we performed a primary factor analysis. Correlations were measured among all five O*NET job

descriptors to determine factor loadings. All calculations were performed using SAS Statistical Software, Version 9.2. In order to account for the complex survey design, survey weights from the 2010 NLSY79 dataset were applied in the logistic regression to calculate the weighted results.

Results: The of each study are provided below:

Study #1: In these analyses, a "high" level of exposure among each of the five relevant O*NET descriptors was found to be significantly associated (at a level of < 0.01) with a diagnosis of arthritis. In general, analyses of the linear trend and by quartiles produced evidence for a pattern of increasing risk with higher levels of mean intensity for all five job descriptors. There was a consistent increase in risk observed among all descriptors for the second quartile compared to the first quartile, and for the third quartile compared to the second quartile. The linear trend analysis showed that each 10 point increase in MIL was associated with approximately a 10% increase in the odds of arthritis (range: 8-11%, Table 4), and was statistically significant for all descriptors except "Working in a Cramped Work Space or Awkward Postures.

Study #2: The risk of contracting COPD was significantly associated with long-term work in very hot or cold temperatures (OR=1.50, CI:1.07-2.10), performing physically demanding activities (OR=1.65, CI:1.20-2.28), working outdoors exposed to weather (OR=1.45, CI:1.06-1.99), and workplace exposure to contaminants (OR=1.42, CI:1.05-1.96). In general, the effects of exposure were greater for COPD than for asthma. With respect to contracting asthma, only exposure to work in very hot or cold temperatures (OR=1.35, CI:1.08-1.70) and performing physically demanding activities (OR=1.23, CI:1.00-1.52) were statistically significant.

Study #3: Six of the seven psychosocial characteristics were significantly associated with lower total indemnity costs. Only one characteristic, time pressure, was significantly associated with higher total indemnity costs. Four of seven psychosocial characteristics were significantly associated with lower medical costs. High levels of all seven psychosocial job characteristics were associated with a greater than average (19-31% higher) level of lost work days

Study #4: The analyses indicated that working long hours is significantly associated with elevated risks for four types of chronic conditions. People working 51-60 hours a week were found to have an elevated risk for heart disease, as did people working more than 60 hours per week. There was also a significant elevated risk for non-skin cancer. Likewise, the risk of arthritis was significantly elevated for cohort members who averaged more than 40 hours per week compared to workers with conventional hours. Additionally, there was a statistically greater likelihood of reporting diabetes among people who worked more than 40 hours per week. There were no statistically significant findings (at $p<0.05$) for an association between long hours and chronic lung disease, asthma, depression, or hypertension.

Discussion and Conclusions:

This NIOSH-supported project aimed to develop a generalizable process to study the relationship between long-term job exposures and the onset of chronic disease later in life. Because measurement of long-term job exposures is usually infeasible, the use of O*NET surrogate exposure indicators may be a useful approach to quantifying the relationship between lifetime job demands and eventual chronic disease onset. As chronic disease prevalence in the U.S. continues to expand, it will become more important to understand the contribution of long-term job history to the onset and progression of chronic disorders such as arthritis, diabetes, asthma, COPD, and chronic heart disease. We believe that our approach provides a useful tool for examining these questions.

Many workplaces, especially in smaller establishments, do not perform monitoring or assessment of exposure conditions, and thus are unable to assess the effects of those exposures on disease risk. Using the O*NET intensity ratings, developed through 70 years of empirical study by DOL, as an indicator of workplace exposure, allows for an indirect and cost-efficient estimation of chronic disease risk even when direct exposure measurement has not been conducted.

In these studies, we used the intensity levels of O*NET job descriptors to estimate exposure levels. This represents a relatively novel approach to studying the potential influence of workplace environments and job activities on chronic disease occurrence. Many workplaces, especially in smaller establishments, do not perform monitoring or assessment of exposure conditions, and thus are unable to assess the effects of those exposures on disease risk. Using the O*NET intensity ratings, developed through 70 years of empirical study by DOL, as an indicator of workplace exposure allows for an indirect estimation of respiratory disease risk even when direct exposure measurement has not been conducted.

The indicators we applied in this study were the most relevant available exposure categories in the O*NET database. Utilizing those O*NET indicators as measures of exposure provides a different, but complementary and potentially informative, framework for investigating potential predictors of asthma and COPD. The primary advantage of using O*NET is it's ability to provide a general approach for estimating risk, even in the absence of direct measurements. Because resources are scarce, extensive on-site exposure assessment may not always be feasible. The approach we describe here, based on O*NET, can provide a relatively easy and accessible screening device to help identify general patterns of respiratory risk and indicate whether more in-depth assessment appears to be warranted.