Supporting Statement

LOW BACK EXPOSURE ASSESSMENT TOOL FOR MINING

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Section A. Justification

1. Circumstances Making the Collection of Information Necessary

A major component of CDC's mission is the prevention of work-related injuries and disorders. Work-related Low Back Disorders (LBDs) are a significant and continuing problem in industry, and are a National Occupational Research Agenda (NORA) Research Priority. LBDs typically account for approximately 20-25% of all injuries in the mining industry at an enormous cost, both financially and in terms of human suffering Mineworkers appear to be affected by LBDs to a greater degree than most comparison populations (Lockshin et al. 1969, Klein et al 1984).

The National Institute for Occupational Safety and Health (NIOSH) proposes to conduct a pilot study on LBD's and miners. This pilot study will include the variety of stresses and individual risk factors as a diagnostic tool for miners' potential for a LBD. Individual results will not be provided to participants but a summary of results will be available to both the mine involved and the mining industry. The next study would allow researchers to focus on certain risk areas and include targeted interventions to lower risk of LBD's. Winn et al. (1996) analyzed the National Occupational Health Survey of Mining (NOHSM) ergonomic hazard data for 24 commodities associated with the metal/nonmetal (M/NM) mining industry and determined that exposure to ergonomic hazards for M/NM miners was high compared to non-mining occupations. Another analysis of results from the National Occupational Health Survey of Mining (NOHSM) by Zhuang & Groce (1995) found that the magnitude of musculoskeletal overload potential for coal mining was even larger than that for M/NM mining.

The unique environmental characteristics of many underground coal mines are thought to be a major factor in the high rates of LBDs in mining. Many underground coal mines are less than 60 inches in height and oblige workers to adopt stooping and kneeling postures for their entire work shifts. Both postures place mine workers in significant spine flexion, which recent studies suggest is a major risk factor for LBDs (Holmstrom et al. 1992; Punnett et al. 1991; Solomonow et al. 1999). In general, compensation claims appear to be highest in seam heights of 0.9 - 1.8 meters (where stooping is prevalent). Claims are slightly lower in seams less than 0.9 meters (where kneeling and crawling predominate), and are substantially reduced when the seam height is greater than 1.8 meters. The finding of increased low back claims in conditions where stooping predominates is in concert with other evidence relating non-neutral trunk postures to low back disorders [Punnett et al., 1991]. It is not surprising, given the physical demands and environmental constraints, that a field survey performed by the NIOSH found that exposure to ergonomic hazards for miners was high compared to non-mining industries [Winn and Biersner, 1992].

Furthermore, manual handling of equipment and supplies is a pervasive activity in mining, and studies have indicated that lifting with a flexed spine may lead to more rapid fatigue failure of spinal tissues (Gallagher et al., 2005). Furthermore, current low back exposure assessment tools (for example the NIOSH Lifting Equation [NLE]) expressly state that they are not applicable to situations involving restricted postures (e.g., Waters et

al. 1994). The NLE is one of the foremost methods for designing lifting tasks to reduce the likelihood of experiencing a low back disorder (Waters et al. 1991). However, certain limitation are inherent in the NLE, one of which is that the equation is not meant to be applied to lifting tasks performed in restricted postures. This effectively nullifies the NLE's use in low-seam coal mines (less than 1.2 cm ceiling height), where every lifting task will be performed in a restricted posture.

Improved methods for reducing LBDs and other musculoskeletal disorders is a common concern expressed by the mining industry. Results of customer needs assessments indicate that reduction of musculoskeletal disorders remains a high priority for the mining industry. The coal mining sector expresses particular concern due to the fact that high seam (> 6 ft) coal reserves are rapidly being depleted and the mining of thinner seams is expected to increase significantly, leading to increased postural demands and loading on the low back and other joints. Thus, a new approach to exposure assessment for low back disorder risk is needed for the mining industry. Another part of reducing LBD's is to consider the role of psychophysical method.

The Psychophysical Approach

The psychophysical method has been used extensively to determine appropriate lifting loads under a wide variety of circumstances. Psychophysics has demonstrated an association with the incidence of overexertion injuries (Herrin et al. 1986) and design in accordance with psychophysical limits has demonstrated an ability to reduce low back claims by up to 33% (Snook et al. 1978). However, limitations exist to this technique as well. The foremost concern with respect to applying the psychophysical technique to mining situations is that psychophysical lifting estimates do not appear sensitive to stooping postures that are associated with the onset of low back pain (Snook 1985). Subjects tend to lift a great deal of weight when stooping in psychophysical tests (e.g., Gallagher et al. 1988), in spite of the association of stooping with back pain (e.g. Punnett et al. 1991). Again, lifting in stooping postures is prevalent in restricted height mines, and setting lifting limits according to the high psychophysical estimates of load acceptability in this posture may not lead to the desired effects.

Goniometric methods (e.g. Lumbar Motion Monitor)

The lumbar motion monitor (LMM) is a device that consists of an exoskeleton of the spine which is strapped on to a worker and records the velocities and accelerations of the lumbar spine during work tasks (Marras et al. 1992). Certain trunk motion characteristics measured via the LMM have been shown to be good predictors of high versus low risk group membership for back disorders in epidemiological studies (Marras et al. 1993, 2000). However, this device is also difficult to use in low-seam coal mines due to the design of the unit, which sticks out from the back and thus requires sufficient space to be worn. In many low-seam mining situations, even the relatively small amount of back clearance required for the unit may not be available (i.e., the unit would be jammed into the mine roof in low-seam operations). In addition, underground mining environment is

typically a harsh one in which to introduce sensitive electronic equipment, which may be costly to repair or replace.

Biomechanical Models

A number of biomechanical modeling methods are available for analysis of spinal loading during manual lifting tasks; however, many of these methods also have significant drawbacks in terms of the analysis of restricted postures. Both kneeling and stooping postures have unique issues with respect to low back analysis. In the stooping posture, for example, there is a shift from active to passive loading as the torso enters full flexion. Despite advances in this area (Potvin et al. 1991), the impact of this phenomenon on lumbar loading is not well understood. Recent research has shown prolonged stretching of spinal ligaments in stooping (common in underground mines) has recently been shown to create changes in the function of the back muscles (Solomonow et al., 2003) and would be expected to affect the spinal loads experienced by workers. Studies also suggest changes in the trunk muscle function when kneeling (Gallagher et al. 2002), which may call into question results of models validated only in standing postures.

Combinations of stressors

Most of the current low back tools have concentrated on analysis of lifting tasks, and clearly these tasks place enormous demands on the back. However, various other factors, both individual and occupational, can also greatly impact low back risk. Such factors might include whole body vibration exposure, individual factors, psychosocial factors, and non-lifting postural demands.

Summary

The unique physical demands encountered in the mining environment make application of many current low back risk analysis tools difficult or impossible. Moreover, none seem to capture the entirety of exposures that may be experienced in a miner's job. As a result a low back exposure assessment tool was developed to address these issues. This tool had increased applicability in mining, captured a broad range of low back risk factors, and utilized recent research findings that have improved our understanding of potential low back injury pathways and attendant risks.

Preliminary Data

Researchers involved with this pilot study have extensive experience with the mining industry and knowledge of the exposures miners experience related to low back disorder risks. This experience involves both field work and experimental laboratory work examining the unique environmental restrictions and awkward working postures commonly adopted in the mining industry. A brief summary of some of the notable findings of this research follows.

Investigators at the Pittsburgh Research Laboratory's (PRL) Ergonomics Laboratory have performed numerous investigations of the effects of performing manual materials handling tasks in restricted environments, specifically the effects of lifting in torso flexed postures and kneeling postures. Studies performed of psychophysical lifting capacity in these postures revealed a reduced load lifting capacity in the kneeling posture (Gallagher

et al. 1988, Gallagher and Unger 1990, Gallagher 1991, Gallagher and Hamrick 1992). The magnitude of the reduction (approximately 13-20 %) may be associated with a similar observed reduction in back extensor strength in the kneeling posture (Gallagher 1997). A biomechanical study of external moments associated with a cable handling task indicated that restrictions in vertical space increase the biomechanical load on the spine no matter what posture was utilized (Gallagher et al., 2001). A recent investigation involved use of cadaver lumbar spine specimens to evaluate the effects of lifting in different torso flexion angles on the cycles to failure (Gallagher et al. 2005). Results indicated that lifting a 9 kg load will result in much more rapid fatigue failure of spinal tissues with increasing torso flexion.

Research has also been performed at PRL related to whole-body vibration (WBV) and seating design in the mining environment. Research has been performed on establishing exposure to whole-body vibration in mining environments, and development of improved seat designs to improve posture and to reduce WBV exposure (Mayton et al. 2000). The ergonomics research team at PRL has considerable field research experience as well in a variety of mining commodities (Steiner et al. 2004).

The Federal Mine Safety & Health Act of 1977, Section 501, and the Occupational Safety and Health Act of 1970, Public Law 91-256 enables CDC/NIOSH to carry out research relevant to the health and safety of workers in the mining industry (Appendix A).

2. Purpose and Use of the Information Collection

The current proposal seeks to develop a tool that will quantify low back postural demands and allow estimates of spinal loading on the low back during performance of mining tasks. Additionally, the tool seeks information on a workers low back pain experience during the prior year as an additional method to identify jobs that may be a priority for intervention. A hypothesized covariance structure model has been developed to examine the relationships between physical loading, tissue tolerance and the development of low back disorders.

The tool will have the potential to be used as a measure of impact, and of job improvement using before and after measures. The tool is designed to allow the data to be collected with a minimal amount of training and it is a goal of the tool developers to distribute the tool widely throughout the industry and allow mine safety personnel to administer the assessment so that the risk of low back disorders in mining can be reduced. The potential for positive Research to Practice (R2P) impact is considered quite good assuming the tool is successful in identifying problem jobs.

3. Use of Improved Information Technology and Burden Reduction

The questionnaire will be administered in an on-site office or training facility. Because this is a small scale data collection, the use of a computer-based data collection is not warranted.-

4. Efforts to Identify Duplication and Use of Similar Information

This exposure assessment tool utilizes results from very recent research findings to evaluate low back injury risk and includes mining specific risks. As the assessment tool uses recent findings regarding low back injury risks, it is virtually certain no other sources of information about these risks are available. US Department of Labor's Mine Safety and Health Administration have no plans to collect this type of information.

5. Involvement of Small Businesses or Other Small Entities

Respondents are individual miners. Data will not be collected from small businesses or impose record-keeping obligations on small businesses.

6. Consequences of Collecting Information Less Frequently

The proposed study is a one-time data collection.

7. Special Circumstances Relating to the Guidelines of 5 CFR 1320.5

This data collection will not involve any of the special circumstances relating to the guidelines of 5 CFR 1320.5.

8. Comments in Response to the Federal Register Notice and Efforts to Consult Outside the Agency

In accordance with CFR 1320.8(d) a review of the proposed study was sought through a 60-day publication period in the *Federal Register*: November 18, 2005 (Volume 70, Number 222)] (See Appendix B).

One comment was received in response to the Federal Register Notice dated November 18, 2005 (see Appendix F). No changes were made to the proposed project based on this response, as the public comment did not relate to the utility and scope as proposed. Our response follows the comment in Appendix D. There were no public comments received from the new Federal Register Notice dated April 3, 2007.

Sean Gallagher (NIOSH) contacted Joe Zelanko and Joseph P. Seiler of (MSHA) to discuss NIOSH's plans to perform such a study. Neither indicated any knowledge of anyone having plans to collect any such data in MSHA.

Agency/Organization	Contact Name	Contact Telephone Number	Dates of Meetings
US Dept. of Labor Mine Safety & Health Administration	Joe Zelanko and Joseph P. Seiler	(412) 386-6169 (412) 386-6980	3/29/2006 3/30/2006

9. Payment of Respondents

No payment will be made to respondents.

10. Assurance of Confidentiality Provided to Respondents

The CDC Privacy Act Officer has reviewed this OMB application and has determined that the Privacy Act is not applicable. Personal identifiers will not be collected. Only authorized project staff of NIOSH will have access to individual level information collected from the interviewees. Completed interview forms will be kept in an access-restricted area while being processed and stored in a locked file cabinet when not in use. Once the information has been entered into an electronic database, the hard copies of completed interview forms will be shredded by project staff members.

The proposed data collection has been determined to be exempt from IRB approval. Participation is voluntary and individual results will not be shared with the miner, however; a summary of the data findings will be provided to all participants as well as the mine owner. No consent form is necessary; however, an informational sheet is provided to study participants which explains the study and how to fill out the questionnaire (see Appendix D).

11. Justification for Sensitive Questions

While the vast majority of questions asked of the respondents in this study are not sensitive in nature, a few assessing the psychosocial dimensions of work could conceivably be considered sensitive. Inclusion of these questions was considered important in light of a growing body of evidence that such factors play a definite role in terms of explaining incidence rates of low back pain (Bongers et al. 1993; Davis and Heaney, 2000). In particular, the questions that might be considered sensitive include those regarding job satisfaction (question 25) and time pressure on the job (question 28). However, it should be noted that since no identifying information will be associated with these questionnaires, and employers will not be given (except in broad summary form) details regarding responses that individual employees provide. As a result, neither investigators nor the employer will be able to attribute responses to such questions to any specific individual, which should effectively eliminate the chances of any adverse consequences to the participant associated with answering these questions.

Race and ethnicity data will not be collected because the sub-population of participants will be too small to use in epidemiologic analyses. Additionally, race and ethnicity are not considered to be risk factors for this study.

12. Estimates of Annualized Burden Hours and Costs

A. Estimated Annual Burden Hours

Table A12-A Estimated Annual Response Burden Based on Pretest Data

Type of Respondents	Number of Respondents	Number of Responses per Respondent	Average Burden per Response (in hours)	Total Burden (in hours)
Miners	320	1	15/60	80
Recruitment Contacts	384	1	2/60	12.8

B. Estimated Annual Burden Cost

Respondents will be interviewed while at work and will be compensated by their regular wages. Based on the terms of the most recent Wage Agreement between the United Mine Workers of America and the Bituminous Coal Operators Association, it appears that coal miners earn an hourly wage of approximately $26. Table A12-B shows that the annual cost burden for this data collection is $2,080. This wage represents an average wage of the different types of miners who will respond to the questionnaire.

Table A12-B Estimated Annual Burden Cost

Type of Respondents	Number of Respondents	Number of Responses per Respondent	Average Burden per Response (in hours)	Average Hourly Wage	Total Cost
Miners	320	1	15/60	$26.00	$2,080

13. Estimates of Other Total Annual Cost Burden to Respondents and Record Keepers

There are no costs to respondents other than their time.

14. Annualized Cost to the Federal Government

The costs of this three year project to NIOSH will consist of the time spent by NIOSH researchers ($140,908), travel to mines to conduct interviews ($10,000) and dissemination of findings through publications and conference presentations ($5,000). NIOSH estimates that the annualized cost of conducting the study will be $155,908. The data collection study will last one year.

Table 14-1. Estimated Personnel Costs

Researcher	Hourly Salary	Time on Project	Cost
Sean Gallagher, PhD Research Physiologist	$50.91	30%	$31,873/yr * 1 = $31,873
Janet Torma-Krajewski, PhD Fellow	$44.12	20%	$18416/yr*1 = $18,416
Diana Schwerha, PhD Fellow	$31.30	20%	$13065/yr*1=$13,065
Position to be filled	$17.01	20%	$7100/yr*1= $7,100
Total Salary Cost	$140,908		
Travel to mines to conduct interviews	$10,000		
Publication and dissemination of study results	$5,000		
Total Cost	$155,908		

15. Explanation for Program Changes or Adjustments

This is not applicable. This is a new information collection submission.

16. Plans for Tabulation and Publication and Project Time Schedule

Table A16. Study Time Schedule

Project Task	Time Schedule (months after OMB approval)
Arrange to Visit Mines	Months 1 to 2
Collect Data	Months 2 to 3
Data Entry	Months 3 to 4
Data Analysis	Months 5 to 6

17. Reason(s) Display of OMB Expiration Date is Inappropriate

There is no request for an expiration date display exemption.

18. Exceptions to Certification for Paperwork Reduction Act Submissions

There are no exceptions being sought to the certification statement.