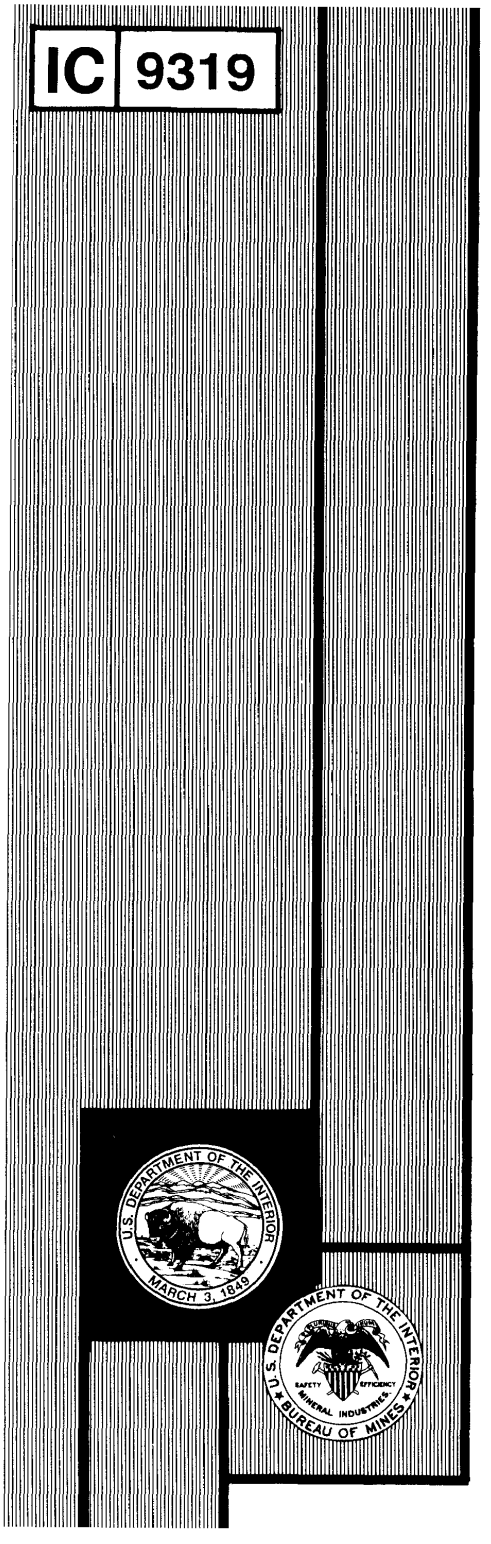

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Risk Profile of Cumulative Trauma Disorders of the Arm and Hand in the U.S. Mining Industry

By S. D. Hudock and C. M. Keran

UNITED STATES DEPARTMENT OF THE INTERIOR

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RISK PROFILE OF CUMULATIVE TRAUMA DISORDERS OF THE ARM AND HAND IN THE U.S. MINING INDUSTRY

By S. D. Hudock[1] and C. M. Keran[2]

ABSTRACT

A review of all upper extremity cumulative trauma disorder (UECTD) injuries was conducted by the U.S. Bureau of Mines for 1985 through 1989. This review was performed by analyzing each injury, as reported by law and maintained on the U.S. Mine Safety and Health Administration's accident data base. This analysis found that incidence rates in mining were lower than in private sector industry, although the number of reported UECTD injuries increased sevenfold and their percentage of all mining injuries increased fivefold from 1985 through 1989. Metal-nonmetal mines accounted for 80 pct of UECTD injuries, while coal mines accounted for 20 pct. Nearly 63 pct of UECTD injuries were accounted for by only four occupations—mechanics, laborers, boney (crusher) operators, and miners not elsewhere classified (NEC)—with an incidence rate well above the private sector industry rate.

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INTRODUCTION

Cumulative trauma disorders (CTD's) are injuries that develop gradually over a period of time, ranging from weeks to months, as a result of repeated stress to a particular body part without adequate time between stresses for full recovery to occur. CTD's, also known as repetitive motion or repetitive strain injuries, have long been thought to be work related (*1-4*).[3] There is increasing concern about the long-term effects on clerical personnel working on word processing equipment for long hours each day. Automotive assembly personnel often work in awkward postures to install the same components continuously throughout the shift. Mine workers are also exposed to a combination of stressors and work design deficiencies that result in arm and hand injuries. For example, certain job tasks and locations, such as that of an underground jackleg driller, expose miners to cold temperatures and segmental (hand-arm) vibration. In fact, vibration white finger syndrome, also known as hand-arm vibration syndrome, is an occupational CTD common to underground hand-held drill operators, especially in hard-rock mining operations (*5*). Operators of underground mobile equipment, such as scoops and trams, regularly have their hands in direct contact with vibrating levers and controls. The same is true of those operating larger jumbo drills and raise borers. Workers at mills, particularly in bagging and palletizing operations, must repetitiously move rock products weighing from 5 to 75 lb, which can contribute to back injuries.

While CTD's occur primarily to the hands, arms, legs, and back, this Information Circular (IC) is concerned with those CTD's effecting only the hands and arms, referred to as UECTD injuries. A summary of common UECTD's is provided in table 1. The stresses that contribute to UECTD's may occur because of the following work components: awkward position of wrist or arm, excessive manual force, high repetitions of manual movement and effort, cold environment, and vibration (*6-9*).

Carpal tunnel syndrome (CTS) appears to be the most widely known UECTD. This disorder occurs in part because of the anatomical structure of the human wrist. The major muscles that flex the fingers and allow humans to grasp and manipulate objects are called flexor forearm muscles. The tendons that connect these muscles to the bones in the hands and fingers run through the wrist between the carpal ligament and the wrist bones. Also running through this carpal tunnel is the median nerve, which is responsible for most motor responses and sensations felt in the thumb and first three fingers of the hand, primarily on the palm side. CTS develops when any of the sheaths of the finger flexor tendons within the wrist become irritated and swell, pressing against the median nerve. The resulting pain, numbness, and tingling of the hands are often more noticeable while asleep, which wakes the individual up and disturbs sleep. Advanced cases of CTS may include apparent clumsiness and weakness in the hands, as well as a deterioration of the muscles at the base of the thumb.

Table 1.—Common UECTD's (*6*)

Disorder	*Description*
Tendon:	
Tendinitis	Inflammation, fraying, or tearing of tendon fibers.
Tenosynovitis	Tendon sheath inflammation and swelling.
Stenosing tenosynovitis	Tendon sheath swells and constricts movement (DeQuervain's disease).
Stenosing tenosynovitis crepitans	Swollen sheath locks tendon, resulting in jerking movement (trigger finger).
Ganglionic cyst	Sheath swollen with fluid.
Lateral epicondylitis	Irritated unsheathed tendon on outer side of elbow (tennis elbow).
Medial epicondylitis	Irritated unsheathed tendon on inner side of elbow (golfer's elbow).
Rotator cuff tendinitis	Shoulder tendon disorder.
Nerve: CTS	Compression of median nerve by swollen finger flexor tendons in the wrist, resulting in pain, numbness, and tingling in hands.
Neurovascular:	
Thoracic outlet syndrome	Compression of the nerves and blood vessels between the neck and shoulder often due to repeated reaching above shoulder level.
Vibration white finger syndrome	Numbness, tingling, and blanching of fingers due to closure of digital arteries often caused by extended use of vibrating hand tools and controls.

[3]Italic numbers in parentheses refer to items in the list of references at the end of this report.

CTD's to the arm and hand have become an ever growing concern among safety and health professionals in a number of different industries and work settings (*10-15*). Meatpacking operations, assembly-line work, and keyboarding have all been associated with the development of CTS. Numerous substantial fines have recently been levied by both the Federal Occupational Safety and Health Administration (OSHA) and State equivalents on meatpacking operations in an effort to curtail cumulative trauma injuries to the arm and hand (*16-18*).

The extent of UECTD's in the mining industry has not been previously determined. As part of the U.S. Bureau of Mines ongoing health and safety research to reduce CTD's in mining, prevalence and incidence rates of UECTD's in the U.S. mining industry from 1985 through 1989 were determined and comparisons to other industries were made.

METHOD

Mining accident information is maintained in a computerized data base by the U.S. Mine Safety and Health Administration's Denver Safety and Health Technology Center for all reportable U.S. mining accidents, injuries, and illnesses that have occurred since 1978. This data base provides information about the injury: type, severity, date, time, etc.; the injured: age, occupation, job experience, and other demographic information; and the mine: type, location, number of employees, etc. A five-line narrative of each incident is also available.

The 5-year period from 1985 through 1989 was selected for analysis. The injuries were selected by specifying irritated tendon injuries and occupational diseases to the upper extremities for both coal and metal-nonmetal mining accidents. The narrative from each of the injuries was then analyzed by the primary author to determine if the injury was due to an acute incident (i.e., struck by object) or to a cumulative trauma. Acute injuries were excluded from all analyses. CTD's were divided into two groups: (1) CTS injuries (identified by a CTS diagnosis or surgery notation within the narrative) and (2) CTD injuries excluding CTS (hereafter referred to as CTD injuries). To reduce CTD's in mining, this study examined whether age, years of work experience, or job title are significant factors in the development of UECTD injuries in mining, with special emphasis on CTS injuries. Also, a comparison was made of the incidence rates in mining to those of private sector industry. (Statistical tests of private sector industry were infeasible since the U.S. Bureau of Labor Statistics does not report the standard deviation of the mean.)

RESULTS

The number of CTS and CTD's occurring from 1985 through 1989 are shown in figure 1. The number of reported CTD's increased from 6 in 1985 to 59 in 1989. The number of reported CTS injuries increased from 9 in 1985 to 72 in 1989. The ratio of CTS and CTD's to all mining accidents is illustrated in figure 2 according to injury and year. Both curves show an increasing trend.

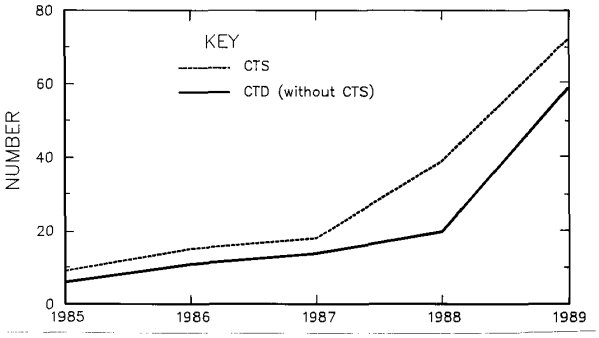

Figure 1.—UECTD injuries in the U.S. mining industry, 1985 through 1989.

This increasing trend may be due to increasing occurrences of CTD's, or more likely, CTD's are increasingly being reported. In either case, it is important to know who the workers are that are being injured. Out of a total 263 reported CTD's during the period 1985 through 1989,

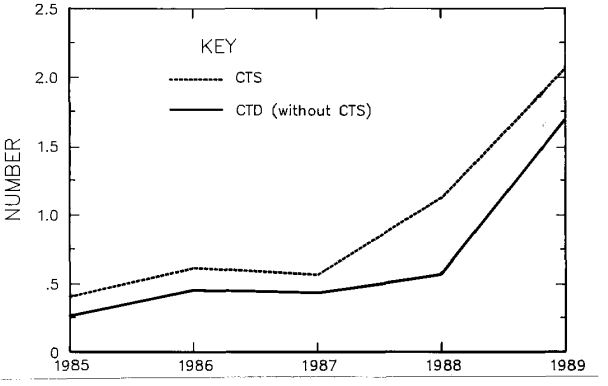

Figure 2.—UECTD injuries per 1,000 injuries in the U.S. mining industry, 1985 through 1989.

80.5 pct of the injuries occurred in metal-nonmetal mines, whereas 19.5 pct occurred in coal mines. In 1986, there were an estimated 166,406 metal-nonmetal mine personnel (excluding office personnel) working in 10,600 metal-nonmetal mines and an estimated 145,691 coal mine personnel (excluding office personnel) working in 7,750 coal mines (*19-20*). The total number of UECTD injuries for 1989 yields an incidence rate of 6.3 per 10,000 metal-nonmetal miners and 1.8 per 10,000 coal miners. Incidence rates represent the number of illnesses per 10,000 full-time workers (*21*) and are calculated as (N/EH) × 20 million, where N = number of illnesses, EH = total hours worked by all employees during the calendar year, and 20 million = base for 10,000 equivalent full-time employees working 40 h per week, 50 weeks per year.

The average age of the mining work force in 1986 was 39.5 years (*19-20*). For that same year, the average age of miners with CTD injuries was 38.2 (N = 11), and for those with CTS, the average age was 40.5 years (N = 15).

The average amount of experience at the job for the entire mining population in 1986 was 4.5 years (*19-20*). For that same year, the average years of experience at the job for miners with CTD injuries was 4.6, and for those with CTS, the average was 10.3 years.

Of the 45 mining occupations that have experienced a CTD during the period 1985 through 1989, four occupations comprise 62.7 pct of all reported CTD's (N = 263). Encompassing approximately 13 pct of the mining work force (*19-20*), the UECTD injuries that these selected occupations contribute are mechanics, 14.6 pct; laborers, 15.5 pct; boney (crusher) operators, 24.4 pct; and miners NEC, 8.2 pct. The total number of UECTD injuries for 1989 for these four occupations yields an incidence rate of 30.4 per 10,000 selected metal-nonmetal miners and 8.7 per 10,000 selected coal miners.

According to the U.S. Bureau of Labor Statistics (*21*), the illness incidence rate for disorders associated with repeated trauma in private sector industry was 19.2 per 10,000 workers. The highest incidence rate was for manufacturing, at 68.9. These rates include repeated trauma injuries to any affected body part, including the upper and lower extremities, ear drum (noise-induced hearing loss), and the back, whereas the mining data only include upper extremity repeated trauma disorders.

DISCUSSION

The total number of UECTD injuries reported during the period 1985 through 1989 increased as well as the percentage of UECTD injuries that comprised all mining accidents.

Metal-nonmetal mine workers had more than four times as many UECTD injuries than coal mine workers from 1985 through 1989.

The existence of a CTD appears to have no relationship with age nor mining experience, although those with CTS tended to have more experience than the general mining work force.

Although the mining sector had low incidence rates, certain mining occupations did experience higher-than-normal incidence rates. In fact, almost two-thirds of all reported CTD injuries during the period 1985 through 1989 were attributed to only four occupations: mechanics, laborers, boney (crusher) operators, and miners NEC. These four occupations comprised only about one-seventh of the mining work force and had an incidence rate well above the private sector industry rate.

CONCLUSIONS

Awareness of a problem is critical for the alleviation of it. Awareness of CTD's in mining is apparently evident, since more and more injuries are being reported every year. Although incidence rates for CTD's in mining are generally lower than in private sector industry, there are certain occupations, in metal-nonmetal mines specifically, that have a greater incidence rate than in private sector industry. Future investigations should identify the specific risk factors associated with these occupations in metal-nonmetal mines [i.e., mechanics, laborers, boney (crusher) operators, and miners NEC] that experience a high incidence rate of CTD's.

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