

Ravindra S. Goonetilleke
Waldemar Karwowski *Editors*

Advances in Physical Ergonomics and Human Factors

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Advances in Human Factors and Ergonomics 2017

AHFE 2017 Series Editors

Tareq Z. Ahram, Florida, USA

Waldemar Karwowski, Florida, USA



***8th International Conference on Applied Human Factors and Ergonomics
and the Affiliated Conferences***

***Proceedings of the AHFE 2017 International Conference on Physical
Ergonomics and Human Factors, July 17–21, 2017, The Westin Bonaventure
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Preface

The discipline of human factors and ergonomics (HF/E) is concerned with the design of products, process, services, and work systems to assure their productive, safe, and satisfying use by people. Physical ergonomics involves the design of working environments to fit human physical abilities. By understanding the constraints and capabilities of the human body and mind, we can design products, services, and environments that are effective, reliable, safe, and comfortable for everyday use.

A thorough understanding of the physical characteristics of a wide range of people is essential in the development of consumer products and systems. Human performance data serve as valuable information to designers and help ensure that the final products will fit the targeted population of end users. Mastering physical ergonomics and safety engineering concepts is fundamental to the creation of products and systems that people are able to use, avoidance of stresses, and minimization of the risk for accidents.

This book focuses on the advances in the physical HF/E, which are a critical aspect in the design of any human-centered technological system. The ideas and practical solutions described in the book are the outcome of dedicated research by academics and practitioners aiming to advance theory and practice in this dynamic and all-encompassing discipline. A total of seven sections presented in this book:

- I. Biomechanics and Ergonomic Modeling
- II. Ergonomic Evaluation and Interventions
- III. Physical Ergonomics Applications
- IV. Risk Assessment and Management
- V. Movement and Balance
- VI. Applied Ergonomics in Fashion Design and Sports Technology
- VII. Ergonomic Performance of Work Systems

Each section contains research that has been reviewed by members of the International Editorial Board. Our sincere thanks and appreciation to the Board members as listed below:

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We hope that this book, which is the international state of the art in physical domain of human factors, will be a valuable source of theoretical and applied knowledge enabling human-centered design of variety of products, services, and systems for global markets.

July 2017

Ravindra Goonetilleke
Waldemar Karwowski

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Biomechanics and Ergonomic Modeling

Hand Arm Vibration, Grip Strength Assessment and the Prevalence of Health Disorders Among Stone Crushing Workers

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Abstract. This research was conducted to analyze the hand-arm vibration exposure levels in the workplace and the effects of vibrations on the health of stone crushing workers. The results suggested that the levels of vibration for rock drilling operators, measured through two different types of systems, were exceeding the Threshold Limit Values. Therefore, a higher percentage of workers may be affected with hand-arm vibration syndrome. In addition, the Hand Activity Level score was calculated with the support of a physician in order to analyze the occurrence of musculoskeletal disorders. Prolonged exposures to hand-arm vibration may also lead to loss of grip strength and proper functioning of hand. A digital hand dynamometer was used to calculate the grip strength of the workers using powered drill machine. A significant decrease of 5.86 kg of force in average grip strength of the workers was found before and after 1 h of drilling.

Keywords: Hand-transmitted vibration · Hand-arm vibration · Hand grip strength · Vibration disorders · Musculoskeletal disorders

1 Introduction

During stone crushing activities, vibrations and noise produced by equipment are among the hardest hazards the worker has to cope with. Work related health problem with occupational vibration transmitted to the hand-arm system is usually termed as Hand-Arm Vibration (HAV) syndrome and affects the workers working with powered tools and machinery. HAV is one of the factors that can cause several diseases and permanent disorders in cardiovascular, musculoskeletal and nervous system of the body. The major disorder related to hand-arm vibration exposure is known as white finger disorder [1]. For example, white finger disorder was reported to be common amongst forest workers using chain saws [2].

The likelihood of occurrence of most common upper extremity cumulative trauma disorders (CTDs) is higher amongst those workers who are working using hand arm powered tools and equipment. Vibration also produces different diseases which are related to muscles and carpal tunnel syndrome and its effects become manifold with age [3].

Effects of noise, low temperature and vibration are very dangerous for the workers. Chao et al. [4] discovered that the most dangerous of these factors (noise, vibration and low temperature) are noise and vibration. According to their research it is very difficult to assess the combined effect of noise, low temperature and vibration on the health of workers. Cardiovascular diseases and stroke in the elderly people are associated with the night time vibration and noise levels. The exposure to vibration and noise at night is more relevant for the start of cardiovascular disease than daytime vibration and noise exposure [5]. Low frequency noise affects the human health annoyance, and the occurrence of annoyance increases with higher sound pressure levels of low frequencies. Low frequency noise annoyance can cause diseases like headaches, unusual tiredness, lack of concentration, irritation, and pressure on the eardrum. Data suggest that also sleep may be negatively affected [6].

According to European legislation [7], the employers have to measure the vibration levels at appropriate intervals to lessen the risks at work. Due to practical constraints, it is very much difficult to measure for long periods; ISO 2631 standard allows the employers to take short term measurements of vibration exposure levels for evaluation [8].

Several studies have proved that the development of musculoskeletal disorders (MSDs) may be caused by vibration exposure, excessive biomechanical load and psychosocial factors [9]. Exposure to hand-arm vibration may cause white finger disorder which significantly affects the work ability of the workers. Stress and perception thresholds also play a vital role in determining the working capacity of the workers under HAV exposure [10].

Numerous studies have been conducted on noise levels and their adverse health effects on stone crushing workers. However, hand-arm vibration exposure due to powered drill machines, grip strength measurement before and after exposure to vibration and health issues associated with the vibration and other environmental factors were not discussed in detail in the literature.

2 Materials and Methods

To study the effects of hand-arm vibration on stone crashing workers, we visited a stone crashing site on the Margalla hills (Pakistan). There workers were working with powered hand drills to break the stone. Official approval from the site owner and consent of the workers were taken to measure the vibration and grip strength of the workers, and collect health personal data. As recommended in the literature [11], in order to reduce possible sources of stress, the workers were informed about the way the data were going to be collected and for what purpose.

At first hand arm vibration data were collected using a 5340B USB Vibration measurement system. The data acquisition system includes 7543B USB accelerometer, 6330A-pin to USB cable and 9008 VibraScoutTM Triaxial measurement software program (DYTRAN INSTRUMENTS, INC). It also includes an onboard temperature sensor. For collecting acceleration data, the sampling frequency was set at 1600 Hz with an update rate of 0.20 s and recording duration of 60 s.

Then, an Arduino board was used for HAV measurement. The Arduino board is one of the emerging devices that can be used not only for measurement of hand-arm vibration but also for robotics, as goniometer for the body assessment, to measure the PH of soil etc. There are many different products of Arduino board, but the Arduino UNO product is used for the HAV assessment by connecting it with an accelerometer.

The Arduino is a hardware device which gathers data from the working environment. It consists of different parts like USB connector, Power Connector, analogue reference etc. The Arduino board was connected with a computer through the USB COM port. The accelerometer was connected with the Arduino UNO through the analogue for connections and the power in port using jumping wires by bread board of sequence power in port of 5 V (5 volts) with VCC_IN of Accelerometer G285 and the GND (ground) with GND (ground) of accelerometer and Analogue. In A4 of Arduino with SDA of accelerometer and A5 of Arduino of with the SCL of the accelerometer. First, we installed the Arduino software, then we used the built-in code of accelerometer for Arduino UNO (Interface is shown in Fig. 1(a)) and integrated the code to take the reading. The measures were dynamic and in three reference axes X, Y and Z. The connections and adjustment of sensor on a worker are shown in Fig. 1(a) and (b).

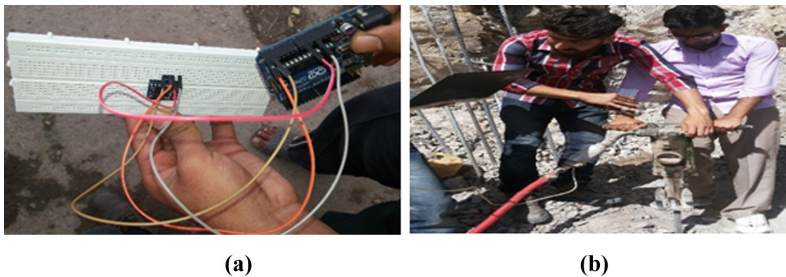


Fig. 1. (a) Arduino Board connections (b) Vibration reading during work.

For every worker, the measure for the first 5 to 10 s was the reference measure (along X, Y, Z axes), and the remaining measure up to 1 min was the actual measure. Then we made an Excel file to perform an analysis through Minitab software. We compared the results with international standards.

In addition, the grip strength of workers with white finger disorder was measured by means of the JAMAR® Plus+ Digital Hand Dynamometer (Fig. 2). The body of the dynamometer is made of aluminum with a scratch resistant UV coating. The dynamometer shows an isometric grip force from 0 to 200 lbs. (0–90 kg). The dynamometer is equipped with digital load cell technology which can calculate the average grip strength, standard deviation and coefficient of variation.



Fig. 2. JAMAR® Plus+ Digital Hand Dynamometer.

3 Hand-Arm Vibration Measurement

The basis for the evaluation of vibration risk is provided by ISO 5349-1:2001 [12]. The assessment of the level of exposure to vibration is based on the calculation of daily exposure $A(8)$ expressed as equivalent continuous acceleration over an 8-h work period, that can be calculated through Eq. (1). For the determination of $A(8)$ it is not necessary to measure over 8 h. It is sufficient to make short-term measurements during representative work periods. The results are normalized to 8 h.

$$A(8) = a_{hv} \sqrt{\frac{T_e}{T_o}}. \quad (1)$$

Where a_{hv} is the vibration total value of the frequency-weighted acceleration during the exposure to machine or process, T_e is the total daily duration of exposure and T_o is the reference duration of 8 h.

For hand-arm vibration, a_{hv} is calculated as the square root of the sum of the squares (vector sum) of the root mean square rms values a_{wx} , a_{wy} and a_{wz} . These are measured as the accelerations in three orthogonal directions and frequency-weighted. The vibration total value a_{hv} is calculated as follows:

$$a_{hv} = \sqrt{a_{wx}^2 + a_{wy}^2 + a_{wz}^2}. \quad (2)$$

Figure 3 shows the coordinate system used to measure HAV. As a consequence, the 3 accelerometer channels were aligned with the powered drill machines.

35 stone crushing workers using powered rock drilling machines were selected for the measurement of hand-arm vibration and hand grip strength. Both older age workers as well as younger workers were involved in the study. The vibration readings were taken 3 times for 1 min for each worker in each axis and the average of the readings was used in the study.

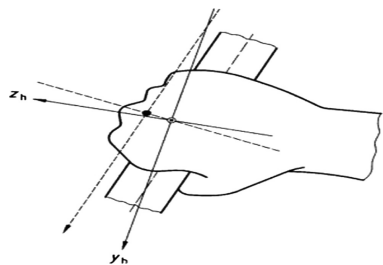


Fig. 3. Coordinate system used for HAV [13].

4 Results and Discussion

4.1 Vibration Levels

Figures 4, 5, 6 and 7 show time and frequency trends of vibration levels. Fluctuations in the HAV values are due to different types of rocks being drilled and the gripping of drill machines by the workers.

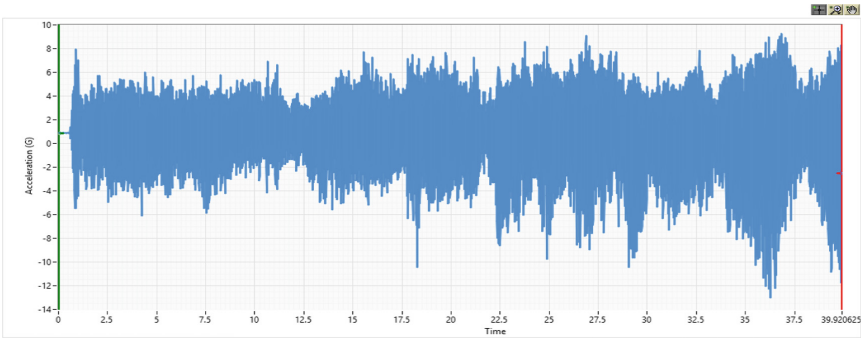


Fig. 4. HAV data from x-axis.

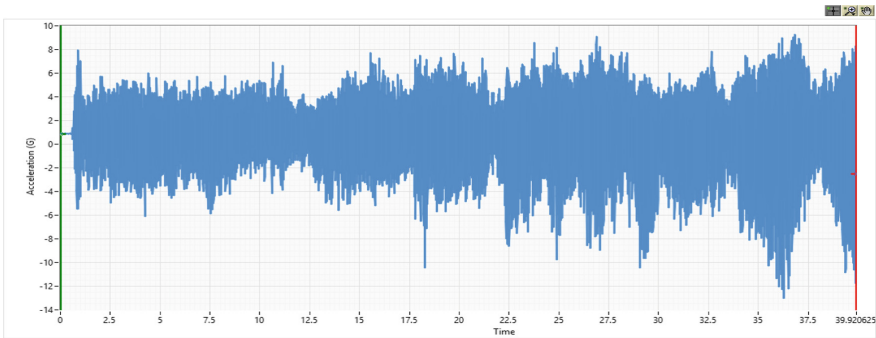


Fig. 5. HAV data from y-axis.

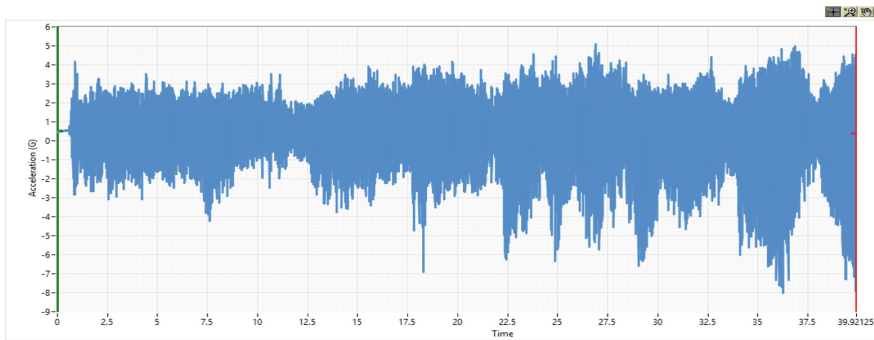


Fig. 6. HAV data from z-axis.

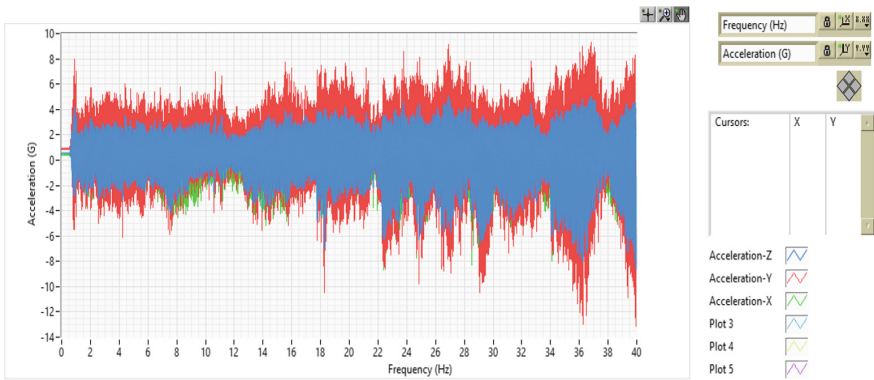


Fig. 7. HAV data from all the three axes.

The average maximum vibration levels found at x, y, z axes with the Arduino board and the USB accelerometer are shown in Table 1.

Table 1. HAV levels of stone crushers using hand drill machines.

	Arduino Board		7543B USB accelerometer	
	Avg. Max HAV (ms^{-2})	SD (ms^{-2})	Avg. Max HAV (ms^{-2})	SD (ms^{-2})
a_{wx}	16	2.22	8.5	1.53
a_{wy}	10	3.5	12.4	2.32
a_{wz}	24	3.74	8.1	1.43
a_{hv}	30.53	—	17.08	—

According to European legislation [7], for hand-arm vibration the daily exposure limit value standardized to an 8-h reference period shall be 5 ms^{-2} .

Based on Eq. (1), the maximum total daily duration of exposure T_e is around 0.2 h in the case of Arduino board and 0.7 h in the case of the USB accelerometer. These durations are extremely short and unlikely for stone crushing activity. These results are consistent also with the TLV recommended by ACGIH. Indeed, according to ACGIH the maximum value of the acceleration which shall not be exceeded for a total daily exposure duration less than 1 h is equal to 12 ms^{-2} .

4.2 Health Hazards and Working Conditions at Crushing Site

Only few workers out of the 35 included in the study have knowledge of vibration exposure and hazards related to noisy environment. A general survey form was used with the support of a physician to collect the data of health hazards of workers at crushing site. Figure 8 shows the percentage of workers affected from different types of occupational pain and diseases.

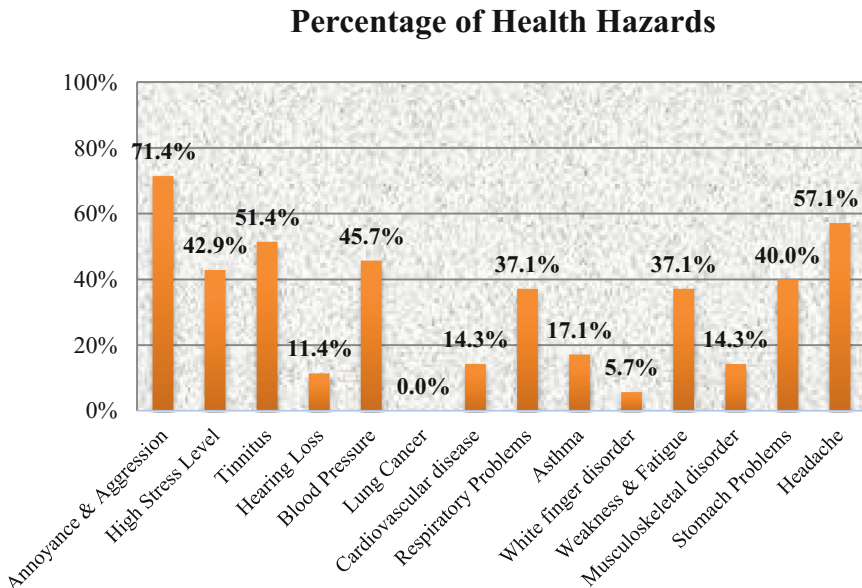


Fig. 8. Health issues of stone crushing operators.

Most of the diseases were found in old aged people probably due to their long exposure to difficult working environment. Annoyance & aggression was found in 71.43% of the workers and the main cause could be high noise level and high temperature at the crushing site. Long exposure to high noise levels can increase blood pressure which in turn produces annoyance and aggression. Also, nervousness, high

stress level, muscle pain and hearing problem called “tinnitus” are due to noise from drill machines and other crushing machinery [14]. About 51.42% of workers were facing the problem of Tinnitus and around 11.42% were having permanent hearing loss. 5.71% of the workers were having white finger problem while cardiovascular and respiratory problems were also significant. This was supposed to be due to the lack of protection from dust. Indeed, only few workers were using dust filters during the work. Headache problem was found in 57.14% of the workers and the main cause of this problem was probably constant blasting of rocks and high noise levels at the site. Weakness and fatigue are also associated with that cause.

Due to poor job security, the workers looked afraid in sharing their health problems during the interview; therefore, the actual percentage of diseases could have been underestimated.

4.3 Grip Strength of Stone Crushing Workers

Hand grip strength of the workers was measured using Jamar digital hand dynamometer. Measures were taken before the start of work and after using the stone drill machine for one hour (see Table 2).

Table 2. Grip strength of stone crushing workers before and after using drill machine.

Sr. No	Grip strength at start (kg)	Grip strength after 1 h of work (kg)
1	72.5	50.7
2	46.9	43.6
3	49.4	42.2
4	58.7	45.6
5	49.3	40.0
6	85.9	72.2
7	49.2	41.5
8	63.2	54.7
9	43.2	43.6
10	47.5	39.7
11	78.7	62.8
12	57.5	59.5
13	48.5	42.1
14	63.7	70.2
15	56.5	57.7
16	47.9	49.0
17	57.2	55.5
18	69.0	55.2
19	81.0	74.5
20	48.0	53.5
21	64.2	55.3

(continued)

Table 2. (continued)

Sr. No	Grip strength at start (kg)	Grip strength after 1 h of work (kg)
22	67.8	67.3
23	55.0	44.8
24	51.0	40.4
25	69.8	54.5
26	41.8	44.7
27	75.5	64.5
28	41.6	35.9
29	48.2	37.1
30	50.6	48.7
31	62.3	64.5
32	54.9	51.6
33	56.8	54.8
34	61.6	60.2
35	62.8	54.8
Average grip	58.22	52.36

The results show a significant average difference of 5.86 kg of force in the grip strength of the workers. This confirms that the vibration level and fatigue level of worker significantly affect the grip strength of the workers.

4.4 Hand Activity Level (HAL) Score Levels

The ACGIH Threshold Limit Value for hand activity considers average hand activity level or “HAL” and peak hand force [15]. It represents conditions to which it is believed nearly all workers may be repeatedly exposed without adverse health effects [16]. Hand activity level was determined to know how difficult the task is and what are the health risks associated. It is aimed to monotask jobs with 4 or more hours of repetitive handwork. The HAL score was calculated only for those workers suffering from white finger disorder (see Table 3).

Table 3. HAL scores of stone crushing workers.

	No. of workers	Range	Minimum	Maximum	Mean	Std. Deviation
Age	35	24.0	18.0	42.0	25.93	5.23
Daily working time	35	4.00	8.00	12.00	8.22	1.25
Hand activity level	02	2.25	6.75	9.00	7.87	1.79

According to TLV an average HAL close to 8 does not cause adverse health effects only if the normalized peak force (ten times the ratio between peak force and the posture specific reference strength) of the activity is extremely low (<2), which is an unlikely condition for stone crushing workers.

5 Conclusions and Recommendations

This research has investigated the hand-arm vibration exposure levels in the workplace and the effects of vibrations on the health of stone crushing workers. In addition, the HAL score and the loss of grip strength were calculated.

The hand-arm vibration measurement results show that the measured values of vibration are notably high. Constant exposure to such levels of vibration can cause vibration induced health disorders, mainly the white finger syndrome among the rock drill operators. Similar results were found also for the HAL score. Furthermore, a significant reduction of the grip strength of the workers was observed.

The survey indicated that the health impacts on workers include hearing disorders, dermatological impacts, respiratory problems, eye irritation, headache and accidental injuries. From the results, it can be clearly deduced that stone crushing operators are prone to various hearing and vascular disorders which in long term can produce permanent disorders.

The time of exposure to hand-arm vibration due to powered drill machine should be significantly limited in order not to affect workers' health. It seems that the occupational diseases associated with vibration are not given much consideration in the site under examination, and probably in the stone crushing industry in Pakistan. Increasing workers' awareness of risks connected to the use of powered machinery and of the importance of using personal protective equipment is needed. In order to investigate all the causes of musculoskeletal disorders further analysis could be carried out using the tools and methods available in the literature (e.g. [17]).

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Understanding Shoulder Injury

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Abstract. Discomfort, restriction of motion, pain, and injuries to the hard and soft tissues of the shoulder are a frequently reported occupational and non-work issue. Outside of trauma, shoulder-related issues often result from physical stressors in the individual's overall life, from individual and personal factors and life-style choices. This paper will discuss the ergonomic and individual/personal risk factors associated with the development of shoulder problems to improve understanding of the multitude of sources for shoulder pain and injury, and provide guidance toward reducing shoulder injury potential through effective task, tool, and work design as well as in educated injury and accident investigations.

Keywords: Shoulder injury · Risk factors

1 Introduction

The shoulder is one part of the biomechanical chain that begins with the hands and ends in the shoulder, neck/shoulder region. Loads, motions, and postures of the hands, forearm, and upper arm are balanced by the shoulder and to some extent by the region of the neck-shoulder region, so while this paper will address “shoulder” issues, the activities of the hands and arms and their impact on the shoulder and neck-shoulder region cannot be totally ignored.

Aches and pains in the shoulder region are not unusual and the overall frequency of shoulder-related disorders is second only to those for low back problems. Reported rates for shoulder problems are quite variable, depending on the definition of “problem,” with typical prevalence rates from 6% to over 26%, incidence rates of from 0.9% to over 2.6%, and with occupations, lifestyles, or sports with higher shoulder overuse having higher rates of complaints. [1–6]

2 Basic Shoulder Anatomy

The shoulder joint is the most complex and flexible joint in the body and is designed to allow considerable joint flexibility and motion rather than for overall strength and load bearing capacity. The shoulder consists of three bones, the scapula (shoulder blade), the humerus (upper arm bone), and the clavicle (collar bone); a large number of muscles

that support the scapula, the neck/shoulder region; and the actual shoulder joint and related supporting joints.

2.1 Bone Structure

The scapula is the origin for many of the power, stability, and motion generating muscles of the shoulder joint. There is a bone projection called the acromion that goes from the back of the scapula upwards to the clavicle where it forms the acromioclavicular (AC) joint and a second projection from the front facing side of the scapula called the coracoid process that angles upwards to the AC joint region. The gap between the AC joint and the clavicle is called the subacromial gap. The AC joint and upper end of the coracoid process are connected by a strong ligament that stabilizes the AC joint and the coracoid process and also creates a strong covering over the subacromial gap that contains bursa and through which tendons and nerves pass from the scapula to the shoulder joint.

2.2 Shoulder Joints

The primary joints in the shoulder are the Glenohumeral joint (GH) or the “shoulder joint” which is where the head of the humerus joins the shoulder joint on the scapula and three other shoulder supporting joints, the Acromioclavicular joint (AC), the Scapulothoracic joint, and the Sternoclavicular joint. These joints and associated muscles, tendons, and ligaments provide support and stability for the shoulder and the neck-shoulder complex. The GH joint is the primary joint involved in normal shoulder motion and the AC joint provides support and motion control of the shoulder and scapula, particularly with loads and awkward postures.

2.3 Shoulder Muscles and Their Actions

The flexibility, load bearing, and control of the shoulder joint rely on a number of muscles in the scapula, shoulder, upper arm, torso, and neck-shoulder region. The muscles of the scapula, upper arm, and torso allow stabilization, elevation, and positioning of the GH joint, and the rotator cuff muscles, and the deltoid and upper arm muscles allow further posture control of the GH joint and the forearm. The GH joint itself is a loose ball and socket joint that has the rounded head of the humerus held in a shallow socket in the scapula by the long tendon of the biceps, the deltoid, and the four muscles of the rotator cuff, the Infraspinatus, Supraspinatus, Subscapularis, and the Teres Minor. Additional joint stability comes from a ring of fibrous tissue around the shoulder joint socket, the labrum that deepens the socket joint and is an attachment point for a number of the tendons of the rotator cuff.

The rotator cuff muscles connect the scapula to the humerus with their tendons passing around the head of the humerus, through and around the subacromial gap and surrounding bursa to their attachments on the head of the humerus and labrum. Additional motion and stability of the shoulder joint is provided by a number of muscles, including the Deltoid, Pectoralis Major, Infraspinatus, and Latissimus Dorsi.

3 Shoulder Injury

There is a wide range of shoulder problems that can range from transient not well-defined aches, pains, and soreness of the soft tissues of the shoulder often called nonspecific disorders, NSD's, to more serious conditions such as impingement, tendonitis, bursitis, arthritic changes and tears of the rotator cuff. While rates of different types of shoulder injury vary, for purpose of this paper, the most commonly reported shoulder problems are summarized next.

3.1 Persistent Soreness, Pain

Persistent shoulder discomfort or NSD's are the most commonly reported shoulder problem and reflects the complexity of the shoulder and its response to overuse, aging, obesity, medical/personal issues, a more significant injury to the hard or soft tissues of the shoulder joint or, in some cases, radiating pain from a cervical spine injury. Psycho-social factors are also implicated in persistent shoulder soreness issues as stress can create static postures and loadings. NSD are of importance as they may reflect the early stage development of more significant injuries if exposures continue.

3.2 Shoulder Arthritis

Arthritis generally refers to degenerative changes of the cartilage including cartilage thinning, development of holes in the cartilage as thinning progresses, bone to bone contact after cartilage loss, bone spurs, and alterations in bone form associated with these changes. Shoulder arthritis generally appears in the GH or AC joints and its development is associated with heavy physical work, a history of shoulder overuse, sports, sub-traumatic injury to the shoulder, some individual or personal conditions or more commonly, a combination of the above. The term "degenerative changes" is also used to describe these injuries or changes in the joint as well as to the changes in the tendons with overuse, aging, or trauma.

3.3 Bursitis

Bursitis is the irritation and swelling of the soft lubricating sacs, the bursa, that surround the tendons and joints/bony projections. Bursa protect these structures and allow easy sliding of the tendons during shoulder and upper arm motions. Bursitis is associated with repetitive shoulder/arm motions, work with poor shoulder postures, static loadings, an impact or degenerative changes in this area, or more commonly, a combination of these factors. Age plays a role in bursitis as the lubricating power of the bursa decreases with age and with aging and overuse, the tendons also begin to wear and fray, possibly accelerating irritation of the bursa. While subacromial bursitis is most "common" due to the size of the bursa and its location in the subacromial gap, any of the other bursa can be affected.

3.4 Tendinitis

Tendonitis is an irritation or the damage/fraying of the tendons due to repetitive motion, outward arm rotation combined with abduction, overexertion, or static or awkward postures of the shoulder. The rotator cuff tendons and the supraspinatus tendon are particularly prone to this type of injury.

3.5 Impingement

Impingement (syndrome) results from the compression of the tendons of the rotator cuff, the subacromial bursa, and other soft tissues in the subacromial gap when the arms are extended overhead; with sustained or static work postures; hunched shoulders; and in tasks with the arms extended fully downwards with effort; Impingement can facilitate bursitis and arthritic changes in this joint region, bone spurs, thinning cartilage, fraying and tearing of the tendons in this region, and perhaps some types of frozen shoulder.

3.6 Frozen Shoulder (Adhesive Capsulitis)

This occurs when the joint capsule of the humerus head adheres to the shoulder blade, causing shoulder pain and stiffness. Static work with awkward or hunched shoulder postures and repetitive, heavy work with poor postures of the arms and shoulder and some types of bursitis are all linked to frozen shoulder syndrome.

3.7 Rotator Cuff Injuries

Pain, discomfort and injuries to the tendons and the muscles of the rotator cuff are a commonly reported problem and include discomfort/pain from tendonitis, changes in free movement, labrum tears, strains, degenerative changes, and tears to the rotator cuff muscles and tendons. A rotator cuff tear injury refers to the wearing, fraying, or degeneration of one of the four rotator cuff tendons, a physical tear of one of the tendons, a tear of the muscle itself or a partial or complete detachment of the tendon from its attachment point(s). Injuries to the rotator cuff result from an acute trauma to the shoulder, a fall onto an extended arm, regular or sudden rotation and abduction of the arm, a sudden heavy force on the hands when the arm is extended, exertion of effort with the hands with arms extended straight down, aging and general overuse of the shoulder. Injuries to the supraspinatus and infraspinatus are more frequently reported.

Rotator cuff tears/injuries are not always symptomatic and the rate of diagnosed non-symptomatic rotator cuff injuries is about two to three times the rate of symptomatic rotator cuff injuries. While tears are found in all age groups, individuals above 50 years of age show an increase in both symptomatic and asymptomatic [7–9].