

## Ergonomic Intervention for Preventing Musculoskeletal Disorders among Farm Women

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**ABSTRACT** For more than a decade, farming has been rated as one of the dangerous occupations. A considerable number of adverse health conditions, including musculoskeletal disorders are linked to agricultural work. This paper presents the results of a literature review undertaken to determine the types and extent of musculoskeletal disorders of the farm women in India and to identify opportunities for ergonomic intervention. It was concluded that numerous types of musculoskeletal disorders such as disorders of the back and neck, nerve entrapment syndromes, tenosynovitis, tendonitis, peri tendonitis, epicondylitis and non-specific muscle and forearm tenderness were consequences of the occupational risk factors in agriculture including static positioning, forward bending, heavy lifting and carrying, kneeling and vibration. At the same time, ergonomics interventions has the potential to reduce musculoskeletal disorders among farm women. These may include designing of women friendly tools and equipment, improved work processes and stipulation of shorter rest periods for farm women. There is a need to increase awareness of musculoskeletal disorders and associated risk factors and to train farm women periodically for the proper and safe ways of handling tools and equipment in order to avoid musculoskeletal disorders. The information presented in this paper should result in (1) Prioritization of researches based on prevention of farm women from musculoskeletal disorders, (2) Development of new technologies for women for critical field problems such as hand cutting of plant materials, stooped posture, and lifting and carrying of heavy materials, (3) Funding and support for awareness and prevention programmes for musculoskeletal disorders.

### INTRODUCTION

Woman is the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. She does the most tedious and back-breaking tasks in agriculture, animal husbandry and homes. Therefore, without intellectual and physical participation of woman, it may not be possible to popularize alternative system of land management to shifting cultivation and promote the care of soil and health of economic plants and animals. It is a fact that the women of rural areas contribute to agricultural work in addition to their domestic work. Presently, they constitute one-third of the agricultural labour force and about 48 per cent of self-employed farmers. Furthermore, management and involvement of Indian women in farming enterprise has been on rise recent years especially in better endowed rural regions (Praveena et al. 2005).

It is also estimated that on an average, the Indian woman, especially in the poverty group spends above five hours per day more than the Indian man in work, including the visible burden of family. As per recent findings, women in India are major producers, of food in terms of value, volume and number of hours worked (Dash 2000). Srivastava (1985) stated that all

women irrespective of land status of family, provide 14 to 18 h of productive physical labour in different chores. Women spends long hours with much labour in respective operations resulting in fatigue and drudgery. Therefore, the life of women is full of drudgery at every stage.

The women play a significant and crucial role in agricultural development and allied fields including livestock production, horticulture, post-harvest operations etc is a fact taken for granted but ignored. The nature and extent of women's involvement in agriculture varies greatly from region to region, even within the region. Also their involvement varies widely among different ecological subzones, farming system, castes, classes etc. but regardless of these variations, there is hardly any activity in agricultural production in which women are not actively involved.

More than half of the world's food is grown by women. Women's work is both wide-ranging and multifaceted throughout the year, and they perform multiple tasks in the sphere of agriculture. Women's indigenous knowledge and skills are vitally necessary for food production and sustainable agriculture. Women's intimate knowledge of seed preparation and soil management, plants and pest control, post-harvest processing and storage, animal husbandry, as well as food

processing and meal preparation are significant - crucial also to ensuring food security through sustainable agriculture. They are the authority on the interface of livestock keeping with farming.

However, there is little recognition of their significant role and contribution to the socio-economic development of a nation. The entrenched social and religious norms that define women's role as secondary and subordinate keep women vulnerable and dependent and allow women's exploitation as agricultural workers and farmers. Agricultural tasks range from highly mechanized operations employing state-of-the-art technology to maintenance of subsistence plots (Fenske and Simcox 2000). Given the vast diversity of agricultural activities, this represents a challenge to health care providers. The identification of occupational health hazards and the development of systems to evaluate, intervene, and decrease musculoskeletal risk factors and resulting disorders can be quite labor intensive and will require extensive occupational health knowledge.

### **MUSCULOSKELETAL DISORDERS IN AGRICULTURE**

There are numerous types of work-related musculoskeletal disorders that are reported in agriculture. These include disorders of the back and neck, nerve entrapment syndromes, musculoskeletal disorders such as tenosynovitis, tendinitis, peritendinitis, epicondylitis and non-specific muscle and forearm tenderness (National Institute for Occupational Safety and Health 1997). The majority of the farm women reported musculoskeletal problems is non-specific and lacks a well-defined clinical diagnosis (National Research Council and Institute of Medicine 2001). The prevalence of specific disorders and syndromes are not precisely known since many of these disorders have been difficult to classify in epidemiologic studies (NIOSH 1997). This may be due to inconsistent case definitions and that many musculoskeletal disorders are difficult to ascertain using conventional medical diagnostic tools. Although quantitative laboratory tests such as nerve conduction studies are available for nerve entrapment syndromes, it is difficult to objectively measure the presence or severity of disease and functional deficits in muscular or tendon disorders.

Work-related musculoskeletal disorders de-

velop slowly over months and years of repeated stresses. The risk factors themselves are ubiquitous, found in most jobs. Left unaddressed, musculoskeletal disorders can result in lifelong pain and permanent disability. As understanding about them has grown, recognition and diagnosis have literally exploded to make them the most frequent and most costly of work-related injuries in most industries. However, despite their growing priority among occupational health professionals, they have largely escaped recognition, prevention and control in most agricultural safety programs. While these injuries were known in 1987, they escaped notice in Agriculture at Risk.

Work-related musculoskeletal disorders are so common among experienced farmers and farm workers that many perceive them as no more than normal and inevitable consequences of farm labor. However, even when limited to the poor sources of data currently available on the extent of these injuries in agricultural workplaces, there is reason for new, high priority concern. We believe that the overall incidence of these injuries in the nation's agricultural workplaces likely exceeds 60 per 1000 workers, placing agriculture squarely among those industries with the highest recorded rates. This estimated incidence rate yields a total of over twenty times as many musculoskeletal injuries and illnesses as estimated pesticide injuries and illnesses in US agriculture annually (Blondell 1997). Musculoskeletal injuries and diseases likely affect the production agriculture workforce more frequently during their working years than any other safety and health problem. Disability due to musculoskeletal injuries and diseases incurred during their working years affect the production agriculture workforce more frequently and more severely than any other safety and health problem during the remainder of their working years and, for many, for the balance of their lives.

Jyotsna et al. (2005) stated that during wheat harvesting activity from morning till evening women usually adapts squatting posture and they continue to work in this posture for long duration without adapting any other posture due to which they reported severe pain in lower back and knees. Gustafsson et al. (1994) investigated the presence of musculoskeletal symptoms in Swedish dairy farmers during the preceding 12 months. As compared to women, men reported more back and knee problems. Women reported more symptoms in the neck, upper back and upper extremities than men.

Meyers et al. (1995) stated that occupational musculoskeletal disorders (MSDs) might affect muscles, tendons, joints, nerves and related soft tissues anywhere in the body. The lower back and upper extremities, including the neck and shoulders, are the most common sites. Because repeated risk factor exposure of the same muscle, tendon, or region may result in injury and inflammation to the affected area, names such as cumulative trauma disorder, repetitive motion injury, repetition strain injury, and occupational overuse syndrome have been applied to these disorders.

Work-related musculoskeletal disorders (MSDs) are rising in incidence and account for a majority of workers' compensation costs (Guo et al. 1999). They are increasing in incidence in California, which has consistently experienced injury rates higher than the national average in all industries (Robinson 1988). Of greatest concern are back injuries which are the most frequently cited cause of disability in persons aged 45 or less (Andersson 1981), account for most lost time from work (Clemmer and Mohr 1991), and account for a significant proportion of workers' compensation costs (Spengler et al. 1986; Robinson 1988; Webster and Snook 1990; Glisan 1993).

A total of 287 male farmers from Iowa completed a mail questionnaire in a study that investigated the frequency of risk factors related to back pain (Park et al. 2001). Daily back pain with duration of one week or more was reported by 31% of the farmers. Farmers in the age range 45-59 years and those with an additional non-agricultural job had the highest risk for back pain.

Considerable variation exists among rates of musculoskeletal health problems due to cumulative trauma among farmers and farm workers. For agricultural crop production, a rate of 9.9 (per 10,000 workers) was reported, as compared to a rate of 27.6 for agricultural livestock production (Bureau of Labor Statistics 1999). The rate for strain and sprains was 117.7 and 126.6, respectively, for agricultural crop and livestock production (BLS 1999).

Women reported more symptoms in the neck, upper back and upper extremities than men. This is similar to the findings by Hildebrandt et al. (1995), in which, 75% of farm workers reported experiencing musculoskeletal symptoms during the previous 12 months.

In the United States, upper extremity injuries

account for about 22% of all lost time injuries that occurred on farms in 1995 (Meyers et al. 2000). Gomez et al. (2003) reported a prevalence of 28% for hand/wrist trouble among 1,700 farmers. Upper extremity injuries have plagued dairy farmers with 27% of all injuries being attributed to this region (Pratt et al. 1992) and tobacco farmers with 25% (Struttman and Reed 2002). Based on a Swedish study, hand and wrist injuries are also prevalent on dairy farms with 51% of female dairy farmers suffering an injury (Stal 2000). Shoulder pain in the previous year was found to be greater in farming (14%) than either other manual labor (9.7%) or non-manual labor (7.1%) jobs (Walker-Bone and Palmer 2002).

The review of literature highlights some musculoskeletal disorders in agriculture as given below-

**Back Pain:** Any pain in the back is usually characterized by dull, continuous pain and tenderness in the muscles of the lower regions of the back. Some causes for back pain include poor posture, bad lifting, pushing and pulling techniques.

**Neck Pain:** Neck pain is usually caused by bad habits including poor posture, poor lifting techniques and overexertion on the job. Another major cause is stress. Some common symptoms of neck pain are persistence aching and stiffness and sharp pain. Scutter et al. (1997) reported that one-third of agricultural workers surveyed reported neck pain at least once a week. Tractor driving was reported most frequently as the activity that contributed to neck pain.

**Tendon:** Tendon disorders can be classified based on the anatomy of the tendon and its surrounding tissues: tenosynovitis, stenosing tenosynovitis, peritendinitis and tendinosis (Viikari-Juntura 1994). The term tendonitis is often used to refer to chronic tendonitis which is associated with repeated loading and is believed to be due to microtears in the tendon. Tendonitis is the deterioration of a tendon from repetitive motion. Animal studies on overuse of tendons have demonstrated an increase in cellularity and collagen disorganization, and an increase in tendon cross-sectional area and a decrease in tissue stiffness (Carpenter et al. 1998).

**Shoulder Disorders:** NIOSH (1997) identified over twenty epidemiologic studies investigating shoulder musculoskeletal disorders. Evidence of association between repetition and shoulder disorders was identified. Few studies investigated

actual repetitive neck movements. There is also evidence of association between a combination of risk factors; repeated or sustained exertions and elevated shoulder postures (>60 degrees of flexion or abduction) and shoulder disorders. There is insufficient evidence for an association between force and shoulder MSDs. The evidence for specific shoulder postures is strongest where there is combined exposure to several physical factors, such as holding a tool while working overhead.

A study specific to agricultural tasks, Palmer (1996) reported an OR=5.9 for neck and shoulder symptoms when comparing tomato trainers and matched workers. Tomato plants can grow quite tall up vertical wires and are supported by an overhead horizontal system. Tomato trainers reach overhead to adjust the support mechanism for the plants at a frequency of 10,000-16000 times per week (Palmer 1996). The risk factors accompany this job include repetition, static contractions of the neck and shoulder muscles, and working at or above shoulder level.

**Cumulative Trauma Disorder:** Cumulative Trauma Disorders (CTD) is a collective term for syndromes characterized by discomfort, impairment, disability or persistent pain in joints, muscles, tendons and other soft tissues, with or without physical manifestations. It is caused or aggravated by repetitive motions including vibrations, sustained or constrained postures, and forceful movements at work or leisure. Many different terms have been used to describe the observed events. For example, the syndrome has also been called over-use injury, cervicobrachial disorder, cumulative trauma injury, repetition strain injury, repetitive motion injury, rheumatic disease, osteoarthritis (Putz- Anderson 1988).

Cumulative Trauma Disorders may be caused or aggravated by impact and vibration from power tools, repetitive motions, forceful exertions, mechanical compression, sustained activities in awkward positions, over extension and over flexion of the wrist and/or use of hands as tools. Factors such as exposure to cold temperatures, genetic predisposition, stress and smoking may cause the discomfort to occur sooner.

A study was carried out by Raffi et al. (1996) among workers on an agricultural farm. The workers' histories were taken and they were given periodical medical check-ups. The presence of upper limb disorders was shown in a group of workers. A sample of 42 people was selected for

the study by means of specific tests: electromyography, ultrasonography and laser-doppler flowmetry. The tests showed a high incidence of carpal tunnel syndrome and microcirculation disorders. The study confirmed that electromyography and ultrasonography are highly useful tools for identifying cumulative trauma disorders.

**Repetitive Motion Disorder:** Tissue damage caused by repeated trauma usually associated with use of hand tools or vibrating tools is identified as repetitive motion disorder. Almost any form of activity that produces repeated trauma to a particular area of soft tissue, including tendons may cause this type of injury.

Repetitive and forceful work activities, awkward or static postures and mechanical pressure associated with work tasks have been cited as important etiological factors for WMSDs (Bernard et al. 1993).

Some movements that may lead to repetitive motion injuries include-

- Repetitive action of the hand or arm
- Bending at the wrist
- Grasping or pinching objects
- Frequently raising the arm and/or the shoulder
- Applying force with the hand or arm

**Carpal Tunnel Syndrome:** Pain, numbness or weakness that affects some part of the median nerve in the hand, thumb or ring finger is called carpal tunnel syndrome. Pain may radiate into the arm. Forceful work and repetitive hand work can cause CTS. According to Donne (1984), Carpal Tunnel Syndrome is a disorder by injury of the median nerve where it passes through the wrist on its way from the forearm to the hand. Injury to this nerve can cause impaired function. This condition is Carpal Tunnel Syndrome, which usually begins with a tingling or numbness in the hand and fingers and may progress to a loss of feeling, loss of grip and finally a loss of some hand functions. Some sources state that Carpal Tunnel Syndrome occurs most often in patients between the ages of 30 and 60 years of age, and is three to five times more frequent in women than men."

NIOSH (1997) concluded that based on the epidemiologic studies reviewed, the evidence is clear that exposure to a combination of the occupational risk factors studied (repetition, force, posture, etc.) increases the risk for CTS.

**Low Back Disorders:** Low back pain is one of the most common health problems in agricul-

ture occupation. Low back pain is a non-specific condition in or near the lumbosacral spine that can be caused by inflammatory, degenerative, neoplastic, gynecologic, traumatic, metabolic, or other disorders.

NIOSH (1997) identified the relationship between low back disorders and occupational risk factors. The five risk factors included for this review are: (1) heavy physical work which is defined as work that has high energy demands or requires some measure of physical strength, (2) lifting and forceful movements, (3) bending and twisting (awkward postures), (4) whole-body vibration (WBV), and (5) static work postures. Many of the studies addressed multiple work-related factors. Heavy physical work and awkward postures are the main causes of low back pain. Low-back disorders are associated with work-related lifting and forceful movements.

Manual materials handling and lifting are the major causes of work-related low back pain and impairments (Waters et al. 1993) with other factors such as bent and/or twisted position (Riihimaki 1991; Hagberg 1992). Manual material handling is the most frequent (36% of all the claims) and costly (35% of total cost) category of compensable loss (Leamon and Murphy 1994) and is associated with the largest proportion (63-70%) of compensable low back disability (Snook et al. 1978).

The prevalence of low back pain (LBP) in farmers has been reported to be around 50%, which is higher than other manual laborers (about 37%) (Walker-Bone and Palmer 2002). Crop cultivation has been related to LBP and more severe cases (e.g. sciatica) with about 20% of farmers working in this area developing pain (Manninen et al. 1995). Chronic back pain (lasting longer than 3 months) prevalence has been reported to be around 10% (Brackbill et al. 1994). Nationally, back injuries account for about 14% of all lost time injuries (Meyers 2001). Park and associates (2001) found that farmers have reported having daily LBP for a week (31%), which is significantly greater than the general working population (18.5%).

Gomez et al. (2003) found that prevalence of low back trouble among farmers was 41%. While the prevalence in specific specialties of farming has not been completely identified, there is no doubt that tasks being performed by farm workers contribute significantly to the development of low back pain.

Ahonen et al. (1990) investigated the level of physical strain accompanying dairy farming and found that female farmers frequently worked above 50% of VO<sub>2</sub> max during most of their work tasks. Heavy physical work has been associated with increased risk of low back pain. In this study, the handling of feed and manure was found to be the heaviest work task in dairy farming.

Working from lower areas—requiring severe trunk flexion, such as picking and deleafing activities, has been found to produce significant LBP (about 45%) (Palmer 1996). Nursery workers are exposed to awkward postures and poor lifting conditions in several of their activities: 1) handling of plants in 1-gallon containers, 2) pruning of plants, 3) weeding, 4) plant labeling, and 5) loading/unloading trucks (Meyers et al. 1997, 2000). Weeding in plant nurseries produces severe stooped postures for extended times that may lead to LBP (NIOSH 2001). Pruning, weeding and labeling are particularly stressful due to prolonged extreme flexion of the trunk (>60°) (Meyers et al. 1997, 2000). Harvesting crops (fruit and vegetables) often requires farm workers to bend over into a stooped trunk posture, oftentimes for significant periods of time (NIOSH 2001).

*Cellulitis:* It is infection of the palm of the hand following repeated bruising called “beat hand”. Use of hand tools, like hoe and sickle coupled with abrasion from dust and dirt can cause cellulitis.

*Epicondylitis:* It is inflammation of the area where bone and tendon are joined. It is called “tennis elbow” when it occurs at the elbow. Repetitive work, often from strenuous jobs like harvesting can cause it.

MSDs are a major concern for farm workers, farmers and health care professionals due to the negative impact on the health and productivity of workers. This impact is measurable in terms of health and safety costs, injury and illness rates, lost work time, treatment duration, and workers' compensation costs. Hopefully, by reducing the incidence of MSDs, a reduction in total costs, an increase in productivity, and improvement in employees' quality of life will be realized. There is a tremendous need for prevention of musculoskeletal disorders among women.

Women farmers may also be at higher risk for musculoskeletal disability. Leigh and Fries (1992) examined subsamples of men and women

from the National Health and Nutrition Examination Survey (NHANES I) Epidemiological Follow-up (NHEFS) conducted from 1982 to 1984 (N = 6,096). Farming was the longest held occupation with the highest disability for women.

Kaur and Sharma (2009) studied that a survey was conducted by taking 200 farm women of Punjab State. The results showed regarding the level of work related body disorders in agriculture by women included pain in many parts of body followed by numbness or stiffness. Some farm women also felt itching and swelling in hands while working in the fields and some felt burning in abdomen and chest especially during spraying of pesticides in the fields due to inhalation. The reasons of pain or stiffness may be due to the poor body postures while performing certain farm operations and lack of awareness regarding the right body postures. Sometimes, they did not even take rest in between which is essential to make our body stress free.

### **Ergonomic Interventions to Reduce Musculoskeletal Disorders**

Ergonomics is the study of work in relation to the environment in which it is performed (the workplace) and those who perform it (workers). It is used to determine how the workplace can be designed or adapted to the worker in order to prevent a variety of health problems and to increase efficiency; in other words, to make the job fit the worker, instead of forcing the worker to conform to the job. Ergonomics examines the physical capabilities of the human body and the limitations of the human body in relation to a person's work tasks, the tools used and the job environment. Meyers et al. (1998) has cited three general risk factors as both endemic and of highest priority throughout the agricultural industry. They are: lifting and carrying heavy loads, sustained or repeated full body bending (stoop) and very highly repetitive hand work (clipping, cutting).

Studies of agricultural safety and health (Murphy 1992) document that agricultural work involves those risk factors associated with musculoskeletal disorders. Despite ongoing changes in the scale of farming operations and types of machinery involved, very little change has occurred in tasks performed by most farm workers, or with those tasks most likely to generate back injuries or MSDs. Field jobs (harvesting,

weeding, irrigating, cultural practices, etc.) remain demanding physical tasks, involving stooped postures, lifting and carrying, and repetitive hand work. Meyers et al. (1996) suggested these three priority risk ergonomic factors as of general concern in California agricultural work. Research has shown that many important risk factors can be successfully addressed in agricultural work using ergonomic approaches (Lundqvist 1992; Lundqvist et al. 1992; Wick 1992; Miles and Steinke 1993; Meyers and Miles 1996, 1997).

Still, addressing them effectively will require developing interventions that are both acceptable to farmers and farm workers and which have significant preventive impact. In this line of attack, designing of tools and equipment and work processes with due consideration of ergonomical characteristics of women are accommodating to prevent MSDs. Stipulation of appropriate rest periods is also mandatory for preventing drudgery and musculoskeletal disorders.

Tiwari and Gite (2006) conducted an experiment with five subjects to study the influence of four work-rest schedules on physical workload during power tiller operation. The study indicated that the work-rest schedules did influence the physiological and postural workload as evidenced by the differences in working heart rate and postural discomfort. It was concluded that to avoid excessive postural discomfort the minimum duration of rest pauses should be of 15 min. The duration of the lunch break should be more than 45 min.

### **A. DESIGN OF WOMEN FRIENDLY TOOLS AND EQUIPMENT**

The industrialization of agriculture has introduced new equipments with little attention paid to ergonomic design. Many agricultural equipment aimed at men with the assumption that they will some how automatically benefit women though ergonomical characteristics of women are different than men workers.

Women have anatomical and physiological differences that may place them at risk for farm injuries (Engberg 1993). Females are, on average, shorter than men and have more adipose tissue. Females also have narrower shoulders, wider hips and proportionally have shorter legs and arms than their male counterparts (Mackay and Bishop 1984). On an average upper body strength

is 40% - 75% less in females than in males, while lower body strength is 5% - 30% less in females (Falkel et al. 1986). The higher prevalence of shoulder-neck disorders among women in industry has been associated with weaker muscle strength in the upper body (Kilbom and Broberg 1988). However, other literature reports that both strength and endurance were similar for men and women when body composition and size were controlled (Falkel et al. 1985; Hosler and Morrow 1982). Whole body vibration affects women more than men because of anatomic and physiologic characteristics.

Circulatory changes in the pelvic organs were found in a study of female tractor drivers; vascular tone decreased and venous stasis occurred at times, depending on the intensity and duration of the vibration (Engberg 1993). Excessive physical strain has been associated with injury events in women (Pickett et al. 1995). Ahonen et al. (1990) reported the physical strain of dairy farming to be high in women because of heavy work tasks and relatively low maximal oxygen uptake ( $VO_{2max}$ ).

In reality, physical stress associated with farm work can be minimized or in some tasks entirely prevented with appropriate ergonomic interventions. This physical stress is related to work requirements, such as production standards and work equipment, and to body size and capacity. The risk of musculoskeletal disorders is mainly due to inconvenient work postures.

From an occupational point of view, the cervical spine, head and shoulders, elbow and wrist joint can be considered to be interrelated as far as the problem of efficiency, design and comfort are considered. Women have different ergonomical characteristics than a man. There is a need to design women friendly tools and equipment as women can comfortably operate these tools and equipment. It will reduce musculoskeletal disorders and increase the efficiency and thereby productivity of the worker.

A study was carried out by Gandhi et al. (2009) in Haryana to compare the efficiency of improved wheel hand hoe and kasola. Field experiments were conducted on a sample of 10 male respondents doing weeding for 30 minutes in guar/sarson fields studying their physiological and biomechanical stress alongwith output capacity. The output capacity was 4.2 times higher using wheel hand hoe (0.05 ha/hr) as compared to only 0.12 ha/hr with kasola. Although,

average heart rate was higher using wheel hand hoe (134 bpm) than with kasola (126 bpm) yet the recovery of HR was vice-versa i.e. faster in wheel hand hoe than with kasola. Respondents felt less fatigued with wheel hand hoe as it involved push/pull operations (15 strokes/min) whereas kasola involved 37 strokes/min, hence, perceived exertion was 2.9 in wheel hand hoe as compared to 3.8 for kasola on RPE scale. Musculoskeletal discomfort using kasola was highest as they reported discomfort of wrist and hands (ms. = 4.3), shoulders (4.1) whereas they scored lesser on MSD for using wheel hand hoe i.e. 3.6 and 3.5 respectively.

Karam et al. (2009) suggested that the best way to prevent an injury is to eliminate the hazard. If a machine can do the job, humans are not at risk. Using mechanical lifting devices is an example of automation. He further added that tools should be well designed and maintained to decrease the force required to complete the task. Ensure that workers are using the proper tool for the task, and that it is the proper size. An example is using a ratchet with a longer handle, which will increase the amount of leverage and reduce force.

### **Ergonomical Characteristics of Women**

The following ergonomical data are important for designing of equipment-

- The mean height and weight of Indian male agricultural workers vary between 161 to 169 cm and 48 to 62 kg respectively as against 148 cm to 158 cm and 41 kg to 45 kg for female workers.
- Woman has about 2/3<sup>rd</sup> muscular strength as that of man.
- Woman has 75% of maximal aerobic capacity as that of man.
- Heart rate and oxygen consumption rate of a woman is also found lower as that of a man (Gite and Majumdar 2005).

### **B. IMPROVEMENT OF WORK STATION AND WORK METHODS**

Agriculture is generally recognized as the most hazardous occupation and displays high rates of musculoskeletal disorders. These musculoskeletal disorders are the upshot of awkward posture (propagation, weeding etc.) and repetitive motion of hand and wrist and other body

parts. The farm women work in the stooping or bending posture for long hours, and this can cause back and neck pain. Review of reported occupational injuries in California agriculture for the period 1981-1990 by AgSafe shows that sprains and strains predominate as major types of injury, accounting for 43% of all reported agricultural occupational injuries. Further, it was estimated by AgSafe that nearly 40% of the reported sprain and strain injuries involved the back. Back injuries are generally acknowledged by agricultural employers and workers' compensation insurers as a significant problem from the perspectives of both incidence and cost.

The injuries and diseases caused by poorly designed or unsuitable workstations and work methods often develop slowly over a period of months or years. However, a worker will usually have some signs and symptoms for a long period of time indicating that something is wrong. For example, the worker may be uncomfortable while doing her job, or feel aches in the muscles or joints after going home from work. Additionally, she may have many minor muscle strains over a period of time. It is important to investigate these kinds of problems because what may begin as discomfort may lead in some cases to serious disabling injury or musculoskeletal disorder.

The application of ergonomics in designing and improving work stations has the potential to reduce musculoskeletal disorders associated with strenuous agricultural tasks. There are evidences which show that improved work station reduces postural stress and musculoskeletal problem of farm women. Top dressing of fertilizer is one of the most arduous jobs in agricultural activities. This activity is performed in standing posture for the field crops like wheat, paddy etc. women carry fertilizer either in plastic bags or tie the fertilizer filled cloth bag to waist and apply fertilizer near the root of the each plant in bending posture in commercial crops like chili, tomato, cotton etc (Annual Report 2001-2003). The bending posture leads to pain in back and cervical region. Reduction in the percentage of farm women complaining about the musculoskeletal problem was observed after introducing improved handy fertilizer trolley. The fertilizer load was shifted from shoulders to trolley (Hasalkar et al. 2007). Hence, cost-effective ergonomic interventions must begin to address for shrinking musculoskeletal problems in agriculture.

Karam et al. (2009) stated in their study that

ideally, each worker should be able to customize a workstation to his or her body size, shape, and sitting or standing position. Adjustable workstations and lift tables are examples of this concept. They further stated that MSD prevention should aim at eliminating risk factors. If this is not possible, employers should consider automation, job rotation, job enlargement, workplace adjustments, tool and equipment design, training, modification of work practices and support of early reporting.

### C. STIPULATION OF REST PERIODS

Every function of the human body can be seen as a rhythmical balance between energy consumption and energy replacement, or between work and rest. This dual process is an integral part of the operation of muscles, of the heart, and of the organism as a whole. Rest pauses are indispensable for farm workers as they do more grueling job and repetitive motions during agricultural activities. Farm workers are exposed bending, squatting, stooping or standing posture for long periods during their work. Lifting or carrying heavy loads are also part of agricultural activities. These awkward postures and heavy work cause musculoskeletal disorders. Appropriate rest periods should be allowed to the farm workers to prevent musculoskeletal injuries.

Turner (2004) affirmed that instituting micropauses might reduce discomfort and pain by reducing muscle and nerve tension. Micropauses to prevent fatigue is more effective than resting than to recover from it. Micropauses may be passive where the employee rests and active where the employee undertakes a range of stretching type exercises.

Ergonomic observation of actual work shows that in most cases even a task that is rated as taking place at 35% VO<sub>2</sub>max involves a combination of bursts of work interspersed with periods of rest rather than a constant rate (Müller 1953; Kilbom 1995). The health correlation of different combinations of work and rest are not clear, but frequent pauses are considered to relieve fatigue and enhance productivity more than the equivalent amount of time in a single longer rest; this implies that carrying a load at slow speed with pauses consumes less total energy (Jackson and Jones 1998).

Hagberg and Sunderlin (1986) reported reduction in discomfort in keyboard operators tak-



ing short pauses ten times per hour. Swanson and Sauter (1992) have also showed that frequent breaks increased productivity and decreased musculoskeletal stress.

### CONCLUSION

Emerging data shows that musculoskeletal disorders have been a widespread problem in agriculture for more than a decade. Occupational risk factors include static positioning, forward bending, heavy lifting and carrying, kneeling, and vibration in agriculture. Unfortunately, there has been limited application of research related to ergonomics and musculoskeletal disorders, although farmers frequently report musculoskeletal signs and symptoms (Myers et al. 1995).

The identification of occupational health hazards and the development of systems to evaluate, intervene, and decrease musculoskeletal risk factors and resulting disorders is quite crucial for safety of farm workers. Role of women in agriculture is increasingly understood and recognized in agriculture. Women play a substantial role in decision making in farm related tasks. There is need to initiate women oriented researches in agriculture. As discussed earlier woman has different ergonomical characteristics than man, design of women friendly tools and equipment is required. Work station should be adjustable to make it comfortable for woman during performing agricultural activities.

### POLICY IMPLICATIONS

The challenges for reducing musculoskeletal disorders among women farm worker are significant-

- 1 There is a need for researchers to make agricultural health and safety as priority along with musculoskeletal disorders among farm women at the most.
- 2 There is a need to develop low cost technologies for the critical field problems of repetitive and forceful tasks such as weeding, harvesting, lifting and carrying heavy loads and so on.
- 3 There is an urgent need to train farm women about using women friendly agriculture technologies and operating improved tools and equipment.
- 4 There is a need for conducting awareness, intervention and prevention programs about musculoskeletal disorders for farm women.

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