PROGRAM:	ERASMUS+
ACTION / SUBPROGRAM:	Key Action 2 / Strategic Partnerships
PROJECT TITLE:	"OSH+ for the European Agriculture sector - Stimulating growth in rural areas through capacity building for providers (and beneficiaries) of occupational medicine and OSH services"
Intellectual Output :	O5 "Course 2 Training Materials - Occupational Physicians"
Module:	11. Musculoskeletal diseases for employees working in Agriculture

11. Module 11: Musculoskeletal diseases for employees working in Agriculture

11.1. Objectives

Knowledge objectives

- The traineeknows basic risk factors for MSDs
- The trainee recognizes the determinant and favorable etiological factors for MSDs at the workplace;
- The traineeidentifieswork-related MSDs, and can make the difference with the non-professional MSDs;
- The trainee understands the role of ergonomics at the workplace;
- The trainee knows anddescribes the steps in the management of a MSD;
- The trainee recognizes in agriculture specific professions with their activities, physical demands, posture, type and frequency of movements, workload, type of force, repetition.
- The trainee understands and knows the prophylactic principles in MSDs prevention;

Skills /attitudes related objectives

- The trainee can apply an ergonomic check-list;
- The trainee can record and interpret medical records for surveillance purposes;
- The trainee can recommend an ergonomic method of MSDs risk evaluation;
- The trainee can conduct the professional anamnesis to recognize physical job demands (kind and intensity of effort, posture, frequency and/or duration of movements, etc.;
- The trainee is able to propose and participate in a workplace health promotion program to reduce MSDs in an enterprise;
- The trainee can counsel the workers, and the employees about preventive measures at the workplace;
- The trainee is able to use outside resources and is familiar with methods for finding reliable resources about work-related physical risk factors and MSDs' prevention.

11.2. Glossary (Source: Frank van Dijk, Inge Varekamp, Katja Radon, Manuel Parra, Glossary for Basic Occupational Safety and Health, 2011)

Term	Definition
Ergonomic principles	A concept whereby the work to be carried out is organized and specified – and tools and equipment designed and used – in such a way as to be matched with the physical and mental characteristics and capacity of the worker. [ILO 2001]
Musculoskeletal disorders (MSD)	Disorders of the muscles, joints, tendons, ligaments, bones and nerves. Most work-related MSDs develop over time and are caused or exacerbated by the work itself and/or by the working environment, especially by using force, repetition of movements, awkward posture, or vibration. MSDs affect the back, neck, shoulders, upper and lower limbs. Health problems range from discomfort, minor aches and pains to more serious medical conditions requiring time off work and medical treatment. In more chronic cases the disorders could result in permanent disability and loss of employment.
Occupational ergonomics	An applied science that studies the interaction between people and the work environment. It focuses on matching the job to the worker to ensure a healthy and productive worker. [IAPA 2007 adapted]
Repetitive strain injury	A problem with the muscles, tendons or nerves that develops over time due to overuse. Examples of repetitive strain injuries include: carpal tunnel syndrome and tendonitis. A similar term is Cumulative trauma disorder. [IAPA 2007]

11.3. Introduction

One of the three most hazardous sectorsin the working world is agriculture. Farmers and farm workers' safety and health canbe affectedby their working conditions.

About half of the world's workforce, more than 1.3 billion workers (ILO, 2003) is employed in agriculture, one of the mosthazardous industries. Epidemiological studies show thatagricultural workers suffer most of musculoskeletal disorders; respiratory diseases; pesticide-related illnesses; noise induced hearing loss, and cancer [14]. MSDs are a group of troubles that affect the main articulations of the human body. They continue to be a significant hazard for rural workers, respectively the most frequent injury caused by physical jobs. Different studies, national and international, confirm that farming is a physically demanding occupation with work tasks that can cause musculoskeletal disorders [2-7].

Our days, modern agriculture coexists with traditional agriculture. Despite the technical developments, there is still a high prevalence of MSDs, reported especially by female workers, in some activity sectors, like dairy farms, and nurseries.

Mean causes of MSD are: repeated gestures; bad postures; loading and uploading heavy weights; whole body vibrations [24].

Among people engaged in Swedish farming, 70% of reported occupational diseases are musculoskeletal sufferings, compared with 55% for all other occupations (according to the Swedish Work Environment Authority) [8].

In the European Union, the most common work-related health problems are MSD, with 23% of European workersreporting backaches and pains in themusculoskeletal system [28].

MSD consequences are: pain, lost work time, disability, increased production costs, and financial losses. Increase production costs are the consequence of decreased work capacity, worker absence, medical and insurance costs, and loss of employees to turnover and competition from other less physically demanding industries [26].

11.4. Ergonomics. Definition.Classification

“Ergonomics (or human factors) (HFE) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance” (IEA - International Ergonomics Association. What is ergonomics? ISO 26800:2011 Ergonomics -- General approach, principles and concepts)[27].

The terms “Ergonomics” and “Human Factors” are therefore synonyms and can be used interchangeably, although some do regard them as separate (but complementary) entities.

Ergonomics is a systems-oriented discipline, which can be applied to all aspects of human activity. In the context of work system, ISO 6385 establishes the fundamental principles of ergonomics as basic guidelines for the design of work systems [19]. In the wider context, ISO 26800 presents the general ergonomics approach and specifies basic ergonomics principles and concepts applicable to the design and evaluation of tasks, jobs, products, tools, equipment, systems, organizations, services, facilities and environments [20].

Ergonomics contribute to the design and evaluation of tasks, jobs, products, environments and systems. The consequence is to make them compatible with the needs, abilities and limitations of humans. These fact permits the safety and welfare of people [27].

Ergonomics is the science of the work, derived from the Greek “ergon” (work) and “nomos” (laws). It was first introduced in the nineteenth century. Our day, ergonomics become a system-oriented discipline, extended across all aspects of human activity. There are three domains of specialization in ergonomics:

Physical Ergonomics- concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity.

- Relevant topics: working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health (H. Krueger AEH - Centre for Occupational Medicine, Ergonomics & Hygiene) [27]

Cognitive Ergonomics- concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system.

- Relevant topics: mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.

Organizational Ergonomics- concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes.

- Relevant topics: communication, crew resource management, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work paradigms, virtual organizations, telework, quality management.

When is Ergonomics considered?

- When workers complain about discomfort or pain;
- When workers performance goes down;
- When workers get sick or injured on the job;
- When management wants design input from the workers;
- When a product is evaluated because of defects.

Ergonomics can be involved in all stages of planning, design, implementation, evaluation, maintenance, redesign and continuous improvement of systems (Japan Ergonomics Society 2006).

There is difficult to apply ergonomics in a country where the profession of ergonomist did not exist, like Bulgaria (See Figure 1). In Romania the ergonomist profession started to be recognized since 2017. The activity is assured by engineers, technicians, occupational physician, anthropologist, designer, etc.

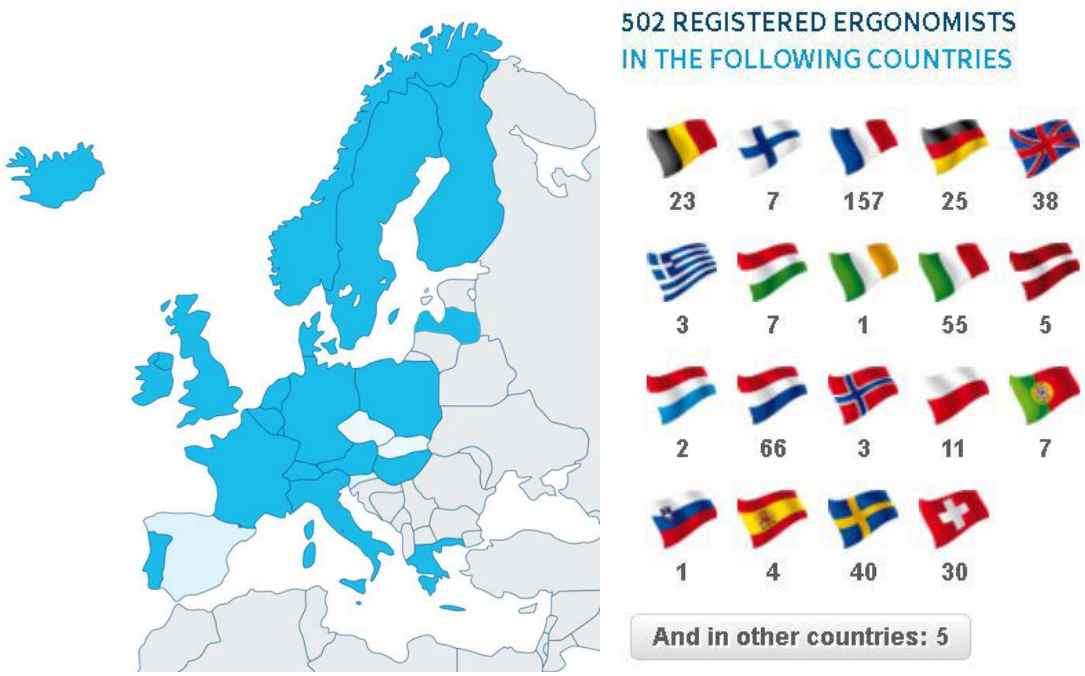


Figure 1. Registered ergonomists in EUCREE (Centre for Registration of European Ergonomists, July 2017)

Performance and health and well-being are the mean objectives of ergonomics [30]. By fitting the environment to the human, two related system outcome, can be achieved:

Performance: productivity, efficiency, effectiveness, quality, innovativeness, flexibility, (systems) safety and security, reliability, sustainability, empowerment to work [30].

Health and well-being: health and safety, satisfaction, pleasure, learning, personal development, aesthetics, etc. [30].

Performance can influence well-being and well-being can influence performance. Their interaction is strong [30]. Global changes of work systems influenceboth, performance and well-being.

11.5. MSDs' risks. Specific aspects in agriculture. Risks assessment

Agricultural workers involved in labor-intensive practices areexposed to a multitude of MSD risk factors. The literature hasshown three main risk factors that are of utmost priority in agriculture (Meyers et al., 2000, 1997, 2001). These include: lifting andcarrying heavy loads (over 22.5kg); sustained or repeated full bodybending (stoop); and very highly repetitive hand work (clipping, cutting).

There are some similarities in the general classes of MSD riskfactors within various types of production agriculture. However, the uniqueness of crop maintenance, harvesting, and packing isexpected to result in the distinct manners of how workers areexposed to MSD hazards, and how the corresponding musculoskeletalinjuries and disorders are manifested. This challengingunique situation has generally resulted in the need to developprevention and intervention strategies that address specific aspectsof the crop and farming conditions at hand.

Risk factors for musculoskeletal disorders are [16,17,31,32,34]:

- *High repetition* (repeating movements every few seconds for 2 hours, or constantly using a device, more than four hours/day);
- *Forceful movements* (lifting weights greater than 34 kg once/day, greater than 25 kg more than ten times/day or above 12 kg 25 times/day; pushing / pulling heavier objects of 9 kg (pushing an object of 22.5 kg on the floor, more than two hours/day);
- *Heavy carrying*, especially more than 33% of body weight;
- *High levels of physical exertion*, especially more than 33% of a person's aerobic capacity
- *Extended use of awkward and static postures* (repeatedly lifting arms or working with hands over the head, or the elbow above the shoulder level for more than two hours a day, working with back, neck, or hand, twisted or twisted for more than two hours a day; kneeling, stooping, squatting, or lying down for significant periods of the workday;
- *Long duration static hold* (prolonged sitting or standing in the same position, more than 6 hours/shift);
- *Fast-paced work* (work on conveyor belts);
- *Direct pressure on soft tissues of the body* (use of the hand or knee as a hammer (stroke, compression) more than 10 times/hour or more than 2 hours/day);
- *Heavy loads, handling loads, especially when bending and twisting* (weights – more than 11.3-15.8 kg, caring potato bags, fruit bowls, especially below knee level);
- *Frequent lifting* (more than 8-10 lifts/min);
- *Exposure to vibration* (especially in the range of 4.5-6.0 Hz, use of tools or equipment with high vibration levels, like pneumatic hammers, more than 30 minutes/day; or tools with moderate vibration levels, such as electric saws, grinders more than 2 hours/day), *poor lighting* (in old stables, in cellars) or *cold working environments* (in winter time, late autumn, cold rooms);
- *Monotonous and repetitive work*;
- *Unexpected movements* (slips, trips, and falls account for 9%-10% of low back pain in most industries);
- *Local or whole-body exposure at could;*

- *Job dissatisfaction*, especially with high levels of responsibility or job stress. There is growing evidence linking MSDs with psychosocial risk factors (especially when is combined with physical risks), including: high demand of work or low autonomy and low job satisfaction;
- *Fatigue, insufficient time to recovery.*

These risk factors can act individually, or, usual they are combined and can conduct at cumulative damage. Posture, force and frequency (repetition) are combined in a lot of occupational activities, including agriculture. Which are the MSDs risk factors for the activities that can be find in table 1?

Table 1. Jobs performed especially by youth on farms that likely [16]

Work with animals	• Feed and water livestock daily. • Cows milking. • Spread straw in animal pens. • Bottle or bucket feed milk to calves or lambs. • Move sows and pigs from pen to pen. • Sort animals.
Operating equipment	• Drive tractor with no specific implement attached. • Operate a lawn mower. • Drive tractor to plant or drill crops. • Drive a tractor raking hay. • Drive tractor to till the soil. • Operate combine to harvest corn, soybeans or wheat. • Operate a skid loader to clean pens. • Drive tractor and grain wagon to barn, and then unload grain into bin. • Drive tractor to pull wagons of hay to barn. • Drive tractor to hay baler. • Drive truck around the farm.
Moving materials (Manual material handling)	• Stacking bales of hay or straw on wagon • Place bales on an elevator off the wagon • Stack bales in the barn. • Shovel, fork or scrape manure to clean barn. • Shovel grain or spillage.
Tasks that require awkward postures	• Pull and sort sweet corn. • Weed vegetables with hand hoe. • Pick up rocks.

For episodic musculoskeletal disorders there are described intrinsic risk factors, as (Source Adapted from WHO Scientific Group, 2003):

- Obesity, height
- Age, ageing
- Genetic predisposition
- Pregnancy
- Spinal abnormalities
- Health beliefs: locus of control, self-efficacy, perception of disability and expectation
- Psycho-social stress: self-perception
- Family stress
- Psychological stress: somatization, anxiety and depression

There is a consensus in literature that psychosocial factors have an important role in the apparition and evolution of MSD. Psychological factors are strongly associated with the progression of back pain and make the difference between acute to a chronic condition.

Psycho-social and organizational factors associated with MSDs include [33]:

- Rapid work pace or intensified workload;
- Perceived monotonous work;
- Low job satisfaction;
- Low decision latitude/ low job control;
- Low social support;
- Job stress.

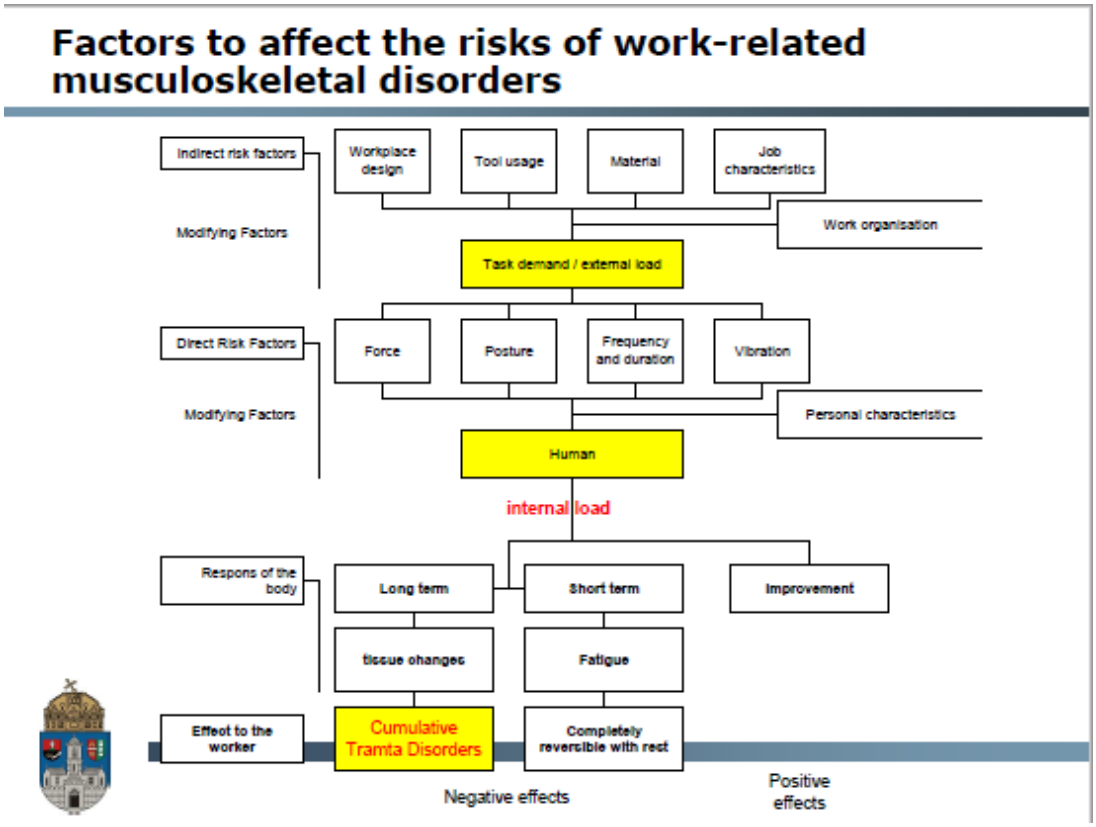


Figure 2. Factors to affect the risks of work-related musculoskeletal disorders [37]

To characterize a specific job and to recognize the specific demands and harms at a workplace is necessary to perform the risk assessment. For evaluating MSDs risks there are described more than 150 methods. Existing tools for risk assessment measure just one risk that consists in physical demands (force, posture, duration, load, etc.) It is not evaluated in according with other factors, as climate, vibrations, lighting, etc.).

There are some methods applied more frequent in many countries, others are new, and using modern tools to investigate the risks.

A. ***Study of medical information and absenteeism***(statistical and epidemiological data, morbidity) is the first priority for the jobs at which injuries or illnesses have been reported. There will be consulted health certificates, workers compensation records, first aid logs, accident records, other available medical records, morbidity data (incidence).

B. ***Analyze of turnover*** in the enterprise can be a source of data that can evaluate the difficulty of job and the presence of stress.

C. ***Worker performances analyze*** (quality, quantity, production data). There is a link between work and health and a double direction determination. The quality of the product is high and the productivity is increased when the workers' health status is a good one. Fatigue, stress, pain, family and economic problems, and disease affect workers' performance.

D. ***Ergonomic checklists*** are used in many of workplaces because are relatively easy to be applied, the results can be compared with others and permit conclusions for improvements of activity and working conditions.

The ILO and IEA product, "*Ergonomic Checkpoints in Agriculture*, Practical and easy-to-implement solutions for improving safety, health and working conditions in agriculture" [29] presents The ERGONOMIC CHECKLIST FOR AGRICULTURE that contains 100 items grouped in ten topics:

- Storage and handling of materials
- Workstations and tools
- Machine safety
- Agricultural vehicles
- Physical environment
- Control of hazardous chemicals
- Environmental protection
- Welfare facilities
- Family and community cooperation
- Work organization and working schedules

It can be used either the whole list, or an own list containing only those items relevant to the investigated workplace. Usually, a checklist of about 30–50 items suitable for the workplace are easier to apply. To apply the checklist there are recommended six steps:

1. Knowing the workplace
2. Defining the work area to be checked
3. Initial walk-through
4. Writing your check results
5. Selecting priorities
6. Group discussion about the check results

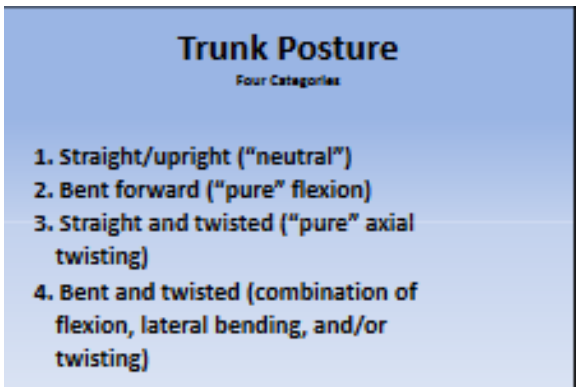
The role of the ergonomic checklist is to recognize specific problems, their amplitude, hierarchy, implied factors. This will facilitate the risk management and the real improvement of working conditions, and, in consequence, the health and the well-being of the workers.

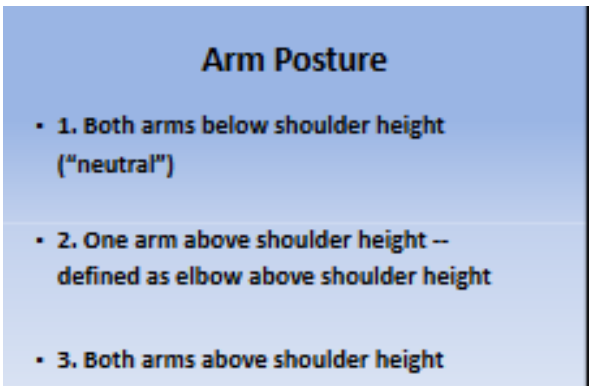
E. Discomfort surveys / Subjective discomfort surveys

A discomfort survey contains a simple body diagram. It is shaded and for each shaded area ratings of the intensity of discomfort are marked. The respondent indicates the area/areas and the intensity of discomfort. The diagram can have attached a questionnaire that helps to identify the sourceand the amplitude of the problem and a request for improvement proposals.

F. ***OWAS (Ovako Working posture Assessment System)*** was developed in Finland.

OWAS consists in an exposure description which identifies the most common work postures for the back (4 postures), upper limbs (3 postures),7 for the lower limbs, and 5 for head and neck [35,37]. There are defined 3 categories of the handled load (less than 10kg, 10-20kg, and more than 20kg). Are described the magnitude/amplitude, the duration and the frequency A four-digit code describes the whole-body posture by these body parts. The totals of 252 postures were classified to four action categories indicating needs for ergonomic changes. Sampling was made at constant time intervals and usermakesaseriesofinstantaneousobservationstorecordposture. Required equipment is a checklist, a portable computer system for coding and analysis of OWAS (WinOWAS can be find: http://turval.me.tut.fi/owas/. OWAS was applied in agriculture: warehouse workers (Carrasco 1995), sawyers and woodworking machinists, packers in auction of flowers (Burdorf 1992), workers in fishing wessels (Fulmer 2002), agricultural workers (Gangopadhyay 2005, Nevala-Puranen 1995, 1996, Perkio-Makela 2005, Tuure 1992), and workers in professional fishing. The method is widely used and documented, is time-consuming and some decisions rules are arbitrary [37].





Lower Body Posture

- 1. Sitting
- 2. Standing -- weight on 2 legs, knees straight
- 3. Standing -- weight on 1 leg, knees straight
- 4. Standing -- weight on 2 legs, knees bent
- 5. Standing -- weight on 1 leg, knee bent
- 6. Kneeling -- 1 or 2 knees touching the ground
- 7. Walking or moving

Head And Neck Posture

- 1. Upright/free ("neutral")
- 2. Bent forward -- flexion more than 30º
- 3. Bent to side -- "pure" lateral bending more than 30º
- 4. Bent backward -- extension more than 30º
- 5. Twisted -- axial twisting more than 45º

OWAS Stress Ranking System

1. **Normal posture** -- no intervention required
2. **Slightly harmful** -- corrective action should be taken during next regular review of work methods
3. **Distinctly harmful** -- corrective action should be taken as soon as possible
4. **Extremely harmful** -- corrective action should be taken immediately

Source: http://eng.pdn.ac.lk/old/mechanical/menu/class/downloads/notes/OWAS%20method.pdf

A prototype of integrated software, which is based on image processing techniques, was developed (I-OWAS), and the performance of the model was presented. I-OWAS begins with separating the video film into frames, producing OWAS codes belonging to working posture in each frame, and then classifying the images according to risk categories. Despite OWAS being a successful method for analyzing working postures, it requires an expert analysis. Also the manual analyzing process is so laborious and time consuming. I-OWAS provide the computer support for the manual coding stage and eliminates the need for an expert analyst; hence, the method can be widely used in industry (NilgünFığlalı, 2015)

OWAS basicconceptshavebeenincorporatedintootherpostureanalysissystems like RULA,REBA,Univ.ofMichigan,etc.)

G. The Job Strain Index (JSI)

JSI method has been developed by Dr. J.S. Moore and Dr. A. Garg [39].This method is used to estimate the risks of injury based upon assessments of force, repetition, posture and duration.It is based on physiological, biomechanical & epidemiological principles. It is evaluating jobs to determine if they expose workers to increased risk of developing MSDs of the distal upper extremity, like elbow, forearm, wrist & hands.

A JSI assessment gives a quick and systematic assessment of the hand/wrist postural risks to a worker. The analysis can be conducted before and after an intervention to estimate its efficiency to lower the risk of injury (Alan Hedge, 2011).

The validity of this method has been demonstrated in pork and poultry processing.

Job Strain Index Worksheet

	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
Exposure data						
Ratings						
Multipliers						
SI Scores						

JSI = IE x DE x EM x HWP x SW x DD

Job Strain Index

Rating	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
1	Light (1)	<10% (0.5)	<4 (0.5)	Very good (1)	Very slow (1)	<1 (.25)
2	Somewhat hard (3)	10-29% (1)	4-8 (1)	Good (1)	Slow (1)	1-2 (.5)
3	Hard (6)	30-49% (1.5)	9-14 (1.5)	Fair (1.5)	Fair (1)	2-4 (.75)
4	Very hard (9)	50-79% (2)	15-19 (2)	Bad (2)	Fast (1.5)	4-8 (1)
5	Near maximal (13)	80-100% (3)	>=20 (3)	Very bad (3)	Very fast (3)	>=8 (1.5)

JSI = IE x DE x EM x HWP x SW x DD

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Figure 3. Job Strain Index Worksheet

H. REBA (Rapid Entire Body Assessment)

This ergonomic assessment tool consists in a systematic process to evaluate whole body postureand MSD risks associated with job tasks. It is used a single page worksheet to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling. Are evaluated wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees and assigned a score for each body region.
After collecting and scoring data for each region, are usedtables on the form to compile the risk factor variables. Finally is generated a single score representing the level of MSD risk.
The worker must be observed and interviewedto understand which are the job tasks and demands. It is necessary to observeseveral work cycles the worker's movements and postures.

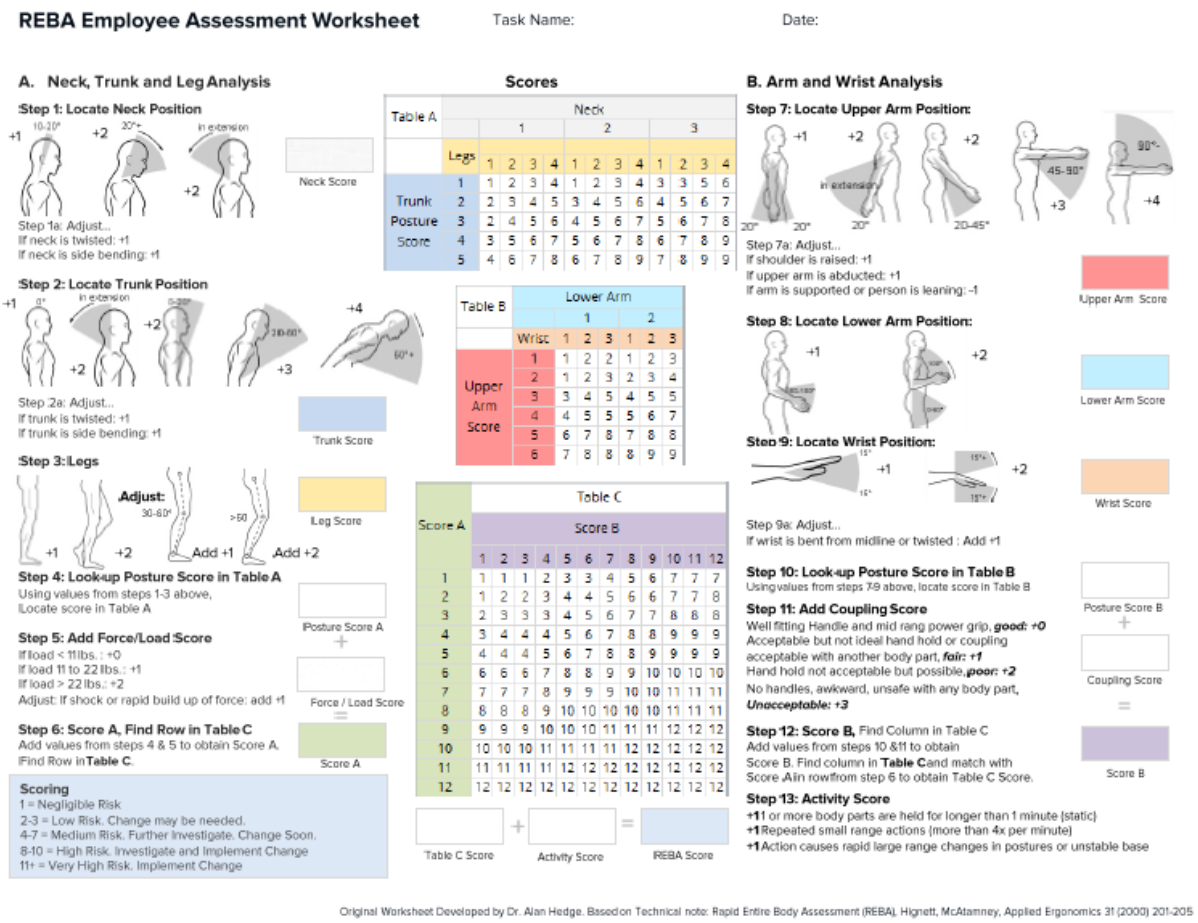


Figure 4. REBA Employee assessment worksheet

Selection of the postures to be evaluated should be based on:

- the most difficult postures and work tasks (based on the initial observation and the worker interview);
- the posture sustained for the longest period of time;
- the posture where the highest force loads occur.

Multiple positions and tasks of the work cycle can be evaluated quickly, with low effort cost. Only the right or left side is assessed at a time when applying REBA. Just after interviewing and observing the worker the evaluator can determine if only one arm should be evaluated, or if an assessment is needed for both sides.

I. RULA (Rapid Upper Limb Assessment)

One of the most popular observational methods is the RULA. The examiner has to rate a static key posture of the worker based on direct observation or a picture. This evaluation is

based on an estimation of the main upper body, trunk and neck joint angles. Each joint angle is associated with a joint score according to a predefined range of angles. These joint scores lead to final grand scores and to recommendations. RULA is used to assess posture force and movement associated with tasks where the worker is seated or standing without moving about. It is a qualitative assessment.

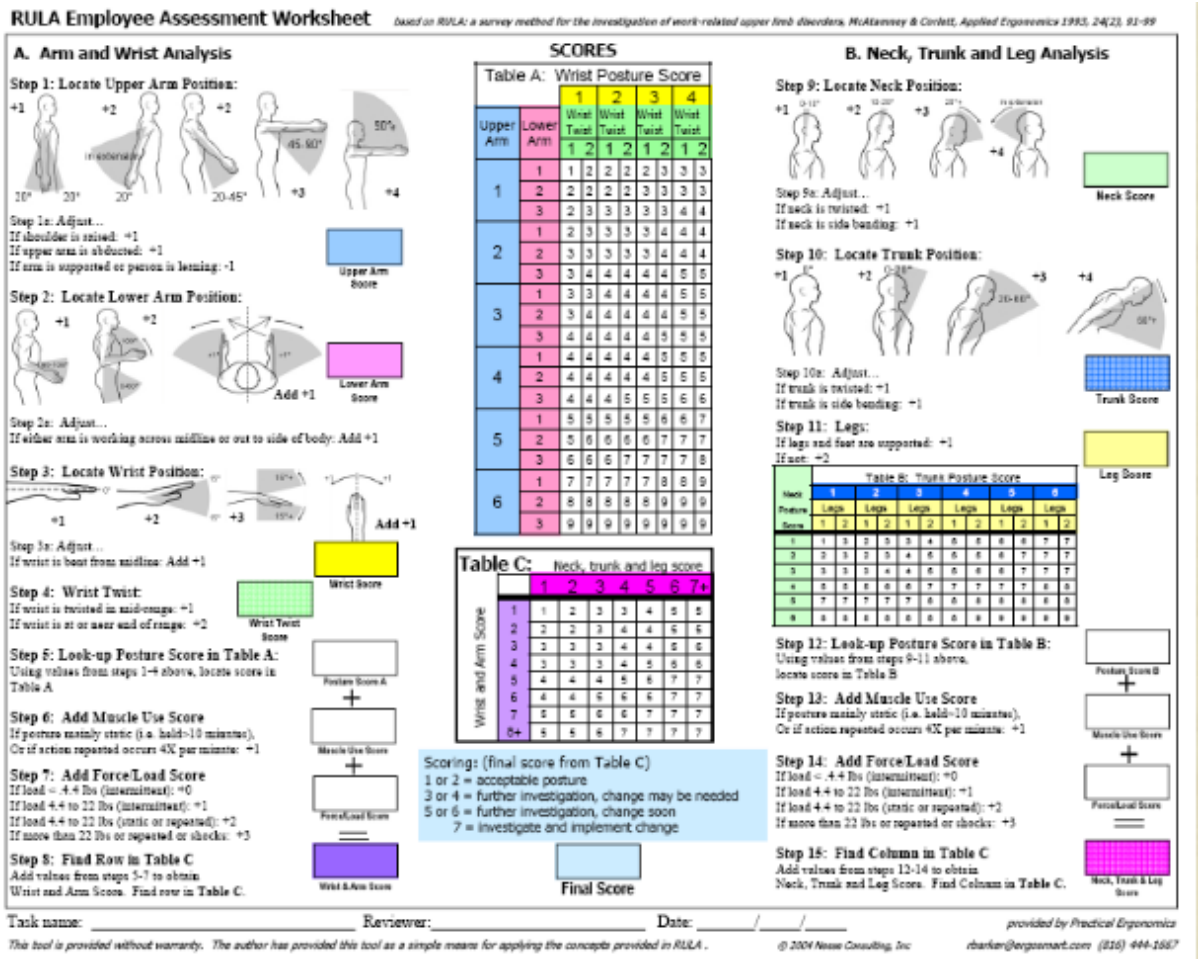


Figure 5. RULA assessment worksheet

J. OCRA method

Risk factors in repetitive work include the frequencyof actions; the exposure duration; the postures andmovement of body segments; the forces associated withthe work, work organization; job control; demands onwork output (e.g. quality, task precision); level oftraining/skill. Additional factors can include: environmental factors (climate, noise, vibration, illumination). All the above mentioned factors were introduced intoa formula by the Italian researchers Occhipinti and Colombini, formula which resulted into an index,

theso-called OCRA index, which gives the rightmeasurement of the risk. The value of the OCRA indexclassifies the risk into 3 areas: green (no risk, acceptable, no consequences), yellow (very low risk, it is advisableto set up improvements with regard to structural riskfactors: posture, force, technical actions, or to suggestother organizational measures), and red (high risk, redesign of tasks and workplaces according to prioritiesis recommended) [42].

The authors updated the OCRA method, and they set of a sum of tools enabling different levels of risk assessment based on the desired specificity, variability and objectives. The OCRA method contains the OCRA Mini-Checklist, the OCRA Checklist and the OCRA index.

The OCRA Checklist applies to repetitive work (using criteria from international ISO 11228-3 standard) characterized by cycles (regardless of the duration thereof); and by a series of virtually identical technical actions that are repeated for more than half the analyzed working time [41]. The new calculation procedure for the OCRA Checklist contains a sum of evaluated parameters: frequency, force, posture, additional factors, recovery multiplier, and duration multiplier [41].

K. The Composite Ergonomic Risk Assessment

The Composite Ergonomic Risk Assessment method was realized according to EN 1005 series of standards for appropriate assessment of the elements as: posture, manual handling, effort, repetitive movements, subjective discomfort, workplace history, improvement ideas.

CERA is an easy-to-use method that can be adapted to specific circumstances. A training including practice is necessary before assessment sheets will be filled in. Assessment sheets contain textual answers, yes/no questions, and the indication of parts of the body. This paper-pencil method is easy to use and gives a simple evaluation after a separate determination of the different ergonomic risks. The workbook allows detailed assessments and provides risk levels in borderline cases, according to the standard methods. It gives a detailed evaluation, but needs few days of training before working with it. An imaging-based method, which is based on observations of real activity is the

L. RBG risk scale

A composite measure is RBG risk scale. It provides a single measure of the ergonomic assessment in terms of several factors (e.g. posture, biomechanical forces, environmental, etc.) collectively contributing to ergonomic impairments. This integrated score provides a

clearer picture of the risk involved in the job and hence it can be used as a basis for prioritizing operations for ergonomic interventions [37].

M. Other methods

Low Back Compressive Force Model. Is used only as an estimation of lowback compressive force, for a standingposition. Applicable lifting situations are two handed lifts and smooth lifting situations withoutsudden changes in acceleration.

Heart Rate. It is very easy to gather withtoday's technology. Heart rate is the most convenientphysiological measure of job stress. In many situation heart ratesare closelyrelated to maximum aerobic capacity. A work capacity level of 33 % for aneight-hour work shift has long been theaccepted guideline for jobs where wholebodyfatigue is primary concern.

Rogers Muscle Fatigue Analysis. Looks at muscular effort (static &dynamic) in relation to recovery time. Included variables are effort, duration and frequency. The test is not appropriate if fatigue is not likely tooccur during the task.

Section 3. Occupational Musculoskeletal Disorders. MSDs in agriculture. Definitions. Statistical data. Costs.

Musculoskeletal disorders (MSDs) are health conditions or disorders that involve the muscles, nerves, ligaments, tendons, joints, cartilage, bones, spinal discs and other supporting structures of the body that are caused or exacerbated by a person's tasks and activities (NIOSH, 1997). Most work-related MSD develop over time. Their cause is the work itself but an important role has the working environment [18].

MSD are a number of troubles affecting the main articulations of thehuman body which might be caused by: repeated gestures; loading and uploading heavy weights; whole body vibrations; bad postures (European Agreement on the reduction ofworkers' exposure to the risk of work-relatedmusculoskeletal disorders in agriculture).

Walker-Bone et al. [9] shows that farming is a physically arduous occupation. That determines a high risk of musculoskeletal disorders such as low back pain, osteoarthritis of the hip and knee, hand-arm vibration syndrome, and neck and upper limb complaints. Less often are affected the lower limbs. Chronic back pain, especially low back pain, chest pain and miscarriages can be a consequence of carrying heavy loads [10].

Analyzing job hazards for musculoskeletal disorders, Bartels et al. [11] found that long hours of work, lifting object, forking, or shoveling was responsible for most of the serious non-traumatic injuries. Other harmful activities were: bending over while working, sitting in an awkward or in a cramped position, looking back at equipment from a tractor, and looking down at a combine header. They described different symptoms, appeared daily, like muscle aches and strains of the arms, shoulder, back or neck and legs.

Male agricultural workers aged under 65 years, had significantlyraised standardized incidence rate ratios (SRRs) for MSD (2.3, 95% CI 1.6–3.3), allergic alveolitis (32, 95% CI 19–51), asthma (1.9,95% CI 1.2–3.0) and skin neoplasia (7.9, 95% CI 5.8–10.9), according to a UK study [12].In the 2004-2007 period, self-reported data from the Health & SafetyExecutive showed skilled agricultural workers had significantly higher prevalence, but notincidence, of occupational diseases compared to all industries.An increased incidenceand prevalence of backmusculoskeletalproblems was reported [13].

A major European study, conducted by The WorkFoundation across 27 European countries shows that one in six, respectively over 44 million members of the European Union workforce has a long-standing health problem or disability that affects work ability. Musculoskeletal disorders attributable to the work account for a higher proportion of sickness absence from work than any other health problem. Real data seems to be that chronic musculoskeletal pain affects 100 million people in Europe, especially working age population (Veale, Woolf and Carr, 2008), and the fourth European Working Conditions Survey (EWCS) published by the European Foundation [34] has shown that 24.7% of workers across the EU report experience backache and 22.8% muscular pain. This, of course, has an impact on the work ability of people who experience MSDs. The European Commission estimates that MSDs account for 49.9 per cent of all absences from work lasting three days or longer and for 60 per cent of permanent work incapacity.

In over 40% of cases is undiagnosed. It is estimated that each year up to 2% of European gross domestic product (GDP) is accounted for by the direct costs of MSDs. Repetitive strain injury at work costs €2.1billon each year, in Nederland.

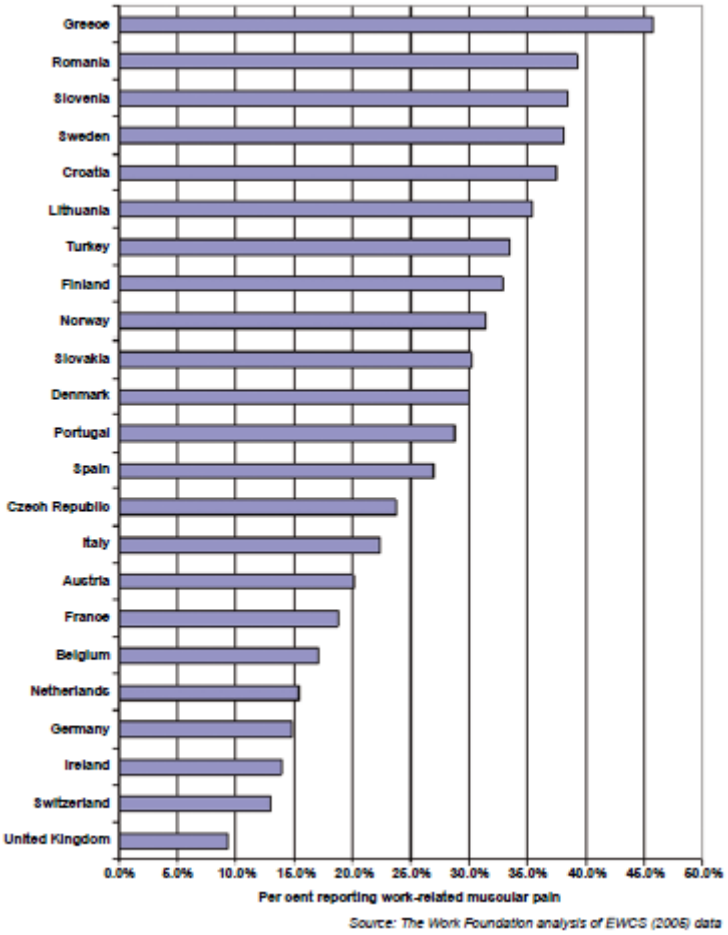
A quarter of European workers report muscular pain, located in their neck, shoulders and upper limbs. Estimations show that half of the Europeans will suffer back pain in their lives, and that a third of the European workforce suffers from low back pain. The costs of this back pain have been estimated to exceed €12billion [33].

In Sweden about 7% of the nation's expenditure on health services represent a total cost of for back and neck patients on sick leave [33].

Work-related upper limb disorders determine pain, discomfort, numbness and tingling sensations in the tendons, muscles, joints, blood vessels and/or the nerves

Estimations show that half of the Europeans will suffer back pain in their lives, and that a third of the European workforce suffersfrom low back pain. The costs of this back pain have been estimated to exceed €12billion.About 85% of back pain affected people take less than 7 days off. That representjust half of the total working days lost by back pain; 15% of people suffering back pain are absent for over a month [33].

Figure 6. Work-related muscular pain – self-reports from European workers [33]



The most common reported musculoskeletal disorders among agricultural workers, caused or aggravated by poor ergonomic working conditions, long working days, and heavy workloads are low back pain and degenerative osteoarthritis of the hip and knee [21].

Knee osteoarthritis affects elderly persons, both sexes, which have to perform repeated lifting of heavy weights, bending, squatting, kneeling, for years and long hours. Repetitive movements determine carpal tunnel syndrome among meat and poultry processing workers. Musculoskeletal disorders are the most common health reason for farm workers and farmers to contact a healthcare professional. Frequently, to manage a MSD is necessary to apply ergonomic measures and/or to modify work practices [21].

Health problems range from discomfort, minor aches and pains, to more serious medical conditions. Chronic cases require time off from work and medical treatment. In complicated cases, treatment and recovery are often unsatisfactory with the risk of a permanent disability and even loss of employment.

Common musculoskeletalconditions are [21]:

Acute injury and delayed effects of acute injury

- Fractures and dislocations;
- Sprains (injury of a ligament that has been partially or completely torn);
- Strains (muscle, tendon, or ligament pushed or pulled to its maximal limit).

Inflammation

- Tendonitis (inflammation of a tendon);
- Tenosynovitis (inflammation of a tendon sheet);
- Enthesitis (inflammation of a tendinousinsertion);
- Bursitis (inflammation of a bursa);
- Myositis (inflammation of a muscle, which maybe primary (e.g., polymyositis) or secondary tomechanical injuries).

Arthritis

- Post-traumatic arthritis (after acute trauma);
- Infectious arthritis (due to direct infection of ajoint);
- Reactive arthritis (inflammation of a joint dueto an immunologic process or reaction, e.g. rheumatic arthritis);
- Osteoarthritis (sometimes also called arthrosis; a degenerative process in joint cartilage ofpartly unknown causes).

Chronic Pain Conditions

Several factors affect the perception of pain, as described by Waddell in the Glasgow illnessmodel 1984. Waddell's model describeshow physical problems transcend into distress, illness, and sick leave. His concept of illnessbehavior describes how pain and other symptoms may be related to hope of compensationin terms of moving to another job, financial gain, or sympathy. The neurologist Henry Miller coined the term "accident neurosis" todescribe a category of patients with chronicpain related to litigation processes.

Other psychosocial issues may predispose tochronic pain, including depression, childhooddeprivation, family difficulties, and personalitydisorders. The point is that the health professional may be challenged to determine work-relatedinjuries in the absence of

objective signs of physicalinjury or disease. Psychosocial conditions may beimportant etiologic factors of chronic pain or effectmodifiers, or may have no relationship.

Psychosocial conditions may act as an important etiologic factor, but mostly theimpacts of psychosocial conditions are regardedas effect-modifying factors.

Several studies have reviewed the associationof psychosocial factors with low back problems, neck problems, and shoulder problems. Such factors are demand/control imbalance, jobcontent, social support, job dissatisfaction, shiftworkovertime, and stress in the work environment. Evidence for association between low jobsatisfaction and back and neck pain has beenreported. Complex psychosocial factors may be relevant for back and neck problems. The economic burden, particularly indirectcosts, of chronic pain is very high.

Because development of chronic pain is notwell understood, a number of models havebeen presented to describe how this kind ofchronic pain develops and persists. One ofthese models is the concept of myofascial pain. This syndrome is described as a regional musclepain disorder characterized by localized muscular tenderness and pain. So-called rigger pointsare pathognomonic. A trigger point is a hyperirritable spot, painful on pressure. Tendernessand referred pain are common as well. Fibromyalgia may be described as a more generalized myofascial pain syndrome, accompaniedby fatigue and sleep disturbance. Alternative models have been presented of howchronic pain emerges and how repeated painsignals may be transformed into persistinghyperexcitability. Pain research hasdemonstrated (the gate control theory) thatnociceptive receptors (peripheral, cutaneousreceptors) are inhibited by central mechanismsactivating other receptors. Fast nociceptive sensory information transmitted to the brain relieson interplay between the inputs from nociceptive and non-nociceptive primary fibers, normally under strong inhibitory control in thespinal cords dorsal horn. Two amino acids, GABA and glycine, serve pivotal roles in thisprocess. Disturbance of these descending inhibitory signals may play an important role inchronic pain syndromes.

Injuries of the Neck

Neck pain is second only to low back pain asa common musculoskeletal disorder and is frequently reported among workers. Although neckpain may be related to cervical degenerative diseaseor whiplash injury, years of research on chronicneck pain plus advanced radiological methodshave provided little understanding for mostchronic neck pain. Perhaps a more psychologicalapproach, focusing not only on the pain but alsoon counselling and general physical conditioning, may be helpful.

- Cervical Degenerative Disk Disease
- Neck Tension Syndrome
- Whiplash Injury

Injuries of the Spine

The annual incidence of low back pain episodesis reported to be about 50% ofworking age adults. More thanl0% seek medical care for theirback condition. The cost of back conditionsis substantial and includes the costs of medicaltreatment, lost productivity, disability, workabsence, and disability pensions. Low backproblems are defined as acute or subacute for thefirst few weeks and chronic if they persist formore than 3 months. Most patients withlow back pain recover spontaneously within aweek or a month. However, most people sufferrecurrent episodes of low back pain.

Risk factors for low back injury include heavylifting, bending and lifting, bad work positions, whole-body vibration, and prolonged sitting infixed position. Several research studies of farmershave reported high rates of low back pain. Tractor driving has been identified as a major factor as well as whole-body vibration andprolonged sitting.

Most of the studies reporting a relationshipbetween farming and low back pain have beenbased on cross-sectional studies. Furthermore, few studies have included any results on physicaldiagnosis (e.g., degenerative disk, etc.). Moredefinitive prospective studies and case-control studies are lacking. Part-time farmers havebeen reported to have more problems than fulltime farmers. Physical factors as well as psychological factors have been demonstrated asrisks, but explain fewer than half of the cases of low back problems. Despite frequent symptoms of low back pain, farmers do not often seekmedical care and are generally not away from their work for very long.

- Spinal Degenerative Disk Disease
- Spinal Stenosis
- Spondylolysis and Spondylolisthesis
- Ankylosing Spondylitis
- Coccygodynia
- Low Back Pain

To protect the spine is important to know that:

- The lowest pressure on disc is in lying position
- The sitting position, especially with curved spine is significantly worsen comparing to standing position
- The biggest pressure on disc is during bending and lifting

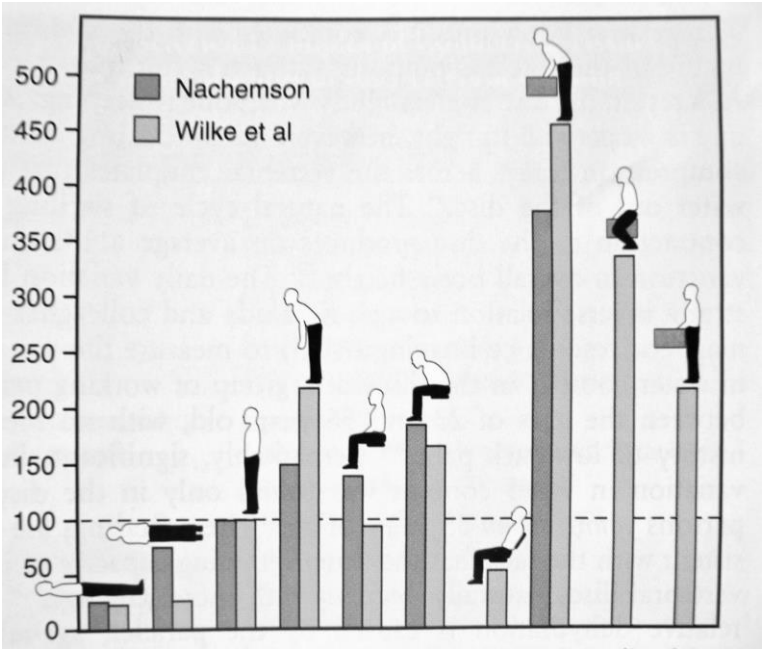


Figure.7. Disc pressure normalized to standing (percent)

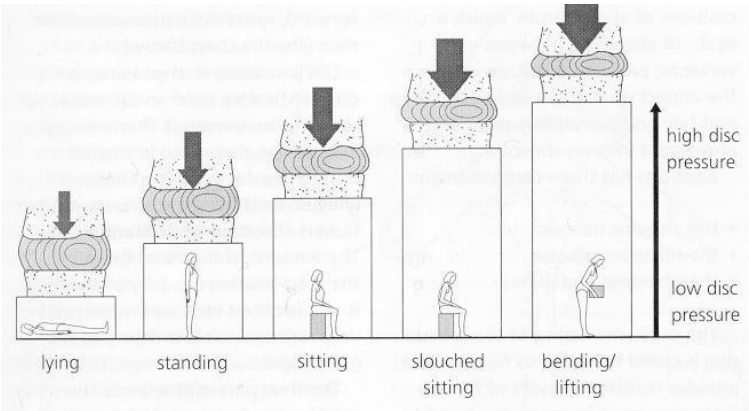


Figure .8. Relative disc pressure

Injuries of the Shoulder

The shoulder is the most movable mechanicalsystem in the body. Three joints, the gleno-humoral, the acromioclavicular, and the sternoclavicular, and more than 20 muscles integrate as a complex unit that creates stability and force in awide range of motion.

Shoulder pain is a very common symptom often related to occupational activity. Shoulder pain affects the ability to work in a widevariety of jobs ranging from heavy manual jobs(e.g., farming and construction) to low physicaldemand jobs (e.g., computer terminal jobs).

Repetitive motion, fixed static work, prolonged sitting, poor posture, excessive force, and vibrationsare the mechanical stresses related to shoulder disorders. Psychosocial conditions (aswith other chronic musculoskeletal conditions) arestrongly related to shoulder pain and disability.

- Impingement Syndrome or Shoulder Tendonitis
- Shoulder Dislocations
- Thoracic Outlet Syndrome
- Frozen Shoulder
- Osteoarthritis of the Acromioclavicular Joint
- Cervicobrachial Syndrome

Injuries of the Elbow, Wristand Hand

All common work-related hand and arm problemscan be seen among farmers. Some studies indicate arisk for forearm problems among milkers. Vibration is related to a variety of symptoms fromthe hands and arms in different occupations amongfarmers and lumberjacks.

- Epicondylitis
- Olecranon Bursitis
- Flexor Pronator Syndrome
- De Quervain's Tenosynovitis
- Ulnar Nerve Entrapment or Compression
- Trigger Finger
- Fractures and Nonunion of the Scaphoid
- Carpal Tunnel Syndrome
- Dupuytren's Contracture
- Ganglion Cyst
- Herbeden—Bochards Osteoarthritis
- Osteoarthritis of the First Carpometacarpal Joint

Injuries of the Hip

- Trochanteritis
- Osteoarthritis of the Hip

Injuries of the Knee, Ankle, and Foot

- Knee Ligament Injuries
- Bursitis of the Knee
- Chondromalacia Patellae
- Injuries of the Meniscus

- Baker's Cyst
- Osteoarthritis of the Knee
- Ankle Sprains

General Disorders, Infections, and Reactive Arthritis

- Inflammatory Bowel Diseases
- Reactive Arthritis

Section 4. Prevention. Interventions

The prevention of musculoskeletaldisorders associated with agricultural work ischallenging at best due to the variety of the work, the variable nature of the commodity handled, and the work environment. However, the principles of ergonomic assessment can be applied toagricultural tasks to reduce ergonomic risk factors [21].

One ergonomic intervention in agriculture is introduction of the tractor into agricultural practice in the late 1800s. The tractor allowed farmers to increase their production capabilities and continued to do so for decades to come as new implements and hydraulic powered systems were introduced to the tractor. However, since its introduction and until our present day, the tractor continues to be a major source for fatalities and severe injuries to operators and people around them. One major source of these deaths and injuries is the lack of a roll-over protection structure (ROPS) on more than half of the tractors used throughout the world, especially in developing countries. However, since its introduction and until our present day, the tractor continues to be a major source for fatalities and severe injuries to operators and people around them. [14].

The major types of potential interventions for controlling and preventing MSDs in agriculture are administrative and engineering controls. Administrative and engineering controls in agriculture have been well described in detail before (Fathallah et al., 2006); hence, a brief description of each will be presented [14].

	Administrative controls	**Engineering controls**
Goal	To reduce and prevent exposure to ergonomic risk factors	To eliminate or reduce and prevent exposure to ergonomic risk factors
How?	Implies management of work practices and polices	Implies technical measures /approach
Strategies	1.change the job rules and procedures 2.rotating workers 3. training workers related	1. new approach in the worker-tool-workspace interface 2.mechanical protection measures for the worker

		3.mechanized operations-fully or partially
When?	For short time or as temporary measure when: - the technical measures are not feasible, or -until the engineering controls can be implemented	**Are preferred** as action in the long run and when it is possible

To reduce or prevent exposures to ergonomic risk factors are applied management-dictated work practices and policies, respectively administrative control strategies. They include changes in job rules and procedures (e.g. more rest breaks); job/workers rotating to avoid the physically tiring operations; workers training to recognize ergonomic risks and to learn how to reduce strain and stress in their tasks. Hazards are not eliminated. Usual engineering controls are preferred. Common examples of administrative control strategies for reducing the risk of WMSDs are as follows [23]:

Some examples of administrative controls strategies used frequently in practice for reducing the risk of work musculoskeletal diseases are:

1. change the job rules and procedures, as follows:
   - shortening work schedule or limit additional hours;
   - giving more breaks for rest and recovery

2. rotating workers /work

   - through different jobs with other types of physical activities to reduce the stress/ solicitation on the musculoskeletal system;
   - changing the content of work to compensate certain ergonomic risk factors, such as – repetitive movements, static and awkward postures
   - giving the worker more control of the work by adjusting the pace of work to reduce the risk of repetitive movements

3. training the workers to recognize the risk factors for work-related MSDs and teach them how to protect themselves by using the correct techniques and procedures to reduce the stress and strain of job demands and to do the work more easily.

- Reducing shift length and the amount of overtime;

- Reducing the stress on limbs and body regions by rotating workers through several jobs, which have different physical demands;
- Changing/varying the job content;
- Adjusting the work pace in repetitive movements;
- Training in risk recognition for work-related MSDs;
- Preparing in easier/ergonomic work practices.

MSD risk factors can be mitigated by the use of administrative controls. These controls rely on workplace policy, procedures, and practices to change worker exposure to MSD risk factors. Examples range from reducing or eliminating piece-rate pay structure to job rotation and training workers to identify potential MSD risk factors [14].

One proven effective administrative control is the use of programmed rest breaks as a potential intervention for MSDs (Faucett et al., 2007). The results of the study showed that intermittent brief rest breaks appear to reduce the symptoms of fatigue and musculoskeletal discomfort, while productivity appears to be minimally affected. This intervention was permanently and successfully implemented into tree nurseries in California [14].

Examples of engineering control interventions in order to reduce ergonomic risk factors are as follow:

- Changing the way to transport the materials, e.g, for the packages/objects which require manual handling using handles or slotted hand holes, for the lifting and carrying heavy objects using the mechanical assist devices;
- Changing the technological process, for example, in order to reduce the manual removal of flashing it is necessary to maintain the fit of plastic molds, and for reducing the manual forces to use the easy-connect electrical terminals. Also, for reducing physical effort the containers should be modified, such as the adjustable height of the bins;
- Changing the workstation components, replacements the fixed structures with height adjustable workbenches or the locating tools and materials within hand reach
- Changing the way to manipulate the tools or materials, for example, for heavy tools, suspending them to reduce weight and allow easier access, to avoid the awkward hand and arm position using fixtures to hold work objects (clamp, vise-grips, etc)
- Modifying tools design, so as to be as ergonomic as possible, for example, to reduce wrist bending posture and to replace the finger-trigger-actuated screwdrivers, replace the straight-handle knives or squeeze-grip-actuated screwdrivers with pistol handle grips for knives;
- Changing the type of materials or the fasteners, for example, using the light –weight package materials to reduce the force when lifting;

- Improve the assembly access and sequences to eliminate any mechanical or visual causes and reduce static and awkward postures.

Potential core business effects of ergonomics interventions [43]

Increased productivity: more efficient movements, less fatigue, better motivation, less personnel turnover, fewer temporary workers, easier to assemble products;

Lower operational costs: fewer lost working days, fewer cases of disability easier and quicker return to work, fewer temporary workers, lower costs to assist sick workers, fewer rejected products;

Improved competitiveness: improved production, increased flexibility of production, improved product quality, improved worker's satisfaction, improved clients' satisfaction, higher reliability of delivery, better position on the labor market.

Company's values and standards, health and safety taken seriously "we are proud of our workers", improved safety: lower accident rate, sustainable production, sustainable products.

Ergonomics is present in organizing the workplace in all stages from the conception to the final form, which includes project design, development, evaluation, modification, correction, maintenance, and continuous improvement.

The ergonomics specialist must have knowledge of anatomy and physiology, of technique and environment, must know and apply the methods for concept design, in order to analyze, assess and manage the technical and organizational environments, in order to correct, redesign and improve the work and the workplace.

Several examples of changing the interface between worker and his/her workspace have been shown to hold promise in reducing the risk of MSDs among agricultural workers. This approach is usually achieved by providing alternative tools or alters the workspace to reduce the risks of awkward postures. Examples of altering the workspace to reduce trunk bending are raised beds in strawberries and trellising, which is very common in grapes, but also has a potential in fruit trees such as apples [14].

Many tools have also been developed to reduce the amount of bending required from the agricultural worker. For example, extended-handle carriers for potted plants in nursery work substantially reduce stooping or squatting when handling these pots. Also in nursery, use of shears for cutting plants for future propagation is a very common task; however, one that exposes workers to severe risk of hand/wrist MSDs. Use of bench based pneumatically-powered cutter eliminates the need for manual cutting and potentially increases productivity [14,15].

As in other industries, but particularly in agriculture, effective ergonomic interventions must be developed and implemented using a team approach and as a part of a comprehensive risk management approach. The most crucial members of the team are the farm workers themselves. Worker participation in developing ergonomic interventions in agriculture is paramount in providing the crucial feedback on efficiency, comfort, and socio-cultural issues that may affect worker acceptance and understand barriers to adoption (Fathallah et al., 2006) [14,15].

The seven elements of an effective program comprise a seven-step "pathway" for evaluating and addressing musculoskeletal concerns in an individual workplace. Each step is addressed in more detail in the primer, with examples drawn from actual NIOSH workplace evaluations. The seven steps are as follows [22]:

1. Looking for signs of a potential musculoskeletal problem in the workplace, such as frequent worker reports of aches and pains, or job tasks that require repetitive, forceful exertions.
2. Showing management commitment in addressing possible problems and encouraging worker involvement in problem-solving activities.
3. Offering training to expand management and worker ability to evaluate potential musculoskeletal problems.
4. Gathering data to identify jobs or work conditions that are most problematic, using sources such as injury and illness logs, medical records, and job analyses.
5. Identifying effective controls for tasks that pose a risk of musculoskeletal injury and evaluating these approaches once they have been instituted to see if they have reduced or eliminated the problem.
6. Establishing health care management to emphasize the importance of early detection and treatment of musculoskeletal disorders for preventing impairment and disability.
7. Minimizing risk factors for musculoskeletal disorders when planning new work processes and operations it is less costly to build good design into the workplace than to redesign or retrofit later.

MSDs situation in the project countries

In all the countries involved in the AGROSH+ project MSDs are an actual reality. We did not find data for Bulgaria.

Greece [33] MSDs affect a large proportion of the Greek population and likelycontribute to the overall health of the Greek workforce.

• A large proportion of the Greek population report having an MSD including low back pain, neck pain, WRULDsand inflammatory rheumatic conditions and one out of five visits to the physician were related to MSDs.
• Back problems are frequently reported as serious work-related health problems among Greek workers. About47 per cent of Greek workers report experiencing back pain each year due to work. This is the highest withinEurope. In the general population, of the almost 32 per cent who reported low back pain in the previousmonth, just over 19 per cent reported work absenteeism that on average lasted about 4.5 days.
• About 46 per cent of Greek workers report muscular pain in their neck, shoulders and upper limb disorders. Again, this is the highest within Europe.
• Prevalence estimates suggest that between 32,000 and 75,000 people in Greece have RA. Patients with earlyRA experience psychological distress, particularly during times of exacerbation, which may affect their abilityto carry out their daily activities.
• Spondyloarthropathies are a family of inflammatory conditions that affect the joints, tendons andligaments. Estimates based on prevalence data suggest that about 44,000 people in Greece have AS and psoriatic arthritis.

Ireland [33]
By some margin, MSDs are the most commonly reported cause of work-related illhealthin Ireland. The direct cost of MSDs at work in Ireland is estimated to be at least €750million.
• The estimated total annual cost of work-related accidents and ill-health is likely to be close to €3.6billion. About €1.8billion was accounted for by lost output caused by temporary and permanent absence from work.
• Chronic musculoskeletal pain remains undiagnosed in 42 per cent of adult cases. Despite this 67 per centreported that pain caused a significant reduction in their quality of life, 49 per cent were limited in the kind ofwork they were able to perform and 25 per cent of adults with chronic musculoskeletal pain had never seen adoctor about their pain.
• Over 14 per cent of Irish workers report experiencing back pain each year and over a quarter of non-fatalinjuries in Irish workplaces are attributable to back pain.
• Just under 14 per cent of Irish workers suffer from muscular pain in their neck, shoulders and upper limbs.
• Almost 40,000 people in Ireland have RA with 30 per cent of all GP visits each year being attributable to it. Arthritis Ireland estimates that the annual cost of lost productive time due to RA and other forms of arthritis is€1.6billion.
• Over 44,000 people in Ireland have AS. Reported unemployment rates are three times higher among peoplewith ankylosing spondylitis than in the general population. It is a condition most often diagnosed among menin their early twenties.

Romania [33]
The health of Romanian workers also plays an important role in economic productivity. Many lost working days are theresult of MSDs, such as back pain, arm or neck strains, or diseases of the joints. MSDs are one of the most commonlyreported causes of work-related ill-health in Romania. Therefore, MSDs cost Romanian employers and the Romaniangovernment a considerable amount of money in lost productivity.
• MSDs comprise the majority of work-related health problems. About 22 per cent of absence days are a resultof MSDs from physical strain.
• Back problems are frequently reported as serious work-related health problems among Romanians. About 42per cent of Romanian workers report experiencing back pain each year due to work, which is one of the higherproportions among European countries.

• About 30 per cent of Romanian workers report muscular pain in their neck, shoulders and upper limbdisorders.
• Around 143,000 people in Romania have RA. The total costs of RA are estimated to be about €619million peryear.

Conclusions

MSDs can cause work-limiting pain and fatigue, which many people feel unable to disclose [33]. The MSDs pain can affect work performance: stamina and resilience, cognitive capacity or concentration, rationality/mood, fatigue, mobility and/or agility [33].

The lack of standardization and validation of the terminology and classification of MSDs is one of the reasons for the contradictory findings in the literature regarding the diagnosis, epidemiology, treatment and rehabilitation of theseconditions (WHO, 2003).

Over 100 million European citizens suffer from chronic musculoskeletal pain and MSDs account for a higher proportion of sickness absence from work than any other health condition (Veale, Woolf and Carr, 2008). Over 40 million workers in Europe are affected by MSDs attributable to work (Cammarota, 2005).

Recommendations [29, ShengliNiu, KazutakaKogi, et al, 2014]

- Keep the routes from the transport of agricultural products clear, wide and solid.
- Maintains these routes plan without dangerous height differences.
- Bridges must be stable and large enough, and help to improve the communication between people.
- The wheels of carts and hand-trucks must be large, well-designed, to be using by farmers even the road is bumpy, muddy or uneven.
- Using multi-level shelves and racks to save time and space.
- Handling lighter weight because it is a safer and increase the productivity. Heavy packages must be divided into lighter ones.
- The containers, pallets or trays must have specially designed and size to be easy to move or carry.
- Using the easy-to-grasp grips or holding points, are easier and safer when handling containers or packages.
- Using mobile racks to reduce the handling materials and time of transport.
- Using rollers and conveyors for moving heavy objects on a short distance.
- Lifting and carrying the load close to the body, when others ways of carrying are not available.
- Work at working height, move the materials using mechanical devices to raise or lower them at this level.
- The waste containers must be placed in appropriate places.
- Placing tools, switches and materials in hand reach area. Save time and energy!
- Providing a special place- „home" for each tools, materials, means safety and efficiency in work!

- Avoid bending and squatting postures to reduces pains, fatigue and increase the work efficiency.
- Using the holding devices to reduce the physical efforts and injury.
- Using safe platforms, proper guards and safety belts to reduce the risk of falling accidents. Safety work means good productivity.
- Using colors and easy –to- read labels for chemicals
- Avoid to work in one single posture for long time. For comfort, health and good efficiency, the worker must alternate the standing and sitting posture.
- Using the appropriate design tools and devices to reduce fatigue and increased work efficiency. Tools with grips must be fit with the worker's hands in size, shape and friction.
- The labels and signs must be easy to understand to reduce the mistakes and avoid the accident.
- Using the portable stepladders for safety work at elevated level.
- Before purchasing a machine, it must study the security features of the machine.
- It is very dangerous to work near the moving's parts of a machine. The best way to protect the worker is to attach a guard to prevent the contact of him with the machine.
- Using the convenient feeding devices!
- The productivity and safety of machines are greater if they are fixed in safe place.
- When you use the machines is better to work with your partners for or more safety and efficiency.
- A good maintenance of machine means more safety and high productivity for farmers.
- Keep a properly maintenance for well-protected electrical wires in order to reduce the accidents and damage of machine.
- Using stable handgrips for powered hand tools to increase safety and productivity of farmers.
- Using the hoists and cranes properly, respecting the loading limits and safety measures.
- Respecting protective measures can avoid accidental activation of machine and moving parts of tools.
- In an emergency is very important to can see very clear and to be easy to understand the controls and switches.
- Consults the specialists and other colleagues before purchase a new vehicle. Pay attention to roll over and other risk for safety and health.
- Using properly the traffic safety signs, warning signs, mirrors and reflectors to reduce the accident.
- Reading, understanding and respecting the indications from the operation manuals.
- Improve and maintains the safe, smooth routes for agricultural vehicles, saving time and effort, avoid the accidents. For this is necessary to collaborate with neighbors.
- The cabin of vehicle must be ergonomic and properly to ensure the comfort of driver and to protect him in case of rollover, extremely weather and lack of experience.
- Using the rollover protection frames to reduce the rollover injuries. The drivers must respect the precautions on slopes safely (driving and slow speeds).
- The visibility is essential for driver. Each driver adopts the best position according with own needs to increase the visibility.
- The best and cheapest source of illumination is daylight.
- The quality of lighting must be sufficient and good and at minimum cost. Depends by situation, can combine general and local lights.
- Reduce the effects of outside heat and sunlight by multiple methods.

- Avoid the excessive exposure to heat or cold using protective clothes and adjust the time of work.
- The good natural ventilation protects for heat and pollutants.
- The confined spaces are very dangers. The entrance is only allowed to trained workers, working in a team.
- In exposure of noise or/and vibrations, the first step in protection is to enclose or screen the source and second one is wearing the personal protective equipment.
- Reducing the dust from machine using the push-pull ventilation or local exhaust.
- Providing sufficient number of extinguishers located in easy access area.
- Using the individual equipment of protection save money and reduce human injuries.
- Use suitable shoes, boots, gloves, hats and another protective device!
- Using regular the individual equipment of protection reduces the exposure of chemical agents and health effects.
- The animals must be handled only by the trained persons. In this way are reduced the unexpected accidents and diseases.
- Avoid the risk of poisoning and danger of misuse, using the label written in local language on all recipients of pesticides.
- Keep the pesticides carefully in a safe and specific place away from the home.
- Using pesticides respecting the specific rules, safely and wisely!
- It is essential to know and understanding how to store and use the pesticide to protect yourself and the family.
- Using the safe methods to store the agrochemicals waste and to protect the environment!
- The first important step in order to protect community from the environmental pollution is to collect and reuse waste!
- Reducing the waste by avoid the unnecessary or excessive packaging, use the ecological materials.
- Converted human and animal wastes into biogas, in low cost way.
- Safe drinking water to farms and crop fields is essential to keep a good health and recovery to fatigue of farmers.
- The clean toilets and washing facilities are mandatory to be near the work area!
- In an emergency is mandatory to have well-equipped and maintained fist-aids kits and a person who know some basic health knowledge.
- Protect the children, keep them safe and healthy from the risk of the work and life in agricultural sector.
- Endowment with the rest facilities in the workplace and also home facilitate recovery from fatigue
- Promote health and community collaboration by the recreation facilities in the village.
- A regular and nutritious meals are mandatory to prevent the fatigue, reduce risk of errors and accidents, and increase the productivity!
- A good sleep is mandatory for the good health and work in the daytime.
- The cooperation between the farmers are necessary for accomplishes the strenuous tasks.
- Distribution of family responsibilities increases the productivity and improve the family harmony.
- Collaborations with neighbors to achieve together machines, increase productivity and reduced workload.
- Periodical meetings of farmers improve the human and work relations.
- Ensure a safety and friendly environment for pregnant women.

- Ensure a safety and friendly conditions of work to elderly farmers, using their experience and knowledge.
- Providing safety and health conditions of work to farmers with disabilities; organizing group of mixed discussion.
- Practicing the group physical exercises to maintain the fitness and facilitate the communication between farmers.
- Avoid monotony of workplace, combining different tasks.
- Giving information's to prevent the WMSD, based by analyses the recording accidents, sickness and absences.
- Changing the layout of workplace can reduce physical stress.
- Reduce excessive workload by alternation heavy and light work, decrease the risk of work-related MSDs.
- Reduce manual work using the simple and easy devices.
- For farmers working alone on the field develop a written plan in case of emergency.
- Special protection and welfare facilities for migrant farmers.
- Ensure safe and productive agricultural work by well-planned annual work schedules
- Giving regular week breaks to improve the family ties and also to facilitate the recovery from fatigue.
- Giving frequent short breaks to recover from fatigue and increase the productivity.
- Acquiring the good rules of eating habits, it is very important to have a safety and healthy working life.

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