

Master's students' exploration of musculoskeletal injuries affecting ranchers and food growers.

Patricia Siegel, OTD, OTR/L, CHT

UNM Occupational Therapy Graduate Program

Who we are...

Mary Thelander, MOT OTR/L ATP

- Fieldwork Educator with the NM AgrAbility Project
 - Training OT Students in the Occupations of Farming and in Farm site Evaluations
 - Supporting people with I/DD in learning the occupations of farming



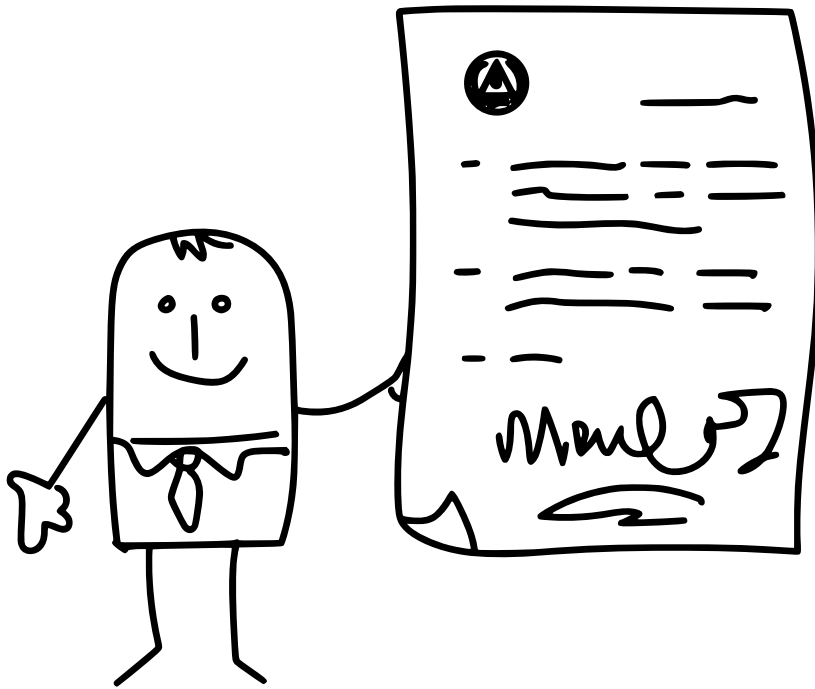
Work of Students with the NM AgrAbility Fieldwork Program

- Barrett Harding – Energy Conservation for food Growers with Chronic Fatigue
 - AOTA – 2022 (Reach: 1500 Rehab Professionals)
 - NMOTA – 2022 (250 Rehab Professionals)
- Robin Gibbs – Promoting occupation for food growers with three-dimensional printing
 - NMOTA – 2022 (250 Rehab Professionals)
- Athena Paguio – Promoting Health for people with I/DD
 - NMOTA – 2024 (250 Rehab Professionals)
 - UNM Scholarship and Practice Meeting – 2024 (60 Rehab Professionals)

Trish Siegel

- Associate Professor -- UNM OTGP
 - Teach anatomy/kinesiology (which includes ergonomics)
 - Orthopedics
 - Specialized Hand Therapy Elective





- Mary has a Master's in OT, a certification in Assistive Technology and she is currently pursuing a PhD in Curriculum and Instruction at NMSU
- I have a Bachelor's in OT, a Post-Professional Doctorate and a specialty certification in Hand Therapy

Objective

- Participant will
 - gain an understanding of ergonomic assessments
 - learn about the role Occupational Therapists in assessing and mitigating injuries and conditions affecting a variety of farming and food growing occupations
 - learn about UNM OTGPs objective to teach ergonomic principles to Master's students

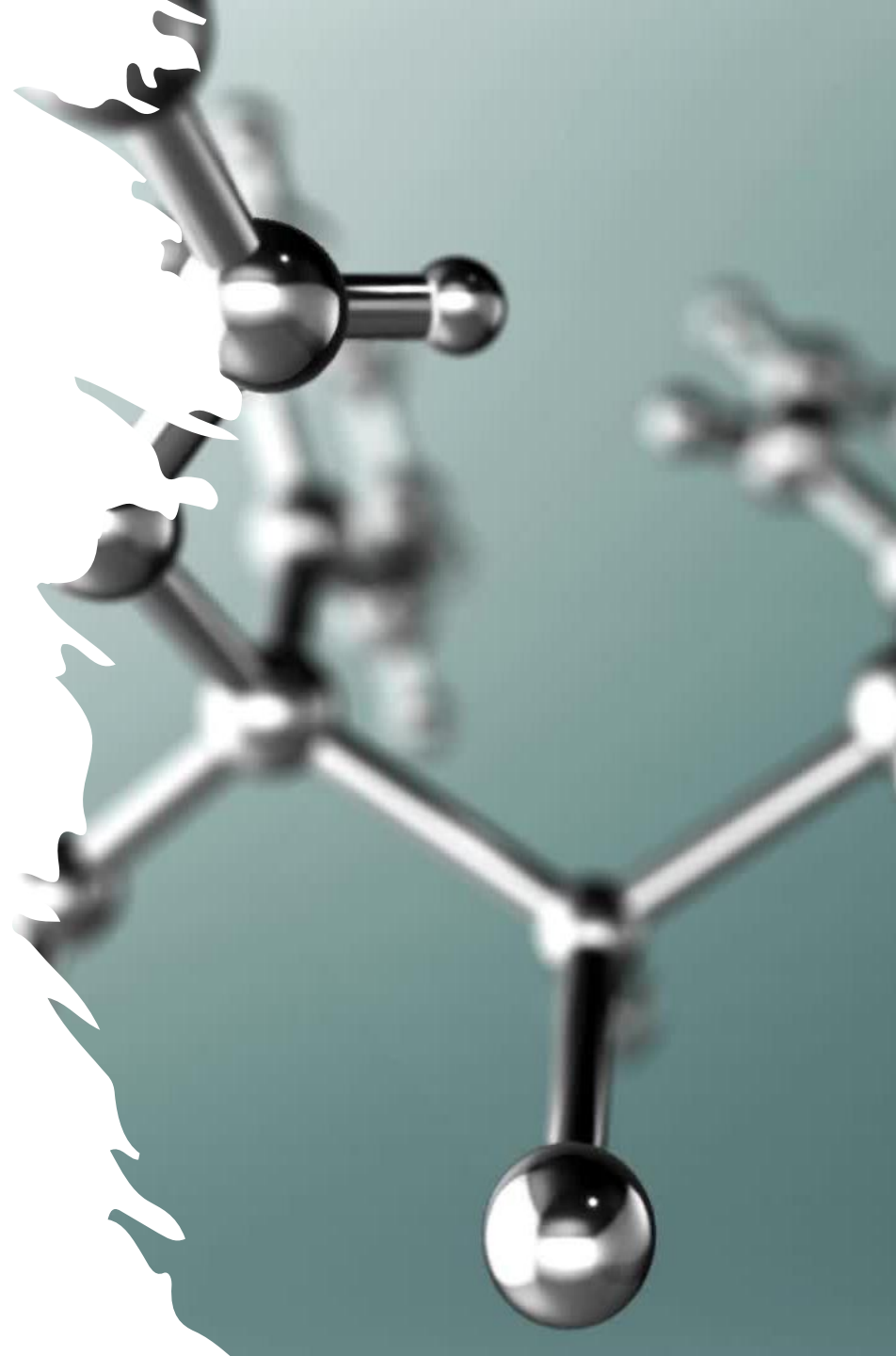
Two Greek Words

Ergos meaning work

AND

Nomos meaning law

**Ergonomics can also be called
the scientific study of work.**





What goes into an ergonomic assessment?

- It starts with descriptive terminology to describe how joints move in relation to each other: For example:

Glenohumeral
(shoulder) forward
flexion

That's Heidi →
She's our boss 😊



Next

- Research tells us that specific movements or activities can increase the risk of musculoskeletal (or other) injury
- For example we know that shoulder impingement syndrome may be caused by repetitive overhead movements that irritate the tendons of the shoulder. The problem causes the person to have pain in a specific range – usually 60 to 120 degrees of shoulder abduction
- So how do we know what 60 to 120 degrees of shoulder abduction looks like?

What is impingement syndrome?

- Impingement syndrome occurs when the tendons of the rotator cuff muscles get pinched between the top of the humerus (long bone in the arm) and a part of the scapula. That means we have to add anatomy....

Descriptive
technology

Joint
Measurement

Anatomy

And finally – a little research....

Prolonged exposure to a non-neutral wrist posture is associated with a twofold increased risk for CTS₍₁₎

Prolonged Pressure at the elbow or repetitive or prolonged elbow flexion can cause cubital tunnel₍₂₎

Lifting loads over 25 kg/55# and lifting at a frequency of over 25 lifts/day will increase the annual incidence of LBP₍₃₎

Over the past two years, there have been 16 scientific posters created as a part of this project:

Two have been presented at State conferences:

Siegel, P. & Rinaldi, M. **Injuries in food growers: Are there gender differences?** New Mexico Occupational Therapy Association state conference. August 19, 2022. This poster was updated and presented at AgrAbility 2023

Crocket, M. & Romero, R. **Cumulative trauma and ergonomic assessment of Apiarists.** New Mexico Occupational Therapy Association state conference, September 7, 2024.

Presented at UNM Scholarship of Practice:

Trujillo, M. & Salcido, B. **Pecan and Pistachio Farming Ergonomics** University of New Mexico Scholarship of Practice Event. December 3, 2024

Other Topics

- Ergonomic risks of Dairy Farming
- Chicken farming ergonomics
- Common shoulder injuries involved in ranching
- Apple farming
- Chile farming
- Pecan and Pistachio farming (two posters)
- Ergonomics of Fish Hatchery
- Home gardening
- Goat farming
- Fungi Farming
- Hay bailing
- Viticulture

Ergonomic Risks of Dairy Farming

Archella Clay MOT/S and Erin Saunders MOT/S

Dairy Farming in the United States

- Dairy farming has long been known to be associated with a high risk of injury among agricultural workers:¹
- In NM dairy farming makes up 20.5% of agricultural employment.²
- 76% of dairy farmers in the US are migrant workers.³
- Despite advancements in Technology dairy farming rates of incidents have not made significant declines⁴
- The "Dairy Dozen" – In 2018 began the OSHA Dairy Farming Directive. This was issued as an attempt to reduce injuries in dairy farming operations nationwide.⁵

Musculoskeletal Injuries and Causes

Specialized Tasks	Types of Injuries	Mechanism of Injury
Milking Parlor: Nearly 50% of livestock handling injuries took place while performing a milking task. ⁶	-27% of injuries to the wrist, hand, and fingers ⁴ -Lower back injuries ⁴	Animal Behavior: Stepping and kicking while attaching teeters.
Confined spaces and manure handling- (Most fatalities)	34%- Repair and maintenance of manure handling equipment. 22%- rescue of another person ⁴	Equipment/Tractors/PTO/Feeding equipment
Cow and Calving	Shoulder and low back pain ⁷	Kicked or positioning when pulling from the birth canal.
Feeding	Low back, neck, and knees. ⁴	Little rest/heavy load bearing postures

CUMULATIVE TRAUMA DISORDERS

Musculoskeletal Disorders
Osteoarthritis
Tendonitis

INCREASING RISK

- Awkward postures
- Forceful exertions
- High muscle loads on joints
- Minimal rest opportunities and high work load: cows have to be milked 2-3x a day

MITIGATING RISK

- Safety equipment such as shields
- Elevation of cows during milking to prevent kicks
- Education: Safety consultations annually, quarterly and monthly (10+employees)
- Dairy Multi-Stakeholder Initiative (DMSI) DMSI: customer-led collaborative effort to encourage fair, safe and healthy work environments on U.S. dairy farms



Assessments

Quick Exposure Check Questionnaire
Modified Nordic Questionnaire
DASH
ROM/MMT
Pinch and Grip Testing



OT Prevention and Interventions

- Ways in which an OT can help:
- Education in proper body mechanics
 - Adaptive and assistive equipment
 - Modify tasks
 - Take breaks
 - Modify the environment if possible
- **Put a splint on it!!!

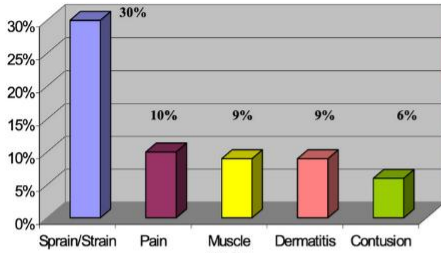
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Apple Farming Poster

By: Brooke McGee-Calhoun &
Brenna Pehrson

Diagnoses: Orchard Fruit-Top 5



Gregario: "It was at the end of the day, reaching for that last piece of fruit. Down I went, breaking my back. Now, I can no longer work. I lost my house, my savings, my dreams. My life - irreversibly changed that day."

Musculoskeletal Disorders and Injuries

- Strain, sprains, contusions, fractures, and dislocations
- Most common injury: back, shoulder, upper spine, and neck strain/sprain
- Tools involved: Ladders
 - Ladder movement was a contributing cause in 65% of the accidents and the main cause in 47% of the cases.
- Prevalence:
 - Prevalence of low back pain was greater in farming at 41% than in other manual and non-manual occupations.
 - The prevalence of shoulder injuries was also greater in farming at 14% than in other types of labor



Structures Involved & Symptoms

- | | |
|--|---|
| <ul style="list-style-type: none"> • Cervical spine • Thoracic spine • Lumbar spine • Glenohumeral joints • Elbow joints • Wrist joints • Hip joints • Knee joints • Ankle joints (for stability) | <ul style="list-style-type: none"> • Low back pain • Muscle spasms • Weakness • Impaired function • Impaired ROM |
|--|---|

What Increases The Risk

- Buckets carried weigh up to 40 lbs when full
- Carrying full apple bags down a ladder and emptying them into a bin 5 yards away
- Postures like leaning to one side on the ladder, stooping down to release apples, and spending time in an awkward arm/leg position for prolonged periods
- Poor weather
- Uneven terrain
- Production pressures

Causes

- 79%: Carrying a full or potentially full bag of apples
- 63%: Picking (reaching over, pulling fruit/twisting apple to separate from stem, bagging fruit)
- 8%: Releasing apples into bin (lifting/bending)
- 4%: Moving/climbing the ladder (lifting, carrying)
- Proportion of time spent in awkward postures

Provactive Tests

- Straight leg test: (most common test)
 - Supine and passively move the extended leg in slight flexion
 - Positive test: pain in back/down leg
- Tripod Sign Test:
 - Patient seated, passively elevate one leg
 - Positive test: pain in the back, the patient leans back placing both arms on the table
- Femoral stretch test:
 - Prone position, flex knee, and place hip in extension (hold)
 - Positive test: pain in the L2-L4 region

Ergonomic Assessments

1. Rapid Upper Limb Assessment (RULA)
 - A postural targeting method for estimating the risks of work-related upper limb disorders.
 - Looks at positions of the shoulder, lower arm, wrist and gives a grade accordingly.
2. Rapid Entire Body Assessment (REBA)
 - A postural targeting method for risk of work-related disorders of the entire body.
 - Looks at the neck, trunk and legs and is graded accordingly.

How OT Can Help

- **Education:** on proper body mechanics when lifting and carrying. This includes having a neutral spine, bending from the hips, carrying objects close to the body, lifting with the legs and having a wide base of support.
- **Education:** energy conservation strategies that include planning ahead, setting priorities, learning personal activity tolerance and implementing breaks.
- **Establish:** pacing through time management skills and alternating between periods of activity and rest
- **Promote:** lifestyle changes like positive eating, sleeping and exercising.
- **Use of adaptive equipment to modify tasks at work and home.**

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ERGONOMICS OF PECAN FARMING

Claire Benton, MOT/S; Jacqueline Padilla, MOT/S



PECAN FARMING IN NEW MEXICO

Pecans are a staple of Southern NM

- Southern NM is home to over 51,000 acres of pecan farmland, comprised of both small family businesses and some of the largest pecan growers in the world.
- Pecan Farming is a highly involved, year-round process.

MUSCULOSKELETAL INJURIES ASSOCIATED WITH PECAN FARMING

Vegetable, Fruit, and Nut Farmers experience approximately 3.8 injuries per 200,000 hours worked. (Davis & Kotowski, 2007)

Low Back Pain (LBP)

- **Prevalence**
 - According to a 2011 Systematic Review of the Prevalence of MSDs Among Farmers:
 - Lifetime Prevalence of LBP was 75%
 - 1-Year Prevalence of LBP was 47.8%
- **Causes**
 - LBP is common in agricultural tractor drivers.
 - Exposure to Whole-Body Vibration (WBV)
 - Postural requirements (prolonged sitting, frequent twisting, etc.)
- **Symptoms** include stiffness, decreased ROM, postural issues, muscle spasms ranging from mild to extreme, functional limitations
- **Provocative Test:** Straight Leg Test (most common)
 - Patient lays supine and evaluator passively elevates the fully extended leg of the affected side to 30–60°.
 - The results of this test would be considered positive if the individual experiences pain in the region they were complaining of, often radiating down the leg
 - In more severe cases, pain can be elicited by lifting the leg opposite of the affected side.

WHAT INCREASES THE RISK?

- **Repetitive Motion**
 - Bending down repeatedly
 - Shoveling
- **Forceful Exertion**
 - Shoveling, lifting, digging, etc.
- **Vibration**
 - Whole Body Vibration (WBV)
- **Static Postures**
 - Prolonged standing
 - Prolonged sitting
- **Age**
 - Prevalence of MSDs increases to greater than 50% after age 65 (Davis & Kotowski, 2007)



1. Shaking



2. Harvesting



3. Cleaning debris



4. Cracking the pecan

PECAN FARMING PROCESS

- 1 Shaking**
 - Using a machine called a shaker, the farmer shakes the nuts loose from opened husks
 - A mechanical arm extends out, and padded clamps fit snugly around the tree trunk.
 - The shaker shakes the trees vigorously, causing branches and sticks to fall along with the pecans.
 - Before harvesting, the path must be cleared of debris.
- 2 Harvesting**
 - The harvester collects the pecans, ejecting leaves from the back, and transports them to a hopper. When the hopper is full, the pecans are dumped into a trailer.
- 3 Cleaning Debris**
 - The harvested nuts are then shoveled into a bin, fed onto a conveyor belt, and then dropped into a machine to separate the nuts from the leaves and husks.
 - The leaves, husks, and bad nuts are blown out of the back.
 - The good nuts are fed onto another conveyor belt, where workers further identify the defective/bad nuts.
 - Looking for mold, holes, or cracks.
- 4 Cracking the Nut**
 - The nuts are taken to a pneumatic machine called a cracker that uses compressed air to crack the nut.

HOW CAN OT HELP MITIGATE THE RISK?

Provision of Adaptive Equipment

- Reacher/grabber or use of long handles to decrease the frequency of bending over, tractor seating with better shock and vibration absorption, tractor seating with proper positioning and lumbar support, back brace, floor mats for standing work

Task Modification

- Incorporate regular breaks, provide stools for standing tasks when possible, reduce weight of loads, avoid positioning tools/other items above shoulder height

Worker Education

- Educate workers on the importance of proper body mechanics and self-care practices.

EVIDENCE-BASED ASSESSMENT

Postural Assessment and Ergonomics Checklist

- Can help identify risk factors for LBP and determine appropriate follow-up treatment
- **Rapid Entire Body Assessment (REBA)**
 - Evaluates different body parts: upper limbs (arm, forearm and wrist), lower extremities, trunk and neck
 - Identifies forced postures
- **Agricultural Whole-Body Assessment (AWBA)**
 - Assesses various postures commonly assumed in agricultural settings and prevent WMSDs

Assessment of Environmental Risks

- Identification of ergonomic hazards within the working environment such as:
 - Repetitive Motion
 - Forceful Exertions
 - Awkward Posture
 - Static Postures
 - Compression/Mechanical Stress
 - Vibration
 - Temperature

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Cumulative Trauma and Ergonomic Assessment of Apiarists

Mark Romero MOT/S and Matthew Crockett MOT/S
University of New Mexico Occupational Therapy Graduate Program

An Introduction to the Apiary Industry

- Apiculture is the art and science of beekeeping. It includes cultivating and managing bee colonies.
- The practice focuses on harvest products including honey, beeswax, pollen, royal jelly, and propolis.
- In the US, the Apiculture industry grosses over \$624,000,000 a year and employs over 16,800 employees.⁵
- In New Mexico, the annual # of hives varies from 3000-6000 colonies a year with pollination and honey products being the sources of income. In 2021, the NM bee industry grossed over \$838,000.⁷



Structures, Symptoms & Provocative Tests for CLBP

- Anatomical structures involved with CLBP include: nerve root, muscles, fascia, joints, bones and intervertebral discs.¹
- Chronic low back pain is defined as back pain lasting more than 12 hours with symptoms including: burning or stabbing sensations and stiffness in the affected area.^{1,8}
- Imaging tests like x-ray, CAT scans, and MRI's are used to assess the extent of damage to the structures of the low back.⁹
- Provocative tests such as the straight leg test, tripod sign, and the femoral stretch test are used to elicit a pain response.⁹
- Neurological exams are also used for those with prolonged symptoms associated with CLBP and potential neurological dysfunction.⁹

Musculoskeletal Injuries Affecting Apiarist

- Risk factors associated with beekeeping: musculoskeletal injuries, bee stings, burns from smokers, lacerations from tools, exposure to the environment and chemicals.³
- **The primary musculoskeletal injury that afflicts apiarists is chronic low back pain (CLBP).**^{3,8}
- This is due to the intensity, repetition, and duration of work.³
- The primary culprit of CLBP for apiarists comes from lifting and lowering heavy bee boxes without proper ergonomics. These boxes can weigh up to 80lbs.³
- Musculoskeletal risk factors associated with this work are due to lifting heavy loads, manual handling, twisting and assuming awkward positions while working.^{3,8}
- CLBP accounted for 51.5% of injuries in apiarists.⁸

How Can OT's Help?

As OT's, we are in a unique position to help find modifications and provide insight to minimize risks by:

- Educating individuals on necessary precautions to prevent injury or re-injury.
- Providing equipment and task modifications.
- In the event of injury, OT's can help individuals return to work quicker.
- Adapting the workplace to reduce risks and enhance effectiveness.
- Developing fitness programs to help maintain optimal health
- Educating the apiarist on energy conservation strategies and adapting duration and intensity

Ergonomic Assessment

- When performing an ergonomic assessment of an apiarist, one must look at their work environment, posture, lifting technique, the tools used, and work habits for potential risk factors.^{3,8,9}
- The Ovako Working Posture Analysis System (OWAS) is used to analyze and categorize risky working postures among apiarists.⁹
- The Rapid Entire Body Assessment (REBA) is a useful tool in addressing posture, load/force placements, and the activity.⁴
- Assessing bee box weight/height, handle ergonomics, and adaptive equipment such as abdominal belts and lift assist systems should be taken into consideration.^{3,8,9}



*References included on separate handout

Some of what they found

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