Ergonomics case studies in Healthcare
Outline

• Overview of ergonomics
• Overview of work-related musculoskeletal disorders
• Ergonomics case studies
  – Hospital switchboard workers
  – Ultrasound radiographer
Definitions

- Ergonomics is the science of human capacity in relation to work demands and the application of this knowledge to improve work (ICOH MSDs scientific committee, 1996)

- Direct translation of ergonomics – “Laws of work”
Laws of work

Work capacity $\leftrightarrow$ Work demands

Musculoskeletal $\leftrightarrow$ Work demands function
Areas of ergonomics

• Cognitive
  – Mental processes: perception, memory, decision making
  – Control rooms and Human computer interaction

• Organizational
  – Policies, processes and culture: arrangement of working time
  – Shiftwork

• Physical
  – Human characteristics: anatomy, physiology, biomechanics, anthropometry
  – Physical activity
Ergonomic risk factors

• Posture
• Exertion of force
• Vibration
• Manual handling
• Repetitive and monotonous work

Frequency, magnitude, duration
Work-related musculoskeletal disorders (WRMDs)
Background

- Conditions that affect muscles, tendons, blood vessels, nerves and joints

- Most commonly reported in working population

- Work-related because work contributes significantly to their development (WHO, 1985)
Characteristics

- Develop over time

- Upper extremity and low back are body sites frequently affected

- Cumulative trauma
  - Cumulative trauma disorders
  - Overuse syndrome
  - Repetitive strain injuries
Examples of WRULDs and associated work factors

**Work factors**
- Static posture, forceful exertion, repetitive movements, working with arms above the head, combination of posture, force and repetitiveness
- Static posture, forceful exertion, repetitive movements, extreme elbow flexion and extension
- Extreme forearm pronation, supination and twisting
- Extreme flexion and extension of wrist, radial and ulnar deviation, forceful exertion, repetitive movements, static posture and vibration

**Disorders**
- Rotator cuff syndrome
- Medial epicondylitis
- Lateral epicondylitis
- Cubital tunnel syndrome
- Radial tunnel syndrome
- Osteoarthritis
- Flexor tenosynovitis
- Extensor tenosynovitis
- Carpal tunnel syndrome
- Osteoarthritis
- De Quervain's tenosynovitis
- Trigger finger
- Raynaud's phenomenon
- Hand arm vibration syndrome

NIOSH 1997
Symptoms

- Pain
- Burning sensation
- Numbness
- Tingling
- Swelling
- Stiffness
- Weakness
Compensation

• Compensable under the Occupational Injuries and Diseases Act’1993
  – Circular Instruction 180
An ergonomic risk assessment of an ultrasonographer’s workstation
Background

• 48 year old female ultrasonographer was seen at Occupational Medicine Clinic for possible work-related upper limb disorder

• She was complaining of a 2 yr history of L upper back pain that radiated to the L shoulder
Background

- Ultrasonographer was employed by a private hospital
- Providing antenatal clinical services
- Pregnant women offered ultrasound scans free of charge
- Scans performed from 28-32 weeks
Clinical history

• 1984-1991: worked as a radiographer at two hospitals; CT-Scan, X-Rays

• 1991-1994: not working; raising 2 kids

• 1995-2001: working in UK as a radiographer digital X-Rays

• 2001-to date: working in a private hospital as an ultrasonographer

• Back operation 17 years ago to repair prolapsed disc

• No family history of rheumatoid or osteoarthritis
Symptoms

• Pain on L upper back
  – Worse when scanning
  – Present when driving and
  – When sleeping on L side
Physical examination

- On palpation
  - Tenderness anteriorly and posteriorly along trapezius and around scapula
  - Neck painful on rotation to both sides
  - Neck lateral rotation painful on L side
  - L shoulder painful on flexion and external rotation
  - R shoulder normal
Special investigations and treatment

- X-Rays
- Pain tablets
Purpose

• Conducted as part of clinical assessment
  – To establish work-relatedness of MSD condition
  – To provide preventive measures
Work organization

• Working alone

• 36 hours a week

• Performed 12-15 scans per day

• Scanning one pregnant woman took 15-20 minutes
Ultrasonographer at work

- Scanning
- Turning the knobs of controls
- Pointing at the image of the baby
Identified risk factors

- Repetitive movements
- Forceful exertions
- Awkward and fixed postures
- Work pressure
- Duration of exposure
Recommendations

• Provide a height adjustable machine
• Provide machine with legroom
• Provide height adjustable bed
• Provide suitable footrest
• Provide sit-stand chair
• Provide education and training on ergonomics
Other recommendations

• Reduce exposure time
  - Reducing number of scans per day
  - Introducing more short breaks
  - Employing more staff
Occupational health doctor’s recommendations

– Continue with treatment
– Consult physiotherapist
– Rest for 2-3 days
– Review
– If persistent submit for compensation
– Job accommodation
Ergonomic risk assessment of a hospital switchboard
Background

- Hospital management requested an ergonomic risk assessment to be conducted at the switchboard
- Seven switchboard operators were complaining of neck and low back pain
- They attributed the pain to the chairs they were using and
- They wanted management to buy them new chairs
Background cont’d

• Management wanted a motivation in order to buy new chairs
  – The motivation had to answer the two question:
    • Is the pain experienced by the switchboard operators associated with the chairs
    • Is the design and layout of the switchboard workstation suitable for the switchboard operators
• **Purpose**
  – To determine if the switchboard workstations were suitable for the switchboard operators

• **Objectives**
  – To identify ergonomic risk factors that switchboard operators were exposed to

  – To determine if switchboard operators were experiencing any musculoskeletal pain

  – To provide recommendations based on the identified ergonomic risk factors
Work organization

• Switchboard operated 24 hours a day- 3 shifts

• 4 workers doing 2 shifts: 7:00-19:00 and 19:00-7:00

• 3 workers doing day shift: 7:30-16:00

• 3 breaks in a shift: two 15 minutes tea and one 30 minute lunch
Work organization cont’d

• Work involved
  – Taking and directing incoming calls
  – Paging hospital staff
  – Answering client queries
  – Giving lines to hospital staff
  – Sorting and filing telephone bills
Measurement methods

• Questionnaire

• Observation

• Direct measurements
Results

• On the day of assessment:
  – There were 3 female switchboard workers
  – 2 were client information clerks and the other was a supervisor
  – Their ages ranged from 35-50 years
  – Their service ranged from 2-10 years
Design of chairs

Table 1: Characteristics of chairs used in the switchboard

<table>
<thead>
<tr>
<th>Chair characteristic</th>
<th>Switchboard</th>
<th>Supervisor’s workstation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>The chair has a five star base and wheels</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The chairs has a swivel mechanism</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The chair has a backrest</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The backrest is height and angle adjustable</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The chair has armrests</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The armrests are height adjustable</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The armrests have been adjusted to correct working height</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The seat has a tilt function</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The seat has a waterfall edge</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>The seat height has been adjusted to correct working height</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Workstation and body measurements

Figure 2: Sitting, working and desk height of switchboard workstation

Figure 3: Screen height of switch-board workstation

Figure 4: Desk height of supervisor’s workstation

Figure 4: Desk depth of supervisor’s workstation
## Workstation and body measurements

<table>
<thead>
<tr>
<th>Worker</th>
<th>Desk height</th>
<th>Working height</th>
<th>Screen height</th>
<th>Sitting height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchboard worker 1</td>
<td>81</td>
<td>79</td>
<td>165</td>
<td>126</td>
</tr>
<tr>
<td>Switchboard worker 2</td>
<td>81</td>
<td>86</td>
<td>165</td>
<td>127</td>
</tr>
<tr>
<td>Supervisor (1)</td>
<td>77</td>
<td>79</td>
<td>132</td>
<td>131</td>
</tr>
<tr>
<td>Supervisor (2)</td>
<td>79</td>
<td>79</td>
<td>127</td>
<td>131</td>
</tr>
</tbody>
</table>
Workstation and body measurements

• Working height was lower than desk height (difference of 2 and 5 cm)

• Screen height higher than sitting height in the two switchboard workstations (difference of 38 and 39 cm)

• These discrepancies force the workers to work in awkward postures
<table>
<thead>
<tr>
<th>Body site</th>
<th>Worker 1</th>
<th>Worker 2</th>
<th>Worker 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>2</td>
</tr>
<tr>
<td>Shoulder</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Upper arm</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>Elbow</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Forearm</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Wrist</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>2</td>
</tr>
<tr>
<td>Hand</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Back</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>3</td>
</tr>
<tr>
<td>Lower back</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>3</td>
</tr>
<tr>
<td>Hip</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>1</td>
</tr>
<tr>
<td>Thigh</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>1</td>
</tr>
<tr>
<td>Knee</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Leg</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>Ankle</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>Foot</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>
Occurrence of musculoskeletal pain in workers

• Have you had pain that lasted for more than a day in the indicated anatomical sites in the past 12 months?
  – There was a total of 15 anatomical sites reported
  – Two switchboard workers reported pain in 6 anatomical sites while the Supervisor reported 3 anatomical sites
  – All the workers reported back pain
  – Switchboard operators reported neck and wrist pain
Recommendations

- Develop and implement an ergonomic programme
  - Constitute an ergonomic team

- Procure ergonomically designed chairs
- Improve the design of the switchboard
- Make it possible for workers to alternate between sitting and standing
- Educate and train workers on:
  - Computer workstation ergonomic risk factors
  - Health effects thereof
  - Computer workstation set up
  - Good working posture
  - Physical fitness

- Introduce medical surveillance for work-related musculoskeletal disorders
- Investigate workstations of workers who develop work-related musculoskeletal disorders
- Review changes after implementation
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