THE AGING WORKFORCE AND IMPACTS ON ERGONOMIC DESIGN

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Introductions

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What is Aging?

- Gradual accumulation of a wide variety of molecular and cellular damage that leads to a gradual decrease in physiological reserves, an increased risk of many diseases, and a general decline in the capacity of the individual (Steves, Spector and Jackson, 2012).

- But these changes are neither linear nor consistent, and they are only loosely associated with age in years.

(World report on ageing and health, 2015)
What is Aging?

Health characteristics
- Underlying age-related trends
- Health-related behaviours, traits and skills
- Physiological changes and risk factors
- Diseases and injuries
- Changes to homeostasis
- Broader geriatric syndromes

(World report on ageing and health, 2015)
Who is the Aging Population?

• Older workers (≥55 years) represented 19% of the U.S. workforce in 2009 and are the nation's fastest growing segment of the working population (Toossi, 2009)
Why are we Concerned?

Fig. 3.1. Proportion of population aged 60 years or older, by country, 2015

(World report on ageing and health, 2015)
Why are we Concerned?

Fig. 3.2. Proportion of population aged 60 years or older, by country, 2050 projections

(World report on ageing and health, 2015)
Why are Companies Concerned?

Projected percentage change in labor force by age, 2006-2016

<table>
<thead>
<tr>
<th>Age</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 and older</td>
<td>84.3</td>
</tr>
<tr>
<td>65 to 74</td>
<td>83.4</td>
</tr>
<tr>
<td>55 to 64</td>
<td>36.5</td>
</tr>
<tr>
<td>25 to 54</td>
<td>2.4</td>
</tr>
<tr>
<td>16 to 24</td>
<td>-6.9</td>
</tr>
</tbody>
</table>

Why are IH’s Concerned?
Why Should we be Concerned?

A review of the literature since 1940 (63 studies) across 18 countries documents that (Salminen, 2004):

- 56% of studies show that younger workers have higher non-fatal occupational injury rates
- 27% of studies show that younger and older workers have similar non-fatal occupational injury rates
- Only 17% of studies showed that older adults have higher non-fatal occupational injury rates
- Thus, younger workers have a higher risk of occupational injuries.
Why Should we be Concerned?

• In 1982 and 1998, rates of non-fatal occupational injuries and illnesses in the United States were high for younger workers (Jackson, 2001)

*Figure 1  Rate/100 full-time equivalent (FTE) workers by sex and age for injuries and illnesses treated in an emergency department for 1982 and 1998. (Note: age is plotted as a linear function by using the mid-point of the age categories shown in table 1.)*
Why Should we be Concerned?

• More recently (2009), older workers had similar or lower rates for all non-fatal occupational injuries and illnesses compared with younger workers (U.S. Bureau of Labor Statistic)
Why Should we be Concerned?

• However, the length of absence from work increased (peaked at 11-12 days) steadily with age (U.S. Bureau of Labor Statistics)
What is the Cause of Injuries?

- Based on the 2016 Liberty Mutual Workplace Safety Index (data from 2013), the top cause of serious, non-fatal workplace injuries is Overexertion.

![Graph showing the top 10 causes and direct costs of disabling U.S. workplace injuries.](image)
What is the Cause of Injuries?


<table>
<thead>
<tr>
<th>Year</th>
<th>% of Overexertion Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>26.3%</td>
</tr>
<tr>
<td>2008</td>
<td>25.7%</td>
</tr>
<tr>
<td>2009</td>
<td>24.0%</td>
</tr>
<tr>
<td>2010</td>
<td>25.1%</td>
</tr>
<tr>
<td>2011</td>
<td>25.4%</td>
</tr>
<tr>
<td>2012</td>
<td>26.8%</td>
</tr>
<tr>
<td>2013</td>
<td>25.7%</td>
</tr>
<tr>
<td>2014</td>
<td>25.3%</td>
</tr>
<tr>
<td>2016</td>
<td>24.4%</td>
</tr>
</tbody>
</table>

2007 - 2016 Liberty Mutual Workplace Safety Index
What is the Cause of Injuries?


<table>
<thead>
<tr>
<th>Year</th>
<th>Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>$12.7</td>
</tr>
<tr>
<td>2008</td>
<td>$12.4</td>
</tr>
<tr>
<td>2009</td>
<td>$12.7</td>
</tr>
<tr>
<td>2010</td>
<td>$13.4</td>
</tr>
<tr>
<td>2011</td>
<td>$12.75</td>
</tr>
<tr>
<td>2012</td>
<td>$13.61</td>
</tr>
<tr>
<td>2013</td>
<td>$14.2</td>
</tr>
<tr>
<td>2014</td>
<td>$15.1</td>
</tr>
<tr>
<td>2016</td>
<td>$15.08</td>
</tr>
</tbody>
</table>
Overexertion & Aging?

- Rates for overexertion for both younger and older worker age groups are about the same. (U.S. Bureau of Labor Statistic)
Overexertion & Aging?

- Conversely, median number of days absent from work increased steadily with age (U.S. Bureau of Labor Statistic)
Changes in Strength with Age?

The following strength changes occur:

- **Strength** – muscle mass, strength, and function declines with increasing age (Cruz-Jentoft, et al, 2010)

![Graph showing changes in hand grip strength over age](image)

**Fig. 3.11.** Hand grip strength, males and females aged 50 years and over

Note: The figure focuses on the fourth wave of SHARE (2010-2011) because the timing of project implementation coincided approximately with the first wave of SAGE (2007-2010). Data are not adjusted for height and weight.

Sources: (16, 14).
Changes in Movement with Age?

The following movement changes occur:

- **Force control** – adults grip twice as hard (Cole. 1991)
- **Force perception** – decreases (Cole et al., 1991)
- **Endurance** – muscle endurance decreases
Changes in Movement with Age?

The following movement changes occur:

• **Range of motion** – reduction in ROM (Chaparro et al., 2000)
Changes in Movement with Age?

The following movement changes occur:

- **Movement precision (deceleration)** - movement precision decreases (Walker et al., 1997)
Changes in Movement with Age?
Changes in Movement with Age?
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Changes in Movement with Age?
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Changes in Movement with Age?
Changes in Movement with Age?
Muscle Physiology Changes?

The following changes in muscle physiology occurs with age:

- **Sarcopenia** – normal loss of skeletal muscle mass/strength and function with age (Baumgartner et al, 1999)
- Muscle mass loss of just under 1% per year
- Loss of muscle strength is 2-5 times greater than loss of mass
Design for the Aging Population

• Guidelines:
  • Acceptable hand wheel turning force - ≤ 35 lb (15.9 kg)

• Guidelines for Aging population:
  • Ages 51-60 have a 19% reduction force capability
  • Ages 61-70 have a 35% reduction force capability
Design for the Aging Population
Design for the Aging Population

• Guidelines for Aging population:
  • Optimal Zone: 38"-49" (0.97-1.25m)
  • Acceptable Zone: 24"-62" (0.61-1.58m)
Designing for Aging Population – Thumb Force

• Guidelines:
  • 1-thumb - ≤ 5.3 lb (2.4 kg)
  • 2-thumbs - ≤ 10.0 lb (4.5 kg)

• Guidelines for Aging population:
  • Ages 51-60 have a 8% reduction force capability
  • Ages 61-70 have a 34% reduction force capability
Designing for Aging Population – Pull Force

• Guidelines:
  • Acceptable hand wheel turning force - ≤ 35 lb (15.9 kg)
  • Guidelines for Aging population:
  • Ages 51-60 have a 19% reduction force capability
  • Ages 61-70 have a 35% reduction force capability
Designing for Aging Population – Hand Tool

- Guidelines will be provided for the following hand tools:
  - In-line power tool
  - Pistol-grip power tool
  - Right-angle power tool
Torque Reaction Guidelines

• Guidelines:
  • In-line power tool - \( \leq 2.36 \text{ lb-ft (3.2 Nm)} \)
  • Pistol-grip power tool - \( \leq 5.02 \text{ lb-ft (6.8 Nm)} \)
  • Right-angle tool - \( \leq 37 \text{ lb-ft (50 Nm)} \)

• Guidelines for Aging population:
  • Ages 51-60 have a 13% reduction in torque capability
  • Ages 61-70 have a 32% reduction in torque capability
Operating Mode Guidelines

• Guidelines:
  • Recommended – Hydraulic pulse systems or automatic shut-off mechanisms to reduce peak torque reaction and duration
  • Acceptable – Mechanical clutch mechanisms that limits the torque reaction exposure (but increases vibration)
  • Avoid: Stall or direct-drive mechanisms that put torque reaction under operator control

• Guidelines for Aging population:
  • Ages 51-70 provide hydraulic pulse systems or automatic shut-off mechanisms
Quantify Injury Risks

Division of Safety & Hygiene - Lifting guidelines

Enter the criteria for the specific situation in your workplace, and then click submit. You can enter the lifting specifics in one of two ways. You can click on the drop-down arrows, and then click on what you want to enter. Or, you can click on the image in the spot that matches the criteria you want to enter.

Select the back type for your scenario.
- Healthy
- Lower back disorder

Select the vertical lift origin (the level from which lifts will be made):
- Knee level

Select the horizontal reach, distance from the spine (measured from spine to the center of the load):
- Between 12 and 24 inches

Select the trunk-twisting angle during the lift. The twisting angle can be either to the left or to the right and is relative to the feet.
- Between 30 and 60 degrees

Guidelines for lifts involving trunk-twisting angle* of +/- 30 degrees

*Angle in which the person doing the lifting will twist (left and/or right).
Summary

• Overexertion (lifting, lowering, pushing, pulling, etc.) is the primary injury concern for the full working population, as well as older workers.

• Physiological changes occur as we age that reduces:
  • strength capabilities
  • force control
  • force perception
  • muscular endurance
  • range of motion
  • movement precision

• Risk assessment tools and design guidelines are available to accommodate and design for the older worker in order to reduce the likelihood of occupational injuries.