Impact of Thomas Waters on the Field of Occupational Ergonomics

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Disclaimer: The findings and conclusions in this webinar are those of the speaker and do not necessarily represent the views of the National Institute for Occupational Safety and Health.
Dr. Thomas R. Waters (1952-2014)
Learning Objectives

• Impact of the revised NIOSH lifting equation (RNLE) on the field of ergonomics
• Advancements in healthcare ergonomics
• Ergonomics for youth working in agriculture
Learning Objective #1

Impact of the Revised NIOSH Lifting Equation (RNLE) on the Field of Ergonomics
Learning objective #1: Impact of RNLE

Where is the Standard?
History of NLE

- Applications Manual for the RNLE (1994)
What is the Revised NLE?

A mathematical equation to determine the Recommended Weight Limit (RWL) for a particular manual lifting condition by using a number of lifting-related task variables.

\[ \text{RWL} = \text{LC} \times \text{HM} \times \text{VM} \times \text{DM} \times \text{AM} \times \text{FM} \times \text{CM} \]
Key Technical Terms of RNLE

Recommended Weight Limit (RWL)

The weight of the load that nearly all healthy workers could perform over a substantial period of time without an increased risk of developing lifting-related low back disorders

Lifting Index (LI)

A term that provides a relative estimate of the level of physical stress associated with a particular manual lifting task
Lifting Index (LI)

LI = Weight of Load Lifted / RWL

Example
Assuming RWL for job was 25 lbs. and weight lifted was 50 lbs., the LI would be:

\[
LI = \frac{50}{25} = 2.0
\]
Single-Task vs. Multi-Task

- **Single Task** – Used when task characteristics do not change significantly between lifts.
  
  **Risk measure:** Lifting Index (LI)

- **Multi-Task** – Used when job consists of discrete tasks with different task characteristics (e.g., Palletizing, machining, sorting, etc.)
  
  **Risk measure:** Composite lifting index (CLI)
Results of a Systematic Review

(Lu et al., Human Factors 2016; DOI: 10.1177/0018720815623894)

Learning objective #1: Impact of RNLE

Number of documents (N=137) relevant to the RNLE from 1/1/1991-12/31/2014
Learning objective #1: Impact of RNLE

## Type of RNLE-related Literature

*(in press, Lu et al., Human Factors 2016)*

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<td><strong>Total</strong></td>
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Primarily contributed by USA (54%), Italy (7%) and Canada (6%). Authors’ affiliations in 23 countries.
Citation and Usage impact of RNLE

Applications Manual

• Most popular NIOSH publication: Numerous hard copies and more than 18,726 digital downloads as of May 2015

• More than 1,258 citations of the RNLE scientific paper (Google Scholar)

• 2nd most cited paper in journal Ergonomics (accessed 4/14/2015).
Popularity of RNLE

- Most widely used ergonomic analysis tool (Dempsey et al., 2005)
- Preferred by 83% of EHS practitioners (Dempsey et al., 2005)
- Best known ergonomic risk assessment tool among EHS professionals (Arezes et al., 2011)
Association of LI/CLI with Low Back Pain (LBP) Outcomes

- 13 studies linking LI/CLI to LBP outcomes (Lu et al., Human Factors, in press)
- A positive relationship between LI/CLI metrics and severities of LBP outcomes
- Stronger evidence on the relationship between LBP outcomes and LI/CLI above 2
- Healthy or survival worker effect (LI/CLI>3) needs to be further investigated
U.S. Standards/Guidelines Based on RNLE

- Federal ergonomic standard (revoked 2001)
- ACGIH: TLV for lifting (2007)
- AIAG: OHS-5 Ergonomics guidelines for small lot delivery (2007)
- ANSI: Incorporates various guidelines
International Standards/Guidelines Based on RNLE

- EN 1005-2: Human physical performance (2003; reviewed 2014)
- UK: Manual Handling Regulations (2004)-the MAC tool
- Many others: Netherlands, Spain, Italy, etc.
Learning Objective #2
Advancements in Healthcare Ergonomics
Ergonomics for Patient Handling

• Myth: Proper lifting techniques can reduce risk of back disorders associated with patient handling.

• Fact: There is no safe way of lifting a patient manually!
Lifting Assist Equipment for Patient Handling

• Using equipment for patient handling is effective in reducing the risk of injuries (Collins et al., 2004), and the equipment can pay for itself in <3 years after purchase (NIOSH, 2006)
Lifting Assist Equipment for Patient Handling (cont.)

- Ceiling lifts appear to reduce spinal loading more than floor lifts
- Control capabilities of floor lifts greatly influence risk
Learning objective #2: Advances in healthcare ergonomics

Ergonomics Guidelines for Patient Handling Equipment

- Veterans Health Administration published Safe Patient Handling and Movement Algorithms (i.e., decision trees) for choosing equipment (VHA, 2006)
AORN Safe Patient Handling and Movement Series

- #1: Lateral transfer of a patient from stretcher to bed
- #2: (Re)Positioning supine patient on bed
- #3: Lifting patient’s body parts
- #4: Solutions for prolonged standing
- #5: Tissue retracting
- #6: Lifting and carrying medical supplies
- #7: Pushing, pulling and moving equipment on wheels
AORN Safe Patient Handling and Movement Series (cont.)

- RNLE was used to estimate the RWL for handling patient’s body parts:
  
  **Max 35 lbs. in the ideal lifting condition**

  (Waters, AJN, 2007; AORN, 2011)
Learning objective #2: Advances in healthcare ergonomics

NIOSH Safe Patient Handling Training Document
Learning Objective #3
Ergonomics for Youth Working in Agriculture
Learning objective #3: Ergonomics for youth working in agriculture

Background

- ~2 million youth <20 years old are potentially exposed to agriculture hazards each year (NIOSH, 2001).
- ~50% of jobs routinely performed by youth would be considered from moderate-high risk of LBP for adult workers (Allread et al., 2004).
- Long-term risks of MSDs associated with youth performing physical work in agriculture are unclear (Waters, 2002).
Research Agenda (in 2002)

• Identification of high risk jobs
• Surveillance research
• Intervention effectiveness
• Etiological research
Significant Findings

• Farm parents underestimate the risks of MSDs faced by youth working on farms.

• Farm youth have stiffer bones than age matched non-farm youth, suggesting a potential precursor for early onset of osteoarthritis in adult farmers (Bhattacharya et al., 2007)

• A clinical-based surveillance system likely would be effective for tracking MSDs.

• Effects of ergonomic interventions on farm youth’s risk of MSDs are unclear.
Learning objective #3: Ergonomics for youth working in agriculture

**Significant Research Products**

2D biomechanical model for youth (2010)

Book chapter (2008): Prevention of MSDs for youth working on farms
Takeaway Messages

• RNLE appears to be an effective tool for identifying risks of various LBP outcomes.
• Patient lifting assist equipment is recommended, despite its varying effectiveness in reducing risk of injury.
• Benefits of ergonomic interventions for youth working in agriculture are inconclusive. More research is needed.
Questions?

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