Using the Lumbar Motion Monitor to Assess Housekeeper Room-Cleaning Tasks

Summary Trunk Motion and Low Back Disorder Risk Data from Various Research Studies

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The Lumbar Motion Monitor (LMM)

- An electro-goniometer, developed in the late 1980s, by researchers at The Ohio State University
- Tracks instantaneous movements of the back in its three planes of motion (i.e., lateral/coronal, sagittal, twisting/transverse planes of motion)
- Allows one to determine the velocity and acceleration of trunk movement required for work tasks
- Is worn “on-site,” as employees perform their actual jobs
The Lumbar Motion Monitor (LMM)

- Is used by researchers and practitioners from around the world (e.g., Australia, Canada, Denmark, South Africa, Taiwan, UK, US) to study lifting tasks and jobs that involve use of the spine
- Can be used as inputs to a validated low-back disorder (LBD) risk model
- The LBD Risk model was developed from the analysis of work requirements for over 400 high- and low-risk jobs
- Publication of the LBD Risk model (*Spine*, 1993) was ranked 59th on the list of 100 most-cited spine articles (*European Spine Journal*, 2012), a measure of the importance of spine-related research

The LMM Low-Back Disorder (LBD) Risk Model

- Industrial surveillance research found there to be five workplace and trunk motion measures that, together, best distinguished “high-risk” jobs from “low-risk” jobs
- Independent studies have also validated the biomechanical relationships between each of these five measures and loading on the lumbar spine
- Each measure contributes equally to the model
- Risk benchmarks
  - “High Risk” - LBD Risk values greater than 60%
  - “Moderate Risk” – LBD Risk between 30% and 60%
  - “Low Risk” - LBD Risk values below 30%
The LMM Low-Back Disorder (LBD) Risk Model

- Example LBD Risk Chart
  - This risk model is used to determine the probability that a task monitored with the LMM would have a profile similar to jobs in a historical data base that had high numbers of LBDs associated with them.
  - The magnitude of each measure of a task of interest is shown by the five bars.
  - The dotted line indicates the LBD Risk value for the task.
  - In this example, LBD Risk is 65% ("high risk").

Study 1

USING THE LMM TO ASSESS HOUSEKEEPING TASKS IN AN EAST COAST HOTEL
Study 1 – East Coast Hotel: LBD Risk Results

- The LMM was worn by three experienced housekeepers working in a full-service hotel
- Each housekeeper cleaned double-bed rooms following guest checkout

Study 1 – East Coast Hotel: LBD Risk Results

- The cleaning tasks monitored included:

  - Bed-Making
    - Lifting mattress at head of bed
    - Lifting mattress at foot of bed
    - Taking top comforter on/off
    - Taking pillows on/off bed
    - Taking pillowcases off/on
    - Taking inner comforter on/off
    - Taking sheets on/off
  
  - Bathroom-Cleaning
    - Cleaning tub
    - Cleaning shower wall
    - Cleaning toilet
    - Cleaning floor
    - Cleaning other surfaces
    - Cleaning mirror
  
  - Other
    - Vacuuming
    - Dusting
    - Replenishing from cart
    - Checking furniture drawers
Study 1 – East Coast Hotel: LBD Risk Results

- LBD Risk results – individual tasks

![Graph showing LBD Risk results for individual tasks with benchmark values for high and low risk.]

- LBD Risk results – job risk across tasks = 73%

![Graph showing the probability of high risk group membership for different tasks with metrics such as lift rate, twisting velocity, and sagittal flexion.]

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Study 1 – East Coast Hotel: LBD Risk Results

- LBD Risk results – interpretation
  - No LBD Risk values for any room-cleaning task were considered to be “low-risk”
  - Most tasks would be considered “moderate risk”
  - Two room-cleaning tasks would be considered “high risk”
    - Cleaning shower walls
    - Dusting
  - Overall, the LBD Risk for the job is high (73%)

Study 2

USING THE LMM TO ASSESS HOUSEKEEPING TASKS IN A MIDWEST HOTEL
Study 2 – Midwest Hotel: LBD Risk Results

- The LMM was worn by three experienced housekeepers working in a full-service hotel
- Each housekeeper cleaned one king bed checkout room and one double bed checkout room

- The cleaning tasks monitored included:
  - Bed-Making
    - Lifting mattress at head of bed
    - Lifting mattress at foot of bed
    - Tucking linen into sides of mattress
    - Taking top comforter on/off
    - Taking pillows on/off bed
    - Taking pillowcases off/on
    - Taking bedsheets off/on
  - Bathroom-Cleaning
    - Cleaning tub
    - Cleaning shower wall
    - Cleaning toilet
    - Cleaning floor
    - Cleaning other surfaces
    - Cleaning mirror
  - Other
    - Pushing/pulling supply cart
    - Vacuuming
    - Dusting
    - Replenishing from cart
Study 2 – Midwest Hotel: LBD Risk Results

- LBD Risk results – individual tasks

![Graph showing LBD Risk results for individual tasks]

- LBD Risk results – job risk across tasks = 79%*

![Graph showing job risk across tasks]

* Cart pushing/pulling is not included in this risk assessment.
Study 2 – Midwest Hotel: LBD Risk Results

- **LBD Risk results – interpretation**
  - No LBD Risk values for any room-cleaning task were considered to be “low-risk”
  - Most tasks would be considered “moderate risk”
  - Four room-cleaning tasks would be considered “high risk”
    - Cleaning shower walls
    - Cleaning bathroom floor
    - Vacuuming
    - Dusting
  - Overall, the LBD Risk for the job is **high (79%)**

Study 3

**USING THE LMM TO COMPARE THE IMPACT OF USING LONG-HANDED TOOLS FOR CLEANING**
Study 3 – Impact of Long-Handled Tool Use

- A total of 12 female housekeepers who worked in a full-service Southern California hotel, wore the LMM
- Each housekeeper performed bathroom-cleaning and dusting tasks, in both their usual method and with a tool whose handle could be extended

Study 3 – Impact of Long-Handled Tool Use

- The cleaning tasks monitored included:
  - Bathroom-Cleaning
    - Wiping tub
    - Wiping shower walls
    - Wiping floor
  - Dusting
    - Dusting armoire
    - Dusting night stand
Study 3 – Impact of Long-Handled Tool Use

- Trunk motion results – maximum forward/sagittal flexion

The amount of forward bending required to do all tasks was, statistically, significantly lower when the long-handled tool was used.

Study 3 – Impact of Long-Handled Tool Use

- Trunk motion results – maximum lateral velocity

The speed/velocity at which the spine moved laterally (side-to-side) to do all tasks was, statistically, significantly lower when the long-handled tool was used.
Study 3 – Impact of Long-Handled Tool Use

- Trunk motion results – average twisting velocity

- The speed/velocity at which the spine twisted to do the three bathroom-cleaning tasks was, statistically, significantly lower when the long-handled tool was used.

- LBD Risk results

- The resulting LBD Risk values assessed for the three bathroom-cleaning and two dusting tasks all were, statistically, significantly lower when the long-handled tool was used.
Study 3 – Impact of Long-Handled Tool Use

- Results summary
  - From a large sample of experienced hotel housekeepers who were monitored wearing the LMM while performing common bathroom-cleaning and furniture dusting tasks:
    - Most individual trunk motions were substantially and, statistically, significantly lower when long-handled tools were used, compared to normal cleaning methods.
    - Overall LBD Risk values were significantly lower when these cleaning tools were used.