Lumbar Forces While Making a Bed With and Without an Instant Tuck™ Mat

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Abstract

Introduction:

Conventional wisdom to avoid back pain while making your bed recommends not to lean across your bed to tuck in the sheets, and to keep your back straight and use Core Muscles. This is not practical or possible with any of the many different designs currently available. At present, there is no safe way to make your bed, which can significantly increase the risk of injury and create lifelong disabilities for both individuals and certain professional bedmakers such as house keepers, and caregivers.

Objective:

It was hypothesized that the use of an Instant Tuck™ Mat can significantly lower the Back-Compression Force (BCF) on the Lower Back and fall far below the risk threshold level stated by the NIOSH. The Instant Tuck™ Mat addresses this major health problem of back pain and injuries by eliminating the need to ever lift a mattress when making the bed.

Method:

A sample of 35 subjects performed the task of making a bed with a queen-sized mattress with and without the Instant Tuck™ Mat in a random order. BCF, the number of lifts to make the bed as well as the length of time for each lift, and the number of times each individual bent forward was measured during each trial.

Results:

There were significant differences for all the measured variables. Regarding the BCF, there was an approximately 85% reduction of pressure on the lower back when using the Instant Tuck™ Mat vs. not using it, which was a highly significant decrease ($p<.001$). Also, the number of times the mattress was lifted was lower by 12 times when using the Instant Tuck™ Mat vs. not using it ($p<.001$). Finally, the times each individual bent down was approximately 9 times less when using the Instant Tuck™ Mat vs. not using it ($p<.001$).

Conclusion:

BCF's making a bed in its current form is by a wide margin out of compliance with NIOSH standards and as a result it poses a significant risk of injury especially for those who are required to perform this for their occupation, such as hotel housekeepers and hospital, nursing home, and in-home caregivers. Making a bed using the Instant Tuck™ Mat reduced the BCF's by 85% and is in line with NIOSH standards. The Instant Tuck™ Mat has that it can make the repetitive act of making a bed safe and that it can significantly reduce the risk of injury based on NIOSH standards.

Key Words: Core Muscles, Low Back, Low Back Injury, Low Back Pain, Muscle Force, Force Gauge, Stress, Threshold, Instant Tuck, Instant Tuck Mat.

Introduction

Conventional wisdom to avoid back pain while making your bed will recommend not to lean across your bed to tuck in the sheets, to get on your knees to tuck in the sheets, to keep your back straight, and to use your Core Muscles. This is not practical or possible with any of the different mattress designs currently available. Currently there is no safe way to make your bed, which poses a significant risk of injury and can create lifelong disabilities for certain professions such as hotel housekeepers, hospital, nursing home, and in-home caregivers, and even for individual consumers.

Conventional wisdom to avoid back pain while making your bed will recommend not to lean across your bed to tuck in the sheets, to get on your knees to tuck in the sheets, to keep your back straight, and to use your Core Muscles. This is not practical or possible with the different bed designs available. Currently there is no safe way to make your bed, which can significantly increase the risk of injury and create a difficult situation for certain professions such as house keepers, which could cause lifelong disabilities.

“About 80 percent of adults experience Low Back pain at some point in their lifetime. It is the most common cause of job-related disability and a leading contributor to missed workdays. In a large survey, more than a quarter of adults reported experiencing Low Back pain during the past 3 months” (1). Low Back injuries primarily occur as a result of lifting, repetitive bending, and twisting often seen in Manual Material Handling (MMH) tasks (2), such as making beds which is a primary task for house keepers whether it be in their own home or at a large scale hotel.

“Seminal studies demonstrate that work-related bodily pain and injuries are significant problems. Very high proportions (77% to 91%) of housekeeper’s self-report pain primarily in their lower backs” (3). “In 2010, housekeepers had the highest rates of workers for overall injuries (7.9 per 100) and musculoskeletal disorders (3.2 per 100)” (4). “Analyses of Workers Compensation data from a subset of unionized hotels revealed housekeepers' annual claims cost upwards of $4.7 million” (5).

National Institute for Occupational Safety and Health (NIOSH) work practices guide for Manual Lifting states: Biomechanical Back Compression Forces (BCF’s) are not tolerable over 650 kg (1430 lb) and a 350 kg (770 Ib) BCF can be tolerated by most young, & healthy individuals (6).

In this study, we hypothesized that the use of an Instant Tuck™ Mat can significantly lower the BCF, and the impulse forces on the Low Back and fall far below the risk threshold level stated by the NIOSH, as well as significantly reducing the time needed to make the bed. The Instant Tuck™ Mat addresses this major health problem of back pain and injuries by eliminating the need to ever lift a mattress when making the bed.

Methodology

Design

Quantitative Study

Participants

The study consisted of 35 subjects.

Inclusion criteria

Healthy individuals between the ages of 20-70 years old were randomly recruited into this study. Demographics of the participants is shown in (Table.1).

Exclusion criteria

Participants who have current symptoms in their lower backs or have experienced back pain during the previous 3 months or have a history of spinal surgery. Also, any subject on pain killers, or is currently using any types of NSAID's was excluded.

Table.1 General Demographics of the Subjects

	Age (Years)	Height (Cm)	Weight (lbs.)	Gender
Mean	40.3	172.5	159.7	14 (Male)
Standard Deviation (SD)	(+/- 12.1)	(+/- 10.5)	(+/- 38.8)	21 (Female)

Outcome measures

The measurements of interest related to this study were: Back compression forces and impulse forces to lift a queen size mattress (to tuck in the sheets). The number of times needed to bend forward to make the bed. The number of lifts needed to make the bed and the length of time for each lift. These outcomes were collected while making a queen size bed with and without an Instant Tuck™ Mat.

Back Compression Force (BCF):

A force gauge was used to determine the pressure needed to lift the mattress, in order to tuck in the sheets while making the bed. Each participants height (in cm's), and weight (in lbs) was collected. This data was used to determine the back-compression and impulse forces with each lift using formula's A, B, C listed in **Figure 1.** (7) The variables consistent with the average height and weight of our participants 5''6', and 160 lbs respectively, served as a constant for the formula in figure 1; 40 degrees of trunk flexion from horizontal, reaching 18 inches front of the lumbar spine to grasp the load and lift, 10.4 inches anterior of the lumbar spine to reflect the center of mass, and total lift time is 2.5 seconds/lift.

Figure 1

Equation A:

Moment from the weight of the load = (x lbs.) x (y in.) = z in-lbs

Moment from the weight of the upper body = (x lbs.) x (y in.) = z in-lbs

Total Moment (clockwise) = x in-lbs

Equation B:

x in-lbs = (Force generated by erector spinae muscles) x (2 in.)

(x in-lbs)/(2 in.) = (Force generated by erector spinae muscles)

x in-lbs = Force generated by erector spinae muscles

Equation C:

Force X ΔTime=Impulse

Procedure:

Each participant was asked to place the fitted sheet and the flat sheet on the bed, according to how they would do it at home, with additional instruction to tuck in both sheets for the bed without the Instant Tuck™ Mat. For the Instant Tuck™ Mat, they are provided with minimal instructions (Figure 2).

Figure 2

1. Spread the sheet on the bed as you would normally do.
2. Start pushing the sheet into the opening between the Instant Tuck mat and the bottom of the mattress. Use whatever body position you are most comfortable with. No need to lift the mattress.
3. Keep pushing the rest of the sheet into the opening all around the mattress.

The participants were randomly divided into 2 groups. The first group started off with making the bed without the Instant Tuck ™ Mat, and for the second trial with the Instant Tuck ™ mat. The time needed to complete the bed, the number of lifts to make the bed, and the number of times each individual bends was measured during each trial. Each trial was recorded and performed twice. The fastest time for each trial was used, and the amount of lifts and bends during that performance was recorded for each trial. The 2nd group of participants were asked to perform the same trials, but in the opposite order (where they will begin with the Instant Tuck™ Mat, then without the Instant Tuck™ Mat).

Data Analysis

Means, and Standard Deviations (SD) were calculated for each variable. Changes between post and premeasures were examined using paired t-test. Data was analyzed using SPSS (version 22.0; IBM Corp, Armonk, NY), and Excel (Excel 2016) (Microsoft, Redmond, WA), and the level of significance was set at $p \leq 0.05$.

Results

Significant differences between the variables of both groups (Making the bed with the instant Tuck device Vs. Making the bed without the instant Tuck Device) were observed:

1. The number of times the mattress was lifted.

    a. On average, the mattress was lifted 12 (± 4.5) Times when making the bed without the Instant Tuck™ Mat Vs. 0 Times while making it with the Instant Tuck™ Mat. This difference of 12 additional lifts while making the bed without the Instant Tuck™ Mat was very significant ($p<.001$).

2. The number of times the participants bent to make the bed.

    a. On average, the number of times the individuals bent over to make the bed was 18 (± 4.5) times without the Instant Tuck™ Mat Vs. 9 (± 2.3) times while making the bed with the Instant Tuck™ Mat. This difference of approximately 9 additional bend overs while making the bed without the Instant Tuck™ Mat was highly significant ($p<.001$).

3. The back-compression and impulse forces on the lower back.

    a. On average, the pounds of pressure on the lower back (lumbar spine region) to make the bed once (with 1 Bend & 1 Lift of the mattress) including the time factor for each lift (approximately 2.5 seconds) without the Instant Tuck™ Mat was 3,923.25 lbs (± 302) Vs. 1245.3 lbs (± 302) to make the bed with the Instant Tuck™ Mat (1 Bend with 0 lift of the mattress). This difference of around 2,677.95 lbs less pressure while using the Instant Tuck™ Mat for 1 lift was highly significant ($p<.001$), with approximately 68.25% reduction of pressure on the lower back.

    b. On average, the pounds of pressure on the lower back (lumbar spine region) to make the bed once (with the average number of lifts, and bend overs without lifting), including the time factor for each lift (approximately 2.5 seconds) without the Instant Tuck™ Mat was 88594.3 (± 32236.6) Vs. 11138.2 (± 4345.5) lbs to make the bed while using the Instant Tuck™ Mat (0 lift of the mattress and 9 bend overs), without the time factor for each lift (as the mattress wasn't lifted). This difference of around 77,456.1 lbs less pressure while using the Instant Tuck™ Mat to make 1 bed (including the number of times the mattress is lifted, the bend overs, and the duration for each lift) was very significant ($p<.001$), with approximately 85% reduction of pressure on the lower back.

Discussion

In the current investigation, it was evident that making the bed using an Instant Tuck™ mat was Compliant with the Maximum Pounds Per Lift Threshold Set by National Institute For Occupational Safety And Health (NIOSH), which was approximately (1,430 lbs.). Another critical finding was the fact that there was a 85% decrease in the back compression forces on the lower back when making a bed using the Instant Tuck™ Mat in comparison to not using it, during a real life situation and considering all aspects of the process, including: the number of times the mattress is partially lifted, the number of times needed to bend over, and the duration needed to tuck the sheet while the mattress is lifted.

Limitations & Recommendations

Additional studies can be done for specific occupations that repeat this process daily. Examples: hotel staff, nursing home staff, and hospital staff.

Conclusion

Based on the findings we can conclude that the BCF's of making a bed in its current form is not in compliance with NIOSH standards and as a result poses risk of injury especially for those who are required to perform this for their occupation, such as hotel housekeepers and hospital, nursing home, and in-home caregivers. In addition, using Instant Tuck™ Mat significantly reduces these BCF's when making a bed by 85% and follows NIOSH standards and therefore makes the tasks of making a bed safe. Based on our findings we recommend the use of the Instant Tuck™ Mat as it has to make the act of making a bed safe and to significantly reduce the risk of injury based on NIOSH standards.

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