Effects of Lumbar Extensor Progressive Resistance Exercise Versus Core Stabilization Exercise on Low Back Strength and Endurance in Soldiers: Preliminary Results of a Randomized Clinical Trial

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“Promoting Readiness Through Research”

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- **IRB Approval** - Brooke Army Medical Center
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- **Registration**:
  - http://clinicaltrials.gov

Background

- The lifetime prevalence of low back pain is up to 80%.¹
- The recurrence rate of individuals with first-time low back pain is high (40-60%).²³
- 10% low back injuries are not resolved within 6 months and account for 80% of all costs related to low back injuries.⁴

Objective

- **Specific Aim**: Assess the effectiveness of a progressive resistance exercise training program to improve lumbar extensor muscle strength and endurance in US Army Soldiers in training to become combat medics.
- **Hypothesis**: A high intensity progressive resistance exercise (HIPRE) for the lumbar extensors will result in a 25% increase in lumbar extensor muscular strength and endurance compared to core stabilization training following the 11-week intervention.

Background

- While many treatment strategies for warfighters with LBP are available, many do not return to the line of duty after onset of LBP.
- LBP is the “Silent Killer” in the military
- Prevention is KEY!
Research Design

- 592 (12 platoons, 3 companies) Army Soldiers from the 232 Medical Battalion
- Fort Sam Houston (AMEDD)
- 2 groups (experimental and control)
- 12 week intervention
- Pre and Post intervention follow-up
- 1 year for recruitment

Inclusion Criteria

- 18-35 years of age
- English Speaking and Reading

Exclusion Criteria

- Diagnoses of condition that would affect their ability to complete interventions
  - Cardiovascular contraindication, orthopedic complaints, systemic inflammatory disease, history of spinal surgery, etc.
- Currently seeking or receiving treatment for LBP
- Currently performing progressive resistance exercise for the lumbar extensors (outside of standard military fitness programs)

Randomization

- Due to military training and living environments individual randomization was unfeasible for risk of treatment contamination.
- Balanced cluster randomization by company was used.
  - Lumbar Extensor HIPRE Training (n=298)
  - Core Stabilization Exercise Training (n=284)

Data Collection

- Baseline and 12 weeks
- Physical performance tests and questionnaires
Baseline Collection
- Subjective and Physical Exam
- Questionnaires
- Height and Weight
- Lumbar Extensor Strength and Endurance Testing
  - Lumbar dynamometer
  - Timed prone plank test
- All participants underwent identical baseline tests prior to randomization

Intervention
- Group 1 (experimental, HIPRE) - High intensity exercise program targeting the lumbar extensor muscles
- Group 2 (Control, CORE) – Core Stability Exercises
  *Interventions are in addition to normal military physical training.

Group 1 (Experimental)
- 1x per week for 11 weeks
- MedX, Welttek Inc, Orlando, FL
- Each session consisted of one set of dynamic, full ROM isolated HIPRE training on dynamometer.
- One warm-up set was completed prior to training set.

Group 2 (Control)
- 1x per week for 11 weeks
- 1 set of 6 repetitions of each exercise within 1 minute with no rest between exercises
- 5 Core Stability Exercises
  - Abdominal drawing-in crunch maneuver
  - Horizontal side support
  - Supine shoulder bridge
  - Quadruped alternating arm and leg
  - Woodchopper
Outcome Measures

- Primary measure evaluated was lumbar extension strength defined as maximum voluntary lumbar extension isometric torque (ft-lb).
- Secondary measures:
  - Dynamic lumbar extension endurance (number of repetitions on dynamometer)
  - Times prone plank test (seconds)
- Outcomes were assessed by raters blinded to group assignment.

Statistical Analysis

- Performed using SAS software, version 9.
- Demographic and baseline variable compared using ANOVA.
- Primary analysis was conducted according to intention to treat principles using a mixed models approach.
- T-tests were performed using exercise compliance as a between group factor (compliance=completion of 11+ sessions)
- Alpha level was a priori set to 0.05 for all analyses.

Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>CORE (n = 284)</th>
<th>HIPRE (n = 298)</th>
<th>TOTAL (n = 582)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous variables:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age (yrs)</td>
<td>21.5 (3.7)</td>
<td>21.8 (3.8)</td>
<td>21.6 (3.6)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.74 (0.09)</td>
<td>1.75 (0.17)</td>
<td>1.75 (0.19)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.4 (11.3)</td>
<td>76.0 (11.5)</td>
<td>75.7 (11.4)</td>
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<tr>
<td>Categorical variables:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sex (F/M)</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>History Low Back Pain (Y/N)</td>
<td>24.3</td>
<td>22.3</td>
<td>23.4</td>
</tr>
</tbody>
</table>

Results - Lumbar Extension Strength

All participants:

- At follow up, adjusted (by baseline) lumbar extension strength was 9.7% greater in HIPRE compared to Core (HIPRE: 310.2 ± 6.1 Nm; Core: 282.7 ± 6.1 Nm, respectively, p = 0.001)
- Significant improvements in lumbar extension strength were observed in both groups (HIPRE 13.3%, Core 3.3%, p < 0.05)

Compliant participants:

- At follow up, lumbar exercise strength HIPRE was 11.9% greater in HIPRE compared to Core (HIPRE 313.9 ± 99 Nm; Core 280.4 ± 92.1 Nm, respectively, p = 0.004)
- Significant improvements in lumbar extension strength were observed in both groups (HIPRE 14.9%, Core 4.4%, p < 0.05)
Results - Lumbar Extension Endurance

**All participants:**
- At follow-up, adjusted (by baseline) lumbar extension endurance was 12.3% greater in HIPRE compared to Core (HIPRE 24.6 ± 1.0 repetitions, Core 21.9 ± 1.0 repetitions, \( p = 0.001 \))
- Significant improvements in lumbar extension endurance were observed in HIPRE (11.4%, \( p < 0.001 \)), but not Core (\( p > 0.05 \)).

Results - Prone Plank

**All participants:**
- At follow-up, no significant between group differences or within group improvements were observed.

Discussion

- HIPRE training results in significantly greater improvement in lumbar extension isometric strength and dynamic endurance compared to core stabilization exercise
- Previous research (Mayer 2002) among civilians had:
  - Nearly identical baseline values
  - 16% improvement was observed in the Mayer study which is similar to the 15% improvement observed in the current study

Discussion

- Ceiling effect may have limited magnitude of improvement (10% instead of hypothesized 25%) due to high baseline endurance/strength
- Unlikely a ceiling effect occurred near the ranges of strength we observed
  - In a previous study (Pollock, 1989), the average pre-training/post-training strength values were 223 and 337 ft-lb, respectively
  - Among compliant Soldiers in our HIPRE group, the average pre-training/post-training strength values were 202 and 232 ft-lb, respectively
- Likely a ceiling effect occurred with the timed prone plank test
  - Consistent with previous literature regarding core muscular endurance in (Mayer, 2013 and George, 2011)

Future Research

- Explore strategies for improving compliance
- Test hypothesis in injury prevention RCT of lumbar extensor HIPRE training to reduce the incidence/severity of low back injury during peacetime and theater of operations
- Explore benefits of HIPRE training in other highly active civilian populations as well (e.g., police, firefighters)
- Test whether effects of lumbar extensor HIPRE training are further enhanced in the most highly actively occupations within the military (i.e. special ops forces)

Conclusion

- Results suggest HIPRE training results in significant improvement in lumbar extension isometric strength and endurance compared to core stabilization exercise
- While the observed lumbar extensor strength and endurance gains were statistically significant, the clinical relevance of these gains is unclear
- Need for future research
Questions

References


Army-Baylor DPT Involvement

- Assist with study related procedures including but not limited to screening and intervention procedures, data collection and management, and other study related duties.
- Assist in carrying out fitness tests as part of baseline and 12 week measurements.
- Assist in delivering interventions to both study groups.