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Does resistance training reduce low back pain?

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ABSTRACT

OBJECTIVE: The objective of this selective EBM review is to determine whether or not resistance training reduces low back pain.

STUDY DESIGN: Review of three English language primary studies published in 2011, 2014, and 2015.

DATA SOURCES: Randomized controlled and clinical trials comparing resistance training (kettlebell training, graded activity, TOTRX, LEXT) to physiotherapy exercise and no exercise intervention, found using PubMed.

OUTCOME MEASURED: Severity of pain in the low-back area, measured using Pain Numerical Rating Scale (NRSpain) and pain visual-analog scale.

RESULTS: Two out of three studies found that resistance training reduced low back pain in comparison to a control group without an exercise intervention. One RCT found that resistance training/graded activity had the same effects of reducing low back pain as physiotherapy exercises.

CONCLUSIONS: The result of the RCT and clinical trials demonstrated that resistance training reduces low back pain in comparison to no intervention. Resistance training compared to other forms of exercise intervention, specifically physiotherapy, is equally as effective in reducing low back pain.

KEY WORDS: Low back pain; back pain; resistance training; resistance exercises; weight training; weighted exercises; weight-baring exercises; strength exercises

INTRODUCTION

Low back pain (LBP) is the second most common cause of disability in US adults overall[1] and the most common cause of disability in patients under 45 years old[2]. Approximately, 70-80% of American adults will experience back pain throughout their life[3]. LBP is extremely common and is treated by a plethora of health care providers. Physicians, physician assistants (PAs), nurse practitioners (NPs), and chiropractors in primary care, orthopedics, and pain management specialties all manage and treat patients with LBP. According to data developed by NCCPA in 2015, there were 23,011 certified PAs in primary care[4] and 17,090 certified PAs in family medicine/general practice.[4] There were 9,071 certified PAs practicing in orthopedic surgery, consisting of 11.2% of all PAs in surgical sub-specialties.[4] According to the CDC's 2014 State and National Summary Tables from a National Ambulatory Medical Care Survey, there were 20,360 office visits with a primary complaint of low back or back symptoms of the 884,707 total office visits.[5] The total cost of LBP care in the US is greater than $100 billion.[6] Expensive imaging (XR, MRI) techniques are also highly utilized to diagnose and manage LBP after failing conservative measures. There are known causes of LBP, including arthritis, spinal stenosis, lumbar sprain/strain, herniated disc, vertebral compression fractures, kyphosis, lordosis, and pregnancy. When the cause is identifiable, the treatment can be targeted to the specific etiology. The methods traditionally used to treat LBP include physical therapy and/or occupational therapy and involves strengthening exercises, proper bending techniques, and electric stimulation. Medications used to treat LBP include NSAIDS, Acetaminophen, muscle relaxers such as Cyclobenzaprine, and federally controlled substances used to treat pain, such as Tylenol #3 and opioids. Procedural techniques used to treat LBP include corticosteroid injections, spinal blocks, and surgery, specifically laminectomies and surgical decompressions.

Back pain may not have a specific etiology, and is classified as unspecified LBP. This is more difficult to treat and more resistant to multiple modalities of treatment. Patients tend to fail multiple treatments or only receive minimal pain relief from their current intervention.

Exercise, specifically resistance training, can help strengthen and build muscle tone in the back and muscles in the surrounding area, specifically, the gluteus, quadriceps, and hamstring muscles. Resistance training involves using a force, specifically weighted modalities, that makes a movement more difficult to perform. Using weighted modalities enhance muscle development and muscular endurance, therefore preventing mechanical injuries and improving pain symptomology in the low back.

OBJECTIVE

The objective of this selective EBM review is to determine whether or not resistance training reduces low back pain.

METHODS

All three studies selected for this review met the following criteria: The population under study included men and women >18 years old with current, non-specific LBP. The inclusion criteria included RCTs or clinical trials after 2002, and participants greater than 18 years old and less than 85 years old.[7,8,9] The exclusion criteria included a medical history of any life threatening diseases, cardiorespiratory illnesses, abnormal ECG screening results, specific LBP due to acute injury (lumbar disc herniation/rupture, fractures), known or suspected spinal pathology (spinal stenosis, tumors, inflammatory rheumatologic disorders, infective diseases), previous back surgery, and pregnancy.[7,8,9]

The interventions used include resistance training involving graded activity, kettlebell training, total body resistance exercises (TOTRX), and lumbar extension resistance exercises

(LEXT). The comparisons used include a control intervention, involving no training implementation, and a physiotherapy exercise group. The outcomes measured determine severity of pain in the low-back area, measured using the Pain Numerical Rating Scale (NRSpain)[7,8] and pain visual-analog scale.[9]

The study performed by Magalhaes MO, Muzi LH, Comachio J, et al.[7] involved an RCT with single-blinding to compare a 6 week intervention of graded activity to physiotherapy exercise. The graded activity group involved treadmill aerobic training and lower limb/trunk strengthening exercises. Exercises were performed using 50% of the participant's maximal load for weeks 1-2, and were increased by 10% in 2 week increments for the total 6 week intervention. The physiotherapy exercise group involved stretching the erector spinae, hamstrings, and triceps surae, strengthening the rectus abdominis, abdominus obliquus internus, and abdominus obliquus externus, and motor control exercises focusing on the TrA and lumbar multifundus muscles, 2 times a week for 6 weeks.

The study performed by Vincent HK, George SZ, Seay AN, et al.[8] involved a clinical trial with randomization and single-blinding to compare TOTRX and LEXT interventions to a control (CON). TOTRX and LEXT involved 1 set of 15 repetitions of the following exercises performed at a resistance load of 60% of the participants' 1 repetition max, 3 times a week. Resistance load was increased by 2% per week to maintain relative muscle effort. Leg press, leg curl, leg extension, chest press, seated row, overhead press, tricep dip, bicep curls, calf press, abdominal curls, and lumbar extensions were the exercises utilized in TOTRX. LEXT involved lumbar extension exercises. CON did not receive an exercise intervention.

The study performed by Jay K, Frisch D, Hansen K, et al.[9] involved a RCT with single-blinding to compare a training intervention to a control intervention. The training group involved a 5-10 minute warm-up of stretching and practicing exercise-specific movements and positions, followed by 10-15 minutes of interval training. The interval training consisted of 10 intervals of various kettlebell swings for 30 seconds with a rest period of 30-60 seconds. As time increased in training, less rest periods were allotted. The kettlebell swing exercises included an un-weighted swing, deadlift, two-handed swing, and a one-handed swing. Women began the training session with a 8-kg kettlebell and men with a 12-kg kettlebell. Participants had the option to increase the weight if they could complete all 10 intervals of the one-handed swing successfully. The control group received the recommendation to continue their usual physical activities. The areas of LBP were defined with a drawing from the Nordic Questionnaire.

The types of studies included are 2 Randomized Controlled Trials with single-blinding and 1 Clinical trial with randomization and single-blinding. The data sources used include three English language primary randomized controlled and clinical trials published in 2011, 2014, and 2015. The studies compared resistance training to physiotherapy exercise and no intervention. All articles were published in peer-reviewed journals and found using PubMed. The articles were selected based on relevance to the topic/question being asked and that the outcomes of the studies mattered to patients (classified as "Patient Oriented Evidence that Matters"). Key words used include low back pain, back pain, resistance training, resistance exercises, weight training, weighted exercises, weight-baring exercises, and strength exercises. Statistics reported and used include change in mean from baseline, difference between groups, one-way ANOVA, two-way ANOVA, p-value, Tukey's post hoc, and F-score.[7,8,9]

Table I – Demographics and characteristics of included studies

Study	Type	# Pt	Age (years)	Inclusion criteria	Exclusion criteria	W/D	Intervention
Magalhaes MO, Muzi LH,	RCT	66	18-65 years old	Patients with chronic, non specific LBP,	Patients who had known or suspected spinal pathology (fractures, tumors, inflammatory	6	Physiotherapy exercise group VS. graded

Comachio J, et al.[7]				between the ages of 18-65 years old, and had a minimum pain score of 3 out of 11 on NRSpain	rheumatologic disorders, nerve root compromise, infectious diseases), scheduled surgery, pregnant women, cardiopulmonary illness, comorbid conditions that would interfere with exercise program		activity group
Vincent HK, George SZ, Seay AN, et al.[8]	Clinical trial	60	60-85 years old	Patients aged 60-85 years old, suffering from LBP for greater than or equal to 6 months, obese, and free of abnormal cardiovascular responses during ECG screening	Patients that were wheelchair bound, prior regular resistance training (3 or more x week within last 6 months), specific low back pain due to acute injury (lumbar disc herniation/rupture), spinal stenosis, back surgery, concurrent use of weight loss medications	11	Total Body Resistance Exercise (TOTRX) VS. Lumbar Extension Resistance Exercise (LEXT)
Jay K, Frisch D, Hansen K, et al.[9]	RCT	40	Mean age = 44	Patients who were willing to participate	Patients who had a medical history of life threatening disease, serious chronic disease, traumatic injury to neck/back, BP >160/100 mmHg	3	Training group (kettlebell interval training) VS. control group

OUTCOMES MEASURED

The primary outcome measured in all three studies was change in low back pain from pre-intervention to post-intervention. Change in pain and grading of pain was measured using either NRSpain[7,8] or the pain visual-analog scale[9]. Each involved an 11-point scale that graded pain from 0 = no pain to 10 = worst possible/imaginable pain. All three studies conducted measurements using standardized methods. Measures were collected pre-intervention and post-intervention.

The study performed by Vincent HK, George SZ, Seay AN, et al.[8] specifically measured level of back pain while performing specific daily movements, including rising from a chair, climbing a set of stairs, and walking on a level surface. The study performed by Magalhaes MO, Muzi LH, Comachio J, et al.[7] measured participants' average pain level over the past week. The study performed by Jay K, Frisch D, Hansen K, et al.[9] measured patients' average neck/shoulder and LBP during the previous month.

RESULTS

Two studies compared resistance-training interventions (TOTRX, LEXT, kettlebell training) to a control, no exercise intervention.[8,9] One study compared resistance training (graded activity) to another form of exercise intervention (physiotherapy).[7] All trials involved adults with unspecified LBP. Individual studies excluded specific spinal pathology as to avoid further injury and additional pathological changes.[7,8,9] Individual studies also excluded patients with comorbid health conditions in order to avert exacerbations, prevent complications, and avoid death.[7,9] Vincent HK, George SZ, Seay AN, et al.[8] also excluded patients with prior exercise conditioning to prevent experience bias when comparing to unconditioned participants.

All patients presented with LBP in various settings such as rehabilitation centers, orthopedic clinics, and aging centers.[7,8] Jay K, Frisch D, Hansen K, et al.[9] recruited participants with LBP from a pharmaceutical company, mainly laboratory technicians. Compliance with intervention was measured based on attendance rate and percentage of exercise training sessions completed. No adverse effects were included in the studies.[7,8,9]

The study performed by Magalhaes MO, Muzi LH, Comachio J, et al.[7] compared a 6-week program of graded activity exercises (n=33) to physiotherapy exercises (n=33). Participants included men and women with chronic, non-specific LBP between the ages of 18-65 years old. All participants had a minimum pain score of 3 on the 11-point NRSpain before the study began. 60 out of the 66 original subjects completed the study for the duration of the intervention. Mean difference in pain intensity from pre-treatment to post-treatment for the physiotherapy exercise group was 4.8, and a 66% improvement in pain intensity. ANOVA was utilized with a $p<0.001$, making the data from pre-treatment to post-treatment statistically significant. Mean difference in pain intensity from pre-treatment to post-treatment for the graded exercise group was 4.7, and a 65% improvement in pain intensity. ANOVA was utilized with a $p<0.001$, making the data from pre-treatment to post-treatment statistically significant. The difference in mean change between the two groups was 0.1, utilizing t-test with a $p=0.872$, making the data statistically insignificant. The F-score was 0.26, which means that the treatment effect between the two groups was small. Therefore, the graded activity group versus the physiotherapy group had similar treatment effects. One intervention was not significantly superior to the other; both exercise interventions reduced pain at similar rates. There was no control group, and therefore the treatment effect of exercise therapy overall could not be determined.

Table 2: Mean NRSpain score at pre-treatment and post-treatment by treatment group[7]

	Pre-Treatment	Post-Treatment	
Physiotherapy	7.6 (SD=1.7)	2.6 (SD=1.6)	p<0.001
Graded Activity	7.2 (SD=2.1)	2.4 (SD=1.8)	p<0.001

Table 3: Effect of intragroup difference and between group difference in group mean[7]

Effect of Intragroup Difference		Effects of Group Differences			
Physiotherapy	Graded Activity	Diff between groups mean	Difference between groups CI (95%)	F-score	P-value
4.8 (SD=2.9)	4.7 (SD=2.3)	0.1	-1.1-1.4	0.26	0.872

The study performed by Vincent HK, George SZ, Seay AN, et al.[8] compared a 4-month program of TOTRX (n=22) and LEXT (n=20) to a control, non-exercise group (n=18). Participants included men and women 60-85 years of age, suffering from LBP for greater than 6 months without an acute back injury. All participants had a mean pain score from 4.3-5.2 on the 11-point NRSpain scale before the study began. 49 out of the 60 original subjects completed the study for the duration of the intervention. 5 participants dropped out due to worsening back pain.

LEXT mean percent change in pain severity, using NRSpain, from baseline to month 4 of intervention during a chair rise was 3.7%, during a stair climb was -14.7%, and during walking was -60.5%. TOTRX mean percent change value in pain severity from baseline to month 4 of intervention during a chair rise was -49.8%, during a stair climb was -25.4%, and during walking was -6.4%. Control group mean percent change value in pain severity from baseline to month 4 of intervention during a chair rise was 3.7%, during a stair climb was -19.7%, and during walking was -6.4%. Utilizing ANOVA, the between group percent change value for a chair rise had a p=0.038, making the data statistically significant. The between group percent change value for a stair climb had a p=0.955, making the data statistically insignificant. The between group percent change value for walking had a p=0.033, making the data statistically significant. There was a significant difference in percent change of pain severity for a chair rise and walking from baseline to conclusion between the groups. Therefore, exercise intervention overall reduced LBP during these specific movements. There was a significant decrease in pain with a chair rise in the TOTRX intervention, compared to the other two interventions. There was a significant decrease in pain with walking in both the TOTRX and LEXT intervention, compared to the control intervention. There was not a significant difference in percent change for a stair climb, signifying that the exercise interventions were as effective as no intervention for the specific movement.

Table 4: Pain severity mean ratings during specific movements within groups[8]

	LEXT	TOTRX	Control
Chair rise			
Baseline	0.7 (SD=1.3)	1.2 (SD=1.3)	1.4 (SD=2.1)
Month 4	0.9 (SD=1.6)	0.3 (SD=0.7)	1.3 (SD=2.4)
% change	0.3 (SD=40.0)	-49.8 (SD=56.7)	3.7 (SD=88.0)
Stair climb			
Baseline	1.9 (SD=2.5)	1.1 (SD=1.3)	2.3 (SD=3.1)
Month 4	1.7 (SD=2.4)	0.4 (SD=0.7)	1.4 (SD=2.5)
% change	-14.7 (SD=66.2)	-25.4 (SD=62.9)	-19.7 (SD=54.3)
Walking			

Baseline	3.2 (SD=2.4)	2.2 (SD=2.1)	3.0 (SD=2.5)
Month 4	1.1 (SD=2.4)	0.7 (SD=1.6)	2.6 (SD=2.9)
% change	-60.5 (SD=63.1)	-42.0 (SD=87.6)	-6.4 (SD=69.8)

The study performed by Jay K, Frisch D, Hansen K, et al.[9] compared an 8-week program of kettlebell resistance training (n=20) to a control, non-exercise group (n=20). Participants included men and women from occupations with a prevalence of reported musculoskeletal pain symptoms, specifically and largely, laboratory technicians in a pharmaceutical company. A defined level of musculoskeletal pain was not required for inclusion in the study. 38 out of the 40 original subjects completed the study for the duration of intervention. 1 participant dropped out of the study due to severe neck pain. Participants that dropped out of the study were included in intention-to-treat analysis. The mean difference in pain, using the pain visual-analog scale, from baseline to follow-up in the kettlebell training group was -1.6 with a 95% CI of -2.5-(-0.6). The mean difference in pain from baseline to follow-up in the control group was -0.2 with a 95% CI of -1.2-0.7. The mean difference in pain between the two groups was -1.4 with a 95% CI of -2.7-(-0.02). Utilizing ANOVA with a p=0.05, the data was statistically significant. There was a significant difference in pain intensity between the groups, with a larger mean difference in pain severity from baseline to follow up for the kettlebell training group.

DISCUSSION

As validated by the results above, the research presented in this review suggests that resistance training can reduce LBP intensity compared to no exercise intervention. However, resistance training did not outperform other types of exercise intervention. The review signifies the importance of exercise training to treat unspecified LBP. Given these findings, recommendations should be made in primary care, orthopedics, and pain management to implement exercise interventions. Physicians, PAs, and NPs can recommend and prescribe supervised and instructed interventions by physical therapists and personal trainers. According to the IRS Publication 502 Medical and Dental Expenses Report, physical therapy, and other forms of exercise therapy, can be included in medical expenses as long as therapy is for the purpose of medical treatment.[10] Health club dues and exercise lessons cannot be included in medical expenses if to improve one's general health or physical discomfort not related to a medical condition.[10] A health care provider can write a prescription for physical therapy, personal training, gym memberships, and exercise programs, for medical treatment classified under a specific diagnosis. Patients can also implement exercise interventions at their own discretion and expense under the recommendation of their health care provider. Instructors and resources, if independently participating in exercise interventions, are widely available within the US.

Limitations of the selected studies may have influenced the results of the studies. The study performed by Magalhaes MO, Muzi LH, Comachio J, et al.[7] lacked a control group. A control group would be beneficial to determine if the treatment effect of exercise intervention overall would reduce LBP significantly more than no exercise. The study performed by Vincent HK, George SZ, Seay AN, et al.[8] had limitations regarding participant ethnicity, as the participants were largely Caucasian. Similar results may not apply to participants of varying ethnicities. Additionally, LBP severity was not controlled at enrollment. The study performed by Jay K, Frisch D, Hansen K, et al.[9] only included participants from a pharmaceutical company, therefore skewing applicability to the general population. Single-blinding was also utilized in all studies[7,8,9]; participant blinding was absent although inherently difficult given the type of intervention. All studies had a small sample size (n=66)[7] (n=60)[8] (n=40)[9], therefore decreasing the ability to detect small differences between groups. Additionally, a small sample size does not accurately represent the general public. Although participants dropped out of Magalhaes MO, Muzi LH, Comachio J, et al.[7] and Vincent HK, George SZ, Seay AN, et al.[8] studies, an intention to treat analysis and "worst-case" analysis were not completed. Completing these analyses would better determine if LBP increased during the study and therefore influence the results. Magalhaes MO, Muzi LH, Comachio J, et al.[7] and Jay K, Frisch D, Hansen K, et al.[9] both had a short duration of exercise intervention, involving 6-8 weeks of training, compared to Vincent HK, George SZ, Seay AN, et al.[8], involving 4 months of training. Additional studies need to be performed to determine the duration of exercise intervention that yields the largest reduction in LBP intensity.

CONCLUSION

Resistance training reduces LBP intensity in comparison to no exercise intervention. Compared to other exercise modalities, resistance training yields similar reductions in LBP. Current research has illustrated the promising nature of resistance training in reducing LBP. Before routine use is implemented, further research must be conducted. The duration of intervention that yields the greatest reduction in LBP must be determined before prescribing to patients. As resistance training yields similar results to other exercise modalities, characteristics must be determined that infer resistance training is superior to other modalities. Determining if resistance training yields less harm and fewer injuries compared to other exercise interventions would increase desirability to prescribe resistance training over other modalities. Studies must also be conducted to determine if exercise intervention should be used as an adjunct to other medical therapies (anti-inflammatories, muscle relaxers) or used as mono-therapy for LBP. LBP will affect 70-80% of American adults throughout their life[3] and will commonly arise as a chief complaint in primary care, orthopedics, and pain management. With further research, resistance training can be the gold standard, non-pharmacologic intervention that physicians, PAs, and NPs recommend and prescribe to patients to improve LBP.

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