Bachelor's thesis

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The Effect of Resistance Training in Treatment and Rehabilitation of Chronic Low Back Pain

Bachelor`s Thesis in Human Movement Science
BEV2900 - Spring 2020

May 2021

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Abstract

Introduction: Low back pain is a problem affecting millions of people worldwide. It is a costly issue, leading to sick leave and disability in both men and women of all ages. This study looks at the relationship between resistance training and the effect a training program has on perceived pain in the lower back. **Methods:** On the 22. of February 2021 a literature search was done on PubMed using terms found in form a PICO form and MeSH-terms. The search came up with 229 studies, theses were then condensed down into 9 studies based on different inclusion and exclusion criteria. The studies were then assessed using the PEDro scale for quality assurance. **Results:** In total out of 14 resistance exercise groups all had a statistically significant reduction in perceived pain compared to the control, except two. **Conclusion:** The result from this study shows that RT can reduce perceived pain for people suffering from CLBP, when the training load is sufficiently high. Factors like intensity, periodisation and frequency may affect the extent of pain reduction. The long-time effect is not clear and needs more research.

Abstrakt

Introduksjon: Korsryggsmerter er et problem som påvirker millioner av mennesker over hele verden. Det er et kostbart problem som leder til sykefravær og funksjonshemming i både menn og kvinner i alle aldre. Denne studien ser på forholdet mellom styrketrening og effekten det har på oppfattet smerte i korsryggen. **Metode:** Datoen 22. Februar 2021 ble det gjort et litteratursøk på PubMed ved bruk av søkeord funnet ved hjelp av et PICO-skjema og MeSH synonymer. Søket ga 229 studier som var videre kondensert ned til 9 studier basert på inklusjon og eksklusjons kriterier. Studiene var så vurdert ved hjelp av PEDro skalaen for kvalitetssikring. **Resultat:** Av 14 styrketreningsgrupper fant alle en statistikks signifikant reduksjon i oppfattet smerte i forhold til kontrollen, utenom to. **Konklusjon:** Resultatet fra denne studien viser at styrketrening kan redusere oppfattet smerte for folk som lider av kroniske korsryggsmerter, om treningsbelastningen er høy nok. Faktorer som intensitet, periodisering og frekvens kan spille en rolle for grad av smertereduksjon. Langtidseffekten av forholdet er ikke klar, og behøver mer forskning.

Introduction

Low back pain (LBP) is a problem affecting millions of people each day. According to the global burden of disease study (1) LBP is common in countries worldwide and is one of the top 10 leading causes of disability adjusted life years for all ages. The problem seems to affect both men and women relatively similarly (2). Half the population will have experienced back pain in the last year and approximately 40-50 percent will have experienced back pain during the last month (2). 15-20 percent will experience that the back pain is giving them a hard time, and most people report that pain is occurring at varying times to varying degrees (2). According to the Norwegian health department back pain is the condition that affects people the most, and at the same time costs society the most money (2). Back pain was also found to be the cause of 13 percent of all sick leave lasting longer than eight weeks (2). In summation, back pain is a burden for society and is affecting a lot of people individually in a negative way.

LPB is defined as pain, muscle tension, or stiffness around the lumbar part of the vertebral column and can be presented with or without sciatic pain. Most cases of LBP (Around 90%) are defined as non-specific without any clear cause. When the pain has sustained longer than three months, it meets the criteria for chronic low back pain (CLBP) (2). The aetiology of CLBP is shown to be multifactorial. CLBP and can be viewed with the biopsychosocial framework (3). The biopsychosocial model takes into consideration the pathoanatomical, physical, neurophysiological, psychological, and social factors that can contribute to the development of CLBP. It is proposed that people suffering from CLBP can have a maladaptive movement and impaired control, giving a reduced dynamic spinal stability and loading of the lumbar spine (3). Some research shows that people suffering from CLBP can have weaker abdominal and back extensors and can benefit from strengthening (4 p. 605, 5).

Resistance training (RT) is an exertion of force against a load in different training exercises and can be used to develop strength, hypertrophy, power, and endurance for muscles (4 p. 589). The cause-and-effect relationship between RT and LBP is not clear, but RT of these muscles has been shown to have a positive effect on LBP (4). This gives RT the potential to reduce pain in the lower back for people suffering from CLBP. This study will investigate the effect of RT on people with CLBP. In specific, does RT affect perceived pain for adults diagnosed with CLBP?

Method

The literature search started with filling out a PICO-form to decide search terms. The PICO-format is a systematically structured format that aid in retrieving relevant clinical trials to the literature search (6). When filling out the PICO-form, MeSH-terms was used to find synonyms for different search terms. The terms used are displayed in table 1.

Table 1: PICO-form filled out with MeSH terms.

Population, type of patient/what is the problem.	Intervention, intervention/ exposure group	Control, search term for the control group	Outcome, search term for the outcome
Adults OR adult/ Back pain, Low back pain, Lumbar pain, Chronic lower back pain, Non-specific lower back pain,	Resistance training Resistance exercise Strength training Weight training	RCT, randomized control trial, randomized controlled trial, controlled trial, cohort, case-control, Control group.	reduce lower back pain, decrease lower back pain, minimize lower back pain, prevent lower back pain (reduce or decrease or minimize or prevent)

The literature search for this paper was done on the 22. February 2021on the PubMed database. The search terms used was (“low back pain” or “lumbar pain” or “lumbar spine pain” or “nonspecific low back pain” or “chronic low back pain”) AND (“resistance training” or “strength training” or “weight training” or “resistance exercise”) AND (“ct” or “randomized control trial” or “randomized controlled trial” or “controlled trial” or “cohort” or “case-control”) AND (“reduce” or “decrease” or “minimize” or “prevent”) established from the PICO-form.

Inclusion and exclusion criteria

The inclusion and exclusion criteria for the studies are displayed in table 2. Using the criteria all studies from the final search were reviewed independently by us, and we came together and formed a consensus on which studies to exclude, and which studies met the inclusion criteria.

Table 2: Inclusion and exclusion criteria

Inclusion criteria:
- Used a visual analogue scale (VAS) to measure pain - The study measured LBP - Includes persons with chronic LBP
Exclusion criteria:
- If it was not a randomized controlled study - If the controlled group had an RT intervention - The participants in the study were under the age of 18 - The article was from earlier than 2000 - The study did not have LBP as an outcome measure - The control was too similar to the intervention - Was not published in a peer-reviewed journal

Quality control

To assess the quality of the individual studies the PEDro (7) was used to rate the studies on a scale of one to ten. Higher scores indicate superior methodological quality.

Results

The search on PubMed resulted in 229 articles. An RCT filter was applied, and a filter removing all studies form before the year 2000 to limit the search down to the latest studies. This gave 96 studies, 35 studies were then selected from the search results based on the abstract and title. Nine studies met the inclusion criteria and were picked out to be included in this study. Figure 1 displays search results and article exclusions.

Table 3 displays a description of all the studies included in this review. Nine studies were included and consist of a total of 873 people suffering from CLBP, with males and females aged 18- 75. All participants were either in a resistance exercise group, traditional treatment of CLBP or no treatment at all. The intervention period varied from 8 – 20 weeks Table 4 displays reported average pain intensity (VAS) (0-10cm or 0-100mm) before and after the intervention or the difference between before and after intervention and the respective study's conclusion. Table 5 shows the PEDro score for each included study, and the criteria they scored on.

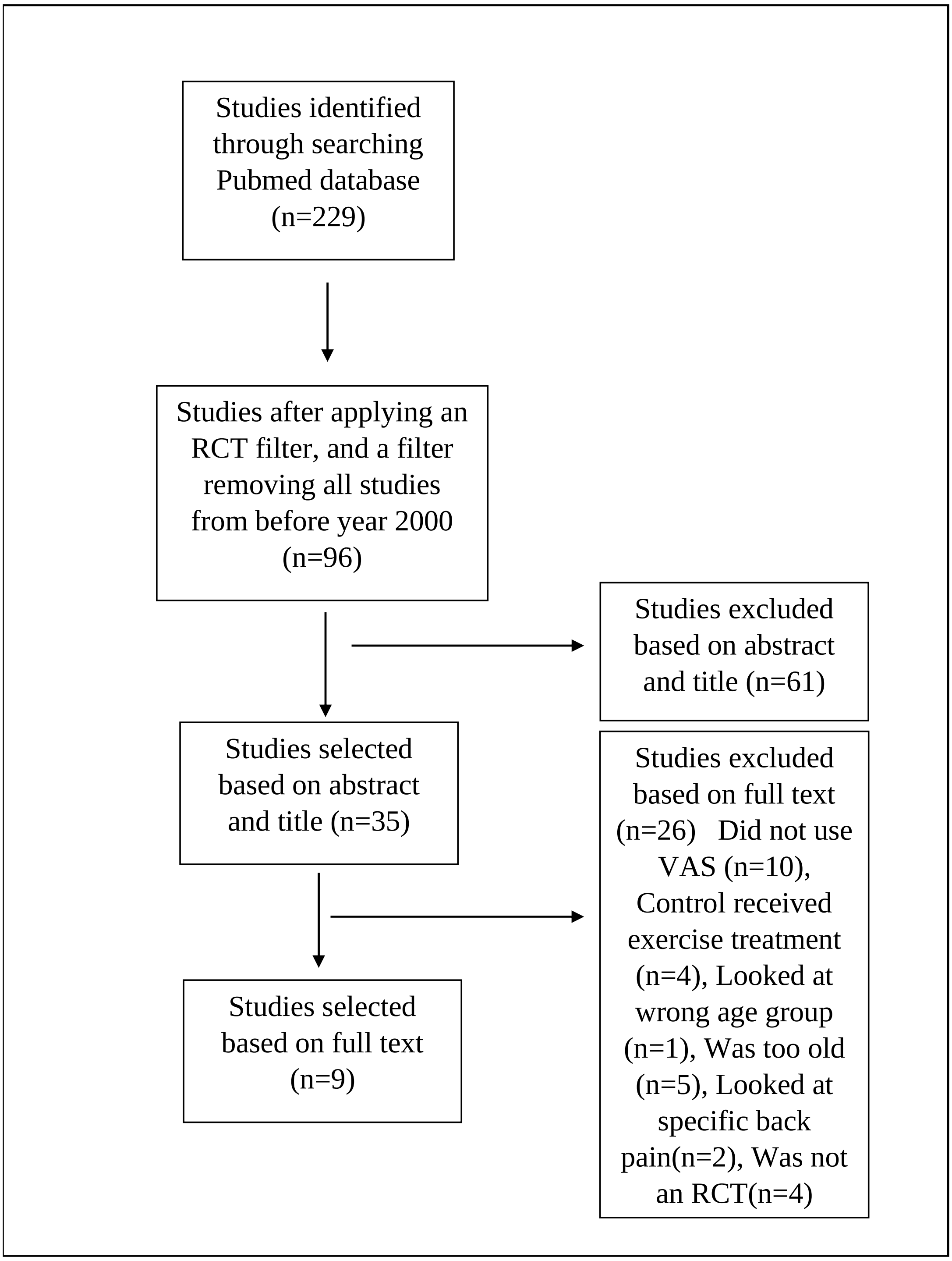

Figure 1: Flow diagram from the search strategy

Table 3. Displays a description of all the studies included in this review.

Study	Population	Sex Age (mean ± SD)/ (age-range)	Description of Intervention and Control	Intervention period
Kell RT, Asmundson GJ. (2009) (8)	Total=27 RT (n=9), Aerobic training (n=9), Control (n=9)	Male and female Resistance intervention (40.1 ± 8.7 years) Aerobic intervention (36.7 ± 8.9) Control (35.3 ± 7.3)	*Resistance intervention*: RT for the upper and lower body using free weights, machines and bodyweight. Three sessions pr week, intensity 53-72% 1RM, with a 3-minute phase in between set *Aerobic intervention*: Multiple sessions of aerobic training on a Borg scale range of 8-12, (three times pr week 20-35 min) *Control*: Not specified	18 weeks, with 2 weeks orientation, 16 weeks of exercise training and testing. VAS was measured at baseline, week 8 and week 16
Henchoz Y, et al. (2010) (9)	Total=105 Intervention (n=56) Control (n=49)	Male and female Aged 18-60	*Intervention*: Group submaximal training sessions (90 min) overseen by a therapist after normal Functional, 24 times over a 12-week period. Dynamic resistance exercise was performed on a 15 rep 2 set basis, on participant level after Multidisciplinary Rehabilitation *Control:* routine follow up after the Functional Multidisciplinary Rehabilitation	12 weeks, VAS was measured at baseline, after intervention and at a one year follow up
Jackson JK, et al. (2011) (10)	Total=45 Middle-age group (n=15) Old-age group (n=15) Control group (n=15)	Males Middle-age group= 52±2.7 Older-aged group=63±3.1 Control=57±7.7	*Intervention*: Instruction on periodized RT, permitted to do at any fitness facility, four sessions pr week with progressive overload, the intensity was between 50 and 83% of 1RM *Control:* Tok part in the familiarization period, then they were instructed to stop all resistance exercise, regular recreational activity was permitted	16 weeks, 3 weeks of familiarization, VAS was measured at baseline, week 8 and week 12
Kell RT, et al. (2011) (11)	Total=240 Intervention 2 days a week (n=60) Intervention 3 days a week (n=60) Intervention 4 days a week (n=60) Control (n=60)	Male and female Aged 18-50	*Intervention*: Periodized RT two, three or four times a week, intensity, rest time and exercise selection was the same in all groups, program was similar to Kell RT, Asmundson GJ. *Control*: No training	16 weeks, 3 weeks of familiarization, VAS was measured at baseline, week 4 week 8 and week 12

Table 3 continued

Smith D, et al. (2011) (12)	Total=46 Stabilisation group (n=16) Non stabilisation group (n=17) Control (n=13)	Sex not specified Age 42,93 ± 10,8	*Stabilisation intervention*: Dynamic variable resistance exercise on the lumbar extension machine once a week using pelvic stabilisation, one-session pr week, 8-12 reps with a 5% increase in weight when 12 was completed. *Non-stabilisation intervention*: Dynamic variable resistance exercise on the lumbar extension machine once a week not using pelvic stabilisation, one-session pr week, 8-12 reps with a 5% increase in weight when 12 was completed. *Control*: Continued normal course of LBP treatment	12 weeks, VAS was measured at baseline and after intervention
Bruce-Low S, et al. (2012) (13)	Total=75 Intervention once a week (n=31) Intervention twice a week (n=20) Control (n=21) Lost to relocation (n=3)	Male and female Age= 45.5 ± 14.1 years	*Intervention:* Lumbar extension training program once or twice a week and their normal treatment of CNLBP. Both groups did training sessions involving 8-12 repetitions of 80% of the maximum voluntary isometric torque, on a lumbar extension machine to volitional failure. The twice a week group also completed a training session with 50% of maximum voluntary isometric torque *Control*: Continued their normal treatment of CNLBP	12 weeks, VAS was measured at baseline and after intervention
Haufe S, et al. (2017) (14)	Total=226 Exercise group (n=112) Control group (n=114)	Male and female Aged 18-67	*Intervention*: Unsupervised exercise sessions for 20 minutes three times per week. The sessions were planned by a physiotherapist. Training sessions were individual, with exercises for muscles in the trunk, particularly the lower back. *Control*: Was put on a waiting list	20 weeks, VAS was measured at baseline and after intervention
Cortell-Tormo, et al. (2018) (15)	Total=24 Exercise group (n=12) Control group (n=12)	Female Aged 20-55 No history of former exercise training	*Intervention*: Functional RT, 24 sessions in groups of 3-5. On a pre determent load using the OMNI resistance exercise scale, readjusted for strength progression to maintain intensity. *Control*: Continued daily activities	12 weeks, VAS was measured at baseline and after intervention
Calatayund J, et al. (2020) (16)	Total=85 Intervention group (n=42) Control (n=43)	Sex not specified Age 18-75	*Intervention*: Group training sessions, following a progressive strength training program. The program had a focus on increasing core muscle strength. Three times a week, dynamic resistance exercise performed in a circuit manner. Intensity started at 20-RM and was set to progress every two weeks, down to 10-RM (20-RM,15-RM, 12-RM and 10-RM) *Control*: Received the usual care (back-school)	8 weeks, VAS was measured at baseline and after intervention

VAS = Visual Analog Scale= 10 cm long scale reported eighter as 0-10cm or 0-100mm, SD= standard deviation 1 RM = 1 rep max

Table 4. Displays reported average pain intensity (VAS) (0-10cm or 0-100mm) before and after the intervention, the difference between before and after intervention and the respective study's conclusion.

Study	Baseline VAS (0-10)/ (0-100), mean ± SD	VAS after intervention (0-10)/ (0-100), mean ± SD	Difference, mean ± SD	Conclusion
Kell RT, Asmundson GJ. (8)	Resistance intervention: 5.4± 0.9 Aerobic intervention: 5.1± 0.8 Control: 4.9± 0.6	Resistance intervention: 3.3± 0.5 Aerobic intervention: 4.8± 0.8 Control: 4.8± 0.7	Intervention: Not reported Control: Not reported	The Resistance intervention group showed significant improvement in VAS (p≤0.05) From baseline to week 8 and to week 16. The aerobic intervention group did not show significant improvement. Periodized RT can be a safe and effective form of rehabilitation for those with CLBP.
Henchoz Y, et al. (9)	Intervention: 53.24±18.27 Control: 51.56±21.54	Intervention: 37.45±21.73 Control: 35.93±23.67	Intervention: Not reported Control: Not reported	The two groups had significant improvement in VAS. No statistical difference in VAS was found between the two groups. A 12-week exercise program did not reduce LBP at a one-year follow-up.
Jackson JK, et al. (10)	Intervention middle-aged group:4.3±0.9 Intervention older-aged group:4.5±0.8 Control:4.2±0.6	Intervention middle-aged group: 3.2±0.9 Intervention older-aged group: 3.3± 0.7 Control: 4.5±0.8	Intervention middle-aged group: Not reported Intervention older-aged group: Control: Not reported	Both intervention groups showed a statistically significant reduction in VAS (p≤0.05). Traditional periodized training may be useful in reducing CLBP.
Kell RT, et al. (11)	Intervention 4xweek: 6.05±0.90 Intervention 3xweek: 5.80±1.00 Intervention 2xweek: 5.79±0.88 Control: 5.83±0.60	Intervention 4xweek: 4.35±0.95 Intervention 3xweek: 4.77±1.00 Intervention 2xweek: 4.96±1.03 Control:5.70±0.86	Intervention 4xweek: Not reported Intervention 3xweek: Not reported Intervention 2xweek: Not reported Control: Not reported	All training volumes had a significant reduction in pain, the most effective intervention group was the 4xweek group. Weight training strengthening the musculoskeletal system will reduce back pain
Smith D, et al. (12)	Intervention with stabilisation: 30.40±17.20 Intervention without stabilisation: 28.70±17.39 Control: 26.80±9.00	Intervention with stabilisation:13.40±10.80 Intervention without stabilisation: 28.07±21.82 Control: 26.50±10.20	Intervention: Not reported Control: Not reported	The intervention group with stabilisation showed a statistically significant reduction in VAS (p≤0.05), the other groups did not show statistical changes in VAS. To reduce back pain the lumbar extension exercises need to include pelvic stabilisation.

Table 4 continued

Bruce-Low S, et al. (13)	Intervention 1xweek: Not reported Intervention 2xweek: Not reported Control: Not reported	Intervention 1xweek: Not reported Intervention 2xweek: Not reported Control: Not reported	Intervention 1xweek: -16.4±14.6 Intervention 2xweek: 21.16±16.4 Control: 0.04±4.5	The study showed significant ($p \leq 0.05$) improvements in VAS for both training groups and no improvements in the control. However, there were no statistical difference between the two training groups. In rehabilitation of workers suffering from LBP, RT of the lumbar muscles decrease pain.
Haufe S, et al. (14)	Intervention: Not reported Control: Not reported	Intervention: Not reported Control: Not reported	Intervention: -0.9± 2.26 Control: -0.17±1.84	The training group did reduce LBP more than the control with statistical relevance. A 20 week non supervised exercise program improved LBP in middle-aged men
Cortell-Tormo, et al. (15)	Intervention: 4±1.8 Control: 4.5±1.6	Intervention:1.5± 1.5 Control: 4.4±1.4	Intervention: Not reported Control: Not reported	The study showed that periodized functional RT significantly decreased pain and disability in females with CLBP.
Calatayund J, et al. (16)	Intervention: 6.2±2 Control: 6.3±2	Intervention: 4.3±2 Control: 5.1±3	Intervention: Not reported Control: Not reported	Showed significantly greater odds for reducing LBP in the intervention group

VAS = Visual Analog Scale= 10 cm long scale reported eighter as 0-10cm or 0-100m, SD= standard deviation, CLBP= Chronic lower back pain, LBP= lower back pain

Table 5. Displays the studies included what PEDro criteria they meet and their total PEDro score.

Study	Kell RT, Asmundson GJ. (8)	Henchoz Y, et al. (9)	Jackson JK, et al. (10)	Smith D, et al. (12)	Kell RT, et al. (11)	Bruce-Low S, et al. (13)	Haufe S, et al. (14)	Cortell-Tormo, et al. (15)	Calatayund J, et al. (16)
Eligibility criteria	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Random allocation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Concealed allocation	No	Yes	No	No	No	No	No	No	Yes
Baseline comparability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Blind subjects	No	No	No	No	No	No	No	No	No
Blind therapists	No	No	No	No	No	No	No	No	No
Blind assessors	No	No	No	No	No	No	Yes	No	No
Adequate follow-up	No	No	Yes	Yes	Yes	Yes	No	No	No
Intention to treat analysis	No	Yes	Yes	Yes	No	No	Yes	No	Yes
Between group comparisons	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Point estimates and variability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total PEDro score	**4**	**6**	**6**	**6**	**5**	**5**	**6**	**3**	**5**

Findings

Only one study (15) was found to be considered poor, according to the PEDro quality assurance. Cortell Tormo et, al. (15) found that periodized functional RT did indeed significantly decrease CLBP and disability in females compared to a controlled group.

Four studies (8, 11, 13, 16) were found to belong in the category fair scoring 4 or 5. Kell RT, Asmundson GJ. (8) found in their study that the RT group had a significant improvement in LBP at week 8 and 16, the study also found that the aerobically trained group did not improve LBP and concluded that periodized RT can be used to treat LBP. Kell RT et, al. (11) also, found a statistically significant improvement in VAS, in all three training groups showing that periodized RT did reduce LBP and was the most effective at four times a week. The study concluded that weight training did strengthen the musculoskeletal system and thereby reduce back pain. Bruce Low et, al. (13) found significant improvements in VAS in both groups one training one time a week and the other training two times a week. However, the study did not find a significant difference between the two training groups. This study also concludes that RT of the lumbar muscles can be used to reduce LBP. Calatayud J, et al. (16) did not find a significant difference between the groups, however the study concludes that the training group showed reduced odds for reoccurrence of LBP.

Four studies (9, 10, 12, 14) were considered good using the PEDro scoring system. Henchoz Y, et al. (9) found in their study no statistical difference in VAS between the two groups. A 12-week exercise program did not reduce LBP at a one-year follow-up compared to the control group. Jackson JK, et al. (10) showed both intervention groups had a statistically significant reduction in VAS ($p \leq 0.05$). The study showed that traditional periodized training may be useful in reducing CLBP. Smith D, et al. (12) showed a difference in VAS only in the intervention group that had pelvic stabilisation in the dynamic variable resistance exercise. No statistically significant difference in VAS was found in the training group that did not have stabilisation. Lastly, Hafue S, et al. (14) found that regular exercise might help LBP and be a part of reducing sickness absence from work, but more research is need on the subject.

Discussion

Al studies included in this review showed a significant relationship between some form of resistance exercise and a reduction of perceived LBP or VAS, except for two. Henchoz Y,et al (9) did not show any difference in LBP after a one-year follow-up compared to the control group. The control group did receive a "routine follow-up treatment" of LBP. Henchoz Y, et al (9) indicates that an additional exercise routine is not necessary for treatment of LBP when other types of treatment are in place but can be beneficial for reducing disability and improve isometric trunk muscle endurance. Calatayund J,et al. (16) did also not see any significant difference in VAS between the two groups.

Two of the studies Bruce-Low S, et al. (13) and Kell RT, et al. (11) also looked at the influence of training periodization showing slightly different results, Kell RT, et al. (11) having a larger sample size and three intervention groups instead of two tested for a higher frequency. Kell RT, et al. (11) found that the highest frequency was the best for LBP, whereas the Bruce-Low S, et al. (13) did not find any difference in frequency. Kell RT, Asmundson GJ, (8) also compared the resistance intervention with an aerobic intervention as well, favouring the resistance group. Jackson JK, et al. (10) also had more than one intervention group, having two groups divided by age, one older and one middle-aged group. Both groups showed a statistically significant reduction in VAS compared to the control. Hafue S, et al. (14) and Cortell-Tormo, et al. (15) found a statistically significant reduction in VAS, Hafue S, et al. (14) being one of the two studies (along with Bruce-Low S, et al. (13) who only reported the differential in VAS. Hafue S, et al. (14) and all others reported their results in VAS pre and post intervention. Lastly, Smith D, t al. (12) also looked at the difference between an intervention with and without pelvic stabilisation. Finding that pelvic stabilisation was necessary for improving LBP.

The studies included in this study have a broad population that includes males and females from the age 18-75. When comparing the studies, it is important to take into assumption that the difference inn population can affect the result of the intervention. Cortell-Tormo, et al. (15) looked at females aged 20-55 with no history of former exercise training. Jackson JK, et al. (10) looked at males aged 45 and older which were recreationally active and moderately trained. Although the study population is different, the studies included in this study indicates a positive effect of resistance training independent of age and history of exercise. A study by Häkkinen, K. et al. (1998) showed that RT gave the same effect on both middle-aged and elderly men and women (17). Both the middle-age and elderly group showed and increased strength in isometric and dynamic strength. Jackson JK et al. did in their study also find that there was no difference in the outcome between middle-aged people and elderly-people on VAS, this study also looks at recreationally active males, indicating that trained individuals may also benefit for RT. Based on Häkkinen, K. et al (17), one can assume that the difference in sex and age does not confound the results from this study if the difference in VAS is because of a strengthening mechanism after RT.

In this study, there are some variations in the type of resistance exercise intervention. Al studies had a program consisting of exercises that did include strengthening the muscles in the lower back. Since there are also studies that had more than one exercise intervention group there are in total 14 different RT groups in total with varying intervention, age range, exercise frequency and total volume. Most studies did however have a reduction in VAS indicating that the most important factor for the relationship between RT and LBP is that RT is being done.

Regarding frequency and volume, two studies have RT groups with different frequencies. Kell RT. et al. 2011 (11) had RT groups that train two, three and four times a week. The study showed that training four times a week gave the best result in reducing pain and disability compared to two times a week. While Bruce-Low et al. (13) did not find any difference with training one or two times a week. This indicates that it is not clear if frequency of RT affect reduction in CLBP but may have an effect if the frequency is high enough.

It is widely accepted that high intensity RT improves maximal muscle strength and is defined at intensity over 70% of 1 repetition maximum (4 p. 597). The included studies that had an intensity surpassing 70% 1RM in the intervention program were Kell RT. et al. 2009 (8), Kell RT. et al. 2011 (11), Jackson JK et al. (10), and Bruce-Low et al. (13) In all these studies the RT group showed a significant reduction compared to the control groups. This indicates that improvements in maximal muscle strength can be effective to reduce CLBP.

Out of all the resistance intervention groups, two out of 14 did not register a significant reduction in VAS compared to the control. One of which was the no stabilisation group in the Smith D, et al. (12) study. The study manages to produce a reduction in VAS in the stabilisation group with a small amount of exercise, making the required amount of exercise for improvement in VAS seam easily applicable to most lifestyles. The no-stabilisation group will possibly have a more global movement performing the exercise. This will allow more hip mobility letting the glutes be involved in the movement making the extensor muscles in the lower back work more isometric. Stabilization of the pelvic will possibly isolate the extensor muscles in the lower back, giving the extensor muscles a higher training load compared to the no-stabilisation group, explaining the difference in results.

The other intervention group without significant reduction in VAS compared to the control was the 12-week exercise group in the Henchoz et al. (9) study. Henchoz et al. compares functional multidisciplinary rehabilitation and an additional strength training program designed to maintain the improvements from the rehabilitation, with only the functional multidisciplinary rehabilitation. The study finds that both groups does have a reduction in VAS, without significant difference between the two. Several factors may explain why the exercise group did not improve more than the control. The first one being that booth groups did attend a rehabilitation program that also did involve exercise for muscle strengthening. This may mean that the adaptions that would have happened from the exercise program already happened in the rehabilitation, and training needs to occur on a higher exercise level for further improvements. This is especially true when the training was based on maintaining improvements, and not improving further. This study also measures the VAS at a one-year follow-up time, thereby one must discuss the possibility that the benefits of the resistance exercise might have been there in the short term but may have disappeared over time. The present study indicate that RT does help reduce CLBP, but considering Henchoz, et al. one year follow up time it does seem that the reduction in pain only occurs when training is done on a regular basis. This was the only study that had a follow-up of their participants after the conclusion of the study intervention.

Little research has been done on the long-term effect of resistance training and LBP, making the relation hard to discuss. Some studies have found a relationship between healthy lifestyle behaviour and a reduced risk of developing chronic LBP(18). Training may be part of a larger treatment involving change in lifestyle. On the other hand, other studies have found that moderate exercise were not associated with chronic widespread pain at an 11-year follow-up (19). More research is needed about resistance training and CLBP and the long-term effect.

In this study, one of the inclusion criteria was that the study measured pain using VAS. VAS has been shown to be reliable and responsive to change (20). A systematic review by Chapman J. et al. (20) found that the VAS is reliable and responsive in a population with CLBP and recommended that when measuring pain either VAS or a numeric pain rating scale, should be considered when measuring pain. There are however some differences in reporting of VAS is this study, two studies (Bruce-Low S, et al. (13) , Hafue S, et al. (14) reports VAS only as a differential between the measurement pre and post intervention. The difference in reporting of VAS and the different ways VAS has been used (cm and mm), may reduce some accuracy when comparing the result.

In this study, the PEDro scale has been used to assess the quality of the different studies. This making the reviewer's aware of what limitations the studies included may have. PEDro is a database made by physiotherapist to give access to high quality research, PEDro has also created the PEDro scale that can be used on studies to identify valid studies to help physiotherapist worldwide (7). In this study four has been considered "good", four have been considered "fair" and one has been considered "poor" according to the PEDro criteria. Cortell Tormo et, al. (19) was the only study that were put in the "poor" category, this is because the only criteria the study met was that it had a random allocation, between group comparison, and had points estimates and variability. All studies included in this review scored on these criteria. The study scoring in this category does meet the required inclusion criteria, and thereby included in this study.

As the mechanism of CLBP is considered multifactorial, we still see from the included studies that RT has a positive effect on CLBP. As strengthening of the deconditioned muscles can be the explanation of the effect of RT, we also must be aware of other possible effects RT can have beside increased strength. Given the increased knowledge of the biopsychosocial mechanism (3) we can assume that RT also has a psychological effect as emotional believes and reduction of fear-avoidance (21) and promoting a healthier lifestyle.

Conclusion

The result from this study shows that RT can reduce perceived pain for people suffering from CLPB when the training load is sufficiently high. Factors like intensity, periodisation and frequency may affect the extent of pain reduction. The long-time effect is not clear and needs more research.

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