Bachelor's thesis

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Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Neuromedicine and Movement Science

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High Intensity Training in Treatment of Non-Specific Chronic Low Back Pain

Bachelor's thesis in Human Movement Science
Supervisor: Nordstoga, Anne Lovise
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Abstrakt

Bakgrunn: Kronisk uspesifikke korsryggsmerter er et globalt problem. Prevalensen er så høy som 84% og 23% vil oppleve disse smertene i løpet av livet. Det er mye forskning på trening som behandlingsform, men forskning på høyintensitetstrening som behandling er begrenset. Dette litteraturstudiet skal derfor se på effekten høyintensitetstrening som behandling av kroniske uspesifikke korsryggsmerter. **Metode:** PICO-søkestrategi ble brukt for å finne studiene gjennom databasen PubMed mellom 25.03.2022 - 30.03.2022. Studiene måtte være randomiserte og inneholde en treningsintervensjon som ble gjort ved høy intensitet. De ulike intensitetene på treningsformene ble definert. VAS-skala og NPRS var de eneste målene på smerte som ble brukt. Studiene ble kvalitetssjekket og evaluert gjennom "Physiotherapy Evidence Database", basert på deres kriterier. Alle fikk en skår fra 0-10. **Resultat:** Ni studier ble inkludert i litteraturstudie. Alle studier viste at trening ved høy intensitet hadde en positiv effekt når det kom til nedgang av oppfattet smerte. **Konklusjon:** Basert på dette litteraturstudie viser HIT å ha en nedgang på oppfattet smerte for personer med uspesifikke kroniske korsryggsmerter.

Abstract

Purpose: Chronic nonspecific low back pain is a major health issue worldwide. The prevalence is at 84% and during a lifespan 23% will experience chronic low back pain. There is to a large degree research on exercise as a treatment, but limited research on high intensity training. This literature study will evaluate if high intensity training is a feasible training method to reduce chronic nonspecific low back pain. **Method:** PICO-search strategy were used to collect studies through PubMed between 25.02.2022-30.03.2022. The studies had to be randomized and include a training intervention with high intensity training. The different training intensities were defined further. VAS-scale and NPRS were the only measurements used. The studies were evaluated through "Physiotherapy Evidence Database", based on their criterias. All studies got a score of 0-10. **Results:** Nine studies were included in the literature study. All studies showed that training with high intensity resulted in a decrease in perceived pain. **Conclusion:** Based on this literature study high intensity training decreases perceived pain in people with chronic nonspecific low back pain.

1. Introduction

Chronic nonspecific low back pain (CNSLBP) is a major health issue worldwide [1]. The prevalence of low back pain is as high as 84%, and during a lifespan, 23% will experience chronic low back pain. Additionally, during the second half of the 20th century it became one of the largest challenges for public health care systems in the western world [2].

CNSLBP is defined as pain lasting more than three months in the lower regions of the spine with no specific pathology [2]. It is characterized by a "fluctuating pain and high levels of functional disability, and consequently has a major impact on activities such as daily living, work and social interactions" [3].

Estimates indicate that low back pain is not only the most extensive musculoskeletal disorder, but also the largest health care expense in Norway [4]. Lærum et.al [5] estimated that in 2007 approximately 13-15 billion Norwegian kroner (NOK) could be related to back pain. In general, one half of people with chronic pain reported that it interferes with work. Additionally, across Europe one in five reported that they lost their job due to the pain [6].

In Norway, 80-90% of all chronic low back pain cases are non-specific. The increasing prevalence of CNSLBP and back related injuries is a severe and a demanding medical challenge, resulting in two million back related consultations every year. Low back pain is also the most frequent cause of absence due to illness (11%) and disability (9%) in musculoskeletal disorders. It is responsible for 13% of all "sick leaves" lasting more than eight weeks [7].

Over the last few decades, there has been an increasing enthusiasm when it comes to exercise as a treatment of back pain. Exercise as a treatment is safe, and the majority of studies have observed improvements in global pain ratings after different exercise treatments [8], although the most optimal exercise treatment remains unknown [9]. Aerobic exercise can result in a decrease of perceived pain because of the production of endorphins in the brain. Additionally it can improve the amount of blood flow and nutrients in the soft tissue in the back which can reduce pain. A reduction in core strength can result in lumbar instability, and strengthening these muscles can reduce back pain [10]. Progressive resistance training can be optimal for restoring lumbar deconditioning. This is because of endurance adaptations at lighter intensities [11], followed by greater maximal strength and neural adaptations at later heavier intensities [12].

High intensity resistance training is often related to training close to failure with a load of 70-90% of 1RM) [13]. High intensity in cardiorespiratory training is defined as more than 80% of VO2-max [14] or more than 80% HR-max [15]. In core muscle training, a muscle activation of more than 60% of the maximal voluntary muscle contraction (MVC) is considered as very high. [16].

Exercise is safe and well tolerated as a treatment [8]. However it is important to understand which training intensity optimizes the effectiveness of exercise therapy. HIT improves both the cardiopulmonary health and overall strength [17], however the effects on pain intensity needs further research. To be able to optimize the effectiveness of treatment, we will look at the effect of HIT on perceived pain in CNSLBP, to evaluate if it is a feasible method to reduce pain.

2. Methods

2.1 Study design

This literature study aims to give an overview and evaluation of the selected literature on the topic of CNSLBP.

2.2 Search strategy

Using the PICO-search strategy, search words for identifying relevant literature were chosen. These were used to find original studies through Pubmed over the period of 25.03.2022 - 30.03.2022. The PICO-search strategy is a method which splits the research questions into four parts (population, intervention, comparior and outcome), and helps for the construction of the research question and bibliographical research [18].
86 studies were found using the search words: *(("low back pain" or "lumbar pain" or "lumbar spine pain" or "nonspecific low back pain" or "chronic low back pain") AND ("rct" or "randomized control trial" or "randomized controlled trial" or "controlled trial" or "cohort" or "case-control")) AND (("resistance training" or "strength training" or "weight training" or "resistance exercise" or "cardiorespiratory exercise" or "cardiorespiratory training" or "high intensity training" or "HIT" or "HIIT")).*

2.3 Inclusion- and exclusion criterias

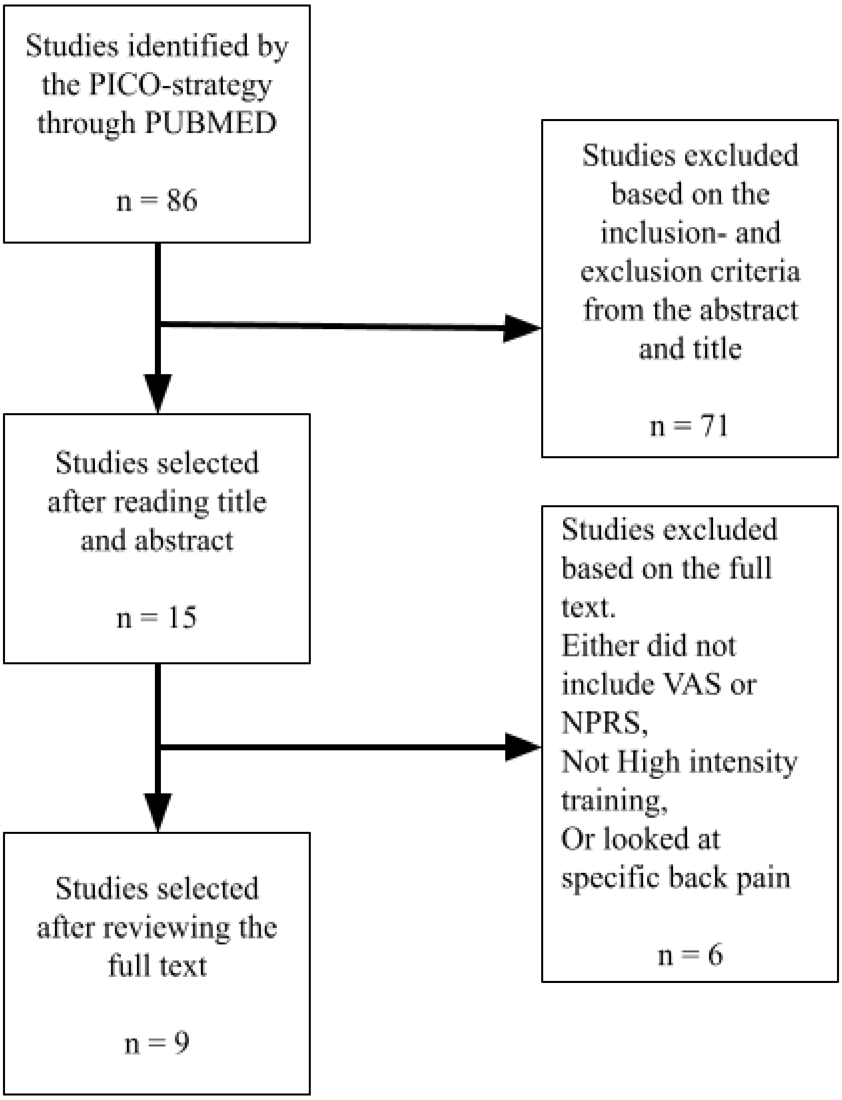
Inclusion criteria: The studies had to be randomized controlled trials (RCT) as it is considered the gold-standard for estimating treatment effect [19]. Part of the interventions had to include a phase of one of the following high intensity training interventions, which was defined as; high intensity resistance training (training close to failure with a load of 70-90% of 1RM)[13], 4-12 repetitions until absolute failure (is equivalent to 70-90% of 1RM [20]), high intensity cardiorespiratory training (more than 80% of VO2-max [14] or more than 80% HR-max [15]), core muscle training with more than 60% of the maximal voluntary muscle contraction [16] or OMNI-scale above 7-9[21]. Perceived pain had to be measured by either Visual Analog Scale (VAS) (0-10cm or 0-100mm) or Numeric Pain Rating Scale(NPRS)(0-10). Both methods were included because of their similarity, as they are both subjective and measure pain by a 0-10 scale. Subjects had to suffer from chronic(>3 months) non-specific low back pain.

Exclusion criteria: If the study was not published through a peer-reviewed journal [22]

2.4 Selected studies

Through reading the abstract and title, studies were excluded based on the inclusion- and exclusion criteria. Nine studies were chosen after reading the full text for the remaining studies. This is further specified in figure 1. In the included literature all VAS-scores were converted to centimeters to make the measurements of VAS and NPRS as similar as possible.

Figure 1. Flow chart



2.5 Quality Assessment

The studies were individually evaluated for quality assessment. Evaluation was based on the "Physiotherapy Evidence Database" (PEDro) criterias [23] which is proven to be a valid measure of methodological quality of clinical trials [24]. Based on the criterias each study was awarded a PEDro score of 1-10. This is presented in Table 1. Based on the points awarded, the studies were split into the categories "excellent", "good", "fair" and "poor". It is important to mention though, that due to the importance of interaction between patient and therapist in the interventions, none of the studies fulfills the subject and therapist criterias related to blinding.

Table 1. Total PEDro score based on PEDro criteria [23]

Study	Cortell et al. [25]	Jackson et al. [26]	Kell et al. [28]	Michaelson et al. [31]	Steele et al. [29]	Kell & Asmundson. [27]	Verbrugghe et al. [16]	Calatayud et al. [9]	Smith et al. [30]
Eligibility criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random allocation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Concealed allocation	No	No	No	Yes	No	No	Yes	Yes	No
Baseline comparability	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
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	Yes	No	No	No	No	No
Adequate follow-up	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Intention to treat analysis	No	Yes	No	Yes	No	No	Yes	Yes	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	**3**	**6**	**5**	**8**	**5**	**6**	**7**	**5**	**6**

3. Results

This literature study included nine articles whereas eight of them focused solely on high intensity resistance training, and two of the studies included a combination of high intensity aerobic- and high intensity resistance training. The articles in this study look at the impact of HIT on perceived pain in people with CNSLBP. All studies included a control group as a comparison. The control groups either received no intervention/continued their daily routines or received an alternative training intervention with low- or medium training intensity. Training interventions are described in detail in table 2. The results show a decrease in perceived pain in all of the nine studies. Table 3 describes this in further detail.

Table 2. Study demographics

Article	Training intensity	Duration	Sex	Sample size	Average Age(yr)
Cortell-Tormo et al. [25]	**Resistance training:** Two sessions per week. Week 1-3: Light intensity, 20rep, no rest, 4 OMNI Week 4-7: Middle intensity, 15 rep, 30 sec active rest, 6-7 OMNI Week 8-12: High intensity, 12 rep, 30 sec active rest, 8-9 OMNI **Control group:** No intervention.	12 weeks	Female	Total = 19 Resistance training = 11 Control group = 8	 Resistance training = 36 Control group = 36
Jackson et al. [26]	**Resistance training:** Whole-body resistance training (50-83% of 1RM). Four sessions per week. Split into a middle age- and old age group. **Control group:** No intervention.	12 weeks	Male	Total = 45 Middle age group = 15 Old age Group = 15 Control group = 15	 Middle age group = 52 Old age group = 63 Control group = 57
Kell et al. [28]	**Resistance- and core training:** 50-83% of 1RM, 1-2 min rest, 2-5 set per exercise, 13 exercises. **4 days:** Four days per week. Did three core exercises each day. Split the other 10 exercises in two groups of five exercises, performing one part at day one and three, the other part at day two and four.	15 weeks	Male and female	Total = 240 4 days = 60 3 days = 60 2 days = 60 Control group = 60	 Group A = 42 Group B = 42 Group C = 43 Control group = 43

	3 days: Three days per week. Did all 13 exercises each day. **2 days**: Two days per week. Did all 13 exercises each day. **Control group:** No intervention.				
Michaelson et al. [31]	**Resistance training:** Deadlift. Five sets of five repetitions, 70–85% of 1RM. 2-3 min rest between sets. 1-2 sessions per week. **Control group (n):** Three stages of low load motor control exercises.	8 weeks, follow up after 12- and 24 months	Male and female	Total = 70 Deadlift = 35 Control group = 35	Deadlift = 42 Control group = 42
Steele et al. [29]	**Resistance training:** **With full range of motion :** One set of 105 sec of isolated lumbar extensions. Used full range of motion. 80% of 1RM performed until failure. One session per week. **With 50% of range of motion**: Used 50% of their range of motion and performed the same intervention as the full range of motion group. **Control group:** No intervention.	12 weeks	Male and female	Total = 24 Full range of motion = 10 50% of range of motion = 7 Control group = 7	Full range of motion = 46 Limited range of motion = 42 Control group = 42
Kell & Asmundsen. [27]	**Resistance training:** Three training sessions per week. Intensity at 53-72% of 1RM.	16 weeks	Male and female	Total = 18 Resistance training = 9 Control group = 9	Resistance training = 40 Control group = 35

	Control group: No intervention				
Verbrugghe et al. [16]	**Aerobic, resistance and core training:** Aerobic training (100% vo2 max workload), resistance training (80% of 1RM) and core strength training (<60% of maximum voluntary contraction). Two sessions per week **Control group, middle intensity training:** Aerobic training (60% vo2 max), resistance training (60% of 1RM) and core strength training (<60% maximum voluntary contraction)	12 weeks	Male and female	Total =36 Aerobic, resistance and core training = 18 Control group = 18	Aerobic, resistance and core training = 44 Control = 44
Calatayud et al. [9]	**Resistance training focused on core strength:** Three days per week. Performed both dynamic- and isometric exercises. **Dynamic exercises:** Exercises progressively increase each two weeks (20 RM, 15 RM, 12 RM, 10 RM). **Isometric exercises:** Week one to week four the reps increased from 15 to 30, and total time under tension from 75-150s total.	8 weeks, follow up after 100 days	Male and female	Total = 85 Core strength training = 42 Control group = 43	Core strength training = 52 Control group = 50

	Control group: Eight weeks Back-School rehabilitation program.				
Smith et al. [30]	*All participants attended a physiotherapist before the interventions.* **Resistance training:** **With stabilization:** Lumbar extension training with pelvic stabilization, 8-12 repetitions till failure. 1 session per week **Without stabilization:** Lumbar extension training without stabilization 1x week, 8-12 repetitions. **Control group:** Continued their course of LBP treatment with the same physiotherapist	12 weeks	Male and female	Total = 44 Stabilization = 15 No stabilization = 17 Control group = 12	Total average age = 43

OMNI = exercise scale of perceived exertion, RM = Repetition maximum, Vo2 Max = Maximal oxygen consumption

Table 3: Pre and post results for VAS and NPRS

Article	**Outcome measure**	**Group**	**Change within each group**		**Follow up**
			Pre	**Post**	
Cortell-Tormo et al. 2018	VAS	body strength Control	4.0 4.5	1.5 4.4	No follow up
Jackson et al. 2011	VAS	Middle age Old age Control	4.3 4.5 4.2	3.2* 3.3* 4.5	No follow up
Kell et al. 2011	VAS	4 days 3 days 2 days Control	6.1 5.8 5.7 5.8	4.4* 4.8* 5.0* 5.7	No follow up
Michaelson et al. 2016	VAS	High load lifting Control	4.3 4.7	2.2* 3.0*	After 12 month: 2.4* After 24 month: 2.7* After 12 month: 2.5* After 24 month: 3.0*
Steele et al. 2013	VAS	Full range of motion 50% of full range of motion Control	4.7 4.1 1.9	1.6 2.5 2.6	No follow up

Kell & Asmundsen, 2009	VAS	Resistance training Control	5.4 3.3* 4.9 4.8	No follow up
Verbrugghe et al. 2019	NPRS	Aerobic, resistance and core Control	5.7 2.5* 5.6 3.4*	No follow up
Calatayud et al. 2020	NPRS	Core strength Control	6.2 4.3 6.3 5.1	After 100 days: 3/36 recurrence, avg. after 62.7 days After 100 days: 10/30 recurrence, avg. after 57.8 days
Smith et al. 2011	VAS	Stabilized exercise Not stabilized exercise Control	3.0 1.0* 2.9 2.8 2.7 2.7	No follow up

*p = <0.05 for change in pain compared with pretreatment pain level, p = <0.05 difference compared with post treatment control group,

VAS = Visual Analog Scale, NPRS = Numeric Pain Rating Scale

3.1 Primary findings

3.1.1 High intensity resistance training compared with no intervention

Five studies [25-29] compared high intensity resistance training with a control group with no intervention. All studies showed that HIT resulted in a decrease in perceived pain. The control groups showed either no improvement or an increase in pain.

The greatest reduction in perceived pain was observed in Steele et al. [29], in which the decrease was from 4.7-1.6 cm. The smallest decrease in perceived pain was observed in the "2 days" intervention group in Kell et al. [28], in which the decrease was from 5.7-5.0 cm. Among the five studies, all except Cortell-Tormo et al. [25] showed a statistically significant change from start till the end of the intervention. Furthermore all five studies except the "50% of full range of motion" intervention group in Steel et al. [29] showed a statistically significant difference between the intervention group and the control group at the end of the intervention.

3.1.2 High intensity resistance training combined with high intensity aerobic training compared with Middle intensity

Verbrugghe et al. [16] - The high intensity training group which consisted of both aerobic- and resistance training had a decrease in perceived pain from 5.7-2.5 cm on the VAS-scale, while the medium intensity training group (control group) had a decrease from 5.6-3.4. Both the intervention group and the control group showed a statistically significant decrease in perceived pain.

3.1.3 High intensity compared with common rehabilitation programs

Calatayud et al. [9] - Both the intervention group and the control group showed a decrease in perceived pain. The high intensity group showed 6.2-4.3 on the NPRS-scale and the back school rehabilitation group (control group) 6.3-5-1 on the NPRS-scale. These changes were statistically insignificant for both groups.

Smith et al. [30] - The stabilization group showed a decrease in perceived pain from 3.0-1.0 cm while the no-stabilization group showed little to no decrease from 2.9-2.8 cm on the VAS-scale. No change in perceived pain was observed in the control group showed.The stabilization group showed statistically significant differences for post intervention results when compared to the no-stabilization- and control group.

3.1.4 Long-term follow-up

Two studies looked at the long-term effects of HIT on CNSLBP. The studies included different lengths of follow-ups; 100 days [9], 12 months [31] and 24 months [31].

Michaelson et al. [31] - Both the intervention- and control group showed a statistically significant decrease in perceived pain after the intervention. The pain intensity for the high intensity training group gradually increased by 0.2 cm from the end of the intervention to the 12 months follow-up, and by an additional 0.3 cm after 24 months. On the contrary the control group experienced a decrease in perceived pain of 0.5cm from the end of the intervention to the 12 month follow-up, and an increase of 0.5cm (which returned them to the post intervention pain level) after the 24 month follow up.

Calatayud et al. [9] - As mentioned earlier (in 3.1.3) both the intervention- and control group showed a statistically insignificant decrease in perceived pain. After the end of the intervention, on average after a 100 days follow up the participants in the high intensity training group had a lower recurrence rate, 3/36 compared to 10/30, of low back pain compared to the control group. Additionally on average the high intensity training group experienced a longer interval before the first episode of low back pain recurred.

3.1.5 Quality assessment

In the nine included studies one was considered “poor” [25] three of them “fair” [9, 28, 29] and five of them “good” [16, 26-28, 30], according to PEDro criterias [23].

4. Discussion

The nine studies included investigated the effect of high intensity training on perceived CNSLBP. The results suggest that high intensity training can reduce CNSLBP. Among the interventions all studies resulted in a decrease in perceived pain, with eight out of nine studies [16, 25-31] showing a statistically significant decrease.

4.1 Effect of training intensity

Verbrugghe et al. [16] compares HIT with middle intensity training (MIT). Both interventions showed a statistically significant decrease in NPRS-score. The HIT intervention resulted in a greater decrease in perceived pain compared to the MIT intervention.

Similar findings were presented in the meta-analysis done by Hayden et al [32]. They investigated the effect of different exercise treatments on pain intensity for adults with

CNSLBP. 217 RCT's were included, and it displayed that a high dose of intensity and duration in most exercise treatments resulted in the greatest reduction in perceived pain. This could indicate that training with a higher intensity can be more effective to reduce CNSLBP.

An explanation could be that the increased physical stimulus HIT provides can increase the effectiveness in treating CNSLBP. HIT aerobic interval training can increase the oxygen intake. HIT resistance- and core training increases strength in the trunk and extremity muscles. Such improvements in overall physical health can decrease the physical deconditioning that might be seen in people with CNSLBP [17].

4.2 Long-term follow-up

Two studies [9, 31] investigated the long-term effects of HIT on CNSLBP. They showed a slight recurrence in perceived pain during the first 100 days [9], at 12 months [31] and at 24 months [31] after the interventions. A slight recurrence in pain is also shown in the study of Maul et al [33]. They investigated the long term effects of physical training as treatment of low back pain after one- and ten years. The patients experienced the same amount of pain after the one year follow up, but had increased to near pretreatment levels after ten years. It is not specified what the participants were doing in their free time during the follow ups. This makes it difficult to assume the cause of the increase in perceived pain. However one explanation could be that patients discontinued physical exercise after the end of the interventions. Because of inactivity this can result in muscle atrophy [34]. Loss of muscle mass can result in a decrease in strength. A decrease in strength can lead to a weaker core, which in turn can lead to an increase in perceived pain, as it is stated that a stronger core can reduce low back pain [10]. This indicates that the effect of HIT can be present for years after the intervention. However the effect can decrease with time.

4.3 Methodological strengths and weaknesses

4.3.1 Sample size

As a larger sample size provides statistically more secure estimates, a weakness with some of the included studies is the sample size [35]. One of the studies had many participants [28], one had a medium number of participants [9], while the remaining seven had a relatively low number of participants [16, 25-27, 29-31].

4.3.2 Quality assessment

Based on the quality assessment from Pedro [24], the majority of the studies included are considered “good” and “fair”. RCT was used to assess the effect of the interventions as it is considered the “gold-standard” for estimating treatment effect. It strengthens the internal validity which assures that the results are correct for the selected population in the study. However this can weaken the external validity which makes it difficult to ascertain the generalizability because it may not be valid for other patient groups [35]. The participants in Smith et al. [30] were exposed to treatments before taking part in the intervention and the participants in Jackson et al. [26] were moderately trained male adults who played recreational ice hockey two times a week. These studies can be subject to a relatively larger internal validity. For instance the results could be different if none of these participants had any prior training or treatments pre intervention.

Two forms of measurement methods were used in the included studies. Seven [25-31] studies used the Visual analog scale and two studies used the NPRS scale [9, 16] . The measurement methods of both the NPRS and VAS are recognised to have good validity and reliability when it comes to patients with CNSLBP [36].

4.3.3 Bias

In Jackson et al. [26] the patients themselves applied to join the study. This can affect the results through selection bias as it can lead to extra motivation within the study, which can lead to different, often greater results.

In all the studies patients had knowledge of whether they were in the intervention- or control group because blinding was not present. This can lead to a change in response or behavior which can lead to performance bias. For instance, the patients who know they are in the intervention group might change their diet differently compared to the control group, to improve their effect of the training. This can also lead to patients expecting better results, which can supplement the placebo effect [37].

The VAS-scale and NPRS are subjective scales, which means that the participants themselves evaluate how much pain they feel. The study of Tang et al [38] proves that changes in mood can affect both self reported pain and tolerance for a pain-relevant task. This can lead to self-report bias.

4.3.4 Strength and weaknesses with this literature study

There are several studies looking at exercise as a treatment of CNSLBP. This literature study aims to give a systematic review with emphasis on specifically HIT as a treatment of CNSLBP. It can be used in further research to give health professionals greater knowledge and information regarding HIT as a treatment of CNSLBP.

All of the studies included looks at the short term effect of HIT on CNSLBP. One can assume that a short term reduction in pain can result in the patients being more active because of pain relief. This can further rehabilitate patients into their previous "daily" life. However as this only demonstrates the short term effect, more knowledge of the long term effects could be beneficial. Only two [9, 31] out of nine studies included a follow up. This could be a weak point of our literature study as it limits the information of long term effects. The results indicate a slight increase of perceived pain over time after the end of the intervention. However it could be beneficial to examine more studies including a follow up to further ascertain the long term effects of HIT in treatment of CNSLBP. It's an important topic as a greater long term effect could decrease the chance of further treatment. Additionally it can be an important factor to distinguish whether interventions only have short term effects.

4.4 Future research

For future research it could be beneficial to examine more studies including a follow up and a larger population. More studies with a follow up will help ascertain the long term effect of HIT in treatment of CNSLBP. In general, studies with a larger study population provide more secure estimates, but it can also help generalize the results. This will improve the external validity and make it more applicable for other groups of people.

5. Conclusion

It was observed that high intensity resistance training alone, and various combinations of high intensity resistance training, high intensity core strength training and high intensity aerobic training reduced perceived pain in patients with CNSLBP. The greatest reduction in perceived pain was found in the high intensity resistance training intervention which utilized isolated lumbar extension. Although the greatest reduction in pain was observed when doing high intensity resistance training, a combination of different training interventions is also shown to be an adequate method in treating CNSLBP.

Based on the results in this literature study, it is demonstrated that high intensity training is a feasible method to reduce perceived pain in patients with CNSLBP.

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