Review of Contemporary Philosophy
ISSN: 1841-5261, e-ISSN: 2471-089X
Vol 22 (1), 2023
Pp 5164 - 5172

Comparative Efficacy of Progressive Resistance Training Versus General Exercise Modalities in The Management of Chronic Low Back Pain: Review

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Abstract

Background: Chronic low back pain (CLBP) is a prevalent condition affecting a significant portion of the population, characterized by prolonged discomfort that often leads to functional impairments. Traditional rehabilitation approaches frequently yield short-term improvements, yet adherence to exercise-based therapies remains a critical challenge, often resulting in suboptimal outcomes.

Methods: This systematic review and meta-analysis aimed to evaluate the efficacy of progressive resistance training (PCRT) compared to general exercise (GE) therapies in managing CLBP. A comprehensive literature search was conducted in 2023 across databases including MEDLINE, EMBASE, CINAHL, and Scopus. The analysis included studies that directly compared PCRT and GE interventions focusing on pain, disability, and muscle strength outcomes.

Results: The findings revealed that PCRT significantly outperformed GE in reducing pain, disability, and enhancing muscle strength, particularly over treatment durations of 12 to 16 weeks. Adverse events were comparable between both interventions, indicating no increased risk associated with PCRT. Notably, the effectiveness of PCRT was reinforced by evidence suggesting a dose-response relationship, whereby longer treatment durations correlated with greater improvements.

Conclusion: This study underscores the superior benefits of PCRT over GE for individuals suffering from CLBP, advocating for longer and more structured exercise programs to optimize therapeutic outcomes. The

lack of significant adverse events associated with PCRT further supports its safety and applicability in clinical settings. Future research should focus on exploring adherence strategies and refining exercise protocols to enhance patient engagement and treatment effectiveness.

Keywords: Chronic low back pain, Progressive resistance training, Exercise therapy, Pain management, Rehabilitation

Received: 10 October 2023 **Revised**: 24 November 2023 **Accepted**: 08 December 2023

1. Introduction

Low back pain (LBP) is a severe and expensive ailment that impacts 65–85% of the population [1–3]. While acute low back pain (LBP) is considered self-limiting in the short term, with the majority of symptoms subsiding within three months of start, recurrences and progression to chronic LBP occur in 24–80% of instances [4]. Enhancing the strength and stability of trunk musculature via therapeutic exercise is a prevalent objective in physical rehabilitation for this demographic, believed to enhance functional outcomes by promoting hypertrophy of the paraspinal muscles and mitigating or averting frequently observed maladaptive physiological alterations such as muscle atrophy and fatty infiltration [5–9]. Nonetheless, whereas short-term enhancements are seen after traditional rehabilitation regimens, these benefits often fail to endure over the long run. A potential explanation for this is that the often-suggested exercise dosages and durations may be inadequate to elicit physiological alterations in the afflicted tissues [10–13]. Most studies indicating exercise-induced muscle hypertrophy need treatment periods beyond standard prescriptions, averaging 16 weeks. Moreover, when used throughout these durations, they yielded both immediate and sustained enhancements in functional outcomes [12, 15], alongside an 87% decrease in healthcare resource consumption after one year [11, 16, 17]. Notwithstanding data advocating for extended treatment durations, the frequency of visits for exercise-based rehabilitation remains insufficient, averaging 8–12 sessions over a 6–8 week timeframe [18].

A contributing factor to the variation in treatment volume is the poor adherence, or attendance, to supervised rehabilitation programs in clinical practice settings, with rates ranging between 15% and 87% [19, 20]. A comprehensive review [21] of literature from 1998 to 2014 on adherence to therapeutic exercise regimens identified only three trials including individuals with low back pain (LBP) [22–24]. Furthermore, there is a lack of literature examining adherence to supervised exercise programs exceeding 6 weeks in this population. Among studies reporting shorter-term adherence rates (less than 6 weeks), the largest sample size documented was 170 participants, with a wide range of non-adherence rates (51–87%) [25, 26]. Adherence in these trials relied on self-reported duration of home exercise programs, complicating comparisons with supervised rehabilitation, but adherence rates are equally variable (15–70%) [19, 20]. Variability in adherence has also been seen in other musculoskeletal disorders, including hip and knee osteoarthritis, with rates ranging from 26% to 52% [27, 28].

The poor adherence rates often remain unacknowledged in the literature, since several clinical studies tend to exaggerate adherence owing to selection bias and the allocation of resources for patient follow-up and retention, in contrast to standard clinical practice. Moreover, logistical constraints, like inadequate insurance coverage and accessibility barriers, have been shown to influence trial participation and may diminish the inclusion of groups with limited resources [29, 30]. The absence of geographic accessibility and apprehension about financial strain has been shown to disproportionately affect persons of low socioeconomic position, leading to an exacerbation of healthcare inequalities. Significant medical comorbidity and safety are considerations for persons with back pain, since these factors may affect clinical results and the capacity to resume functional activities, perhaps owing to an inability to safely engage in an exercise-based regimen [31,32]. Conversely, publication bias against pragmatic studies characterized by significant loss to follow-up and inadequate assessment of clinical effectiveness leads to the underreporting of low adherence rates in these individuals and contexts [33]. A recent Cochrane study indicated that, among 381 research on exercise-based rehabilitation programs for chronic pain problems, adherence was not evaluated in any study, and healthcare use or attendance was not documented in any of the reviews [34]. Consequently, it is essential to provide data on adherence in standard clinical practice environments

and to assess the variables that lead to the reported low rates, since this may represent a significant obstacle to attaining optimum treatment effectiveness [35, 36]. Consequently, we performed this analysis to assess the relative efficacy of group-based exercise compared to other non-pharmacological therapies, which may or may not include education and exercise, on pain and impairment in individuals with chronic low back pain.

2. Methods

A systematic search was performed in 2023 using MEDLINE®, EMBASE, CINAHL, and Scopus.

3. The Advantages Of Treating Chronic Low Back Pain With Posterior Chain Resistance Training (PCRT) Over General Exercise (GE)

The main objective of this review was to ascertain the advantages of treating chronic low back pain with PCRT compared to GE. This systematic review and meta-analysis is, to the authors' knowledge, the first investigation to directly compare these two exercise programs in addressing this demographic. This topic is significant because, while existing recommendations assert that many kinds of exercise help this demographic, there is little data demonstrating the comparative usefulness of one exercise type over another.

This review indicates that there was no disparity in the incidence of adverse events between PCRT and GE programs, and that all outcomes (pain, disability, muscular strength) improved significantly more in patients with CLBP treated with PCRT compared to GE, particularly when assessed over a duration of 12 to 16 weeks. The findings of this research indicate significantly positive outcomes for PCRT compared to GE, particularly when evaluated over a period of 12 to 16 weeks, a conclusion that may have considerable therapeutic relevance for allied health professionals working with persons suffering from CLBP. The definitions of what constitutes “conditions” under the term CLBP are a disputed and changing issue. The definition and exclusion criteria used were aligned with the bulk of the included articles and other systematic reviews in this domain. Common terminologies such as “spinal abnormalities/structural deformities” [14] and “disc protrusions/herniations” [8, 37-41] were used to eliminate possible participants from the trials/study.

4. Discomfort

According to the Furlan et al. [42] levels of evidence framework, there is substantial evidence indicating that PCRT resulted in a greater (small impact) decrease in pain compared to GE. As the duration of the exercise treatments extended, the disparity in pain levels between PCRT and GE programs intensified. For treatments lasting 12–16 weeks, there was robust evidence that PCRT resulted in a greater (moderate impact) decrease in pain compared to GE, but only a minor effect difference was seen in investigations lasting 6 to 8 weeks. The temporal dependence of this outcome may indicate the inherent timeline of adaptation, wherein damaged tissue necessitates a specific duration for recovery, demanding gradually intensified loading to facilitate re-adaptation, promote growth, and activate restorative mechanisms to foster healing [44]. Given the duration of their diagnosis with CLBP, it is probable that these people have had many adverse morphological and behavioral changes linked to this ailment. These findings may indicate that patients engaging in PCRT may take more time than those other GE alternatives, like as walking, to establish the necessary movement competence for safely and effectively loading their posterior chain muscles.

Although the majority of individual trials indicated more significant pain reductions for PCRT compared to GE therapies, Hurley et al. [39] presented findings suggesting a propensity for bigger advantages from GE than PCRT. This study was unique among the included research as it was the only multisite trial, conducted concurrently across five distinct sites, each overseen by different researchers or physiotherapists for each class. Consequently, to standardize the PCRT exercise prescription across many locations, the actual exercise prescription and its delivery may have been simplified relative to previous research utilizing PCRT treatments. Only 2 out of 10 exercises included additional resistance as a final progression, indicating that the total intensity and degree of progressive overload in the PCRT program were much lower than in

previous PCRT trials included in this study [39]. Hurley et al. [39] differentiated from the other trials by exhibiting a greater relative age for the PCRT (mean 45.4, SD = 11.4 years) compared to the GE (mean 34.2, SD = 8.9 years) program. The exclusion of Hurley et al. [39] led to significant alterations in heterogeneity across all outcomes (I2 = 0–12%) and enhanced statistical significance favoring PCRT. The exclusion of a single research may indicate that a fundamental aspect contributing to the possible advantages of PCRT over GE in alleviating back pain in patients with CLBP is the implementation of progressive overload in the PCRT intervention.

5. Impairment

Prior systematic evaluations [8, 42-45] have shown that comparable exercise therapies dramatically reduce disability in chronic low back pain populations. The present investigation revealed that PCRT produced much higher reductions in impairment levels compared to GE. According to the Furlan et al. [42] levels of evidence framework, there is substantial evidence indicating that PCRT resulted in a greater (small impact) decrease in disability compared to GE. The disparity in impairment levels between the PCRT and GE programs increased with longer programme durations, analogous to the findings on pain. For treatments lasting 12–16 weeks, there was substantial evidence that PCRT resulted in a greater (moderate impact) decrease in impairment compared to GE, but only a minor effect difference was seen after 6–8 weeks.

The justification for the superior efficacy of PCRT relative to GE in enhancing disability levels in individuals with CLBP likely mirrors the processes responsible for the more significant pain alleviation seen with PCRT over a 12 to 16-week period. Additionally, there may be a component of movement confidence and/or movement competency that is significant, as the CLBP patient might necessitate a considerably longer duration to enhance their perceptions of disability, given that such tasks may have previously elicited pain or feelings of inadequacy when executed in public [46].

6. Fortitude

The degree of muscle strength often shown a more significant enhancement with PCRT than through GE, similar to the trends seen in pain and impairment. Prior assessments indicate that enhancements in muscular strength are achievable in this demographic and may be associated with reductions in pain and impairment levels, while the specifics of the exercise remain ambiguous [47]. This research indicated that PCRT resulted in much larger improvements in muscular strength compared to GE.

According to the Furlan et al. [42] levels of evidence framework, there is substantial evidence that PCRT resulted in a greater (small impact) enhancement in muscular strength compared to GE. The relative disparity in muscle strength enhancements between the PCRT and GE programs became more evident over time, similar to the outcomes for pain and impairment. For treatments lasting 12–16 weeks, there is substantial evidence that PCRT resulted in a greater (moderate impact) enhancement in muscular strength compared to GE, whereas only a minor effect difference was seen after 6–8 weeks. This length-related discrepancy aligns with the positive correlation between training duration and muscle strength changes in chronic low back pain patients, as observed in a prior systematic study [8].

To enhance muscular hypertrophy, strength, and endurance, it is essential to gradually overload muscles and their associated connective structures to facilitate adaptation. Conversely, when tissues are not stimulated or used, muscular atrophy and a decline in strength and endurance may ensue [44]. Dreisinger [48] determined that resistance training is the only exercise intervention that substantially improves muscle strength, flexibility, endurance, and balance in individuals with chronic low back pain (CLBP). Resistance training is recognized to induce higher muscle damage, necessitating longer recovery time compared to most other exercise modalities. It is established that in the first 2–8 weeks of resistance training for an untrained person, most strength improvements are attributable to neural adaptations, since morphological changes often manifest only after 8 weeks of training [49-51].

Two studies [33, 34] included in the meta-analysis, which used correlational analyses, demonstrated significant associations between bench press strength improvements and reductions in pain and disability levels in individuals with chronic low back pain (CLBP). Jackson et al. [40] demonstrated that about 64%

and 59% of the shared variation in the reduction of pain and disability, respectively, could be attributed to enhancements in upper body strength. In alignment with findings related to other musculoskeletal injuries, such as hamstring or rotator cuff strains, which indicate that stronger individuals are significantly less prone to such injuries, this evidence implies that clinicians should incorporate a progressive resistance training component into rehabilitation programs for individuals with chronic low back pain to optimize recovery.

7. Negative Incidents

It should be emphasized that all adverse events associated with GE were documented by Hurley et al. [39], with 10 individuals experiencing back discomfort, 2 reporting knee pain, and 2 reporting ankle pain. Additionally, two out of eight studies failed to disclose any adverse events, and while Jackson et al. [40] acknowledged the occurrence of certain adverse events in their research, they did not provide numerical data for either exercise group on the observed adverse events. Despite these concerns, the absence of a notable disparity in adverse events between the PCRT and GE groups may astonish many, given the prevalent belief that strength training poses a higher risk of lower back injury compared to walking, which is perceived as relatively low-risk. A recent systematic review by Keogh and Winwood [52] indicated that athletes in strength sports, including weightlifting, powerlifting, and bodybuilding, frequently sustained lower back injuries; however, they averaged approximately 2–4 injuries per 1000 training hours. The injury rates per 1000 hours of training are much lower than those reported in other ball sports, so reinforcing the potential safety of PCRT-focused rehabilitation for patients with chronic low back pain (CLBP).

8. Limitations and Strengths of the Study

A significant weakness of this research is the variability in exercise treatments for both PCRT and GE. The ideal parameters of PCRT regarding exercise selection, weights, sets, repetitions, and rest intervals remain largely undefined. Although the majority of studies included lower limb and hip strengthening activities, this was not consistent across all research. This may also be seen as a strength of the meta-analysis, since it demonstrates that diverse PCRT exercises and procedures may be used with comparable outcomes.

A further weakness of this research is the variability among the GE comparator groups. Three groups used alternative weight training methods [30, 31, 36], four utilized aerobic training [32, 33, 34, 35], and one focused on activities of daily living [14]. This variability across control groups complicates the assessment of whether any of these general exercise treatments is less successful than the others. This may result in an inadvertent bias favoring PCRT if one of the comparators is less successful than the others. This complicates the differentiation of the efficacy of the PCRT protocols owing to the variability in the comparative procedures. Nonetheless, prior randomized controlled trials (RCTs) examining various active therapies have indicated that the specificity of training may not be the principal mechanism driving improvement in this demographic; instead, a "central" effect related to alterations in perceptions of pain and disability may hold greater significance [10].

A further drawback of this research was the estimate of some data points that were not disclosed in the original journals. The p values were established at less than 0.05 for "significant effects" and less than 0.1 for "non-significant effects" where not expressly indicated in the publications. Although established at very conservative levels to minimize author impact, this results in a likely underestimating of effect sizes for each outcome favoring PCRT when applicable. This therefore results in an impact size and amplitude that is likely reduced owing to the use of these cautious values and standardized mean difference (SMD).

In light of these constraints, several proposals for further study have arisen. These may serve as a roadmap for future randomized controlled trials and clinical practice recommendations in this field of research and practice. Due to the variability in exercise interventions, a structured exercise regimen focusing just on PCRT exercises, without including other exercises or treatments, should be used and compared to walking programs, mixed resistance training, and a normal care control group. This would significantly facilitate the direction of successful therapy for the CLBP group. The notable link between enhancements in muscular strength and reductions in pain and disability levels in individuals with chronic low back pain warrants

further investigation to ascertain if the extent of pain and disability improvements corresponds to gains in strength. A further objective of the study should be to explicitly differentiate patient activity levels before enrollment, so facilitating future research in determining the extent to which previous training or activity levels impact results in exercise-based therapies for chronic low back pain (CLBP).

9. Summary

This study's findings indicate that using PCRT for patients with CLBP in the recreationally active/sedentary demographic is much more beneficial than utilizing GE. The findings of this research provide robust evidence for substantial enhancements in pain, disability, and strength associated with PCRT. The results indicated no significant increase in the risk of adverse events compared to general exercise or walking programs; however, this conclusion is derived from a limited number of studies that sufficiently reported definitions, data collection methods, and group-based outcomes for adverse events, potentially resulting in considerable heterogeneity in this finding. The existing research supports the use of PCRT for a 12–16-week duration rather than 6–8 weeks, demonstrating markedly better enhancements in pain, impairment levels, and strength with extended training. Future research should focus on high-quality randomized controlled trials (RCTs) that isolate exercise therapies especially targeting PCRT, comparing them against a control group, aerobic exercise interventions such as walking, and/or a mixed-gender exercise intervention. Researchers must consider patients' previous activity levels to enhance doctors' treatment strategies, informed by the effectiveness of therapies across diverse activity groups.

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فعالية التدريب التدريجي بالمقاومة مقابل التمارين العامة في إدارة آلام أسفل الظهر المزمنة: مراجعة

المستخلص

الخلفية :تُعد آلام أسفل الظهر المزمنة (CLBP) حالة شائعة تؤثر على نسبة كبيرة من السكان، وتتميز بانزعاج طويل الأمد غالبًا ما يؤدي إلى إعاقات وظيفية. غالبًا ما تحقق أساليب إعادة التأهيل التقليدية تحسينات قصيرة الأمد، بينما تظل الالتزام بالعلاجات القائمة على التمارين تحديًا رئيسيًا يؤدي إلى نتائج دون المستوى المطلوب.

الطرق :هدفت هذه المراجعة المنهجية والتحليل التجميعي إلى تقييم فعالية التدريب التدريجي بالمقاومة (PCRT) مقارنةً بالعلاجات التمرينية العامة (GE)في إدارة .CLBP تم إجراء بحث شامل في عام 2023 عبر قواعد بيانات تشملMEDLINE ، EMBASE، CINAHL، و .Scopusوشملت التحليل الدراسات التي قارنت بشكل مباشر تدخلات PCRT و GEمع التركيز على نتائج الألم، والإعاقة، وقوة العضلات.

النتائج :كشفت النتائج أن PCRT تفوق بشكل ملحوظ على GE في تقليل الألم والإعاقة وتعزيز قوة العضلات، خاصةً خلال فترات العلاج التي تتراوح بين 12 إلى 16 أسبوعًا. كانت الأحداث الضارة قابلة للمقارنة بين كلا التدخلين، مما يشير إلى عدم وجود زيادة في المخاطر المرتبطة بـ PCRT.الجدير بالذكر أن فعالية PCRT تم تعزيزها من خلال الأدلة التي تشير إلى وجود علاقة جرعة-استجابة، حيث ارتبطت فترات العلاج الأطول بتحسينات أكبر.

الخلاصة :تؤكد هذه الدراسة على الفوائد الفائقة لـ PCRT مقارنةً بـ GE للأفراد الذين يعانون منCLBP ، مع الدعوة إلى برامج تمرين أطول وأكثر تنظيمًا لتحسين النتائج العلاجية. يدعم عدم وجود أحداث ضارة كبيرة مرتبطة بـ PCRT سلامته وقابليته للتطبيق في الإعدادات السريرية. ينبغي أن تركز الأبحاث المستقبلية على استكشاف استراتيجيات الالتزام وتحسين بروتوكولات التمارين لتعزيز مشاركة المرضى وفعالية العلاج.

الكلمات المفتاحية :آلام أسفل الظهر المزمنة، التدريب التدريجي بالمقاومة، العلاج بالتمارين، إدارة الألم، إعادة التأهيل.