

Exercise the Demon
An Updated Approach to Exercise for Low Back Pain

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- I have no conflicts of interest nor financial disclosures

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Objectives

- Review popular historical models surrounding exercise and low back pain in the context of causal clinical reasoning and mechanistic research
- Identify the guidelines for pathological low back pain
- Propose an updated framework of exercise for low back pain based on neurobiological and psychological pain mechanisms
- Discuss current evidence for an updated framework
- Consider key components of exercise selection and prescription for low back pain

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Mechanistic Reasoning

Mechanism: The pathway between a cause and an effect.

Diagnostic Mechanism: **How** a diagnosis causes an effect
 How do weak core muscles cause low back pain
 How do demons cause low back pain

Treatment Mechanism: **How** a treatment causes an effect
 How does exercising increase core muscle strength and thereby decrease low back pain
 How does exercising remove demons and thereby decrease low back pain

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Mechanistic Reasoning and Exercise for LBP

Understanding the mechanisms of our treatment help target the treatment better

Traditionally, exercise has been advocated to decrease back pain via numerous biomechanical mechanism

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Common Hypothesized Treatment-Mechanisms for LBP

<u>Treatment</u>	<u>Mechanism</u>
Motor Control Exercises	→ Coordination of specific muscles fixes dysfunctional movement
Core Stabilization	→ Strength in core muscles protects damage to other back structures
Yoga	→ Flexibility and core strength protect back
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Spinal Manipulation	→ Misaligned joints cause back pain
Directional Preference	→ Reduces disc herniation and takes pressure of painful areas
...	→ ...

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Mechanistic Clinical Reasoning

To determine that a movement dysfunction or tissue pathology (or demons) needs to be treated via exercise for low back pain to improve, we need to establish 5 fundamental truths/conditions, in this order:

- #1. We can accurately and reliably measure the movement dysfunction (e.g., ROM, core instability, posture) or the presence of tissue pathology (e.g., disc degeneration, meniscal tears)
- #2. We can confirm that the measured movement dysfunctions, or the presence tissue pathology, occur in people who have pain and do NOT occur in people who do not have pain
- #3. We have an intervention that can change the movement dysfunction and/or tissue pathology (and, we can measure that change, which is related to #1)
- #4. When we apply this intervention to the movement dysfunction and/or tissue pathology it causes change, and when we don't apply the intervention to the movement dysfunction, there is no change
- #5. When we do change this movement dysfunction or tissue pathology, there is a resolution of symptoms. And when we don't change this movement dysfunction or tissue pathology, there isn't

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Mechanistic Clinical Reasoning

- #3. We have an intervention that can change the movement dysfunction and/or tissue pathology/demons (and, we can measure that change, which is related to #1)
- #4. When we apply this intervention to the movement dysfunction it causes change, and when we don't apply the intervention to the movement dysfunction, there is no change
- #5. When we do change this movement dysfunction or tissue pathology, there is a resolution of symptoms. And when we don't change this movement dysfunction or tissue pathology, there isn't

This is the key research that helps us understand treatment mechanism

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Mediation Analysis

Added onto a randomized controlled trial to understand how a treatment caused an effect on an outcome

Randomized Controlled Trial: PT vs. education for low back disability

A secondary analysis, called a mediation analysis, to determine if changes in a *mediator variable* caused an improvement in the outcome in one group compared to the other

Mediation Analysis: Did a change in strength in the PT group cause the improvement in low back disability compared to the education group

i.e., is strength a mediator between PT and improvement in LBP disability

This is an important question because if we know that strength does mediate the relationship between PT and improvements in LBP disability...we want our exercises to target strength

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Table 2
Causal mediation analysis of pain intensity at 6 months after randomisation.

Variable	Pain catastrophizing (n = 255)	Kinesiophobia (n = 255)
	Mean difference (95% CI)	
Intervention-mediator effect (path a)	-4.17 (-7.17 to -1.17)	-4.65 (-6.70 to -2.60)
Mediator-outcome effect (path b)	-0.03 (-0.09 to 0.03)	-0.00 (-0.09 to 0.09)
TNIE	-0.21 (-0.47 to -0.03)	-0.31 (-0.64 to -0.05)
PNDE	-0.75 (-1.62 to 0.07)	-0.67 (-1.50 to 0.19)
Proportion mediated (treated)	0.20 (0.03 to 1.08)	0.30 (0.03 to 1.45)
Total effect	-0.96 (-1.75 to -0.17)	-0.98 (-1.79 to -0.14)

TNIE = total natural indirect effect; PNDE = pure natural direct effect.

- There was a total effect of -0.96 of Pilates exercises on back pain intensity at 6 months
- Broken down into Total Natural Indirect Effect was of -0.21 and a Pure Natural Direct Effect of -0.75
- In other words, change in pain catastrophizing mediated -0.21 points of the total treatment effect of Pilates on pain intensity
- About 20% (.20) of the treatment effect of Pilates on low back pain intensity was due to a change in pain catastrophizing

Wood et al., *Jour Phys Ther.* 2023

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Low Back Pain Guidelines

CLINICAL PRACTICE GUIDELINES

Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021

2021 Recommendations

A Physical therapists should use exercise training interventions, including trunk muscle strengthening and endurance, multimodal exercise interventions, specific trunk muscle activation exercise, aerobic exercise, aquatic exercise, and general exercise, for patients with chronic LBP.

B Physical therapists may provide movement control exercise or trunk mobility exercise for patients with chronic LBP.

George et al., *JOSPT* 2021

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Low Back Pain Guidelines

CLINICAL GUIDELINE

ACP American College of Physicians®
Leading line of medicine, improving lives.

Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians

Nonpharmacologic

- Exercise: improved pain and function (small effect)
- Motor control exercise: improved pain (moderate effect) and function (small effect)
- Tai chi: improved pain (moderate effect) and function (small effect)
- Mindfulness-based stress reduction: improved pain and function (small effect)
- Yoga: improved pain and function (small to moderate effect, depending on comparator)

Qaseem et al., *ACP* 2017

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Low Back Pain Guidelines

Low back pain and sciatica in over 16s: assessment and management


NICE guideline [NG59] Published: 30 November 2016 Last updated: 11 December 2020

Consider a group exercise program (**biomechanical, aerobic, mind-body, or a combination of approaches**) for people with a specific episode or flare-up of low back pain with or without sciatica. Take **people's specific needs, preferences, and capabilities** into account when choosing the type of exercise.

Nice, 2020

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Low Back Pain Guidelines

 Trusted evidence. Informed decisions. Better health. Cochrane Database of Systematic Reviews

Exercise therapy for chronic low back pain

Jill A Hayden¹, Jenna Ellis², Rachel Ogilvie¹, Armi Malmivaara², Maurits W van Tulder³

We believe that the most effective components and approach of exercise treatments for low back pain patients have yet to be confirmed. Effectiveness studies have only recently raised the importance of considering **likely mechanisms of effect** and **few available trials appear to have planned their interventions considering potentially effective mechanisms**. **Exercise treatments investigated have been heterogeneous in treatment design, dose, delivery format, specific exercise types**

Hayden et al., *Cochrane*, 2021

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Low Back Pain Guidelines

European Spine Journal (2018) 27:1791–1803
https://doi.org/10.1007/s00586-018-5613-2

Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview

Corina E Oliveira^{1,2}, Chris G Maher^{1,2,3}, Rafael P Pires⁴, Adrian C Trappes⁵, Chung-Mei Chen⁶, Jean-François Desautels⁷, Nicolas van Velder⁸, Hui-Mei Kuo^{9,10}

All clinical practice guidelines provided recommendations for exercise therapy. Most guidelines (10 out of 14; 71%) recommend exercise therapy for patients with chronic LBP [1, 3, 7, 11, 15, 20, 26, 28, 31]. Noteworthy, we identified great discrepancy in the type of exercise program (e.g., aquatic exercises, stretching, back schools, McKenzie exercise approach, yoga, and tai-chi) and mode of delivery (e.g., individually designed programs, supervised home exercise, and group exercise). Guidelines provided inconsistent recommendations on exercise therapy for acute LBP.

Oliveira et al., *Eur Spine J*, 2018

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If many different types of exercise can help with low back pain, targeting these specific mechanisms with exercise is probably unnecessary

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But...Exercise is Helpful!

The underlying beneficial mechanism of exercise probably is not biomechanical
 The underlying beneficial mechanism of exercise probably is pain-processing


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Pain Mechanisms of Exercise References

- Lesnak JB, Sluka KA. Mechanism of exercise-induced analgesia: what we can learn from physically active animals. *Pain Rep.* 2020 Sep 23;5(5):e850. doi: 10.1097/PR9.0000000000000850. PMID: 33490844; PMCID: PMC7808683.
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Key Ingredients of Exercise for Pain



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Adherence + Intensity + Duration

Adherence: The patient needs to do it, and not just because you tell them to

Intensity: The intensity of the exercise needs to be sufficient to initiate endogenous and anti-inflammatory processes

Duration: Every little bit helps...but **less more** is more

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Adherence

7 Reasons Why Exercise Sucks
<https://theptinercosolquert.com/2015/10/7-reasons-why-exercise-sucks/>

1. It requires moving
2. Sweating is gross
3. There's not enough time
4. I want to punch the people in workout videos
5. It's embarrassing
6. It hurts
7. It's not fun

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Adherence

What are some barriers to adherence?

Resources

- Time, Equipment, Space, Family responsibilities, other Social determinants

Fear
Pain
Motivation

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Adherence

What are some barriers to adherence?

Resources

- Time, Equipment, Space, Family responsibilities, other Social determinants

Fear
Pain
Motivation

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Fear and Pain

There is a reciprocal relationship between fear and pain
There is a historical belief that exercise, and movement, can cause pain
And, that this pain means something bad is happening

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The Enduring Impact of What Clinicians Say to People With Low Back Pain^(Darlow et al., 2013)

- [The doctor] said most likely it was just a lumbar sprain... when I get that sharp pain, I guess that I've moved in a way that's continually putting strain on an area of the muscle that I've damaged...**my assumption would be that I was making it worse**
- When [the current episode] first happened, the only thing that was going through my mind is the seriousness of my dis-alignment [sic] of my back... I was really petrified...you get scared in the sense that you could damage your spinal cord, or anything, to such an extent that you might become paralyzed
- I injured my back, and I think they described it as...a slipped disc... Something she'd also said to me, "Unfortunately, because you've done this, you have a very high chance of doing it again." Now, I connect any pain that I feel round there to that

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The Enduring Impact of What Clinicians Say to People With Low Back Pain^(Darlow et al., 2013)

- Basically all I've kind of been told to do by physios is to work on my core...I've been tested by various different physios, and Pilates, and I'm apparently ridiculously weak... I had an abortion because I didn't think I could have a baby. I didn't think I could handle it...carrying it, and having extra weight on my stomach
- Do all those things that the physio told me to do. Or not to do... She's told me more what nots [sic] to do, than what to do. So I think those what nots [sic] to do are more important
- I was worried that...I would do things [at work] that would further damage my back... [The doctor] basically said that I shouldn't do any bending or lifting. Which is a lot of the job

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Red and Yellow Flags

Red Flags: Cauda Equine Syndrome, Malignancy, Fracture, Infection

Finucane LM et al. International Framework for Red Flags for Potential Serious Spinal Pathologies. *J Orthop Sports Phys Ther.* 2020 Jul;50(7):350-372.

Yellow Flags: Fear avoidance beliefs, kinesiophobia, pain catastrophizing, expectations for passive treatments, depression, anxiety

Lentz TA, et al. Development of a Yellow Flag Assessment Tool for Orthopaedic Physical Therapists: Results From the Optimal Screening for Prediction of Referral and Outcome (OSPRO) Cohort. *J Orthop Sports Phys Ther.* 2016

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Adherence

Dissociate pain from damage

- Pain science education; Pain neurophysiology education

Associate exercise with analgesia

Discuss maladaptive beliefs

- What do you think will happen if you exercise?
- What do you think the pain means when you exercise?
- What do you think it means if you have increased pain after you exercise?

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Adherence

Elicit behavioral change talk

- What do you think is stopping you from exercising?
- What would it take for you to begin an exercise program?

Design a program that is patient-centered

- What is it that you want to be able to do that you feel like you can't?
- If you were to pick a form of exercise, which type do you think you would want to do?
- How much time do you think is realistic for you to be able to exercise?

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Adherence

Consider the fear-avoidant movements

Break down the movement into small pieces and practice them in a safe environment

- Provide visual reinforcement (e.g., a mirror) to show that they are accomplishing the movement

Build the movement back and bring that movement into the patient's environment

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Adherence - Pain

Green Light
No pain with exercise; Soreness that lasts 1-2 days after. Keep progressing.

Yellow Light
Pain during exercise that is similar intensity to the patient's normal pain, or slightly higher but goes back down after stopping the exercise or within 24 hours. Stay within this exercise

Red Light
Pain increases during exercise by >2 points on NRS. Does not settle down after stopping exercise or within 24 hours. Regress the exercise

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Intensity

Intensity refers to the amount of effort or energy expenditure an exercise (or activity) requires

A common metric used is Metabolic Equivalent Task (MET)

There is a published list of activities and associated METs that can be used to gauge the intensity of an exercise

However, more accurate measures can be used depending on the activity

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Intensity: Metabolic Equivalent Task

Light (1.6-3.0 METs)	Moderate (3.0-6.0 METs)	Vigorous (6.0+ METs)
<ul style="list-style-type: none"> • Walking—slowly • Sitting—using computer • Standing—light work (cooking, washing dishes) • Fishing—sitting • Playing most instruments 	<ul style="list-style-type: none"> • Walking—very brisk (4 mph) • Cleaning—heavy (washing windows, vacuuming, mopping) • Mowing lawn (walking power mower) • Bicycling—light effort (10–12 mph) • Badminton—recreational • Tennis—doubles 	<ul style="list-style-type: none"> • Walking/hiking • Jogging at 6 mph • Shovelng • Carrying heavy loads • Bicycling fast (14–16 mph) • Basketball game • Soccer game • Tennis—singles

<https://www.hsph.harvard.edu/nutritionsource/staying-active>

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Aerobic Intensity: Heart Rate

Measuring Intensity

Intensity can also be measured by a percentage of heart rate

Age-Predicted Maximal Heart Rate (APMHR)

- Fox Equation: $220 - \text{Age}$
- Tanaka Equation: $208 - (0.7 * \text{age})$

Intensity is then prescribed at a percentage of the APMHR

Target Hearth Rate = Target exercise intensity * APMHR

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Intensity: Rate of Perceived Exertion

A crude perceptual-based approach for exercise intensity

Two scales, 0-10 and 6-200

Can loosely carry-over to Target Heart Rate

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RPE and Target Heart Rate

BORG RPE	Modified RPE	BREATHING	% MAX HR
6	0	No exertion	50% - 60%
7			
8	1	Very Light	60% - 70%
9			
10	2	Notice breathing deeper, but still comfortable. Conversations possible.	70% - 80%
11			
12	3	Aware of breathing harder; more difficult to hold a conversation	80% - 90%
13			
14	4	Starting to breathe hard and get uncomfortable	90% - 100%
15			
16	5	Deep and forceful breathing, uncomfortable, don't want to talk	
17			
18	6	Extremely hard	
19			
20	10	Maximum exertion	

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Resistance Intensity: Repetitions in Reserve

- Repetition in Reserve (also called Reps 'till failure) is a measure of the amount of repetitions “in reserve” at the end of one set of an exercise
- The fewer the Repetitions in Reserve, the higher the intensity of the exercise



https://c3rehab.com/

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RPE and RIR

RPE

Rate of Perceived Exertion

- 10 Max Effort. Could not have done any more reps
- 9.5 Maybe could have done 1 more rep
- 9 Definitely could have done 1 more rep
- 8.5 Could have done 1 more rep, maybe even 2
- 8 Definitely could have done 2 more reps
- 7.5 Could have done 2 more reps, maybe even 3
- 7 Definitely could have done 3 more reps
- 6-6 Could have done 4-6 more reps
- 1-4 Very easy to light effort

RIR

Reps in Reserve

- 0 Max Effort. Could have done 0 more reps
- 1 Maybe could have done 1 more rep
- 2 Probably could have done 2 more reps
- 2-3 Could have done 2 more reps, maybe even 3
- 3 Definitely could have done 3 more reps
- 3-4 Could have done 3 more reps, maybe even 4
- 4 Definitely could have done 4 more reps
- 5+ Easily could have done 5 or more reps
- 10+ Very easy to light effort

https://c3rehab.com/

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Exercise Intensity and Duration Guidelines

Exercise intensity needs to be sufficient to elicit the endogenous analgesic effects of exercise

There is no specific intensity guidelines, however, there are physical activity guidelines that can be followed

At least 75-150 minutes of **vigorous-intensity** aerobic exercise week OR 150-300 minutes of **moderate-intensity** aerobic exercise OR a combination of both, per week

At least 2 days of **moderate-vigorous** strengthening exercises involving all major muscle groups

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Intensity Parameter

Moderate Aerobic Intensity: 60%-70% Max HR

Vigorous Aerobic Intensity: 80%-90% Max HR

Moderate Resistance Intensity: 3-4 RIR

Vigorous Resistance Intensity: 0-2 RIR

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Key Takeaways

- We know exercise helps but we don't know HOW it helps (i.e., the mechanism)
- Assess psychological readiness/fear to exercise and use behavioral-change talk
- Develop patient-centered exercise programs based on their preferences, readiness, and resources
- **Sweat** the big stuff (adherence, intensity, duration), not the small stuff (ideal muscle activation, single joint exercises/stretches)

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