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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| In a 53-year-old adult male suffering from chronic low back pain, would reinforcing optimal diaphragmatic breathing mechanics or deep breathing instead of using medicinal methods, such as opioids, better manage and/or reduce their pain? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| During my time at the outpatient clinic in Smithfield, I saw a 53-year-old male who suffered from chronic low back pain for approximately 14 months. At the time of evaluation, he was taking opioids to manage his pain unsuccessfully (his Visual Analog Scale score was 8/10). In addition, the patient had a past medical history of asthma. He reported undergoing physical therapy in the past that had successfully treated his pain. In class, we had a lecture discussing chronic pain and how it is perceived peripherally, centrally in the brain, and biobehaviorally. I decided to research whether using diaphragmatic breathing as an intervention can reduce pain by reorganizing muscle recruitment for healthy breathing patterns, how the brain perceives pain through neurotransmitters, and better coping mechanisms for dealing with stressful situations. This is relevant to clinical practice because of the opioid epidemic. In the upcoming years, PT’s will be at the forefront of treating chronic pain and this may be a viable option to intervene in combination with other techniques. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * Four randomized control trials, two case-control studies, one systematic review, and one case-series met the inclusion/exclusion criteria for this CAT.
* No literature was found that reported on using diaphragmatic breathing as an independent intervention for chronic low back pain, nor if it is comparable to opioids for pain management. Studies found focused on breath therapy, inspiratory muscle training, or other holistic interventions in conjunction with diaphragmatic breathing.
* Chronic low back pain is prevalent in individuals who suffer from respiratory disorders and vice versa.
* Breath therapy with diaphragmatic breathing may be an effective alternative to treat chronic low back pain.
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**CLINICAL BOTTOM LINE**

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| Those who suffer from low back pain are more likely to have a respiratory disorder, and vice versa. These individuals may benefit from undergoing breath therapy or retraining in diaphragmatic breathing to reduce pain. Reductions in pain were found to be maintained for up to 6 months after the intervention. At this time, more high-quality studies are necessary to determine the effectiveness of this intervention independently from other treatments.  |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| low back painChronic low back painMeSH low back pain | diaphragmatic breathingbreathing techniquesdeep breathing | OpioidsPain medication | Pain |

**Final search strategy (history):**

*Show your final search strategy (full history) from PubMed. Indicate which “line” you chose as the final search strategy.*

1. Adult
2. “low back pain” OR “chronic low back pain”
3. “diaphragmatic breathing” OR “breathing techniques” OR “deep breathing”
4. Opioids OR pain medication
5. pain
6. #1 AND #2 AND #3 AND #4
7. #2 AND #3 AND #4
8. Low back pain [MeSH Terms]
9. #3 AND #8
10. low back pain OR chronic low back pain OR lumbar pain OR nonspecific low back pain OR lumbar spine pain
11. #3 AND #10
12. Breathing pattern
13. #3 OR #12
14. #10 AND #13

*In the table below, show how many results you got from your search from each database you searched.*

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed****CINHAL****Web of Science** | **14****8****146** | **Limits were not applied due to narrow results** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| * Studies including breathing mechanics or diaphragmatic breathing to treat chronic low back pain
* Articles discussing side effects of using opioids or pain medication to treat chronic low back pain
* Studies focusing on female and male adults aged from 30-40 years old
* Limited to English language
* Limited to past 15 years.
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| **Exclusion Criteria** |
| * Studies that use exercise as primary alternative for pain instead of medication
* Studies geared to elder adults
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**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

*For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).*

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| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| **Kim (2013)1** | **PEDro: 5/10** | **2b****(Poorly reported)** | **High** | **Randomized Control Trial** |
| **Hansen-Honeycutt (2016)2** | **Downs and Black Checklist: 9/26** | **4** | **Moderate** | **Nonexperimental, Descriptive, Case Series** |
| **Roussel (2009)3** | **Downs and Black Checklist: 12/26** | **3b** | **Low** | **Nonexperimental, Analytical, Case-Control** |
| **Beeckmans (2016)4** | **AMSTAR: 7/11** | **2a****(used mostly cohort and cross-sectional studies)** | **Moderate** | **Systematic Review** |
| **Mehling (2005)5** | **PEDro: 5/10** | **2b****(low retention rate)** | **High** | **Randomized Control Trial** |
| **Mohan (2018)6** | **Jewell text: 6/9** | **4** | **Low** | **Retrospective, Nonexperimental, Case-Control (Prognostic)** |
| **Janssens (2015)7** | **PEDro: 5/10** | **2b** | **Moderate** | **Randomized Control Trial** |
| **Szczurko (2007)8** | **PEDro: 7/10** | **1b** | **High** | **Randomized Control Trial** |

\*Indicate tool name and score

\*\*Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

**BEST EVIDENCE**

The following 2 studies were identified as the ‘best’ evidence and selected for critical appraisal. Rationale for selecting these studies were:

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| * **Mehling (2005)**
	+ **Fair quality RCT according to PEDro Scale**
	+ **Fair Level of Evidence**
	+ **Utilizes the Visual Analog Scale and Short Form-36 as outcome measures, which are appropriate to measure the change in patient’s pain and quality of life**
* **Beeckmans (2016)**
	+ **Fair quality Systematic Review**
	+ **Moderate risk of bias**
	+ **Good Level of Evidence**
	+ **Large sample of studies**
	+ **Large sample of participants in each study**
	+ **Shows a strong correlation between respiratory disorder and low back pain**
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**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of Randomized, controlled trial of breath therapy for patients with chronic low-back pain by Mehling WE, Hamel KA, Acree M, Byl N, Hecht FM (2005)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The aim of this study is to determine the effectiveness of breath therapy versus physical therapy on patients with low back pain. |
| **Study Design**[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| * **Design:** Stratified and Blocked Randomised Control Trial
* **Allocation:** Researchers first randomly assigned participants to breath or physical therapy, then a computer-generated random-sequence table to divide patients into permuted blocks of four strata: pain source (<7 or >or equal to 7 cm on a Visual Analog Scale or VAS of 0 to 10) and pain duration (continuous pain for <6 months or greater than or equal to 6 months).
* **Blinding:** patients were not blinded to the intervention, but group assignment was made using opaque, sequentially-numbered, sealed envelops
* **Intervention:** One group received physical therapy while the other received breath therapy. Two groups received a 60-minute evaluation session followed by 12, 45-minute individual therapy sessions over 6-8 weeks. However, one group received breath therapy and the other group received physical therapy. Patients were expected to complete a 20-30-minute home exercise program everyday given by the breath therapists and physical therapists.
* **Data Collection:** Patients were assessed at the evaluation for a baseline measure, six to eight weeks, and six months after the intervention for a follow-up
* **Primary Outcome Measure:** Pain intensity was measured by the 10 cm VAS, Roland-Morris Disability Questionnaire-16 measured low back pain-specific disability, and Short From-36 to measure overall health
* **Statistical Methods:** Baseline measures were compared between groups using a t-test and Fisher exact test. Overall outcomes were compared between groups by repeated measures of analysis of variance and pre-/post- tests were compared within groups by paired f-tests and between groups by t-tests. 95% confidence intervals were used. The study was powered with a two-sided alpha of 0.05 and beta of 0.20.
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| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| The study states that the setting is an academic medical center, but it does not explicitly state which center it is. It is assumed that the study took place in California due to the therapists being from California and the review board from the University of California approving the study. |
| **Participants**[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| * **N** = 36, 18 to physical therapy intervention and 18 to breath therapy
* **Dropout:** 8 participants (2 in breath therapy and 6 in physical therapy) dropped out before evaluation. Of the 16 remaining participants receiving breath therapy (considered intended to treat), 1 dropped out after 2 sessions due to psychological distress and another left before the post-intervention measurements due to being unable to schedule. Of the 12 subjects receiving physical therapy (considered intended to treat), 1 left after 6 sessions for unknown reasons and was lost to follow up, 2 did not complete all 12 sessions, and 1 stopped after 10 sessions due to increased symptoms.
* **Diagnosis**: chronic low back pain with or without leg pain
* **Eligibility criteria**: 20-70 years old, 3-24 months of symptomatic low back pain, previous treatment from a primary care physician for their low back pain, fluent in English. Patient could not have undergone a previous spinal surgery, compensation for problems related to their back pain, abuse alcohol or drugs, mental or psychological impairments, or other diseases related to pain.
* **Recruitment:** Flyers posted in university-based care clinics, referrals from primary care providers in the same university-based care clinics, referrals from a full research study of yoga for low back pain, and the university medical center database was checked for potential patients to which letters signed by primary care physicians were sent to these patients to inform them about the study
* **Type of Sample:** Purposive; interested patients were pre-screened for eligibility
* **Demographics:** Breath therapy; mean age was 49.7 +/- 12.1, 31.3% male/ 68.7% female, median education was a college degree, 87.5% were on pain medication at baseline, 75% received PT in the past, median pain duration of 11.6 +/-5.9 months. Physical therapy; mean age was 48.7 +/- 12.5, 41.7% male/ 58.3% female, median education was a college degree, 83.3% were on pain medication at baseline, 91.7% received PT in the past, median pain duration of 13.7 +/-5.9 months
* **Baseline variables:** 3/5 postural sway tests demonstrated significantly worse results in the physical therapy group (Normal stance/eyes closed: p = 0.3, single leg stance: p = 0.2, head back/eyes closed: p = 0.2). All other variables did not demonstrate significant differences between groups at baseline.
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| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| * Active-control group led by experienced physical therapists on faculty from the Department of Physical Therapy and Rehabilitation Science
* Participants underwent a thorough 60-minute evaluation session followed by 12, 45-minute individual physical therapy sessions over 6-8 weeks at the academic medical center.
* Therapy included individualized strategies including soft-tissue mobilization, joint mobilization, strengthening, functional task performance, back-related education, postural righting exercises, flexibility, pain relief, and stabilization.
* Participants given a 20-30-minute home exercise program to complete daily
* Patients required to journal daily about treatment, their experience, or thoughts about their pain/life
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| *Experimental* |
| * Experimental group led by experienced breath therapists who worked at the Middendorf Breath Institution followed a study protocol created by the Director of the Middendorf Breath Institute.
* Participants underwent a thorough 60-minute evaluation session followed by 12, 45-minute individual sessions that followed the protocol, but allowed for variance over 6-8 weeks at the academic medical center.
* A session included guided breathing to bring the participant’s attention to movements in the back using verbal and tactile cuing from the breath therapist. Tactile cues included gentle pressure, holding, or gentle stretching of the back, neck, and legs to enhance allocation.
* Participants given a 20-30-minute home exercise program to complete daily
* Patients required to journal daily about treatment, their experience, or thoughts about their pain/life
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| **Outcome Measures**[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| * Pain intensity was measured by the 10 cm Visual Analog Scale (VAS)
	+ The VAS is a self-reported assessment of pain intensity by approximating ratio-level scales.9 It is typically 100 mm with 0 being described as “no pain” and 100 being described as “worst pain imaginable.” Patients then mark where on the continuum perceive their pain.10 For a minimum clinically important difference, a change of 30.0 mm must occur.11
* Roland-Morris Disability Questionnaire-16 (RMQ)
	+ The RMQ is a patient reported outcome measure used to assess a patient’s perceived disability in relation to their low back pain. Scores range from 0, meaning no disability, to 24, meaning maximum disability. Research suggests that a minimum clinically important change to occur, a change of 2.5-5 points must occur.12
* Short Form-36
	+ A patient-reported outcome that assess a patient’s overall health and health-related quality of life.
	+ The SF-36 is broken up into the following 8 subcategories: physical functioning, bodily pain, role limitations due to physical health problems, general mental health, social functioning, energy/fatigue or vitality, and general health perceptions. These subcategories are individually scored and then totalled for a summed score, however, each subscale can be used individually. The scale range is from 0, meaning negative health, to 100, meaning positive health.13
	+ The MCID for the SF-36 is 7-16 points.14
* Postural sway was analysed by Sensory Organization Test (SOT) and a force plate
	+ The SOT assesses a patient’s balance based on visual, vestibular, and proprioceptive components. It enables researchers to see if the patient has poor balance due to one or multiple of the components mentioned above.
	+ The SOT is the composite of the Equilibrium Score. The patient is scored on a continuum where 0 exceeds the limits of stability to 100 which conveys perfect stability.5
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| **Main Findings**[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.] |
| The primary outcome measures of pain using the 10 cm VAS, the bodily pain portion of the SF-36, and the RMQ are relevant to the clinical question for this CAT. The results are reported below:

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|   | **Breath Therapy** | **Physical Therapy** | **P value within groups** | **P value between groups** |
| **Mean VAS score at Baseline (cm)\*** | 5.15 (±2.04) | 4.37 (±2.36) |   | 0.36 |
| **Mean changes from Baseline to Post intervention\*** | -2.71 (± 2.23) | -2.43 (± 2.05) | <0.005 | 0.74 |
| **Mean changes from Baseline to 6 months post intervention\*** | -1.71 (±2.12) | -2.45(±2.55) | <0.006 | 0.56 |
| \*scores reported as mean ± SD in cm |

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|   | **Breath Therapy** | **Physical Therapy** | **P value between groups** |
| **Mean SF-36 bodily pain score at Baseline**  | 50.1 (±16.6) | 42.3 (± 16.0) | 0.23 |
| **Mean changes from Baseline to Post intervention** | +14.9 (±1.5) ¶ | +21.0 (± 2.48)\*\* | 0.45¥ |
| **Mean changes from Baseline to 6 months post intervention** | +14.6 (± 19.5) § | +27.0 (± 22.6) ¶ | 0.27£ |
| \*scores reported as mean ± SD, ¥ byt-test, £ by repeated measures ANOVA for the 3 time points, p value within groups \*\* p < 0.05, § p < 0.01, ¶ p < 0.005 |

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|   | **Breath Therapy** | **Physical Therapy** | **P value between groups** |
| **Mean mRMQ score at Baseline**  | 6.7 (± 3.3) | 6.6 (± 4.0) | 0.94 |
| **Mean changes from Baseline to Post intervention** | -4.28 (± 5.92) § | -3.13 (± 6.90) | 0.51¥ |
| **Mean changes from Baseline to 6 months post intervention** | -3.72 (± 6.03)\*\* | 5.18 (± 5.90)\*\* | 0.53£ |
| \*scores reported as mean ± SD, ¥ byt-test, £ by repeated measures ANOVA for the 3 time points, p value within groups \*\* p < 0.05, § p < 0.01, ¶ p < 0.005 |

* 10/14 participants in the breath therapy group improved their V score by 2 points while, 6/12 participants in the PT group improved their score by 2 points, which was considered clinically significant according to repeated measures taken by ANOVA for the baseline, after the intervention, and the follow-up 6 months after the intervention. P value for the between group difference was 0.42.
* 10/14 participants in the breath therapy group improved their V score by 3 points while, 6/12 participants in the PT group improved their score by 3 points, which was considered clinically significant according to repeated measures taken by ANOVA for the baseline, after the intervention, and the follow-up 6 months after the intervention. P value for the between group difference was 0.42.
* Odds ratio for clinically significant improvement of breath therapy compared to physical therapy in the VAS was 2.5 (95% CI 0.5-12.6). After adjustment for demographic variability, OR was 1.4, with a 95% CI 0.1-26.4
* Adjusted odds ratio for clinically significant improvement of breath therapy compared to physical therapy in the VAS was 8.6 (95% CI 0.7-101.4)
* During the 6-8 weeks the intervention was completed, 71% of the participants in the breath therapy group demonstrated clinically significant improvement in the VAS and RMQ, while only 50% of the participants in the physiotherapy group demonstrated clinically significant improvement in the VAS and RMQ as determined by ANOVA for the baseline, after the intervention, and the follow-up 6 months after the intervention
* At the 6-month follow-up, the breath therapy group showed that 40% of participants still showed improvements that were clinically significant in the VAS and 72% for the RMQ. The physical therapy group showed that 45% of participants showed improvements that were clinically significant in the VAS and 72.7% of participants for the RMQ. The t-test was utilized for the RMQ results.
* 5/15 participants in the breath therapy group experienced a relapse in pain, meaning their pain increased by 3 or more points from their original score on the VAS, while only 1/11 participants in the physical therapy group experienced a relapse.
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| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| While both groups showed clinically significant improvements, there was not a significant difference between groups. While physical therapy remains the gold-standard treatment for those suffering from chronic low back pain at this time, breath therapy demonstrates an equal effectiveness for patients suffering chronic low back pain who have been or are currently being treated with pain medication. |
| **Critical Appraisal** |
| **Validity**[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| * PEDro Scale score: 5/10
	+ Random allocation: Yes; Allocation concealed: Yes; Comparable at baseline: Yes; Blinding of subjects: No; Blinding of therapists: No; Blinding of assessors: No; Adequate follow-up: No; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point measures and variability: Yes.
* Strengths: 1) The study conducted a blocked and stratified randomization of the participants, making the participant’s demographics similar. 2) The study included an intention-to-treat to limit the amount of bias to determine if breath therapy is indeed a more effective treatment than physical therapy. 3) Finally, the study provided between-group comparisons allowing researchers to determine if one intervention was better than another.
* Limitations: 1) The age range of the participants was large allowing room for error, 2) The study had a significant drop-out rate in both groups, leaving the effect size small. In addition, the statistical power was insufficient due to the small sample size and drop out. 3) The investigators state that there was a protocol for each intervention, however, they later state that the intervention was customized to the participant. 4) This study is at risk for bias because the assessors were not blinded to the results and who received what therapy, nor did they search at least 2 separate databases. 5) The authors only used PubMed/MEDLINE for their articles, placing the paper at risk for publication bias.
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| **Interpretation of Results**[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| At baseline, the participants demonstrated comparable measures between groups in mean VAS scores with p = 0.36, the bodily pain portion of the SF-36 with p = 0.23, and the RMQ with p = 0.94, showing that the participants were adequately randomized. Furthermore, a majority of participants were on medication to manage pain (83.3-87.5%) unsuccessfully. The p-values for baseline measures suggest that the study was adequately randomized because participants were similar between groups at baseline, allowing them to be comparable. However, the authors reported that their study was insufficiently powered. This could be due to the large age range, large drop-out number, and small sample size. The study was powered to detect a difference of 2.3 cm in the mean average of the VAS and a difference of 6.6 in the mean average of the RMQ assuming a two-sided alpha of 0.05 and beta of 0.20. While effect size was demonstrated within a group in Table 2, the authors did not report it between groups. They only made a statement that a small effect size was common in studies that reported about chronic low back pain.For there to be a minimal clinically important difference in the VAS, a change of at least 3 points must occur according to Lee et al, while the authors used a 2-point difference to determine a clinically significant change. While both groups improved, neither group demonstrated this clinically significant change at the end of their intervention or at the 6-month follow-up if Lee et al’s MCID is used. In fact, the BT group demonstrated a regression at the 6-month follow-up, while the PT group was able to maintain their progress. If the author’s 2-point change is used, the BT and PT group showed an improvement in pain at the end of the intervention, but only the PT group maintained that change at the 6-month follow-up. Furthermore, the reported CI’s had extremely large ranges that included 0, suggesting that the difference between the two groups are not statistically significant. Finally, the p-values between groups indicated that BT was not a better treatment than PT. For the RMQ, a 2.5-5-point difference must be obtained for there to be a MCID according to Roland et al. The authors specified that they used a 3-point change to demonstrate significance. At the end of the intervention as well as the 6-month follow-up, both groups demonstrated this change, but the PT group continued to improve, while the BT group showed some regression. Again, the CI’s had extremely large ranges that included 0, suggesting that the difference between groups are not statistically significant, and the p-values between groups indicated that BT was not a better treatment than PT. For bodily pain portion of the SF-36, a 5-16-point difference must be observed for a MCID according to Lauridsen et al. While both groups exhibited a clinically significant improvement in their scores, the PT group showed a larger difference. The PT group also showed an increased score at the 6-month follow up, while the BT group maintained their average. Again, the CI’s had extremely large ranges that included 0, suggesting that the difference between groups are not statistically significant, and the p-values between groups indicated that BT was not a better treatment than PT.It is important to note that while both interventions were given a protocol to follow, the therapists individualized the treatment to the patient. The authors noted that several of the participants received similar treatments because the physical therapist included teaching some of their participants diaphragmatic breathing as well as mental imagery techniques. This overlap could explain why no real differences were found between groups.Although the results suggest that BT is an equal, beneficial treatment to PT, the reader feels that the treatment between groups was convoluted due to the previously mentioned integration of retraining in diaphragmatic breathing for those in the PT group. In order to make a better conclusion, more research needs to be completed with a stronger protocol with two different interventions to truly determine if one treatment is better than another. |
| **Applicability of Study Results**[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This study included a patient population that is similar in age and characteristics to the reader’s patient who was a 53-year-old male and suffered from low back pain for approximately 14 months. He had received PT treatment in prior years, similarly to the participants in the study, which he reported had helped. Furthermore, the reader’s patient was taking oral opioids at the time that were not managing his pain. This study included participants who were still experiencing low back pain despite being treated with pain medication. While BT was not proven to be a better therapy than PT, both PT and BT incorporated diaphragmatic breathing into their treatment and all participants showed an improvement in pain and function. This suggests that diaphragmatic breathing may be beneficial as an intervention, however, more research is required to make this conclusion.With that in mind, the reader would implement diaphragmatic breathing into my treatment for this patient in conjunction with other interventions to decrease the patient’s pain. |

**(2) Description and appraisal of The presence of respiratory disorders in individuals with low back pain: A systematic review by Beeckmans N, Vermeersch A, Lysens R, Van Wambeke P, Goossens N, Thys T, Brumagne S, Janssens L (2016)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this systematic review was to determine if there was a correlation between respiratory dysfunction and low back pain. |
| **Study Design**[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| * **Design:** Systematic Review
* **Search Strategy:** Two individual reviewers searched PubMed/Medline for articles ranging from the 1950’s – January 2016. The search string included the following: low back pain [MeSH], dyspnea [MeSH], respiratory problems, lung diseases [MeSH], comorbidity [MeSH], pulmonary disease, chronic obstructive [MeSH], smoking [MeSH], asthma [MeSH], allergy, sinusitis [MeSH], respiratory tract infection [MeSH], hyperventilation [MeSH].
* **Eligibility criteria:** Articles must be published in Dutch or English from the 1950’s to January 2016. They must include original, human data, as well as an abstract or conference proceeding. The article must have the full text available and the content must meet the topic. Participants in the studies had to be male or female adults at least 18 years old who suffer from a diagnosed respiratory disorder and low back pain. Finally, the articles selected had to research if there was a co-occurrence or causality between low back pain and a respiratory dysfunction.
* **Risk of Bias:** Two independent reviewers assessed the studies using STROBE for the cohort, case-control, and cross-sectional studies selected. The reviewers then summarized the results qualitatively. Other authors were brought in to resolve any disputes between the two reviewers.
* **Data Collection and Analysis:** If the studies met the inclusive criteria, then two reviewers extracted the following information from the relevant articles: “study design, sample size, sex, age, type of low back pain, type of respiratory disorder, and the main study results.” (pg 78)
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| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| The article did not state where the study took place, but it is assumed it was conducted in a hospital or academic center. |
| **Participants**[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| * The systematic review included 16 studies with a STROBE score ranging from 45% - 87%. All the articles level of evidence was rated as a B using the GRADE assessment.
* Of the 16 studies, 10 were cross-sectional studies, 4 were cohort studies, 1 was a case study, and 1 was a longitudinal study. All of which correlated several respiratory disorders (asthma, smoking, COPD, respiratory infection, allergies, dyspnea, non-specified respiratory disorder, and other) to acute or chronic low back pain.
* Sample sizes for each study ranged from 60-266,000 participants. Studies included males alone, females alone, or males and females aged from 18-75+ years old.
* Participants were diagnosed with a respiratory disorder and suffered from acute or chronic low back pain.
* No specific outcome measures were used for all included studies in this systematic review.
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| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| This article compared the data qualitatively, therefore, no interventions were utilized. In addition, many of the articles used in the systematic review wanted to determine the prevalence of an outcome (low back pain) in individuals with the prognostic risk factor (respiratory disorders). However, a few of the articles selected by the authors of the review incorporated a control group of individuals without the prognostic factor. |
| *Experimental* |
| There were no real interventions utilized in this systematic review. A few articles considered the group with a respiratory disorder and low back pain as the interested or experimental group. |
| **Outcome Measures**[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| * A total of 5 studies utilized odds ratio to determine if there was a relationship between respiratory disorders and low back pain.
* Two studies reported prevalence of back pain in the studied population
* One study reported the observed/expected ratio
 |
| **Main Findings**[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.] |
| * Dyspnea
	+ One study reported a correlation between dyspnea and low back pain. The study found that those with dyspnea had a higher prevalence of pain (64%) than those who did not (18%). The relative risk for back pain was 1.76 with a 95% confidence interval of 1.71-1.82 after adjusting for other influential factors such as emphysema, asthma, COPD, obesity, and smoking, depression, and ADL impairments. The relative risk increased to 3.26 with a 95% confidence interval of 3.06-3.46 once socio-demographic and health-related variables were adjusted.
* Non-Specified Respiratory Disorder
	+ 5 articles found a positive correlation between low back and non-specified respiratory disorders
	+ 3 articles applied this correlation and researched it for women of different age categories. Young women had a 1.43 and 1.38 odds ratio of developing low back pain if they were recently diagnosed with an acute respiratory disorder versus already having a chronic respiratory disorder, middle-aged women had a 1.13 and 1.63 odds ratio, and older women had a 1.09 and 2.11 odds ratio. The reverse was also true, that women who have low back pain had an increased chance of developing a respiratory disorder with an odds ratio of 1.3 (1.0-1.6 95% confidence interval).
	+ Furthermore, an additional article showed that the prevalence of low back pain increased as a person’s comorbidities did. The prevalence of back pain observed was 79.13 versus the prevalence expected which was 71.55, delta+7.58
* Asthma
	+ A total of 5 articles were able to show a correlation between those who have asthma and low back pain. Those who had a history of asthma had a greater probability of reporting low back pain and vice versa with a p value less than 0.05.
	+ Those who suffer from asthma had a 30% higher prevalence of back pain than those who did not have asthma.
	+ It was most common in people aged 20-39 years old
* Allergy
	+ Two articles did not find a correlation between allergies or atopic eczema and low back pain.
	+ However, another article did find a correlation between hay fever (odds ratio of 1.21 with a 95% confidence interval of 1.06-1.38) as well as allergic contact dermatitis (odds ratio of 1.47 with a 95% confidence interval of 1.29-1.67) and low back pain.
	+ A correlation between allergic urticaria or food allergies with low back pain.
	+ Those suffering from an allergy are 50% more likely to suffer from low back pain.
* COPD
	+ Authors reported that studies have shown a prevalence of low back pain in 69% and 58% in those suffering from COPD, while the general population reported that 11-84% and 3.9-65% did experience back pain.
	+ Acute versus chronic back pain did not affect treatment time of the pain.
* Respiratory Infections
	+ A positive relationship was found between those suffering from a respiratory infection and low back pain in men and women
	+ Women: 25-44 years old (odds ratio 1.31, 1.11-1.55 95% confidence interval), 45-64 years old (odds ratio 1.51, 1.30-1.76 95% confidence interval), and 65-74 years (odds ratio 1.33, 1.00-1.76 95% confidence interval)
	+ Men: 45-64 years old (odds ratio 1.52, 1.3-1.78 95% confidence interval)
 |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| Researchers have concluded that there is a correlation between those who suffer from a respiratory disorder, specifically dyspnea, asthma, some allergies, and respiratory infections, and low back pain. Those with a respiratory disorder are commonly found with an altered breathing pattern as well as poor functioning diaphragm, which has been found to cause instability in the lumbar spine resulting in pain.  |
| **Critical Appraisal** |
| **Validity**[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| * AMSTAR score: 7/11
	+ A Priori design was included; Two independent authors selected articles, extracted data from the selected article, and additional authors brought in for disagreements; A comprehensive literature search was not conducted; status of publication was not used; A list of included and excluded studies were not provided; the characteristics of the included study were provided; the scientific quality of the included studies were provided; A test was not used to test the homogeneity of the articles chosen but authors explained that the data was not suitable for statistic pooling due to the article’s heterogeneity; the likelihood of publication bias was not assessed; conflict of interest was included.
* Strengths: The authors assessed each article individually for risk of bias using the STROBE assessments, as well as their level of evidence by using the GRADE assessment. All the selected articles were ranked as a B for level of evidence according to the GRADE assessment. Two main authors were utilized to select, extract, and review the data. If any disagreements occurred, other authors were brought in to resolve them. Furthermore, the risk of bias of each individual article used was determined. Authors did provide a time frame for the included studies (1950 – January 2016). Finally, the articles selected for the review covered together a wide range of ages, both sexes, and included a high number of participants. Furthermore, 13 out of 16 of the studies included over 5,000 participants in their study.
* Weaknesses: Due to the heterogeneity of the articles’ designs, the data extracted was not statistically pooled. However, authors did explain that they could not due to the heterogeneity of the articles. Instead, other authors were brought in to resolve any disagreements between the two original authors. Furthermore, the study is at risk for publication bias because only one database, PubMed/MEDLINE, was utilized. While the authors did state the number of articles excluded and why they were excluded using a flowchart, they did not provide a list of the excluded articles.
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| **Interpretation of Results**[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| The systematic review provides several cohort, cross-sectional, and case-control studies that show a clear correlation of low back pain and respiratory disorders across many ages and both sexes. Several studies reported a positive odds ratio within the confidence interval provided and did not include 1, specifically in those suffering from dyspnea, asthma, allergies, and respiratory infections. This means that those with a respiratory diseases (dyspnea, asthma, some allergies, and respiratory infections) are not suffering from low back pain by chance, instead, there is a clear correlation. Those with a respiratory disorder have an increased chance in developing or having low back pain. Several studies also determined the reverse to be true, that those who report low back pain show increased odds of developing or having a respiratory disfunction. Based on the statistics, the large number of participants, and range across the life span, it is fair to say that there is a relationship between experiencing low back pain if there is a respiratory disorder present and vice versa, however, this does not prove there is a causal relationship present.It is important to take note that high-level, strong research is lacking at this point and time. There were no randomized control trials reported in this study, nor did the researchers conduct a meta-analysis on the articles they did provide. The studies chosen showed no homogeneity, making it impossible for the authors to statistically pool the data. Moreover, the authors only searched one database, placing this systematic review at high risk for publication bias.  |
| **Applicability of Study Results**[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| The 16 studies chosen covered a wide range of demographics when combined. Ages ranged from 12 to 75+ years old and included males, females, or both males and females, making it applicable to the patient. Furthermore, the patient reported having a past medical history of asthma, similar to some of the participants in the articles discussed in the review. While the article did not answer the reader’s PICO question directly, it did show a correlation between having a respiratory disorder and low back pain in males and females across the lifespan. The reader would recommend that those suffering from low back pain, a respiratory disorder, or both be evaluated by a physical therapist to determine if the patient’s diaphragm is functioning optimally and if there is weakness present in the inspiratory muscles instead of recommending the patient be placed on medication.  |

**SYNTHESIS AND CLINICAL IMPLICATIONS**

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

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| Between the years 2000-2010, the prescriptions for opioids written by physicians increased from 164 million to 234+ million.15 Consequently, opioid related trips to the emergency department increased to 150-200%. Moreover, 18,893 patients died in 2014 from a prescription drug overdose.15 Unfortunately, physicians are still quick to write a prescription for an opioid medication to manage their patients’ low back pain as suggested by the data from insurance claims.16 On October 26, 2017, President Trump officially declared the United States of America’s opioid crisis as a Public Health Emergency.17 In order to appropriately overcome this epidemic, a multidisciplinary approach must be taken to manage these patients’ pain. This includes utilizing physical therapy. Physical therapy can to be a crucial step for those suffering from low back pain because therapists are trained to assess the presence of musculoskeletal movement disorders, which includes diaphragmatic disorders. Lack of diaphragm excursion and increased fatigability is common in those suffering from a respiratory disorder, which has been associated with an increased risk of developing or having low back pain.4 The reverse is also true; those with low back pain are at an increased risk of developing or having a respiratory disorder. Beeckman et al reviewed a total of 16 low-level research articles that exhibited an increased odds ratio for developing low back pain if the patient has a past medical history of dyspnea, asthma, allergies, and respiratory infections. Furthermore, those suffering from low back pain are more likely to develop one or more afore mentioned respiratory disorders. Because of this interrelation, one could deduce that if a patient’s diaphragm is treated with regard to breath, the patient should experience a decrease in back pain. Mehling et al investigated this concept in his study by comparing two interventions: breath therapy and physical therapy. Researchers determined that breath therapy is comparable to physical therapy in decreasing patients’ low back pain, however, the patients who underwent physical therapy exhibited greater long-term effects than those who participated in breath therapy. These articles are applicable to the patient scenario described previously because of the patient’s age, location of pain, duration of symptoms, and current use of opioids to manage pain without success. While it was clear that breath therapy alone was not enough to rid patients of their pain, those who received training in diaphragmatic breathing in addition to soft-tissue mobilization, joint mobilization, strengthening, functional task performance, back-related education, postural righting exercises, flexibility, pain relief, and stabilization, demonstrated statistically and clinically significant improvements on their bodily pain portion of the SF-36 and mRMQ. These results suggest that correcting breathing techniques may actually be the foundation from which the reduction of true lower back pain may begin. However, both of these articles demonstrated significant limitations. Beeckmans et al showed strong biases by only searching one database for articles to answer their hypothesis. In conjunction, the authors only reported on lower-level research articles. No randomized control trials were included, nor were any outcome measures utilized because no strong research exists at this time. The articles chosen did not demonstrate homogeneity, therefore no statistical or a meta-analysis could be conducted to better determine if a causal relationship existed between chronic low back pain and a respiratory disorder. The Mehling article failed to enforce protocol to provide two clear, separate interventions, making it difficult to truly determine if breath therapy is better, the same, or worse than physical therapy in treating back pain. In order to truly determine if this relationship exists, and if training individuals in proper breathing techniques, more research must be conducted. Future studies should include randomized control trials that incorporate functional outcome measures such as the VAS, mRMQ, and the bodily pain portion of the SF-36, blinded allocation, and blinded data analysis to reduce the risk of bias. Groups should include a control group who receive no hands-on treatment, a group who receives just physical therapy with no integration of diaphragmatic breathing, and a final group who just receives breath therapy, specifically diaphragmatic breathing. By enforcing stricter protocols or specific interventions, clinicians will be able to truly determine if diaphragmatic breathing has an effect on decreasing low back pain. While improving a patient’s diaphragmatic breathing in order to control a causal root of pain is important, many may still require the addition of physical therapy interventions in order to alleviate low back pain in its entirety. If reliable research can be done to demonstrate the direct correlations between proper breathing and other techniques, similar to what Mehling et al’s physical therapy group provided, then strong statistical and clinical results showing this improvement in lower back pain will allow physicians the confidence to refer more patients to physical therapy instead of prescribing opioids. Thus, by decreasing the number of prescriptions, there could be serious headway in tackling this Public Health epidemic.  |

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