

## Review

# Breathing technique in pain and cognitive function: a systematic review of the literature

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### Abstract

Breathing techniques are key components of yoga, meditation and relaxation practices that are well known for reducing anxiety and improving overall well-being. To evaluate the efficacy of breathing techniques in pain and cognitive function. We conducted a literature review searching the main literature databases (medline, lilacs, Cochrane library) including randomized clinical trials. We assessed the risk of bias of the included studies using the methodology proposed by the Cochrane collaboration. In total, we found 16 studies that met the inclusion criteria, with an intermediate or unclear overall risk of bias. When combining the different breathing techniques vs control in the included studies, we found a statistically significant difference in terms of the visual analog scale (Difference of means, random effects; -1.21 [95% CI -1.75 to -0.68]; I<sup>2</sup>: 95%). Meditation-based breathing techniques would improve pain and cognitive function in patients with a painful entity or healthy volunteers. **Keywords:** Breathing techniques; pain; cognitive function; systematic review; breath holding

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## Técnicas respiratorias en dolor y función cognitiva: revisión sistemática de la literatura

### Resumen

Las técnicas de respiración son componentes clave de las prácticas de yoga, meditación y relajación que son bien conocidas por reducir la ansiedad y mejorar el bienestar general. Evaluar la eficacia de las técnicas respiratorias en el dolor y la función cognitiva. Realizamos una revisión de la literatura a través de las principales bases de datos especializadas (medline, lilacs, Cochrane library) incluyendo ensayos clínicos aleatorizados. El riesgo de sesgo de los estudios incluidos se evaluó mediante la metodología propuesta el Manual Cochrane para las Revisiones Sistemáticas. En total, encontramos 16 estudios que cumplieron con los criterios de inclusión, con un riesgo general de sesgo intermedio o poco claro. Al combinar las diferentes técnicas de respiración versus control en los estudios incluidos, se encontró una diferencia estadísticamente significativa en términos de la escala analógica visual (diferencia de medias, efectos aleatorios; -1,21 [IC del 95%: -1,75 a -0,68]; I<sup>2</sup>: 95 %). Las técnicas de respiración basadas en la meditación mejorarían el dolor y la función cognitiva en pacientes con una entidad dolorosa o voluntarios sanos. **Palabras clave:** Técnicas respiratorias; dolor; función cognitiva; revisión sistemática; contención de la respiración

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## INTRODUCTION

Breathing techniques are key components of yoga, meditation, and relaxation practices that are well known for reducing anxiety and improving overall well-being (Arsenault, Ladouceur, Lehmann, Rainville & Piché, 2013; Chan et al., 2019; Mah, Turgeon, Loh, Tejani & Sweet, 2019; Mesgarpour et al., 2019). Slow breathing with focused attention to breathing is used in many interventions with the goal of inducing a state of relaxation (Arsenault et al., 2013; Wall, Magee, Campbell & Zed, 2019), including meditation (Warttig et al., 2019).

Slow and deep breathing techniques are also used in the treatment of many conditions such as stress, anxiety, panic disorder, and depression (Lewis et al., 2019; Zhang, Zhang, Grant, Wan, & Li, 2018). In such studies, these breathing techniques were found to alleviate anxiety, depression, daily stress, post-traumatic stress, and illness-related stress. Among the proposed mechanisms, the contribution to calm and alertness driven by the parasympathetic system, the stress response system, the release of neuroendocrine hormones, and thalamic generators are found. On the other hand, it has also been found that the group of respiratory exercises has a decrease in anxiety and depression, however the number of leukocytes did not differ between the groups; these findings suggest that relaxation breathing exercises improve anxiety and depression levels in the general population and in patients who will undergo hematopoietic cell transplantation (Lewis et al., 2019; Zhang et al., 2018).

Buddhist (*Anapama*) meditation practices have focused more on developing mindfulness of breath (Sud et al., 2018; Vojislav,

Ramanathana & Mishraa 2020). However, even these mindfulness-based meditative practices have been shown to modify the respiratory rate and cycle (Choo, Simons & Sheikh, 2018; VojislavMaric, 2020). Suzuki Roshi, a practitioner of Zen Buddhism, describes this process: both the breathing and pulse will tranquilize afterwards a 5 or 10 minutes period of not being distressed by the mind (Connolly et al., 2018).

Many of these mind-body perception-based breathing techniques (Yoga, Reiki, Tai Chi, Quiqong) have also been used with some success to improve pain management (Aamann, Dam, Rinnov, Vilstrup & Gluud, 2018) and in a variety of associated clinical situations. with acute pain such as labor (Pollok, van Agteren & Carson-Chahhoud, 2018) or injections in children (Arsenault et al., 2013; Gilbert-Kawai, Mitchell, Martin, Carlisle & Grocott, 2018).

For these reasons, it is necessary to carry out a review of the literature that evaluates the effectiveness of the different breathing techniques in pain management and the evaluation of cognitive function.

## METHODOLOGY

Systematic review of the literature

*Criteria for including articles in this review*

· *Types of studies*

Randomized clinical trials were included. Cluster, crossover or before and after studies were excluded.

· *Types of participants*

Patients with any condition or pathology were included, as well as healthy participants 12 years of age and older.

### · *Types of interventions*

Any controlled breathing technique at any intensity or number of sessions.

### · *Outcomes*

*Pain*: Measured with any scale used in each study

*Cognitive function*: Including memory, attention and other measures of cognitive function measured in each study.

### · *Search methods to identify studies*

#### · *Electronic searches*

Studies meeting the inclusion criteria were identified in either English or Spanish.

Using a set of controlled and uncontrolled terms for “breathing techniques”, “Pain” and “Cognitive function”, with field labels (title and summary), proximity operators, and Boolean operators. Search strategies will be found in [Appendix 1](#).

Specifically, the following databases were used:

- The Cochrane Central Register of Controlled Trials.
- (CENTRAL, Ovid platform): inception to present.
- MEDLINE<sup>®</sup>, Ovid platform: inception to present.
- MEDLINE<sup>®</sup> In-Process & Other Non-Indexed Citations.
- Ovid platform: inception to present.
- MEDLINE<sup>®</sup> Daily Update, Ovid platform: inception to present.
- EMBASE, embase.com platform: inception to present.

- LILACS, IAHx interface: inception to present.

### · *Data collection and analysis*

#### · *Selection of studies*

Evaluated the inclusion and exclusion criteria of all titles and abstracts found in the search strategy. All potentially relevant studies were evaluated in full text. The entire selection process was documented in a PRISMA flow chart.

#### · *Data extraction and management*

An extraction format was designed for each study and collected the following information:

- Study design.
- Year of publication.
- Participants: characteristics.
- Number of participants in each group
- Loss to follow-up.
- Techniques used (intervention and control).
- Definition and frequency of outcomes in each group.
- Sources of funding.

#### · *Evaluation of risk of bias*

The risk of bias of the included studies was independently assessed using the Cochrane Collaboration's risk of bias assessment that evaluates random sequence generation, concealment, blinding of the intervention to the participant and patient advisor, loss to follow-up, reporting bias, and other biases.

### · *Effect measures*

The studies were combined in a meta-analysis if possible, in cases where the studies could not be combined, a narrative synthesis was performed. A mean difference with a 95% confidence interval was used.

### · *Evaluation of heterogeneity*

Heterogeneity was assessed using an I<sup>2</sup> and chi<sup>2</sup> test, significant heterogeneity will be considered if it is greater than 40% in the I<sup>2</sup> and the p value is less than 0.1 in the chi<sup>2</sup>.

## RESULTS

### *Search results*

When searching the different databases, we found a total of 1428 references, of which, when reviewed in text and abstract, a total of 29 eligible were left, which were

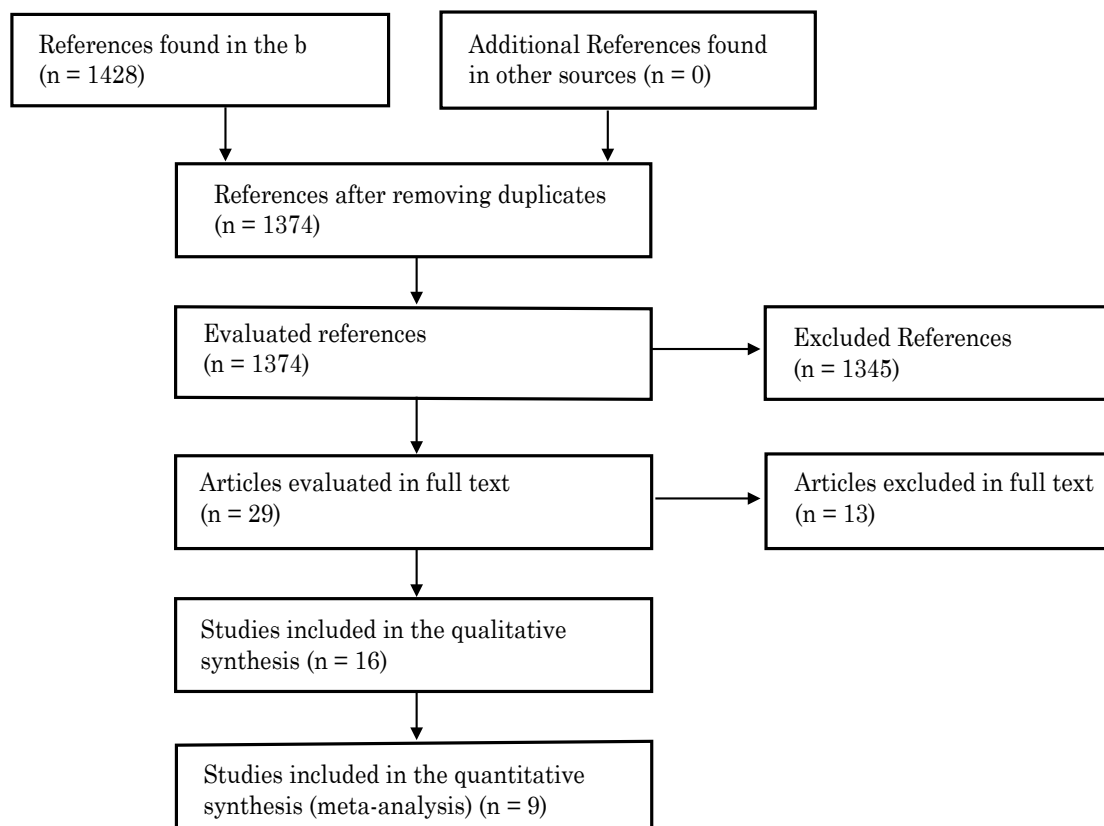
read in full text, leaving 16 references included, of which 9 were combined in a meta-analysis (See Figure 1).

### *Studies included*

In total, 16 randomized clinical trials were included that compared some breathing pattern versus control.

Controls used include sham breathing techniques, different breathing methods (Wongwilairat, Buranruk, Eungpinichpong, Puntumetakul & Kantharadusadee-Triamchaisri, 2018) or social interaction (Ferreira, Tanaka, Santos-Galduroz & Fernandes, 2015).

The two outcomes found in the studies were pain in labor (Boaviagem et al., 2017; Yuksel, Cayir, Kosan & Tastan, 2017), pain in general, cognitive function in terms of memory, abstraction, flexibility and attention (Ferreira et al., 2015; Larky, Roe, Smith & Millstine, 2016) (See Table 1).



**Figure 1.** PRISMA flow chart.

TABLE 1.  
Summary of included studies

Reference	Population	Intervention	Comparator	Outcome	Intervention results	Control results	P-value
Boaviagem, 2016 (Boaviagem et al., 2017)	Women in labor, between 12 to 40 years old with a gestational age between 37 and 41 weeks.	Breathing pattern. N = 67	Control. N = 73	Maternal anxiety	50.6+/- 1.8	49.3 +/- 1.5	NS
				Maternal pain	8.8 +/- 0.3	8.8 +/- 0.3	NS
Yuksel, 2017 (Yuksel et al., 2017)	Pregnant women between 37 to 42 weeks.	Controlled breathing. (n = 125)	Control. (N = 125)	Maternal pain	88.2 +/- 6.3	90.5 +/- 7	P = 0.000
Tomas-Carus, 2018 (Tomas-Carus et al., 2018)	Women with fibromyalgia	Respiratory exercise program N = 18	Control. N = 17	Pain	5.8 (5.16 a 6.43)	7.93 (7.05 to 8.80)	p = 0.025
Saoji, 2018 (Saoji, Raghavendra, Madle & Manjunath, 2018)	Healthy volunteers for yoga courses	Breath-based yoga interventions N = 56	Control. N = 56	Mind-Wandering Question-naire (MWD)	1.89 +/- 0.76	2.41 +/- 0.89	p < 0.01
				State Mindfulness Attention and Awareness Scale (SMAAS)	4.27 +/- 0.75	3.94 +/- 0.75	p < 0.05
Wongwilairat, 2018 (Wongwilairat et al., 2018)	Women with tension neck pain between 20 and 25 years old with normal BMI	Slow deep breathing exercise. N = 8	Other breathing methods N = 8	Pain	0.75 +/- 0.71	0.75 +/- 1.49	NS
Grubić, 2019 (Grubić, Babić & Štimac, 2019)	Multiple sclerosis patients	Home-based breathing exercise N = 9	Control. N = 9	Pain-according to sf36 outpatient	80 +/- 27.4	79.0 +/- 28.8	NS
				Pain-according to sf36 non-ambulatory	72.5 +/- 28.5	45.6 +/- 36.4	NS
Park, 2019 (Park & Lee, 2019)	Low back pain patients aged 18 to 65 years with pain for at least 6 weeks	Breathing resistance training N = 23	Control. N = 23	Pain- NRS	3.6 +/- 1.14	3.65 +/- 1.27	NS
Tomas-Carus, 2019 (Tomas-Carus et al., 2019)	Women with fibromyalgia	Unsupervised breathing exercise program N = 16	Control. N = 15	Pain tolerance	1.58 +/- 0.38	1.71 +/- 0.53	NS
				Pain	6.8 +/- 1.69	7.78 +/- 2	NS
Youn-Jung, 2020 (Oh, Park & Lee, 2020)	Women with low back pain between 40 to 49 years	Abdominal breathing maneuvers. N = 22	Control. N = 22	Pain (Quadruple Visual Analog Scale)	4.58 +/- 0.46	4.45 +/- 0.42	NS
Phattharasupharerk, 2018 (Phattharasupharerk, Purepong, Eksakulkla & Siriphorn, 2019)	Office workers with non-specific low back pain of at least 12 weeks. Between 20 to 40 years of age.	Qigong N = 36	Control. N = 36	Pain	14 +/- 20.5	53.5 +/- 20.9	< 0.001

Reference	Population	Intervention	Comparator	Outcome	Intervention results	Control results	P-value
Peppone, 2015 (Peppone et al., 2015)	Women cancer survivors 2 to 24 months post-surgery	YOCAS. N = 75	Control. N = 95	Functional Assessment of Chronic Illness Therapy with Fatigue Subscale. Changes in FACIT-F-I have pain	-0.18	0.04	0.021
				Multidimensional Fatigue Symptom Inventory-Short Form. Changes in MFSI-SF-my muscles ache	-0.51	-0.13	0.001
				Evocative / declarative memory	21.0 (18.5, 23.6)	25.4 (22.7, 28.1)	NS
Ferreira, 2015 (Ferreira et al., 2015)	Adults between 60 and 79 years	Breathing training. N = 34	Control (Social interaction). N = 34	Evocative memory	17.5 (15.0, 20.0)	22.8 (20.2, 25.4)	NS
				Semantic memory	28.3 (24.6, 32.0)	38.5 (34.6, 42.3)	0.01
				Short term memory	5.2 (4.8, 5.8)	5.0 (4.5, 5.5)	NS
				Mental manipulation	4.2 (3.8, 4.8)	4.1 (3.7, 4.7)	0.03
				Abstraction	4.8 (4.2, 5.5)	4.0 (3.3, 4.7)	0.01
				Mental flexibility	3.7 (1.8, 5.7)	6.0 (4.0, 8.0)	0.02
				Attention	25.7 (22.9, 28.5)	22.0 (19.1, 25.0)	NS
Sagkal, 2015 (Sagkal & Eser, 2015)	Women with cesarean delivery between the ages of 18 and 45 who do not use non-opioid analgesics.	Reiki. N = 50	Control. N = 50	Pain	1.24 +/- 0.99	3.76 +/- 1.61	0.001
Telles, 2016 (Telles, Sharma, Gupta, Bhardwaj & Balkrishna, 2016)	People with degenerative changes in intervertebral discs between 20 and 45 years old.	Breathing techniques in Yoga. N = 20	Control. N = 20	Pain	4.68 +/- 2.3	6.1 +/- 2.19	0.04
Sagkal, 2016 (Sagkal & Ciray, 2016)	Women with cesarean delivery between the ages of 18 and 45 who do not use non-opioid analgesics.	Reiki. N = 16	Control. N = 16	Pain	26.8 +/- 21.3	37.2 +/- 19.1	0.001
Larkey, 2016 (Larkey et al., 2016)	Women diagnosed with stage 0-III breast cancer	Breathing techniques with Tai-Chi and Qigong. N = 49	Control. N = 52	Cognitive function. FACT- Cog PCI	1.01 +/- 0.75	1.1 +/- 0.66	NS

NS: Not Significant.

*Studies excluded*

Out of the articles reviewed in full text, 13 of these were excluded, the most frequent reason for exclusion was that these articles did not assess pain or cognitive function (See Table 2).

*Risk of bias of included studies*

The studies in general had an intermediate risk of bias (See Figure 2), this classification is due to the lack of blinding in

some studies, specifically the blinding of the personnel evaluating the patients and the unclear risk of bias for the concealment of random assignment (See Figure 3).

Some studies had an unclear risk of bias in the generation of the random sequence secondary to the mention of the method, but how this sequence is performed is not explained (Grubić et al., 2019; Park & Lee, 2019; Phattharasupharerk et al., 2019; Telles et al., 2016; Wongwilairat et al., 2018) (See Figure 3).

TABLE 2.  
*Excluded articles*

Reference	Reason for exclusion
Frøkjær 2016 (Frokjaer et al., 2016)	Different outcome
Pettersson 2015 (Pettersson, Faager & Westerdahl, 2015)	Different outcome
Telles 2016 (Telles et al., 2016)	Different outcome
Rietberg 2017 (Rietberg, Veerbeek, Gosselink, Kwakkel & van Wegen, 2017)	Literature review
Smith 2015 (Smith et al., 2015)	Literature review
Janssens 2015 (Janssens et al., 2015)	Different intervention
Gunay 2016 (Gunay et al., 2016)	Different outcome
Nyer 2018 (Nyer et al., 2018)	Different outcome
Patrician 2019 (Patrician et al., 2019)	Different outcome
Smith 2017 (Smith & Norman, 2017)	It is not a clinical trial
Ratcliff 2018 (Ratcliff et al., 2019)	Different intervention
Seyyed-Rasooli 2016 (Seyyed-Rasooli et al., 2016)	Different intervention

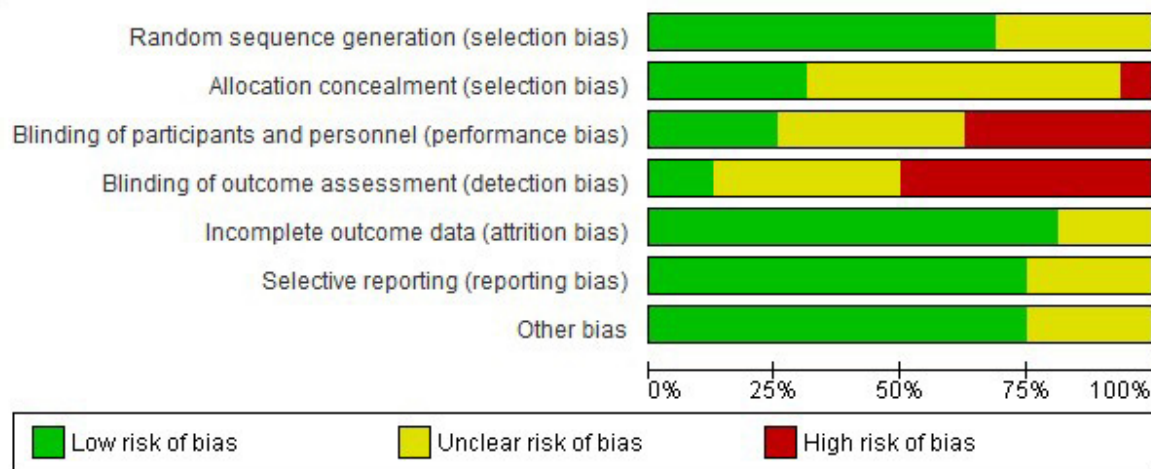


Figure 2. Summary of risk of bias.

*Pain*

*Breathing techniques in pregnant patients*

The Boaviagem in 2016 study (Boaviagem et al., 2017) included women in labor between 12 to 40 years of age and evaluated the efficacy of breathing patterns during the active phase of the first stage of labor. The study did not find statistically significant differences between the intervention and the control for pain measured with the visual analog scale (8.8 +/- 0.3 vs 8.8 +/- 0.3).

Following the line of studies in pregnant women, the study by Yuksel 2017 (Yuksel et al., 2017) evaluated a controlled breathing method in pregnant women between 37 and 42 weeks. Patients in the intervention group received a respiratory exercise session in the first stage of labor. During training, all participants performed abdominal breathing during the second stage of labor. The main components of the breathing exercises were:

- a. First, fill your stomach and then your lungs with air as you inhale;
- b. Feel the expansion in your stomach;
- c. Make sure the muscles from the stomach to the knee are relaxed, as if you were urinating while exhaling;
- d. When there is pain, do deep abdominal breathing exercises, take a deep breath and hold as much as you can;
- e. Try to push the baby down;
- f. You can do this by holding your breath or exhaling very slowly through your mouth;
- g. The most important point at this stage is that you do not have to fill your stomach with air, and you must push down to deliver the baby;
- h. You should continue pushing until the pain is relieved.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Boaviagem, 2016	+	+	-	-	?	+	+
Ferreira, 2015	+	?	?	-	+	?	+
Grubić, 2019	?	?	?	?	+	+	?
Larkey, 2016	+	+	+	+	+	?	+
Midilli, 2014	+	?	-	?	+	+	?
Midilli, 2016	+	?	+	-	+	?	+
Park, 2019	?	+	?	?	+	+	+
Peppone, 2015	+	?	-	-	+	?	+
Phattharasupharerk, 2018	?	+	+	?	?	+	+
Saoji, 2018	+	+	-	-	+	+	+
Telles, 2016	?	?	?	-	+	+	+
Tomas-Carus, 2018	+	?	?	+	+	+	?
Tomas-Carus, 2019	+	?	?	?	+	+	?
Wongwilairat, 2018	?	-	-	-	+	+	+
Youn-Jung, 2020	+	?	+	?	+	+	+
Yuksel, 2017	+	?	-	-	?	+	+

**Figure 3.** Risk of bias of included studies.

*Effects of interventions*

The results of each study are presented below (See Table 1).



When evaluating maternal pain with the visual analog scale, statistically significant differences were found (88.2 +/- 6.3 vs 90.5 +/- 7, p-value = 0.0001).

Similarly, [Sagkal & Eser \(2015\)](#) included 29 women with cesarean delivery between 18 and 45 years of age who did not use non-opioid analgesics, comparing Reiki vs control, finding a decrease in pain in terms of the visual analog scale (1.24 +/- 0.99 vs 3.76 +/- 1.61, p-value 0.001).

### *Breathing techniques in other entities*

The study by [Tomas-Carus et al. \(2018\)](#) included women with fibromyalgia and compared a respiratory exercise program versus a control. The respiratory exercise program consisted of 30 min/ session for 7 times/ week for 12 weeks: 1 time supervised by an expert in breathing exercises, and 6 times/ week without supervision at home with audiovisual training through a versatile digital disc. Each session focused on breathing exercises that strengthened and lengthened the skeletal muscles of the thorax and abdomen, including five breathing exercises (3 min for each one), which were performed in the form of a circuit (2 circuits/session), including, a breathing awareness exercise: in a supine position, inhale through the nose and exhale through the mouth with the lips parted slowly; rib expansion exercise: in supine position, with the arms along the body with a cane held by the hands. Raise your arms and inhale and exhale and lower your arms; and three diaphragmatic breathing exercises: exercise (1) in the supine position, overlapping the hands on the diaphragm located in the abdominal region: breathe in through your nose and breathe out through your mouth slowly with your lips

parted; exercise (2) in the prone position, with a folded towel under the diaphragm located in the abdominal region: breathe in through your nose and breathe out through your mouth slowly with your lips half closed; and exercise (3) in supine position, with a weight of 1 kg on the diaphragm located in the abdominal region: breathe in through the nose and exhale through the mouth slowly with the lips parted. The authors found statistically significant differences between the intervention and the control in pain measured by the visual analog scale (5.8 vs 7.9, p-value 0.025). The same author presented a similar study one year later ([Tomas-Carus et al., 2019](#)), where they also found no statistically significant differences in terms of pain measured by the visual analog scale.

[Wongwilairat et al. \(2018\)](#) included women with tension neck pain between 20 and 25 years of age with normal BMI, compared slow and deep breathing exercise vs other breathing methods, finding no statistically significant differences when measuring pain with the visual analog scale (0.75 +/- 0.71 vs 0.75 +/- 1.49).

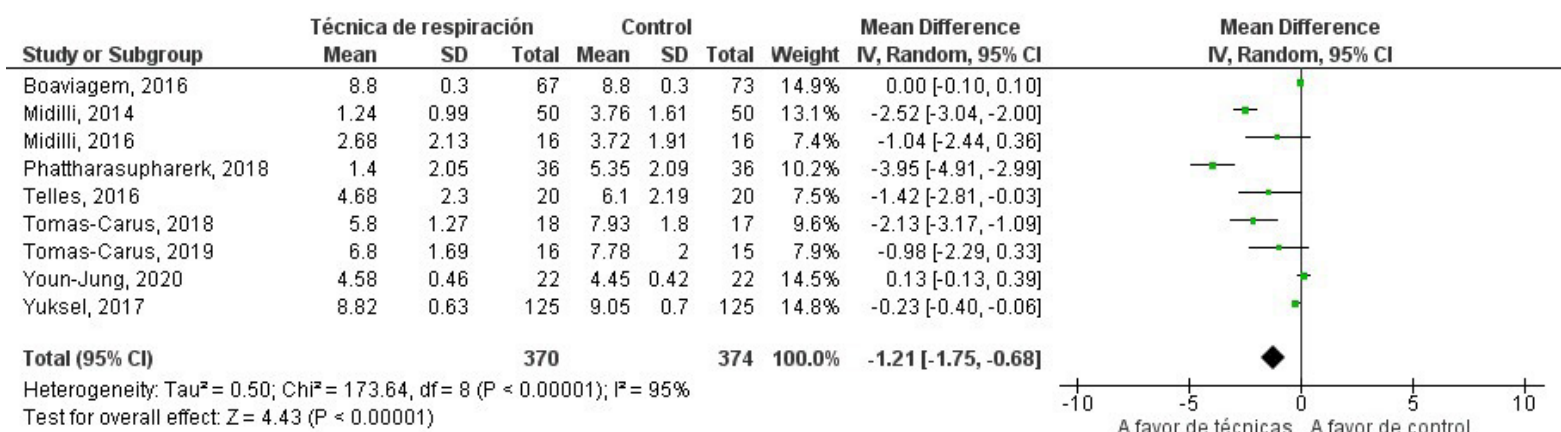
On the other hand, [Grubić et al. \(2019\)](#) evaluated breathing exercises at home vs a control in patients with multiple sclerosis. For the breathing exercises, the basic principle was to inhale and exhale as fully as possible, but slowly to avoid hyperventilation and dizziness. Diaphragmatic or abdominal breathing (1.5 min) was performed to strengthen the abdominal muscles and the diaphragm, and thoracic breathing (1.5 min) to strengthen the intercostal muscles (3 x -20-s pause- 3 x). When evaluating pain according to SF36, statistically significant differences were not found.

*Qigong*

Park & Lee (2019) included patients with low back pain between 18 and 65 years old with pain of at least 6 weeks of progress and compared a respiratory resistance training vs a control evaluating pain with the visual analog scale, the authors found no differences statistically significant. Another similar study in women with low back pain (Oh et al., 2020) evaluated abdominal breathing maneuvers, finding no statistical differences between the groups. On the other hand, Phattharasupharerk et al. (2019) included office workers with non-specific low back pain of at least 12 weeks between 20 and 40 years of age. He compared Qigong vs control group. The Qigong group participants received an hour Qigong practice session each week for six weeks (Guan Yin Zi Zai Gong level 1, developed by Yang Pei Xen since 1995) at their workstation by a professional Qigong instructor from the Master Yang Qigong Center, Bangkok, Thailand. Fifteen minutes of Wu Chi meditation and 28 minutes of static exercise. In the pain outcome, the authors found statistically significant differences (14 +/- 20.5 vs 53.5 +/- 20.9, p-value: 0.001).

*Yoga-based breathing techniques*

Peppone et al. (2015) included women survivors of cancer 2 to 24 months after surgery, compared YOCAS vs control. The intervention includes 16 poses sitting, standing, transitional and supine. Breathing exercises includes low, controlled, diaphragmatic work of breathing coordinated by movements. Mindfulness exercises include meditation, visualization, and affirmation activities. The intervention is delivered in a group format taught by an instructor, twice a week, for 75 minutes each time, for 4 weeks which means a total of eight yoga sessions. Pain was evaluated using the FACIT F-I scale, finding statistical differences (p-value 0.021). In the same line of breathing techniques based on Yoga (Telles et al., 2016) used these techniques in people with degenerative changes in intervertebral discs between 20 and 45 years old, finding differences in the measurement of pain with the use of the visual analog scale (4.68 +/- 2.63 vs 6.1 +/- 2.19, p-value 0.04).



**Figure 4.** Meta-analysis of pain, breathing techniques vs. control.

### *Combination of studies*

When combining the different breathing techniques vs control in the included studies, we found a statistically significant difference in terms of the visual analog scale (Difference of means, random effects; -1.21 [95% CI -1.75 to -0.68]; I<sup>2</sup>: 95%).

### *Cognitive function*

Three studies that measured cognitive function were included, one of these (Saoji et al., 2018) included healthy volunteers in yoga courses and compared breathing techniques derived from yoga vs. control, finding statistically significant differences with the scales used (See Table 1). The second study (Ferreira et al., 2015) found statistical differences in terms of semantic memory, mental manipulation, abstraction and mental flexibility when comparing breathing training vs social interaction in adults between 60 and 79 years old. The last of the studies did not find statistically significant differences in terms of cognitive function with the FACT-COG PCI scale when comparing breathing techniques with Tai-Chi and Qugong vs control in women diagnosed with breast cancer (See Table 1).

## DISCUSSION

An improvement in pain and cognitive function in intervention was found in most of the included studies in terms of breathing techniques accompanied by abstraction of ideas or the use of thoughts during the process of the same. This does not occur with studies that exclusively include breathing techniques.

The present findings appear to be consistent with other studies, which found that breathing techniques could reduce short-term and long-term pain intensity. It seems possible that these results are given because some techniques consist of three elements that could reduce pain: posture, deep breathing and meditation. The breathing techniques comprised various poses and movements that could strengthen the stabilizing muscles of the core. Also, deep breathing and meditation on breathing techniques help relax the body and mind, which in turn reduces muscle activity. In addition, meditation reduces the perception of pain (Abdallah et al., 2018; Abedi, Jahanfar, Namvar & Lee, 2016; Altenau, Crisp, Devaiah, & Lambers, 2017). A previous study by Sharon et al. (2016) demonstrated that meditation significantly reduces pain and cold stimulus-induced pain discomfort score in healthy adults. Interestingly, intravenous injection of naloxone, an opioid blocker, reverses this analgesic effect of meditation, suggesting that meditation modulates pain through the endogenous opioid mechanism (Sharon et al., 2016). Furthermore, a previous study by Movahedi, Ghafari, Nazari & Valiani (2017) showed that acupuncture to specific points 3 times a week for three weeks reduced the severity of chronic low back pain (Babina, Mohanty & Pattnaik, 2016; Barnes, McDonald, Smallwood, & Manser, 2019; Bayer et al., 2017).

A previous study showed that Qigong practice reduced stress and increased social interaction in the hospital staff (Knips et al., 2019; Larkey et al., 2016; Phattharasupharerk et al., 2019). Similarly, Skoglund y Jansson (2007) showed

that Qigong practice reduced the symptoms of low back pain and stress by reducing sympathetic activity. The results of this study showed that breathing exercises significantly reduced heart rate and respiratory rate compared to the reference and waiting list group. During meditation, the body enters a state of relaxation response by decreasing heart rate, respiratory rate, blood pressure, and muscle tone and increasing alpha brain waves, which in turn reduces stress (Lee, Gordon & Osadnik, 2018; Lee et al., 2016; Lee & Jang, 2019).

Among the limitations of this review, the small sample size of the included studies, is found, as well as the fact that several of these interventions were performed in an unsupervised manner and had short follow-up periods. On the other hand, the studies found are very heterogeneous clinically and statistically with each other; therefore, the combination of studies should be interpreted with caution and future studies could modify the interpretation of these results.

It is therefore suggested that randomized studies be carried out with sample sizes greater than those found in this review. We conclude then that meditation-based breathing techniques would improve pain and cognitive function in patients with a painful entity or healthy volunteers.

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APPENDIX 1.  
*Search strategy*

Respiration/  
respirat\*.tw  
Breathing.tw  
Breathing Exercises/  
Respiratory Mechanics/  
Respiratory Rate/  
Inhalation/  
Inhaling.tw  
Inspiration.tw  
Exhalation/  
Exhalation.tw  
Expiration.tw  
Exhaling.tw

Pain, Referred/  
Pain.tw  
Flank Pain/  
Neck Pain/  
Neck Aches.tw  
Cervicalgia.tw  
Pelvic Pain/  
Low Back Pain/  
Lumbago.tw  
Abdominal Pain/  
Colicky Pain.tw  
Pain Measurement/  
Analgesia Test.tw  
Chest Pain/  
Back Pain/  
Backache.tw  
Cancer Pain/  
Headache/  
Headache.tw  
Cephalgia.tw  
Hemicrania.tw  
Myalgia.tw  
Muscle Soreness.tw  
Arthralgia/  
Arthralgia.tw  
Polyarthralgia.tw  
Fibromyalgia/  
Fibromyalgia.tw  
Pain/  
Ache.tw  
Pain Management.tw  
Acute Pain/  
Musculoskeletal Pain/  
Chronic Pain/  
Nociceptive Pain/

Cognition/  
Cognition.tw  
Cognitive Function.tw  
Neuropsychological Tests/  
Neuropsychologic Test.tw

Source: Author.