

**Supplementary table I.** Search strategy according to the focused question (PICO).

Database	Search equation
PubMed	“back pain” [MeSH Terms] AND (“exercise” [MeSH Terms] OR “exercise therapy” [MeSH Terms]) “back pain” [MeSH Terms] AND (“Health Education” [MeSH Terms] OR “cognitive behavioral therapy” [MeSH Terms])
	“back pain” [MeSH Terms] AND (“primary prevention” [MeSH Terms] OR “secondary prevention” [MeSH Terms] OR “tertiary prevention” [MeSH Terms]) “back pain” [MeSH Terms] AND “prevention”
	“neck pain” [MeSH Terms] AND (“exercise” [MeSH Terms] OR “exercise therapy” [MeSH Terms]) “neck pain” [MeSH Terms] AND (“Health Education” [MeSH Terms] OR “cognitive behavioral therapy” [MeSH Terms])
	“neck pain” [MeSH Terms] AND (“primary prevention” [MeSH Terms] OR “secondary prevention” [MeSH Terms] OR “tertiary prevention” [MeSH Terms]) “neck pain” [MeSH Terms] AND “prevention”
	“musculoskeletal pain” [MeSH Terms] AND (“exercise” [MeSH Terms] OR “exercise therapy” [MeSH Terms]) “musculoskeletal pain” [MeSH Terms] AND (“Health Education” [MeSH Terms] OR “cognitive behavioral therapy” [MeSH Terms])
	“musculoskeletal pain” [MeSH Terms] AND (“primary prevention” [MeSH Terms] OR “secondary prevention” [MeSH Terms] OR “tertiary prevention” [MeSH Terms]) “musculoskeletal pain” [MeSH Terms] AND “prevention”
	TOPIC: (“back pain”) AND TOPIC: (“exercise” OR “exercise therapy”) AND TOPIC: (“clinical trial”) TOPIC: (“back pain”) AND TOPIC: (“health education” OR “cognitive behavioral therapy”) AND TOPIC: (“clinical trial”)
	TOPIC: (“back pain”) AND TOPIC: (“primary prevention” OR “secondary prevention” OR “tertiary prevention”) AND TOPIC: (“clinical trial”) TOPIC: (“back pain”) AND TOPIC: (“prevention”) AND TOPIC: (“clinical trial”)
	TOPIC: (“neck pain”) AND TOPIC: (“exercise” OR “exercise therapy”) AND TOPIC: (“clinical trial”) TOPIC: (“neck pain”) AND TOPIC: (“health education” OR “cognitive behavioral therapy”) AND TOPIC: (“clinical trial”)
	TOPIC: (“neck pain”) AND TOPIC: (“primary prevention” OR “secondary prevention” OR “tertiary prevention”) AND TOPIC: (“clinical trial”) TOPIC: (“neck pain”) AND TOPIC: (“prevention”) AND TOPIC: (“clinical trial”)
Web of Science	TOPIC: (“musculoskeletal pain”) AND TOPIC: (“exercise” OR “exercise therapy”) AND TOPIC: (“clinical trial”) TOPIC: (“musculoskeletal pain”) AND TOPIC: (“health education” OR “cognitive behavioral therapy”) AND TOPIC: (“clinical trial”)
	TOPIC: (“musculoskeletal pain”) AND TOPIC: (“primary prevention” OR “secondary prevention” OR “tertiary prevention”) AND TOPIC: (“clinical trial”) TOPIC: (“musculoskeletal pain”) AND TOPIC: (“prevention”) AND TOPIC: (“clinical trial”)
	TOPIC: (“musculoskeletal pain”) AND TOPIC: (“exercise” OR “exercise therapy”) AND TOPIC: (“clinical trial”) TOPIC: (“musculoskeletal pain”) AND TOPIC: (“health education” OR “cognitive behavioral therapy”) AND TOPIC: (“clinical trial”)
	TOPIC: (“musculoskeletal pain”) AND TOPIC: (“primary prevention” OR “secondary prevention” OR “tertiary prevention”) AND TOPIC: (“clinical trial”) TOPIC: (“musculoskeletal pain”) AND TOPIC: (“prevention”) AND TOPIC: (“clinical trial”)
	TOPIC: (“musculoskeletal pain”) AND TOPIC: (“prevention”) AND TOPIC: (“clinical trial”)

**Supplementary table I.** Search strategy according to the focused question (PICO) (*continuation.*)

Database	Search equation
Scopus	TITLE-ABS-KEY ("back pain") AND TITLE-ABS-KEY ("exercise" OR "exercise therapy") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("back pain") AND TITLE-ABS-KEY ("health education" OR "cognitive behavioral therapy") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("back pain") AND TITLE-ABS-KEY ("primary prevention" OR "secondary prevention" OR "tertiary prevention") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("back pain") AND TITLE-ABS-KEY ("prevention") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("neck pain") AND TITLE-ABS-KEY ("exercise" OR "exercise therapy") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("neck pain") AND TITLE-ABS-KEY ("health education" OR "cognitive behavioral therapy") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("neck pain") AND TITLE-ABS-KEY ("primary prevention" OR "secondary prevention" OR "tertiary prevention") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("neck pain") AND TITLE-ABS-KEY ("prevention") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("musculoskeletal pain") AND TITLE-ABS-KEY ("exercise" OR "exercise therapy") AND TITLE-ABS-KEY ("clinical trial")
	TITLE-ABS-KEY ("musculoskeletal pain") AND TITLE-ABS-KEY ("health education" OR "cognitive behavioral therapy") AND TITLE-ABS-KEY ("clinical trial")
TITLE-ABS-KEY ("musculoskeletal pain") AND TITLE-ABS-KEY ("primary prevention" OR "secondary prevention" OR "tertiary prevention") AND TITLE-ABS-KEY ("clinical trial")	
TITLE-ABS-KEY ("musculoskeletal pain") AND TITLE-ABS-KEY ("prevention") AND TITLE-ABS-KEY ("clinical trial")	
Medline	(MH "back pain") AND (MH "exercise" OR MH "exercise therapy") AND (MH "clinical trial")
	(MH "back pain") AND (MH "health education" OR MH "cognitive behavioral therapy") AND (MH "clinical trial")
	(MH "back pain") AND (MH "primary prevention" OR MH "secondary prevention" OR MH "tertiary prevention") AND (MH "clinical trial")
	(MH "back pain") AND "prevention" AND (MH "clinical trial")
	(MH "neck pain") AND (MH "exercise" OR MH "exercise therapy") AND (MH "clinical trial")
	(MH "neck pain") AND (MH "health education" OR MH "cognitive behavioral therapy") AND (MH "clinical trial")
	(MH "neck pain") AND (MH "primary prevention" OR MH "secondary prevention" OR MH "tertiary prevention") AND (MH "clinical trial")
	(MH "neck pain") AND "prevention" AND (MH "clinical trial")
	(MH "musculoskeletal pain") AND (MH "exercise" OR MH "exercise therapy") AND (MH "clinical trial")
	(MH "musculoskeletal pain") AND (MH "health education" OR MH "cognitive behavioral therapy") AND (MH "clinical trial")
(MH "musculoskeletal pain") AND (MH "primary prevention" OR MH "secondary prevention" OR MH "tertiary prevention") AND (MH "clinical trial")	
(MH "musculoskeletal pain") AND "prevention" AND (MH "clinical trial")	

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**Supplementary table II:** Jadad scale.

Authors	JADAD Scale			
	RD	BD	WD	FS
Aliyu et al. (2018)	2	1	1	4
Andersen et al. (2016)	2	2	1	5
Bagheri et al. (2020)	2	2	1	5
Bodes et al. (2018)	2	1	1	4
Cherkin et al. (2016)	2	1	1	4
Garcia et al. (2018)	2	1	1	4
Gorji et al. (2022)	2	0	1	3
Járomi et al. (2018)	2	1	1	4
Javdaneh et al. (2020)	2	1	1	4
Javdaneh et al. (2021)	2	1	1	4
Kuvačić et al. (2018)	1	0	1	2
Llamas-Ramos et al. (2022)	2	1	1	4
Montero-Cuadrado et al. (2022)	2	0	1	3
Rabiei et al. (2021)	2	0	1	3
Tunwattanapong et al. (2016)	2	1	1	4
Turner et al. (2016)	2	0	1	3

RD: Randomization (1 point if randomization is mentioned; 2 points if the method of randomization is appropriate); BD: Blinding (1 point if blinding is mentioned; 2 points if the method of blinding is appropriate); WD: Withdrawals (1 point if the number and reasons in each group are stated); FS: Final score.

**Supplementary table III.** Characteristics of the interventions.

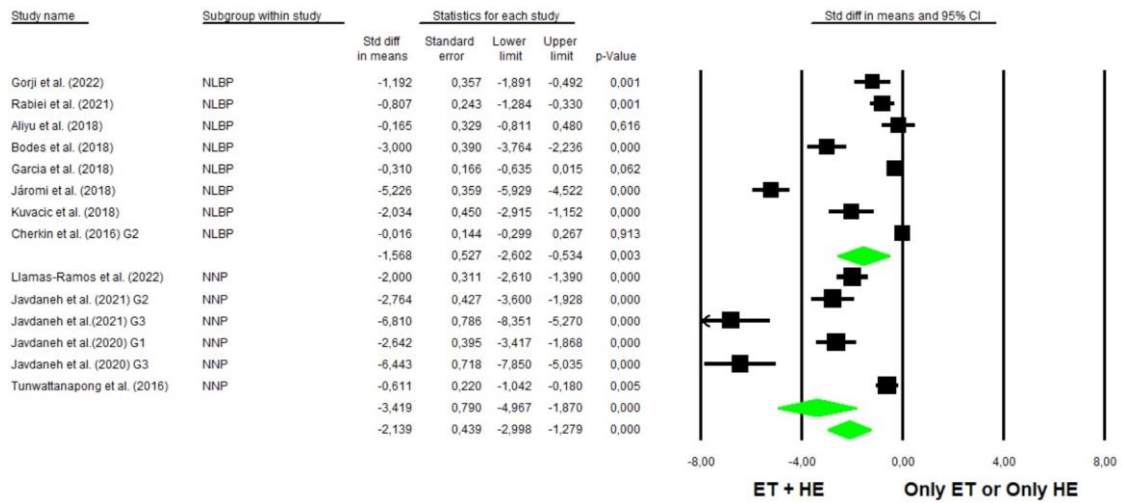
<b>Authors</b>	<b>Groups</b>	<b>Exercise Therapy Intervention</b>	<b>Health Education Interventio</b>
Aliyu et al. (2018)	G1: Lumbar stabilization exercise + CBT G2: lumbar stabilization exercise	18 sessions of 30 min duration led by a physiotherapist combining joint mobility exercises (i.e., cat-camel motion exercise) and lumbar stabilization exercises (i.e., the curl-up exercise or the side-bridge exercise).	12 sessions of 30 min of CBT emphasizing the importance of movement. Relaxation techniques were taught. Understanding automatic negative thoughts and how they affect the experience of pain. Strategies to improve sleep despite pain.
Andersen et al. (2016)	G1: Tailored Physical Activity. G2: Chronic Pain Self-Management Program. G3: health guidance	30 sessions of 50 min duration led by a physiotherapist that included a combination of aerobic and strength training. It began with a 5-mins warm-up, followed by a 20-mins aerobic workout. Participants were then referred to one of three standardized strength training programs based on their primary region of musculoskeletal problems (neck and shoulder pain; arm and/or hand pain; low back pain).	Chronic Pain Self-Management Program consisted of 6 sessions of 150 min. The workshops were conducted by 2 trained facilitators (non-healthcare professionals) who suffered from chronic pain. Topics covered in the didactic sessions included coping techniques such as fatigue, medication use, and communication tools. The classes increased participants' confidence in managing their own health and helped them to stay active in their daily lives.  The health orientation consisted of a 90 min dialogue with a health supervisor, focusing on the participant's lifestyle, motivation, resources, and capacity to act.
Bagheri et al. (2020)	G1: Stabilization exercise + CBT G2: stabilization exercise	16 sessions of 60 min duration led by a physiotherapist. The session began with a 15-mins warm-up. It continued with stabilization exercises (i.e., bridge, quadrupeds). It ended with a 10-mins cool-down.	8 CBT sessions included education about chronic pain, maladaptive thoughts (including catastrophizing) and common beliefs among people with chronic pain (i.e., pain equals harm), relationships between emotional and physical reactions, sleep hygiene, and relapse prevention and maintenance of gains.
Bodes et al. (2018)	G1: MCE + Pain neurophysiology education G2: MCE	A physiotherapist was responsible for teaching a multimodal exercise program to be performed daily for three months consisting of motor control exercises of the lumbar spine (e.g., bridge), aerobic exercises (e.g., continuous walking for 20-30 min at a plausible speed) and stretching (e.g., piriformis stretch). One month after the first session, the physiotherapist reconfirmed the correct execution of the exercises.	Two educational sessions of 30-50 min each. These consisted of an explanation of the main concepts of pain neurophysiology.
Cherkin et al. (2016)	G1 (n=94): Mindfulness + Yoga G2 (n=98): CBT	8 sessions of 60 min that included Yoga exercises and Mindfulness-based stress reduction.	8 CBT sessions of 60 min that included education about chronic pain, relationships between thoughts and emotional and physical reactions, sleep hygiene, relapse prevention,

G3 (n=106): UC		and maintenance of achievement.	
Garcia et al. (2018)	G1 (n=74): McKenzie + Booklet G2 (n=73): Educational booklet	The McKenzie Method prescribes repeated exercises in a specific direction to treat patients with mechanical pain. Patients were instructed to do 10 to 15 repetitions of the exercise, three to five times a day. In addition, all patients also received an educational tip book called "Treat Your Own Back".	All participants received a translated version of "The Back Book". This booklet offers evidence-based advice on overcoming back pain through a mix of activities and positive thinking. The text provides facts about the back, details the causes of back pain and explains exercises to relieve it.
Gorji et al. (2022)	G1: MCE + PNE G2: Core Stability Exercises	Motor Control Exercises 16 sessions of 45-60 min duration led by a physiotherapist that included sensory–motor control training with the facilitation of the proprioceptive system and optimization of coordinated muscle patterns. Patients were instructed to contract the deep muscles of their spine that are separate from the superficial muscles. Core Stability Exercises 16 sessions of 45-60 min duration led by a physiotherapist that included a warm-up (walk for 5 min, stretching exercises for 5 min, the main intervention for 30 min (in the initial weeks) to 45 min (in the final weeks), and cool down for 5 min.	3 sessions of 45-60 min duration led by a physiotherapist. The purpose of the sessions was to control patients' negative perceptions of recurrent pain and provided information about pain to avoid fearful beliefs and behaviours, thus providing key words at this stage to promote self-efficacy.
Javdaneh, Saeterbakken, Shams, and Barat (2021)	G1: Neck and scapula muscle exercises + PNE G2: Neck and scapula muscle resistance G3: Ergonomics	3 sessions of 30-40 mins duration led by a physiotherapist. The session began with a 10 mins warm-up. It continued with stabilization exercises (i.e., cervical isometric exercises, Scapular upward rotation). It ended with a 10 mins cool-down.	The first session was a 1-h lecture the first week and then 30–45 min lectures in the following five weeks. The sessions covered topics concerning the multifactorial nature of chronic pain, sensitization, and plasticity of the brain, aiming at giving patients a better understanding of their chronic pain and thereby engaging the patients in the treatment.
Rabiei, Sheikhi, and Letafatkar (2021)	G1: MCE + PNE G2: Based exercise	MCE: 16 exercise sessions lasting 60 mins led by a physiotherapist. The training consisted of sensorimotor control training by facilitating the proprioceptive system and the patients performed more complex exercises that involved both the deep and superficial muscles of the spine. These exercises, which included movements of the limbs and trunk, started off as static and then became dynamic. Based exercise: 16 exercise sessions lasting 60 mins led by a physiotherapist. The session started with a 10 mins warm up. This was followed by 45 mins of trunk	3 sessions of 45-60 min duration led by a physiotherapist. The purpose of the sessions was to control patients' negative perceptions of recurrent pain and provided information about pain to avoid fearful beliefs and behaviours, thus providing key words at this stage to promote self-efficacy.

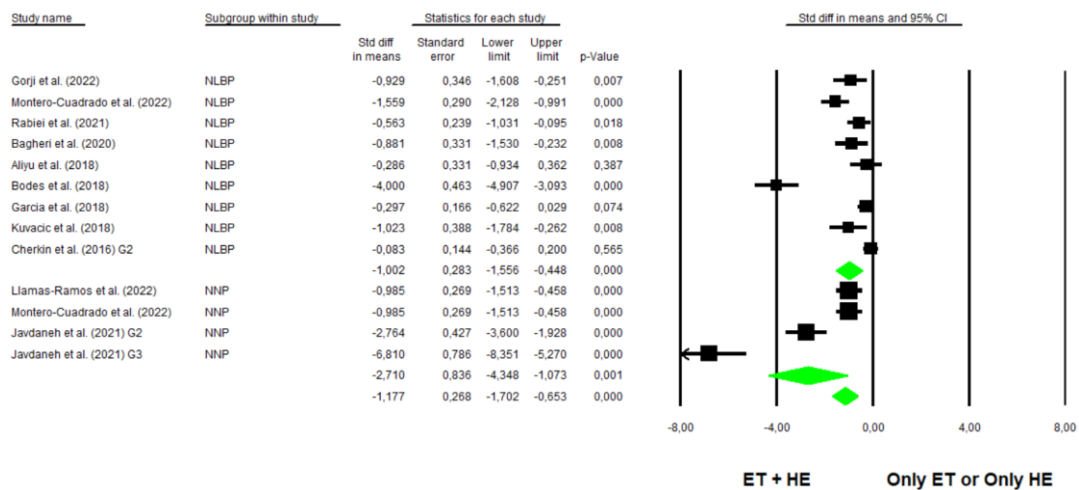
		and upper and lower limb strengthening exercises. Finished with a 10 mins cool down.	
Javdaneh, Letafatkar, Shojaedin, and Hadadnezhad (2020)	G1: Scapular exercise G2: Scapular exercise + cognitive functional training G3: Home exercise program	Scapular exercise 3 sessions of 45 mins duration led by a physiotherapist. The session is a combination of scapulothoracic exercises and stretching exercises (i.e., shoulder abduction, shoulder shrug). Home exercise program that included posture during daily work, as well as demonstrations of lifting, pushing, pulling, office ergonomics, etc.	3 functional cognitive training sessions of 60-30 mins duration. In these sessions, topics such as flare-ups, anguish and worries about pain were explained. Explain how negative beliefs, anxiety, sleep deprivation, activity avoidance, and protective muscle defence set up a vicious cycle of pain sensitivity and disability. In addition, in collaboration with each patient, personalized advice on sleep hygiene and coping strategies, such as respiratory relaxation strategies, were developed.
Járomi et al. (2018)	G1: Back School Program. G2: Booklet lifestyle guidance	24 sessions of 60 mins duration led by a physiotherapist that combine stretching and breathing exercises and static and dynamic lumbar stabilization exercises.	In the theoretical part, basic notions of anatomy, ergonomics and healthy lifestyle recommendations were addressed.
Kuvačić et al. (2018)	G1: Yoga + education on the spine G2: Ergonomic booklet	16 sessions of 60 mins duration led by a Yoga teacher. The Yoga program was based on asanas – selected postures for participants with low back pain, pranayama – a workout on the breathing experience and control, Yoga Nidra – a systematic method to consciously induce physical, mental, and emotional relaxation, and Vipassana – a mindfulness meditation from the Buddhist tradition. In addition, 10 min of education on the spine (biomechanical and respiratory mechanisms) and 5 min of discussion.	Booklet explaining the spine and its biomechanical aspects. This brochure also contained images of ergonomic use of the spine during daily life and sport/recreation, as well as information on proper weight bearing, correct body posture at work, and proper body movement and shape. that must be adapted during normal exercise., daily activities (for example, dressing, eating, and bathing). The breathing mechanism was also explained, and it was recommended to do it at home during the same experimental period.
Llamas-Ramos et al. (2022)	G1: Therapeutic physical exercise program + The Family Caregiver Care Program G2: The Family Caregiver Care Program	Therapeutic physical exercise program for 12 weeks. Each session lasted 60 min with a frequency of 3 sessions per week (every other day), for a total of 36 sessions. The sessions were structured in three phases: warm-up phase lasting 10–15 min (joint mobility exercises), main part phase lasting 35–40 min (strength and aerobic exercises) and cool-down phase lasting 10–15 min (exercises). stretching and relaxation).	The Family Caregiver Care Program consisted of 4 sessions of 90 min for 1 month. The aims of this programme are to provide guidance on care, orientation on social resources, and education for groups of caregivers.
Montero-Cuadrado et al. (2022)	G1: Therapeutic physical exercise program + The Family Caregiver	36 sessions of 60 mins duration led by a physiotherapist. The session started with a 10 mins warm up (aerobic activation and active joint mobilisation). This was followed by 35-40 mins of	The Family Caregiver Care Program consisted of 4 sessions of 90 min for 1 month. The first three sessions comprised theoretical training, while the last session was theoretical and practical. They were taught by a nurse (1st and 2nd session),

	Care Program G2: The Family Caregiver Care Program	strength exercises and Cardiovascular resistance. Finished with a 10-15 mins cool down. that combine relaxation and strength exercises.	a social worker (3rd session), and a physiotherapist (4th session). The aims of this programme are to provide guidance on care, orientation on social resources, and education for groups of caregivers.
Tunwattanapong, Kongkasuwan, and Kuptniratsaikul (2016) [38]	G1: Neck and shoulder program + Ergonomic booklet G2: Ergonomic booklet	The exercise program consists of performing a series of neck and shoulder stretching exercises twice a day, five days a week for four weeks.	All participants received an informative booklet indicating the proper position and ergonomics to be applied during daily work.
Turner et al. (2016)	G1: CBT G2: Yoga + Mindfulness G3: UC	8 sessions of 120 min duration led by a psychologist. The program included mindfulness meditation and Yoga exercises. All sessions included mindfulness exercises (i.e., body scan, sitting meditation) and mindful movement.	8 CBT sessions of 60 min that included education about chronic pain, maladaptive thoughts (including catastrophizing) and beliefs (e.g., inability to control pain, hurt equals harm), relationships between thoughts and emotional and physical reactions, sleep hygiene, relapse prevention, and maintenance of achievement.
G1: Group 1; CBT: Cognitive behavioral therapy; G2; Group 2; G3: Group 3; MCE: Motor Control Exercise; UC: Usual Care; PNE: Pain Neuroscience Education.			

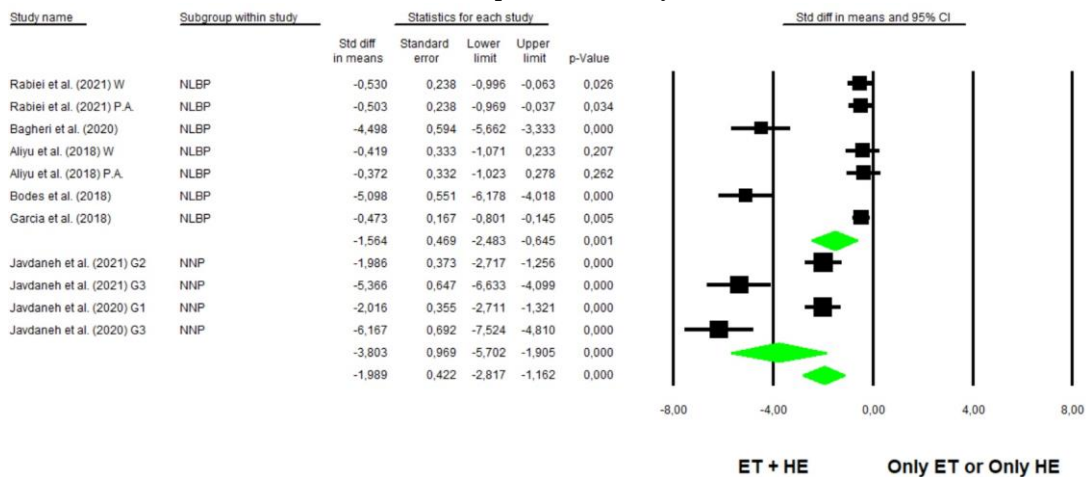
### Supplementary Material IV. Forest Plot for anatomical regions.



Forest plot for pain.



Forest plot for disability.



Forest plot for kinesiophobia.

NLBP: non-specific low back pain; NNP: non-specific neck pain; ET: Exercise Therapy; HE: Health Education.