Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v42i1.47087

Effects of group kinesiotherapy on primary and secondary symptoms of osteoarthrosis

Marcela Regina de Camargo, Alessandra Madia Mantovani, Ellene Cristine Lopes de Oliveira, Cíntia Tiemi Gushiken, Renilton José Pizzol and Cristina Elena Prado Teles Fregonesi*

Faculdade de Ciências e Tecnologia, Universidade Estadual Paulista, Rua Roberto Simonsen, 305, 19060-900, Presidente Prudente, São Paulo, Brazil.
*Author for correspondence. E-mail: cristina.fregonesi@unesp.br

ABSTRACT. The aim of this study was to investigate the influence of a specific, kinesiotherapy-based rehabilitation program on the various symptoms of osteoarthrosis (OA), following group treatment. Thirty-one individuals, of both sexes, aged over 50 years and with medical diagnosis of OA, underwent 16 sessions, twice a week, totaling eight weeks, of a specific rehabilitation protocol based on group kinesiotherapy. Primary OA symptoms were assessed (directly related to the disease: OA symptoms, trunk flexibility, balance and pain), and so were secondary ones (indirectly related to the disease: signs of depression and anxiety, and quality of life). Data were tested through Student's t test or Wilcoxon's test, and contingencies of categorical data were analyzed using McNemar's test. There was an improvement in all primary symptoms of OA after the kinesiotherapy protocol was applied. Signs of anxiety and depression improved only in contingency, when risk stratification was taken into account. In addition, physical components of quality of life also showed improvement, which did not occur with mental components though. Therefore, the kinesiotherapy-based rehabilitation program was capable of positively influencing all primary symptoms, and only some aspects of secondary OA symptoms.

Keywords: osteoarthrosis; physiotherapy; exercise therapy; exercise; chronic disease; rehabilitation.

Received on March 3, 2019.
Accepted on January 18, 2020.

Introduction

Osteoarthrosis (OA) is a chronic-degenerative rheumatic disease of the cartilage, characterized by wear due to an imbalance between formation and destruction of its main components, as a consequence of trauma, overuse and genetic predisposition (Hayashi, Roemer, & Guermazi, 2018; Pereira, Ramos, & Branco, 2015). OA is estimated to affect 10% of the world's population aged over 60 years, being the most common musculoskeletal complaint nowadays (Bhatia, Bejarano, & Novo, 2013). In Brazil, there are few studies addressing the incidence and prevalence of this disease, but results appear to be quite similar to the worldwide scenario (Cunha-Miranda, Faustino, Alves, Vicente, & Barbosa, 2015; Silva, Menezes, & Noal, 2009).

Individuals with OA usually seek medical attention due to arthralgia. However, in addition to it, joint stiffness and limitation also occur, with progressive loss of repair of the cartilage and of the subchondral bone (Sakalauskienė & Jauniškienė, 2010; Sandell, 2012). Pain is the main cause of restriction to physical activity, leading to muscle weakness and hypotrophy, which culminate in decreased physical fitness. The latter, in its turn, leads to an increase in pain, generating incapacity (Runhaar, Luijsterburg, Dekker, & Bierma-Zeinstra, 2015; Sakalauskiene et al., 2010; Sandell, 2012; Silva et al., 2009).

Physiotherapeutic treatment is one of the main forms of rehabilitation for individuals with OA and aims to decrease joint load, improving the alignment between segments and range of motion, which restores the physiological neuromuscular function. Currently, there are no guidelines that indicate which physiotherapeutic procedures are most effective in treating OA. Most likely, this factor is closely linked to variations in the onset of the condition, to the specificity of the treatment and to each patient's individual responses (Page, Hinman, & Bennell, 2011).

In addition to other techniques, physiotherapy includes kinesiotherapy, which can contribute to reducing pain and to the functional improvement of this population. Some current pieces of evidence show that physical activity has been efficient in the prevention and adjunct treatment of OA, especially in the early stages of the evolution of the disease (Allen et al., 2014; Hochberg et al., 2012). This fact may perhaps be explained by improvements in specific components of physical condition, affected primarily by OA, such as muscle strength, overall flexibility, and aspects related to static and dynamic balance, and also by improvements in secondary aspects affected by OA, such as emotional conditions, quality of life, and functional independence (Allen et al., 2018; Allen et al., 2016; Fransen et al., 2015; Oliveira, Vatri, & Alfieri, 2016; Runhaar, Luijsterburg, Dekker, & Bierma-Zeinstra, 2015; Tanaka, Ozawa, Kito, & Moriyama, 2015; Vassao et al., 2019).

Concerning the possible benefits of exercise to primary OA symptoms, studies show some agreement when describing that there are moderate gains as to these aspects, compared to not exercising. There is evidence that strength and flexibility gains and improved proprioception are possible mediators in a positive association between physical exercise and OA symptoms, and also that there seems to be no difference between training with resistance exercises and with kinesiotherapy (Oliveira et al., 2016; Runhaar et al., 2015). Controversially, some studies report very small effects (Rausch, 2018) or no effect at all (Allen et al., 2018) of physical therapy on these aspects.

Regarding the possible effects of physical exercise on secondary OA symptoms, there is evidence that it improves the quality of life and functional capacity of this population (Fransen et al., 2015; Fransen, McConnell, Hernandez-Molina, & Reichenbach, 2014; Tanaka et al., 2015). However, depending on the type of exercise performed, these pieces of evidence are not strong enough (Cheung, Park, & Wyman, 2016; Moseng, Dagfinrud, Smedslund, & Osteras, 2017; Wang et al., 2016). On the other hand, it is known that, in general, engaging in physical activity is effective against social isolation and loneliness, since it can postpone functional declines or even the onset of chronic diseases, by maintaining one's quality of life, autonomy and functional independence (Vagetti et al., 2014).

In recent years, some factors related to how primary and secondary aspects of the disease correlate with each other have been a reason of interest in the scientific literature (Domenech, Sanchis-Alfonso, & Espejo, 2014; Monticone et al., 2013). As previously discussed, there is evidence that physical exercise can somehow act beneficially on the clinical picture of OA (Allen et al., 2018; Allen et al., 2016; Allen et al., 2014; Fransen et al. , 2015; Oliveira et al., 2016; Runhaar et al., 2015; Tanaka et al., 2015). However, some aspects may interfere with the magnitude of this impact, including the fear of executing movements (kinesiophobia) and the catastrophic interpretation of the sensation of pain, with a tendency to develop an exaggerated fear of feeling it (catastrophization). This leads to behaviors towards avoiding movements and, consequently, rewarding activities such as work, family relationships and leisure. There is also an increase in pain hypervigilance, which, associated with depression and disuse, is related to the exacerbation of the painful experience (Burgmer et al., 2011; den Hollander et al., 2010).

As a result, the clinical improvement of pain and incapacity is associated with a reduction in catastrophization and kinesiophobia processes (Domenech et al., 2014; Monticone et al., 2013), since physical exercise can have a potential effect to change the location of pain or decrease it. About knee OA, it has been shown that when the pain is more diffuse, it is also more frequent and sharpened in a generalized manner, causing greater physical dysfunction and higher levels of anxiety (Farrokhi et al., 2016; Lluch Girbes et al., 2016; Riddle & Makowski, 2015; Thompson et al., 2010; Van Ginckel et al., 2016).

When pain is not lessened or when its treatment fails, a chronification process is installed. It remains inconclusive, among scholars, how chronification occurs, what interferes with its emergence, and what the keys of this mechanism are (Ossipov, Morimura, & Porreca, 2014). Loss of descending analgesic activity may also affect pain processing among patients with OA (Lee, Nassikas, & Clauw, 2011). Important contributions of the dysfunction in pain descending modulating circuits are suggested. Therefore, decreased descending inhibition is likely to be a crucial factor in promoting and maintaining chronic pain (Ablin & Buskila, 2013; Arendt-Nielsen et al., 2010; Lee et al., 2011; Meeus et al., 2015), being involved with emotional, motivational and cognitive processes, which communicate with this circuitry, supporting the relationship between chronic pain and susceptibility to environmental factors (Denk, McMahon, & Tracey, 2014; Liang, Mouraux, Hu, & Iannetti, 2013 ; Wager et al., 2013).

Thus, it seems that the dysfunctional mechanisms of central pain are associated with the state of chronic pain, and the removal of the stimulus that causes incitation to pain can lead to the normalization of central-pain processing (Arendt-Nielsen et al., 2010). In the case of knee OA, studies suggest that improvement in pain and in function can be achieved with gains in hip muscle strength, a fact that can be decisive when pain limits specific knee exercises (Bennell et al., 2010). In addition to these gains, decrease in the extent of impairments, and improvements in proprioception are identified as possible mediators in a positive association between physical exercise and OA symptoms (Runhaar et al., 2015).

In this regard, it appears that the multiple physical and psychological factors in people with OA and chronic pain are associated with the development of incapacities and worsened pain in the long run. In this way, pain self-efficacy, negatively charged emotion, and expectations related to the evolution of the sensation of pain are extremely important factors in the approach of people with knee OA (Edwards, Cahalan, Mensing, Smith, & Haythornthwaite, 2011; Helminen, Sinikallio, Valjakka, Väisänen-Rouvali, & Arokoski, 2016; Sinikallio, Helminen, Valjakka, Väisänen-Rouvali, & Arokoski, 2014). Preventing and treating the emergence of these factors may be the key for the chronification condition not to become widespread (Pergolizzi Jr., Raffa, & Taylor Jr., 2014), and for the success of rehabilitation to be reached more effectively.

Taking into account the aforementioned factors, using group therapy may have a beneficial impact on this population, since it has potential to promote improvements in psychological aspects related to motivation, social interaction, interpersonal relationships, exchange of individual experiences, and others (Courtois, Cools, & Calsius, 2015). Studies with rehabilitation of rheumatic diseases have shown, a while ago, that group therapy can lead to better results in the primary and secondary symptoms of diseases (Hidding et al., 1993; Hidding et al., 1994). More recent evidence does not point to significant differences in OA symptoms when physical therapy is performed individually as opposed to in group (Allen et al., 2016). Therefore, there seems to be no loss in the efficacy of physical therapy performed collectively.

In addition to the factors already mentioned, perhaps the divergence about the real benefits of exercising to OA symptoms is a consequence of the lack of specificity of some protocols that do not meet the current literature. With respect to this, there is need for filling in some remaining gaps about the actual relationship between physical exercise and OA symptoms (Runhaar et al., 2015). Besides, the prescription and dosage of exercise for this purpose has not been fully elucidated either (Bennell, Buchbinder, & Hinman, 2015; Runhaar et al., 2015).

Therefore, the importance of physiotherapeutic treatment, with emphasis on physical exercises, in individuals with OA, is worth noting. However, specific aspects related to how physical therapy influences each OA symptom are still being discussed in the scientific literature. Thus, this study proposes to investigate the influence of a specific, kinesiotherapy-based rehabilitation program on OA symptoms, following group treatment.

Methods

Participants

The sample consisted of 31 individuals, of both sexes, aged over 50 years, with medical diagnosis of hip or knee OA and physiotherapy prescription. The study excluded patients with other associated musculoskeletal or neuromotor diseases and who missed up to two sessions during the intervention period. All participants read and signed a Free and Informed Consent Form agreeing to participate in the study. The Ethics Criteria on Research Involving Human Beings were complied with, in accordance with Resolution 466/12 of the Brazilian National Health Council. The study was approved by the local Research Ethics Committee under CAAE protocol No. 69457717.1.0000.5402.

Measurements – Primary Symptoms

OA Symptoms

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), which aims to assess pain, stiffness and physical function in individuals with knee or hip OA, was used for tracking symptoms. Said instrument consists of 24 questions distributed into three dimensions: A (pain), B (stiffness) and C (physical function). Its total score may vary between zero and 96, or being obtained by domain. The assessed dimension becomes worse the higher the score obtained in it (Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988).

Trunk Flexibility

The sit and reach test was used for assessing trunk flexibility. To do so, the participant, sitting with their knees extended, was asked to flex their trunk anteriorly, with the head between the arms, also extended. Data were recorded in centimeters, using a Wells bench (Instant Flex, Sanny®, Brazil). Three attempts were made, and the best result was considered (Wells & Dillon, 1952).

Balance

To assess balance, the Berg Balance Scale was employed, which considers postures and transitions, such as standing, getting up, walking, leaning forward, transferring and turning. The total score is 56, and each item has an ordinal scale of five alternatives, ranging from zero to four, according to the level of difficulty. The higher the score, the better the balance levels (Berg, Wood-Dauphine, Wiliams, & Gayton, 1989). It was duly translated into Portuguese and showed reproducibility in the Brazilian culture (Miyamoto, Lombardi Junior, Berg, Ramos, & Natour, 2004). For stratification of fall risk, it has been proposed that scores between 53–46 suggest low to moderate risk, and scores below 46 suggest high risk for falls (Shumway-Cook, Baldwin, Polissar, & Gruber, 1997).

Pain

To assess pain level, the Visual Analogue Scale (VAS) was used – a continuous scale for pain magnitude estimates, being considered one of the best methods for this purpose. The VAS is one-dimensional and composed of a 10-cm line. Score zero – beginning of the line – indicates absence of pain, whereas ten – end of the line – denotes unbearable pain. (Carlsson, 1983; Joos, Peretz, Beguin, & Famaey, 1991). For application, the patient was asked to indicate what level of pain they were feeling at rest at the time of the assessment.

Measurements – Secondary Symptoms

Signs of Anxiety and Depression

To assess levels of anxiety and depression, the Hospital Anxiety and Depression Scale (HADS), translated into and validated for Portuguese, was used, which aims to detect mild levels of affective disorders in non-psychiatric environments. It is made up of 14 items in total. Seven items correspond to the assessment of anxiety (HADS-A), and the other seven items correspond to the assessment of depression (HADS-D). The score for each item ranges from zero to three, with the maximum score being 21 for both HADS-A and HADS-D. The authors describe the score greater than or equal to nine, with a cutoff for symptom categorization. Thus, for both subscales, scores below nine are classified as absence of symptoms, whereas scores greater than or equal to nine are classified as presence of symptoms (Botega, Bio, Zomignani, Garcia Jr., & Pereira, 1995; Zigmond & Snaith, 1983).

Quality of life

The SF-36 questionnaire was used for assessing the participants' quality of life. This generic instrument is easy to apply and understand; it is multidimensional and composed of 36 items distributed into eight domains: functional capacity; physical aspects; pain; general state of health; vitality; social aspects; emotional aspects, and mental health. It was duly translated and validated in Portuguese. The total score ranges from zero to 100, where zero corresponds to the worst general state of health, and 100 to the best state of health (Ciconelli, Ferraz, Santos, Meinão, & Quaresma, 1999; McHorney, Ware Jr., Lu, & Sherbourne, 1994).

Procedures

Two weekly intervention sessions were carried out, lasting 55 minutes, for eight weeks, totaling 16 sessions. The kinesiotherapy protocol was composed of four stages: 1. Global stretches; 2. Global flexibility exercises with stick and ball; 3. Balance and proprioception training, and 4. Lumbar stabilization exercises. The length of the first exercise stage was 10 minutes, and the other ones lasted 15 minutes.

Table 1 describes the muscle stretches performed at stage 1 (all positions were performed in orthostatism and held for 15 seconds).

Table 1. Description of the muscle stretches performed at stage 1.

Segment	Initial Position	Action
Head/Neck	Neutral.	Tilt and hold the head to the sides.
Head/Neck	Neutral.	Flex/extend and hold the head.
Head/Neck	Neutral.	Move the head in circles.
Arm	Palm between the shoulder blades, with shoulder and elbow flexion.	'Push' and hold the elbow (with the help of the other hand) towards the floor. Bilaterally
Wrist/Hands/Fingers	Palms in 'praying position'.	Lean and hold the wrists and fingers. Bilaterally
Wrist/Hands/Fingers	Shoulder flexion (90º) and extended elbow.	Flex/extend and hold the wrists and fingers. Bilaterally
Thigh	Knee in maximum flexion.	Flex and hold the knee, bringing the heel against the gluteus (with the help of one of the hands). Bilaterally
Leg	Neutral hips, knee extended.	Flex and hold the ankle (with the aid of a bandage grabbed by one hand, around the forefoot sole). Bilaterally
Leg	Slight hip flexion, knee extended, forefoot sole against the wall.	Flex and hold the trunk. Bilaterally
Foot	Neutral.	Move the ankle in circles. Bilaterally

The second stage included four free active exercises with stick and ball, two in orthostatism, and two in sitting position. A detailed description is displayed in Table 2 (two sets of 15 repetitions were executed for each exercise).

Table 2. Description of free active exercises with stick and ball performed at stage 2.

Segment	Initial Position	Action
Trunk/Multi-joint	Orthostatism.	Place the stick on the spine and flex the trunk, keeping the stick immobile.
Multi-joint	Orthostatism.	Squat (knees with maximum flexion of 90°), keeping bimanual support on the stick ahead.
Trunk/Multi-joint	Sitting. Ball between hands, arms above head, legs extended and abducted.	Lean the trunk to both sides.
Trunk/Multi-joint	Sitting. Ball between hands, arms above head, legs extended and abducted.	Put the arms down, resting the ball on the floor, between the legs. Roll the ball forward while progressing into the trunk flexion range.

The third stage included tasks with standing balance training. Each task lasted one minute, with a rest interval of 20 seconds between them. Detailed description below:

- With two small rubber balls under the heels, forefoot resting on the floor, make successive movements, with small range, of knee flexion and extension, while the heels 'bounces' on the balls.
- Release the weight on a rubber ball positioned at three different areas of the soles of the feet (rearfoot, midfoot and forefoot).
- Walk on a mat, on a physiological and reduced support base.
- Stay on one-leg support on the floor, with eyes open and closed;
- Stay on one-leg support on the mat, with eyes open and closed;
- Stay with one foot in front of the other on the floor, with eyes closed;
- Stay on one-leg support and with the sole of the other foot against the inner thigh.
- Keep balance on the latero-lateral proprioception board;
- Keep balance on the anteroposterior proprioception board.

The fourth stage included isometric postures held with or without association of static, upper limb positions, with activation of lumbar-spine-stabilizing muscle groups and deep abdominal muscles. The postures used were orthostatism, sitting, supine and four supports, and can be seen in Figure 1.

Initially, the individuals were only requested to keep their posture (each posture was repeated five times and lasted 10 seconds); afterwards, static, upper limb positions were associated while they were holding positions (example, Figure 1E). First, they were asked to raise an upper limb, then the other; subsequently, they were requested to raise a lower limb, then the other (five times for each limb). Finally, they were instructed to move their limbs alternately, maintaining the position (10 times).

In addition, at that stage, they also executed the following isometric exercises while recruiting lumbar-stabilizing and deep abdominal muscles:

- Side plank held with support on the forearm and on the knees flexed on the mat.
- Hip abduction held in supine position.
- Squat held with ball between the back and the wall, reaching a maximum knee flexion of 90°.
- Sitting position held, on Swiss ball (unstable surface), with the feet resting on the floor.
- Orthostatism held on proprioception board.
- Bridge (pelvic elevation) held, with the feet on proprioception board.

In all exercises at that stage, the postures were repeated five times, each lasting 10 seconds.

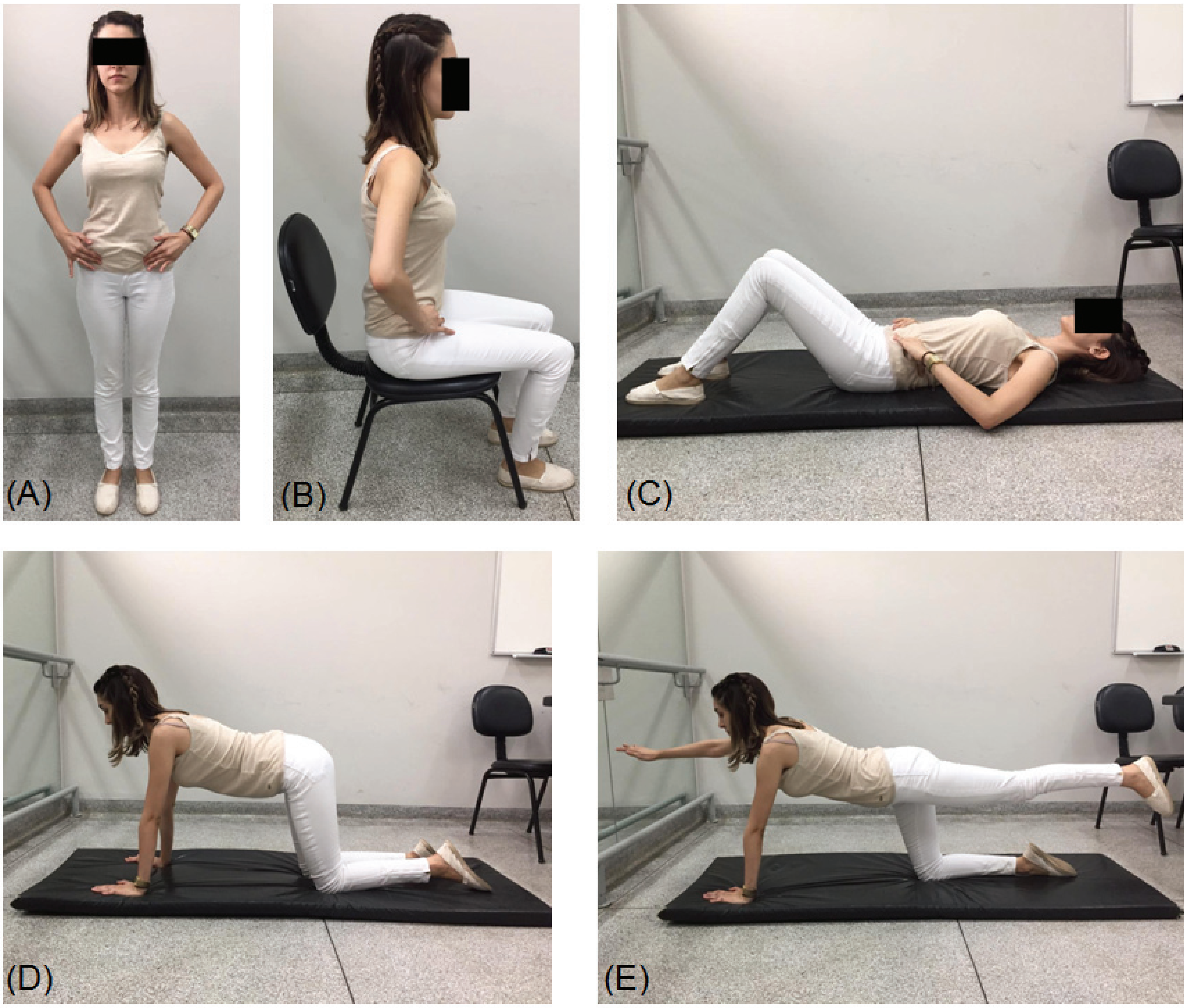

Figure 1. Postures used in the isometric exercises of stage 4. (A): Orthostatism; (B): Sitting position; (C): Supine position; (D): Four supports; (E): Example of exercise involving isometry maintained with the association of upper limb posture.

Statistical analysis

The analyzed continuous data (total values obtained in quantitative measurements) are presented with the aid of descriptive statistics, through means and standard deviations, whereas categorical data (variables organized by categories or groups) are presented by their total values and prevalence (%). The Kolmogorov-Smirnov test was applied to verify data distribution and thus define the use of comparison tests (between pre- and post-intervention moments) for each variable. In the case of normal distribution (Gaussian), Student's t test was applied to paired samples (OA symptoms, trunk flexibility variables, and pain); otherwise, Wilcoxon's test (balance variables, signs of anxiety and depression, and quality of life) was applied. Categorical data (referring to the balance scale and the anxiety and depression scale) were compared using McNemar's chi-square test to find differences between contingencies before and after treatment. The analyses were run on software Statistical Package for the Social Sciences (IBM® SPSS®), and the significance level was 0.05.

Results

The sample was composed of 31 participants, comprising 12 men and 19 women, aged on average 64.01±8.69 – ranging from 51 to 81 years, with body mass index of 30.99±6.76 – ranging from 18.5 to 44.6 kg m^{-2}.

Table 3 displays mean values (standard deviations), medians (maximum and minimum), statistic values (Student's t or Wilcoxon's T) and respective p-values, for primary OA symptoms, after application of the indicated tests.

Table 3. Means (standard deviations) – for parametric tests, and medians (range) – for non-parametric tests; statistic values (Student's t, for parametric, or Wilcoxon's T, for non-parametric) and their respective p-values for primary OA symptoms.

Variable	Mean (sd) / median (range)		Statistical value (Student's t or Wilcoxon's T)	p-value
	Pre-test	Post-test		
OA symptoms (score)	48.48(20.07)	41.73(18.01)	t=3.036	0.005*
Flexibility (cm)	17.34(10.88)	19.43(11.32)	t= -2.444	0.021*
Balance (score)	53.00(38.00–56.00)	55.00 (47.00–56.00)	T=2.750	0.006*
Pain (score)	5.51(2.66)	4.16(3.03)	t= 2.205	0.035*

sd: standard deviation; OA: osteoarthrosis. *p<0.05.

Table 4 displays median values (maximum and minimum), Wilcoxon's T statistic values, and respective p-values, for secondary OA symptoms, after application of the indicated tests.

Table 4. Medians (range) – for non-parametric tests; statistic values and their respective p-values for secondary OA symptoms.

Variable (score)	Mean (sd) / median (range)		Statistic value (Wilcoxon's T)	p-value
	Pre-test	Post-test		
HADS-A	8.00 (0.00–13.00)	6.00 (2.00–20.00)	T= -1.496	0.135
HADS-D	5.00 (0.00–16.00)	5.00 (0.00–16.00)	T= -0.610	0.542
SF-36 – PC	30.00 (0.00–85.00)	40.00 (5.00–100.00)	T= 2.180	0.029*
SF-36 – PA	0.00 (0.00–75.00)	0.00 (0.00–100.00)	T= 1.405	0.160
SF-36 – P	31.00 (0.00–74.00)	41.00 (6.00–100.00)	T= 2.372	0.018*
SF-36 – GSH	62.00 (15.00–95.00)	57.00 (21.00–100.00)	T= 0.903	0.367
SF-36 – V	60.00 (5.00–85.00)	55.00 (0.00–95.00)	T= -0.511	0.609
SF-36 – SA	62.50 (0.00–100.00)	63.00 (0.00–100.00)	T= -0.140	0.889
SF-36 – EA	33.30 (0.00–100.00)	33.30 (0.00–100.00)	T= 0.913	0.361
SF-36 – MH	68.00 (12.00–100.00)	64.00 (0.00–96.00)	T= -1.356	0.175

sd: standard deviation; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; SF-36: Medical Outcomes Short-Form Health Survey (Quality of Life Questionnaire – SF-36); PC: Physical Capacity; PA: Physical Aspects; P: Pain; GSH: General State of Health; V: Vitality; SA: Social Aspects; EA: Emotional Aspects; MH: Mental Health. *p < 0.05.

For the Berg Balance Scale, McNemar's chi-square test showed differences between the contingencies of low and moderate risk scores and the contingencies of high risk scores for falls (χ^2=0.008; p=0.021), after intervention. In addition, this difference occurred in greater number for the change from high to moderate and low risk (n=13; 41.93%), compared to the opposite (n=3; 9.67%). McNemar's chi-square test, for HADS-A, showed significant differences between the contingencies of scores for signs of anxiety and the contingencies of scores without signs of anxiety (χ^2=2.839; p=0.003), after intervention. In addition, this difference occurred in greater numbers for the change from presence to absence of signs of anxiety (n=12; 38.70%), compared to the opposite (n=1; 3.22%). McNemar's chi-square test, for HADS-D, did not show significant differences between the contingencies of scores of signs of depression and the contingencies of scores without signs of depression, after intervention, despite a marginal p-value (χ^2=12.519; p=0.063).

Discussion

The aim of this study was to verify the influence of group kinesiotherapy on OA symptoms. For some time now, kinesiotherapy and group therapy have been used for treating patients with OA, but the specific effects of this resource for this purpose are not yet clear in the scientific literature. A current literature review describes that aerobic resistance and performance exercises, neuromuscular exercises and muscle strengthening are not effective in reducing pain in knee OA. Besides, it describes that currently available evidence suggests a small to moderate effect of exercise (compared to 'non-exercise') on hip or knee OA. However, it emphasizes that exercise prescription and ideal dose are not fully elucidated with studies (Bennell et al., 2015).

Regarding the primary symptoms of OA, the proposed treatment program was effective in improving this population's general symptoms, since the WOMAC score was lower in the post-test. There is solid evidence, reported in previous studies, that most types of physical exercises at rehabilitation level are effective in reducing direct symptoms of OA, assessed by WOMAC (Allen et al., 2018; Allen et al., 2016; Cheung et al., 2016). The results of the present study do not differ from this trend, pointing to the patient's overall improvement as to these aspects.

It was hypothesized, in this study, that gains in some specific aspects of physical capacity in OA may be related to this improvement, since previous studies have been increasingly supporting this statement (Bennell et al., 2015; Bennell et al., 2010 ; Runhaar et al., 2015). Trunk flexibility, balance and quality of life with respect to the participants' physical capacity improved after training, as expected. Moreover, after stratification of fall risk, the contingency of individuals who went from high risk to moderate and low risk was significantly greater. Just as with all other aspects involving the complex systematism of the development of OA clinical condition, issues related to flexibility and body balance, as well as their impact on functional capacity, are interdependent and influenced by the specificity of the provided treatment (Page et al., 2011). Specific training for balance and muscle strength gain has great potential to reach these goals (Chaipinyo & Karoonsupcharoen, 2009; Lin, Lin, Lin, & Jan, 2009).

The kinesiotherapy protocol involved conducts directly linked to these aspects, such as muscle stretching, stimulus for postural reactions, active and proprioceptive exercises. It is known that OA may lead to a decrease in somatic and proprioceptive afferences due to the local pathological process and to restricted movement and generalized pain around the joint (Sandell, 2012). Furthermore, conditions related to the onset and worsening of pain, such as centralization, catastrophization, imbalance in the descending control of pain, and kinesiophobia must be considered, since they can influence the success of the treatment in an incisive manner (Arendt-Nielsen et al. , 2010; Domenech et al., 2014; Monticone et al., 2013). Recent studies that seek to understand the relationship between the most adequate types of exercise for each OA symptom describe that the association of muscle stretching exercises, flexibility exercises and aerobic exercises has been the best protocol for reducing pain and improving functional measures (Page et al., 2011; Uthman et al., 2013). The present intervention protocol did not include aerobic exercises, but covered exercises for body awareness, activation of deep stabilizing axial muscles and proprioception, and, similarly, found improvements in these aspects.

Recently, efforts have been made towards a standardized training dosage for individuals with OA. The American College of Sports Medicine (ACSM) provides recommendations for exercise prescription to adults with levels ranging from moderate to high, for virtually all types of exercise (Garber et al., 2011). The adoption of these recommendations in the training of individuals with OA has resulted in changes in pain, but not in changes in physical function reported by patients (Moseng et al., 2017). This paradigm can perhaps be better understood if we consider the multifactorial aspects of a chronic pain condition. Pain remission resulting from different management techniques (physical exercises, physical therapy activities, analgesic techniques, and drug treatment) may be related to the remission of symptoms linked to cognitive, motivational and emotional processes of the condition (Arendt-Nielsen et al., 2010). However, once again, it seems that improvements in the physical function of patients with OA can be attributed to the most adequate technique for each goal (Chaipinyo & Karoonsupcharoen, 2009; Lin et al., 2009; Page et al., 2011). Thus, one must be cautious when replicating the ACSM recommendations and prescribing any type of therapy or physical exercise to treat patients with OA.

In the present study, no analgesia physiotherapeutic resource was used in combination with kinesiotherapy but, even so, there was improvement in reported pain and in some aspects of quality of life, after the training program. It is known that exercise can contribute to lessening pain in OA (Jansen, Viechtbauer, Lenssen, Hendriks, & de Bie, 2011), but this is still a controversial subject, as there is an inconsistency in the literature that delimits a gap about how the mechanisms involved in improving pain and function correlate (Matsudo & Calmona, 2009), despite recent efforts to reach this understanding (Bennell et al., 2010; Domenech et al., 2014; Lluch Girbes et al., 2016; Monticone et al., 2013; Riddle et al., 2015; Thompson et al., 2010; Van Ginckel et al., 2016). A big portion of the studies that report little effectiveness of physical exercises on function and pain compare their results with a control group without any type of treatment (Bennell et al., 2015), which compromises the generalization of results reported by them.

The key to understanding so much divergence among researchers in this regard can be found in two factors that are still little addressed in the scientific literature. The first one is the fact that pain, in OA, can have peripheral and central components. The traditional rehabilitation model is beneficial in improving the peripheral components of pain, but its effects on the processes involved with central sensitization are not yet known (Lluch Girbes, Nijs, Torres-Cueco, & Lopez Cubas, 2013). It is believed that removing the stimulus that causes its incitation can normalize the central processing of pain (Arendt-Nielsen et al., 2010). It is generically suggested that this can be achieved with gains in muscle strength, improvements in joint condition, and decrease in injury extent (Bennell et al., 2010; Runhaar et al., 2015). The second one, in its turn, consists of the fact that both pain and function are closely related to psychosomatic aspects. These aspects are extremely individual and interdependent, and vary according to a series of conditions that involve the patient as a whole, and not just their illness. Presence of depression and pain catastrophization are associated with the severity of reported pain, with physical incapacity and with treatment failure. Some measures seem to mediate these deleterious effects, and their handling should be an important therapeutic target in the multimodal management of these conditions (Edwards et al., 2011; Sinikallio et al., 2014).

For this reason, it was pertinent to include in the present study the assessment of some secondary symptoms in which a chronic condition, such as OA, can culminate. Post-treatment effects with physical exercises on the secondary symptoms of OA are not widespread in the literature. However, the assessment of these aspects is very important, as they configure conditions that impact the understanding and living with chronic pain (Cunha-Miranda et al., 2015). In the present study, there was no decrease in signs of anxiety and depression after the kinesiotherapy program. However, when risk stratification is considered, the contingency that ceased to present symptoms of anxiety was significantly greater, whereas for depression it was marginal. It is known that there is an inversely proportional correlation between physical function (WOMAC) and anxiety, and between lower limb function and depression (Scopaz, Piva, Wisniewski, & Fitzgerald, 2009), so these are factors that, if not factored in OA treatment, can interfere with the improvement in overall physical condition.

The effects of physical therapy on psychosocial factors caused by OA remain inconclusive (Cheung et al., 2016). However, engagement in physical exercise by individuals with OA provides almost simultaneous beneficial effects on the physical variables, so it is difficult to believe in a purely physical response. Physical therapy ends up covering several psychosocial components, such as acceptance of treatment that demystifies pain and prevents joint damage due to exercise, offering an active coping strategy and, ultimately, reducing incapacity and social isolation (Kruger-Jakins, Saw , Edries, & Parker, 2016). Additionally, it shows potential to promote a rebalancing between pain-regulating descending systems and cognitive and emotional processes. It has been reported that aerobic exercises and kinesiotherapy results in a generalized increase in pain tolerance during and immediately after their execution. The physiological mechanisms of such improvement are still not fully elucidated, although they tend to be attributed to the release of endogenous opioids and to the activation of nociceptive inhibitory mechanisms. However, one must bear in mind that aerobic exercises activate the facilitation of pain in some patients with chronic pain and central sensitization. Kinesiotherapy, in its turn, may lead to increased generalized sensitivity to pain (Nijs, Kosek, Van Oosterwijck, & Meeus, 2012).

For quality of life, as previously described, there was improvement in functional capacity and pain, after intervention. The SF-36 is a scale that can be generically divided into physical and mental components (Ware Jr., 2000); thus, it can be said that, among the mental components, there was no significant difference. A literature review aimed at describing the influence of physical exercises on quality of life, through SF-36, in individuals with OA, observed that most of the included studies found significant improvements both in the physical components and in the mental components of the scale (Tanaka et al., 2015). However, again, there was no standardization of the intervention protocols, and the types of physical exercises, as well as the chosen frequency and length differed greatly, which makes a direct comparison with the present results impossible. As already suggested, the understanding, acceptance and impact that a chronic disease has potential to cause are totally individualized, showing great heterogeneity among patients. Perhaps, if there was a risk stratification within each sub-item of SF-36, one could find information that is hidden by the variability of patient responses.

With the conduction of this study, it was possible to understand a little better about how a kinesiotherapy protocol can act on primary and secondary symptoms of OA. However, if this protocol had been compared to a protocol with another type of physical therapy and/or physical exercises, a better understanding would certainly be achieved, which is a limitation of the present study. In this sense, new researches are worth being developed with this experimental design and covering central sensitization activities, with task-oriented exercises, because, in addition to stimulating motivation, they recruit memory and learning areas that have a close relationship with limbic areas where some of the mental processes affected by chronic diseases occur (Lluch Girbes et al., 2013; Muratori, Lamberg, Quinn, & Duff, 2013).

Conclusion

The kinesiotherapy-based rehabilitation program was capable of beneficially influencing the primary symptoms of OA. Regarding secondary symptoms, there was a tendency of improved psychosomatic symptoms, only in relation to contingents within the risk stratification. As for quality of life, some physical components improved, but the program seems to have no effect on the mental components of this aspect.

References

Ablin, J. N., & Buskila, D. (2013). Fibromyalgia syndrome--novel therapeutic targets. *Maturitas, 75*(4), 335-340. Doi: 10.1016/j.maturitas.2013.05.004

Allen, K. D., Arbeeva, L., Callahan, L. F., Golightly, Y. M., Goode, A. P., Heiderscheit, B. C., ... Schwartz, T. A. (2018). Physical therapy vs internet-based exercise training for patients with knee osteoarthritis: results of a randomized controlled trial. *Osteoarthritis and Cartilage, 26*(3), 383-396. Doi: 10.1016/j.joca.2017.12.008

Allen, K. D., Bongiorni, D., Bosworth, H. B., Coffman, C. J., Datta, S. K., Edelman, D., ... Hoenig, H. (2016). Group versus individual physical therapy for veterans with knee osteoarthritis: randomized clinical trial. *Physical Therapy, 96*(5), 597-608. Doi: 10.2522/ptj.20150194

Allen, K. D., Bosworth, H. B., Chatterjee, R., Coffman, C. J., Corsino, L., Jeffreys, A. S., ... Dolor, R. J. (2014). Clinic variation in recruitment metrics, patient characteristics and treatment use in a randomized clinical trial of osteoarthritis management. *BMC Musculoskeletal Disorders, 15*, Article 413. Doi: 10.1186/1471-2474-15-413

Arendt-Nielsen, L., Nie, H., Laursen, M. B., Laursen, B. S., Madeleine, P., Simonsen, O. H., & Graven-Nielsen, T. (2010). Sensitization in patients with painful knee osteoarthritis. *Pain, 149*(3), 573-581. Doi: 10.1016/j.pain.2010.04.003

Bellamy, N., Buchanan, W. W., Goldsmith, C. H., Campbell, J., & Stitt, L. W. (1988). Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *The Journal of Rheumatology, 15*(12), 1833-1840.

Bennell, K. L., Buchbinder, R., & Hinman, R. S. (2015). Physical therapies in the management of osteoarthritis: current state of the evidence. *Current Opinion in Rheumatology, 27*(3), 304-311. Doi: 10.1097/bor.0000000000000160

Bennell, K. L., Hunt, M. A., Wrigley, T. V., Hunter, D. J., McManus, F. J., Hodges, P. W., ... Hinman, R. S. (2010). Hip strengthening reduces symptoms but not knee load in people with medial knee osteoarthritis and varus malalignment: a randomised controlled trial. *Osteoarthritis and cartilage, 18*(5), 621-628. Doi: 10.1016/j.joca.2010.01.010

Berg, K., Wood-Dauphine, S., Wiliams, J. I., & Gayton, D. (1989). Measuring balance in the elderly: preliminary development of an instrument. *Physiotherapy Canada, 41*(6), 304-311. Doi: 10.3138/ptc.41.6.304

Bhatia, D., Bejarano, T., & Novo, M. (2013). Current interventions in the management of knee osteoarthritis. *Journal of pharmacy & bioallied sciences, 5*(1), 30-38. Doi: 10.4103/0975-7406.106561

Botega, N. J., Bio, M. R., Zomignani, M. A., Garcia Jr., C., & Pereira, W. A. B. (1995). Transtornos de humor em enfermaria de clínica médica e validação de escala de medida (HAD) de ansiedade e depressão*, Revista de Saúde Pública, 29*(5), 355-363. Doi: 10.1590/S0034-89101995000500004

Burgmer, M., Petzke, F., Giesecke, T., Gaubitz, M., Heuft, G., & Pfleiderer, B. (2011). Cerebral activation and catastrophizing during pain anticipation in patients with fibromyalgia. *Psychosomatic Medicine, 73*(9), 751-759. Doi: 10.1097/PSY.0b013e318236588a

Carlsson, A. M. (1983). Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain, 16*(1), 87-101.

Chaipinyo, K., & Karoonsupcharoen, O. (2009). No difference between home-based strength training and home-based balance training on pain in patients with knee osteoarthritis: a randomised trial. *Australian Journal of Physiotherapy, 55*(1), 25-30. Doi: 10.1016/s0004-9514(09)70057-1

Cheung, C., Park, J., & Wyman, J. F. (2016). Effects of yoga on symptoms, physical function, and psychosocial outcomes in adults with osteoarthritis: A Focused review. *American journal of physical medicine & rehabilitation, 95*(2), 139-151. Doi: 10.1097/PHM.0000000000000408

Ciconelli, R. M., Ferraz, M. B., Santos, W. S. d., Meinão, I., & Quaresma, M. R. (1999). Brazilian-Portuguese version of the SF-36. A reliable and valid quality of life outcome measure. *Brazilian Journal of Rheumatology, 39*(3), 143-150.

Courtois, I., Cools, F., & Calsius, J. (2015). Effectiveness of body awareness interventions in fibromyalgia and chronic fatigue syndrome: a systematic review and meta-analysis. *Journal of Bodywork and Movement Therapies, 19*(1), 35-56. Doi: 10.1016/j.jbmt.2014.04.003

Cunha-Miranda, L., Faustino, A., Alves, C., Vicente, V., & Barbosa, S. (2015). Assessing the magnitude of osteoarthritis disadvantage on people's lives: the moves study. *Brazilian Journal of Rheumatology, 55*(1), 22-30. Doi: 10.1016/j.rbr.2014.07.009

den Hollander, M., de Jong, J. R., Volders, S., Goossens, M. E. J. B., Smeets, R. J. E. M., & Vlaeyen, J. W. S. (2010). Fear reduction in patients with chronic pain: a learning theory perspective. *Expert Review of Neurotherapeutics, 10*(11), 1733-1745. Doi: 10.1586/ern.10.115

Denk, F., McMahon, S. B., & Tracey, I. (2014). Pain vulnerability: a neurobiological perspective. *Nature Neuroscience, 17*(2), 192-200. Doi: 10.1038/nn.3628

Domenech, J., Sanchis-Alfonso, V., & Espejo, B. (2014). Changes in catastrophizing and kinesiophobia are predictive of changes in disability and pain after treatment in patients with anterior knee pain. *Knee Surgery Sports Traumatology Arthroscopy, 22*(10), 2295-2300. Doi: 10.1007/s00167-014-2968-7

Edwards, R. R., Cahalan, C., Mensing, G., Smith, M., & Haythornthwaite, J. A. (2011). Pain, catastrophizing, and depression in the rheumatic diseases. *Nature Reviews Rheumatology, 7*(4), 216-224. Doi: 10.1038/nrrheum.2011.2

Farrokhi, S., Chen, Y. F., Piva, S. R., Fitzgerald, G. K., Jeong, J. H., & Kwoh, C. K. (2016). The influence of knee pain location on symptoms, functional status, and knee-related quality of life in older adults with chronic knee pain: Data from the osteoarthritis initiative. *The Clinical Journal of Pain, 32*(6), 463-470. Doi: 10.1097/AJP.0000000000000291

Fransen, M., McConnell, S., Harmer, A. R., Van der Esch, M., Simic, M., & Bennell, K. L. (2015). Exercise for osteoarthritis of the knee: a Cochrane systematic review. *British Journal of Sports Medicine, 49*(24), 1554-1557. Doi: 10.1136/bjsports-2015-095424

Fransen, M., McConnell, S., Hernandez-Molina, G., & Reichenbach, S. (2014). Exercise for osteoarthritis of the hip. *Cochrane Database of Systematic Reviews,* (4), CD007912. Doi: 10.1002/14651858.CD007912.pub2

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., ... Swain, D. P. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine and Science in Sports and Exercise, 43*(7), 1334-1359. Doi: 10.1249/MSS.0b013e318213fefb

Hayashi, D., Roemer, F. W., & Guermazi, A. (2018). Imaging of osteoarthritis-recent research developments and future perspective. *British Journal of Radiology, 91*(1085), 20170349. Doi: 10.1259/bjr.20170349

Helminen, E.-E., Sinikallio, S. H., Valjakka, A. L., Väisänen-Rouvali, R. H., & Arokoski, J. P. (2016). Determinants of pain and functioning in knee osteoarthritis: a one-year prospective study. *Clinical Rehabilitation, 30*(9), 890-900. Doi: 10.1177/0269215515619660

Hidding, A., van der Linden, S., Boers, M., Gielen, X., de Witte, L., Kester, A., ... Moolenburgh, D. (1993). Is group physical therapy superior to individualized therapy in ankylosing spondylitis? A randomized controlled trial. *Arthritis & Rheumatism, 6*(3), 117-125. Doi:10.1002/art.1790060303

Hidding, A., van der Linden, S., Gielen, X., de Witte, L., Dijkmans, B., & Moolenburgh, D. (1994). Continuation of group physical therapy is necessary in ankylosing spondylitis: results of a randomized controlled trial. *Arthritis Care and Research*, *7*(2), 90-96. Doi: 10.1002/art.1790070208

Hochberg, M. C., Altman, R. D., April, K. T., Benkhalti, M., Guyatt, G., McGowan, J, ... Tugwell, P.. (2012). American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care & Research, 64*(4), 465-474. Doi: 10.1002/acr.21596

Jansen, M. J., Viechtbauer, W., Lenssen, A. F., Hendriks, E. J. M., & de Bie, R. A. (2011). Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilisation each reduce pain and disability in people with knee osteoarthritis: a systematic review. *Journal of Physiotherapy, 57*(1), 11-20. Doi: 10.1016/S1836-9553(11)70002-9

Joos, E., Peretz, A., Beguin, S., & Famaey, J. P. (1991). Reliability and reproducibility of visual analogue scale and numeric rating scale for therapeutic evaluation of pain in rheumatic patients. *The Journal of Rheumatology, 18*(8), 1269-1270.

Kruger-Jakins, T., Saw, M., Edries, N., & Parker, R. (2016). The development of an intervention to manage pain in people with late-stage osteoarthritis. *South African Journal of Physiotherapy, 72*(1), a311. Doi: 10.4102/sajp.v72i1.311

Lee, Y. C., Nassikas, N. J., & Clauw, D. J. (2011). The role of the central nervous system in the generation and maintenance of chronic pain in rheumatoid arthritis, osteoarthritis and fibromyalgia. *Arthritis Research & Therapy, 13*(2). Doi: 10.1186/ar3306

Liang, M., Mouraux, A., Hu, L., & Iannetti, G. D. (2013). Primary sensory cortices contain distinguishable spatial patterns of activity for each sense. *Nature Communications, 4*. Doi: 10.1038/ncomms2979

Lin, D.-H., Lin, C.-H., Lin, Y.-F., & Jan, M.-H. (2009). Efficacy of 2 non-weight-bearing interventions, proprioception training versus strength training, for patients with knee osteoarthritis: a randomized clinical trial. *Journal of Orthopaedic and Sports Physical Therapy, 39*(6), 450-457. Doi: 10.2519/jospt.2009.2923

Lluch Girbes, E., Duenas, L., Barbero, M., Falla, D., Baert, I. A. C., Meeus, M., ... Nijs, J. (2016). Expanded Distribution of Pain as a Sign of Central Sensitization in Individuals with Symptomatic Knee Osteoarthritis. *Physical Therapy, 96*(8), 1196-1207. Doi: 10.2522/ptj.20150492

Lluch Girbes, E., Nijs, J., Torres-Cueco, R., & López Cubas, C. (2013). Pain treatment for patients with osteoarthritis and central sensitization. *Physical Therapy, 93*(6), 842-851. Doi: 10.2522/ptj.20120253

Matsudo, V. K. R., & Calmona, C. O. (2009). Osteoartrose e atividade física. *Diagnóstico e Tratamento, 14*(4), 146-151.

McHorney, C. A., Ware Jr., J. E., Lu, J. F., & Sherbourne, C. D. (1994). The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. *Medical Care, 32*(1), 40-66.

Meeus, M., Hermans, L., Ickmans, K., Struyf, F., Van Cauwenbergh, D., Bronckaerts, L., ... Nijs, J. (2015). Endogenous pain modulation in response to exercise in patients with rheumatoid arthritis, patients with chronic fatigue syndrome and comorbid fibromyalgia, and healthy controls: a double-blind randomized controlled trial. *Pain Practice, 15*(2), 98-106. Doi: 10.1111/papr.12181

Miyamoto, S. T., Lombardi Junior, I., Berg, K. O., Ramos, L. R., & Natour, J. (2004). Brazilian version of the Berg balance scale. *Brazilian Journal of Medical and Biological Research, 37*(9), 1411-1421. Doi: 10.1590/S0100-879X2004000900017

Monticone, M., Ferrante, S., Rocca, B., Salvaderi, S., Fiorentini, R., Restelli, M., & Foti, C. (2013). Home-based functional exercises aimed at managing kinesiophobia contribute to improving disability and quality of life of patients undergoing total knee arthroplasty: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 94*(2), 231-239. Doi: 10.1016/j.apmr.2012.10.003

Moseng, T., Dagfinrud, H., Smedslund, G., & Osteras, N. (2017). The importance of dose in land-based supervised exercise for people with hip osteoarthritis. A systematic review and meta-analysis. *Osteoarthritis Cartilage, 25*(10), 1563-1576. Doi: 10.1016/j.joca.2017.06.004

Muratori, L. M., Lamberg, E. M., Quinn, L., & Duff, S. V. (2013). Applying principles of motor learning and control to upper extremity rehabilitation. *Journal of Hand Therapy, 26*(2), 94-102; quiz 103. Doi: 10.1016/j.jht.2012.12.007

Nijs, J., Kosek, E., Van Oosterwijck, J., & Meeus, M. (2012). Dysfunctional endogenous analgesia during exercise in patients with chronic pain: to exercise or not to exercise? *Pain Physician, 15*(3 Suppl), ES205-213.

Oliveira, N. C., Vatri, S., & Alfieri, F. M. (2016). Comparison of the effects of resistance exercise versus kinesiotherapy in knee osteoarthritis. *Acta Fisiátrica, 23*(1), 7-11. Doi: 10.5935/0104-7795.20160002

Ossipov, M. H., Morimura, K., & Porreca, F. (2014). Descending pain modulation and chronification of pain. *Current Opinion in Supportive and Palliative Care, 8*(2), 143-151. Doi: 10.1097/SPC.0000000000000055

Page, C. J., Hinman, R. S., & Bennell, K. L. (2011). Physiotherapy management of knee osteoarthritis. *International Journal of Rheumatic Diseases, 14*(2), 145-151. Doi: 10.1111/j.1756-185X.2011.01612.x

Pereira, D., Ramos, E., & Branco, J. (2015). Osteoarthritis. *Acta Medica Portuguesa, 28*(1), 99-106. Doi: 10.20344/amp.5477

Pergolizzi Jr., J. V., Raffa, R. B., & Taylor Jr., R. (2014). Treating acute pain in light of the chronification of pain. *Pain Management Nursing, 15*(1), 380-390. Doi: 10.1016/j.pmn.2012.07.004

Rausch, A. K. (2018). *The evidence for physical activity in inflammatory arthritis and osteoarthritis.* In Annals of Rheumatic Diseases. Doi: 10.1136/annrheumdis-2018-eular.7804

Riddle, D. L., & Makowski, M. (2015). Knee pain patterns and associations with pain and function in persons with or at risk for symptomatic radiographic osteoarthritis: A cross-sectional analysis. *The Journal of Rheumatology, 42*(12), 2398-2403. Doi: 10.3899/jrheum.150545

Runhaar, J., Luijsterburg, P., Dekker, J., & Bierma-Zeinstra, S. M. (2015). Identifying potential working mechanisms behind the positive effects of exercise therapy on pain and function in osteoarthritis; a systematic review. *Osteoarthritis and Cartilage, 23*(7), 1071-1082. Doi: 10.1016/j.joca.2014.12.027

Sakalauskienė, G., & Jauniškienė, D. (2010). Osteoarthritis: etiology, epidemiology, impact on the individual and society and the main principles of management. *Medicina (Kaunas), 46*(11), 790-797.

Sandell, L. J. (2012). Etiology of osteoarthritis: genetics and synovial joint development. *Nature Reviews Rheumatology, 8*(2), 77-89. Doi: 10.1038/nrrheum.2011.199

Scopaz, K. A., Piva, S. R., Wisniewski, S., & Fitzgerald, G. K. (2009). Relationships of fear, anxiety, and depression with physical function in patients with knee osteoarthritis. *Archives of Physical Medicine and Rehabilitation, 90*(11), 1866-1873. Doi: 10.1016/j.apmr.2009.06.012

Shumway-Cook, A., Baldwin, M., Polissar, N. L., & Gruber, W. (1997). Predicting the probability for falls in community-dwelling older adults. *Physical Therapy, 77*(8), 812-819.

Silva, V. R. L., Menezes, A. M. B., & Noal, R. B. (2009). Chronic joint symptoms in adults from Pelotas, Rio Grande do Sul State, Brazil: prevalence and determinants. *Cadernos de Saúde Pública, 25*(12), 2571-2581. Doi: 10.1590/S0102-311X2009001200005

Sinikallio, S. H., Helminen, E.-E., Valjakka, A. L., Väisänen-Rouvali, R. H., & Arokoski, J. P. (2014). Multiple psychological factors are associated with poorer functioning in a sample of community-dwelling knee osteoarthritis patients. *Journal of Clinical Rheumatology, 20*(5), 261-267. Doi: 10.1097/RHU.0000000000000123

Tanaka, R., Ozawa, J., Kito, N., & Moriyama, H. (2015). Does exercise therapy improve the health-related quality of life of people with knee osteoarthritis? A systematic review and meta-analysis of randomized controlled trials. *Journal of Physical Therapy Science, 27*(10), 3309-3314. Doi: 10.1589/jpts.27.3309

Thompson, L. R., Boudreau, R., Newman, A. B., Hannon, M. J., Chu, C. R., Nevitt, M. C., & Kent Kwoh, C. (2010). The association of osteoarthritis risk factors with localized, regional and diffuse knee pain. *Osteoarthritis Cartilage, 18*(10), 1244-1249. Doi: 10.1016/j.joca.2010.05.014

Uthman, O. A., van der Windt, D. A., Jordan, J. L., Dziedzic, K. S., Healey, E. L., Peat, G. M., & Foster, N. E. (2013). Exercise for lower limb osteoarthritis: systematic review incorporating trial sequential analysis and network meta-analysis. *British Journal of Sports Medicine, 48*(21), 1579. Doi: 10.1136/bjsports-2014-5555rep

Vagetti, G. C., Barbosa Filho, V. C., Moreira, N. B., Oliveira, V., Mazzardo, O., & Campos, W. (2014). Association between physical activity and quality of life in the elderly: a systematic review, 2000-2012. *Brazilian Journal of Psychiatry, 36*(1), 76-88. Doi: 10.1590/1516-4446-2012-0895

Van Ginckel, A., Bennell, K. L., Campbell, P. K., Wrigley, T. V., Hunter, D. J., & Hinman, R. S. (2016). Location of knee pain in medial knee osteoarthritis: patterns and associations with self-reported clinical symptoms. *Osteoarthritis Cartilage, 24*(7), 1135-1142. Doi: 10.1016/j.joca.2016.01.986

Vassao, P. G., Souza, M. C. d., Silva, B. A., Junqueira, R. G., Camargo, M. R., Dourado, V. Z., ... Rennó, A. C. M. (2019). Photobiomodulation via a cluster device associated with a physical exercise program in the level of pain and muscle strength in middle-aged and older women with knee osteoarthritis: a randomized placebo-controlled trial. *Lasers in Medical Science*, *35*(1), 139-148 Doi: 10.1007/s10103-019-02807-3

Wager, T. D., Atlas, L. Y., Lindquist, M. A., Roy, M., Woo, C. W., & Kross, E. (2013). An fMRI-based neurologic signature of physical pain. *New England Journal of Medicine, 368*(15), 1388-1397. Doi: 10.1056/NEJMoa1204471

Wang, C., Schmid, C. H., Iversen, M. D., Harvey, W. F., Fielding, R. A., Driban, J. B., ... McAlindon, T. (2016). Comparative effectiveness of tai chi versus physical therapy for knee osteoarthritis: A randomized trial. *Annals of Internal Medicine, 165*(2), 77-86. Doi: 10.7326/M15-2143

Ware Jr., J. E. (2000). SF-36 health survey update. *Spine, 25*(24), 3130-3139. Doi: 10.1097/00007632-200012150-00008

Wells, K. F., & Dillon, E. K. (1952). The Sit and Reach - A test of back and leg flexibility. *Research Quarterly of the American Association for Health*, *23*(1), 115-118. Doi: 10.1080/10671188.1952.10761965

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67*(6), 361-370. Doi: 10.1111/j.1600-0447.1983.tb09716.x