

The Ottawa panel clinical practice guidelines for the management of knee osteoarthritis. Part three: Aerobic exercise programs*

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Abstract

Objectives: To identify effective aerobic exercise programs and provide clinicians and patients with updated, high-quality recommendations concerning traditional land-based exercises for knee osteoarthritis.

Methods: A systematic search and adapted selection criteria included comparative controlled trials with strengthening exercise programs for patients with knee osteoarthritis. A panel of experts reached consensus on the recommendations using a Delphi survey. A hierarchical alphabetical grading system (A, B, C+, C, D, D+, or D-) was used, based on statistical significance ($P < 0.5$) and clinical importance ($\geq 15\%$ improvement).

Results: The five high-quality studies included demonstrated that various aerobic training exercises are generally effective for improving knee osteoarthritis within a 12-week period. An aerobic exercise program demonstrated significant improvement for pain relief (Grade B), physical function (Grade B) and quality of life (Grade C+). Aerobic exercise in combination with strengthening exercises showed significant improvement for pain relief (3 Grade A) and physical function (2 Grade A, 2 Grade B).

Conclusion: A short-term aerobic exercise program with/without muscle strengthening exercises is promising for reducing pain, improving physical function and quality of life for individuals with knee osteoarthritis.

Keywords

Therapeutic exercise, aerobic exercises, knee osteoarthritis, clinical practice guideline, systematic review

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Introduction

Individuals with osteoarthritis of the knee are recognized to have poor physical fitness.¹⁻³ Promotion of regular aerobic exercise (150 minutes/week) is highly recommended for individuals with chronic conditions such as osteoarthritis,^{4,5} especially to improve pulmonary and functional capacities that are important to perform daily activities such as groceries and taking the bus. Therefore, there is a need to further explore and update evidence on aerobic therapeutic exercises for knee osteoarthritis management. A list of definitions related to aerobic exercise programs can be found in Appendix 1 (supplementary material).

This is the third Ottawa Panel clinical practice guideline providing the most recent quantitative evidence on short- and long-term benefits of aerobic therapeutic exercises on the general and joint health of individuals with knee osteoarthritis. Existing high-quality guidelines^{6,7} (AGREE II for osteoarthritis) and systematic reviews⁸⁻¹¹ have reported

unanimous positive recommendations on aerobic exercise programs for knee osteoarthritis management. While aerobic exercise programs have been strongly recommended,¹²⁻²⁰ or recommended^{8-11, 21} to improve clinical outcomes such as pain relief, physical function and quality of life, these recommendations have not always been based on systematic reviews or are currently outdated.

The objective of this guideline was to identify effective aerobic exercise programs and provide both healthcare professionals and knee osteoarthritis patients with updated, high-quality recommendations supporting traditional land-based exercises for knee osteoarthritis.

Methods

Further details of the methodology used for this systematic review, comprised of five steps evaluating the existing evidence (steps 1-3) followed by the

Table 1. Characteristics of included randomised controlled trials related to intervention and comparator.

Randomised controlled trials	Intervention and comparator
Deyle et al., 2000 ²³	Compared a leg functional aerobic and strengthening exercise program with a placebo ultrasound control group.
Fransen et al., 2001 ²⁴	Examined the effects of individual and group supervised aerobic and strengthening exercise programs and a waitlist control group.
Hay et al. 2006 ²⁵	Compared the effects of community physiotherapy exercise interventions to an osteoarthritis advice leaflet health education control group.
Péloquin et al., 1999 ²⁶	Compared an intervention group using an aerobic, strengthening exercise program and osteoarthritis health education to a control group receiving osteoarthritis health education.
Salacinski et al., 2012 ²⁷	Examined the effects of a cycling exercise program to a waitlist control group.

creation of the recommendations (steps 4-5), and can be found in Brosseau et al.²² A description of the inclusion criteria followed to select strengthening randomized controlled trials for this paper can be found in Brosseau et al.²²

Results

Step 1 – Systematic search and selection

Thirty-five studies with at least one positive recommendation were included in our analysis and five of these were trials on aerobic exercise programs.^{23–27} The reasons for exclusion of studies and the PRISMA flow diagram can be found in Brosseau et al.,²². The characteristics, figures and tables related to studies with positive recommendations ($n=10$) can be found in Appendix 2 (supplementary material).

All five studies were trials^{23–27} that only included patients that were clinically diagnosed with knee osteoarthritis. Three high-quality randomised controlled trials with an aerobic exercise program had neutral recommendations only.^{28–30}

Methodological quality (PEDro scores of included studies). The methodological quality of the five included studies^{23–27} obtained PEDro scores ranging from six to eight out of 10. Additional information on the methodological quality can be found in the characteristics of included studies in Appendix 2. Appendices, tables and figures for neutral

recommendations are available in the supplementary file.

Characteristics of included randomised controlled trials on aerobic exercise programs. Aerobic exercise programs and control/comparator groups varied widely among included studies (Table 1). A description of the characteristics of aerobic exercise programs for included trials is provided (Table 2).

Steps 2 and 3 – Systematic review: Statistical analysis and clinical importance

In order to examine the effectiveness of aerobic exercise programs for knee osteoarthritis management, the statistical and clinical importance were assessed. The grades, mean and relative differences as well as the absolute benefit for each included trial were calculated (available in the supplementary material). The statistical significance of each outcome is presented in Figure 1. The summary results with at least one positive recommendation are as follows. The following recommendations were approved by the Delphi panelists in regards to content and format. The Delphi results section for the aerobic exercises can be found in Brosseau et al.²²

The summary results with only neutral recommendations are as follows:

Table 2. Characteristics of aerobic exercise programs for included randomised controlled trials.

Author/ Year	Types of exercise										Target HR	Supervised	Progressive	Duration	Short term (≤ 6 months)		
	Aerobic			Strengthening			Range of motion		Equipment							Setting	
	General	Cycling	Brisk Walking	Isotonic	Isokinetic	Isometric	Stretching	Elastics bands	Weights	Resistance device						Home	Clinic
Deyle et al. 2000 ²³	✓			✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		
Fransen et al. 2001 ²⁴	✓			✓			✓	✓	✓		✓	✓	50-60% max HR	✓	✓		
Hay et al. 2006 ²⁵	✓			✓			✓			✓	✓	✓		✓	✓		
Péloquin et al. 1999 ²⁶			✓	✓	✓	✓	✓	✓		✓		✓	40-60% HRR	✓	✓		
Salacinski et al. 2012 ²⁷	✓											✓	70-75% max HR	✓	✓		
Ertinger et al. 1997 ²⁸			✓								✓	✓	50-70% HRR	✓	✓		
Messier et al. 2004 ²⁹			✓	✓			✓		✓		✓	✓	50-75% HRR	✓	✓		
Wang et al. 2010 ³⁰			✓	✓			✓							✓	✓		

Max HR: Maximum Heart Rate; HRR: Heart Rate Reserve.

Leg functional aerobic and strengthening exercise program (supervised exercise: riding a stationary bike, active range of motion for the knee, muscle strengthening exercises for the hip and knee, muscle stretching and manual physical therapy) versus Control (placebo ultrasound), level I randomised controlled trial ($n = 83$, high quality [PEDro score 7/10])²³.

-Grade C (no benefit demonstrated) for: Physical Function [6 minute walk test (m)] at 4 weeks (**end of treatment**) and 4 weeks (**follow-up**).

Aerobic exercise programme (slow walking, arm circles, trunk rotation, shoulder and chest stretches, side stretch, 50-70% heart rate walking reserve, shoulder stretch, hamstring stretch, lower back stretch) versus Control (OA health education), level I randomised controlled trial ($n = 293$, high quality [PEDro score 6/10])²⁸.

-Grade C (no benefit demonstrated) for: Physical Function [Self-reported disability (1-5)] at 18 months (**end of treatment**).

Individual and group supervised aerobic and strengthening exercise programs (running, eccentric and concentric exercises, stairs, stepper machine, home exercise program) versus Control (waitlist), level I randomised controlled trial ($n = 126$, high quality [PEDro score 7/10])²⁴.

-Grade C (no benefit demonstrated) for: Quality of Life [SF-36 MCS (0-100)] and Physical Function [WOMAC Function (0-100)] at 8 weeks (**end of treatment**).

Community physiotherapy exercise interventions (an individualised aerobic and strengthening exercise program and advice leaflet about activity and pacing) versus Control (osteoarthritis advice leaflet health education), level I randomised controlled trial ($n = 217$, high quality [PEDro score 8/10])²⁵.

-Grade C (no benefit demonstrated) for: Pain [WOMAC Pain (0-20)] and Physical Function [WOMAC Function (0-68)] at 3 months (**follow-up**) and 9 months (**follow-up**).

Aerobic and strengthening/resistance exercise programme versus Control (health education on OA and exercises), level I randomised controlled trial ($n = 131$, high quality [PEDro score 8/10])²⁹.

-Grade C (no benefit demonstrated) for: Physical Function [6 minute walk test (m)] at 18 months (**end of treatment**).

-Grade D (no benefit demonstrated but favouring control) for: Pain Relief [WOMAC Pain (0-20)] at 18 months (**end of treatment**).

Multi-component exercise programme (warm-up, upper body, lower body, flexibility, aerobic, cool-down) versus Control (no intervention), level I randomised controlled trial ($n = 56$, high quality [PEDro score 7/10])³⁰.

-Grade C (no benefit demonstrated) for: Pain Relief [KOOS Pain (0-100)], Physical Function [6 minute walk test (m)] and quality of life [KOOS quality of life (0-100)] at 12 weeks (**end of treatment**).

WOMAC: Western Ontario and McMaster Universities Osteoarthritis

SF-36: Short Form 36 item general health questionnaire

MCS: Mental Component Summary

AIMS2: Abnormal Involuntary Movement Scale 2

KOOS: Knee injury and Osteoarthritis Outcome Score

Steps 4 and 5 - Ottawa Panel recommendations

The Ottawa Panel recommendations are listed below. Additional information on the characteristics

of included studies can be found in Appendix 2 and 3 (supplementary material).

*Leg functional aerobic and strengthening exercise program*²³

Recommendations: A four-week leg functional aerobic and strengthening exercise program (supervised exercise: riding a stationary bike, active range of motion for the knee, muscle strengthening exercises for the hip and knee, muscle stretching and manual physical therapy) (two 30-minute sessions per week) for the management of knee osteoarthritis for improved physical function (WOMAC subscale)³¹ at end of treatment of four weeks and at the four weeks follow-up is **recommended**. There is a neutral improvement for physical function (6MWT)³² at end of treatment of four weeks and four weeks follow-up.

*Individual and group supervised aerobic and strengthening exercise programs*²⁴

Recommendations: An eight-week individual or group supervised aerobic and strengthening exercise programs (running, eccentric and concentric exercises, stairs, stepper machine, home exercise program) (at the therapist discretion or one hour two times per week) for the management of knee osteoarthritis for pain relief (WOMAC subscale)³¹ at the end of treatment of eight weeks is **strongly recommended**. There is a neutral improvement for quality of life (SF-36 subscale)³³ and physical function (WOMAC subscale)³¹ at end of treatment of eight weeks.

*Community physiotherapy exercise interventions*²⁵

Recommendations: A 10-week community physiotherapy exercise interventions (an individualised aerobic and strengthening exercise program and advice leaflet about activity and pacing) (20 minutes, three-six times over 10 weeks) for the management of knee osteoarthritis for pain relief (WOMAC subscale)³¹ and improved physical function (WOMAC subscale)³¹ at the three months follow-up is **strongly recommended**. There is a neutral improvement for pain relief (WOMAC subscale)³¹ and physical function (WOMAC subscale)³¹ at the three and nine-month follow-up measures.

*Aerobic, strengthening exercise program and osteoarthritis health education*²⁶

Recommendation: A three-month aerobic, strengthening exercise program and osteoarthritis health education (brisk walking, isometric and isotonic muscle strengthening with therapeutic elastic bands, stretching) (one hour sessions, three times per week) for the management of knee osteoarthritis for pain relief during weight-bearing activities (AIMS2 subscale)³⁴ and improved physical function (AIMS2 subscale)³⁴ at the end of treatment of three months is **strongly recommended**.

*Cycling exercise program*²⁷

Recommendations: A 12-week cycling exercise program (warm-up, aerobic loading, cool-down) (20-60-minute classes, two-six days per week) for the management of knee osteoarthritis for pain relief (WOMAC subscale)³¹ and improved physical function (WOMAC subscale)³¹ is **recommended** and is **suggested** for its use for improved quality of life (KOOS quality of life subscale)³⁵ at end of treatment of 12 weeks.

Types of exercise programs

Types of aerobic exercises. The aerobic exercise performed in these trials with positive recommendations varied from walking, running and cycling. Two studies^{23,27} used indoor cycling as their aerobic component. However, Pélouin et al. (1999)²⁶ had participants perform a brisk walk. Fransen et al.²⁴ asked participants to engage in outdoor walking or indoor stationary bicycling. In a study by Hay et al.,²⁵ participants completed general aerobic exercises. These types of aerobic exercises were effective compared to the control group for at least one of the three outcomes of interest.²³⁻²⁷ Studies

with neutral recommendations only²⁸⁻³⁰ included aerobic walking interventions. A summary of the different components analyzed for included aerobic studies is provided in Table 2.

Strengthening exercises. The majority of included trials^{23-26,29,30} examined the effectiveness of aerobic exercises combined with strengthening exercises. Two trials^{27, 28} involved solely an aerobic exercise program. The strengthening exercise programs used isotonic exercises^{23-26,29,30} either combined with isometric,^{23,26} stretching exercises^{23-26,29,30} or range of motion exercises.²³ Two trials used eccentric-concentric exercise as

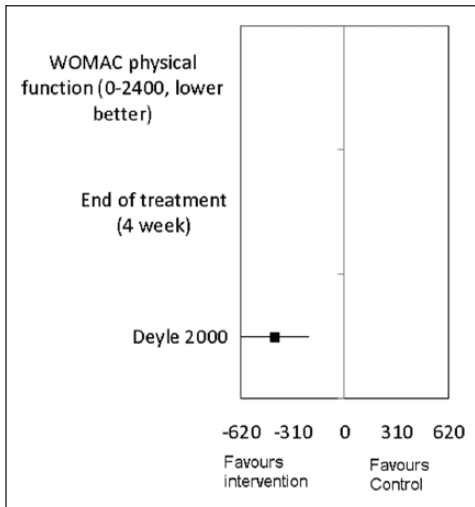


Figure 1. Example graph: Leg functional aerobic and strengthening exercise program (supervised exercise: riding a stationary bike, active range of motion for the knee, muscle strengthening exercises for the hip and knee, muscle stretching and manual physical therapy) versus Control (placebo ultrasound): Physical Function (WOMAC).

isotonic strengthening training.^{23,24} The majority of trials on combined strengthening exercises used weight bearing as well as non-weight bearing exercises.^{23, 24, 26, 29, 30}

No other types of exercise regimens, such as coordination, balance and functional were used.

The type of equipment that was used for strengthening included therapeutic elastic bands for isometric exercises,^{23, 26} cuff weights,^{24, 29} weighted vests,²⁹ or resistance machines such as leg press,²³ resistance climbers and isolator benches.²⁴

Type of settings

In five trials with positive recommendations²³⁻²⁷ participants performed some or all of their exercises in a clinic or in other supervised facilities. In two studies,^{24,25} participants also performed exercises at home. These interventions were effective compared to the control group for at least one of the three outcomes of interest.²³⁻²⁷ In two supervised trials with neutral recommendations^{28,29} participants had to perform exercises both at home and in a clinical setting.

In Wang et al.,³⁰ which also had neutral recommendations, participants only had to perform the intervention in a supervised clinical setting.

Several trials used home-based programs as an additional component with periodic health professional visits,²⁹ telephone follow-up,^{28,29} as a progression component^{28,29} or as a concomitant intervention.^{24, 25, 29}

Progressive program. Three trials with positive recommendations^{23,26,27} used progressive exercise programs. These interventions were effective compared to the control group for at least one of the three outcomes of interest.^{23,26,27} Two trials^{28,29} with neutral recommendations included progressive exercise programs.

Target heart rate. Two trials with positive recommendations^{24, 27} had participants maintain a target heart rate during the intervention session. Fransen et al.²⁴ had participants maintain 50% to 60% of their maximum heart rate. However, Salacinski et al.²⁷ had participants maintain 70% to 75% of their maximum heart rate. Also, Pélouquin et al.²⁶ had participants maintain 40% to 60% of their heart rate reserve. Two studies^{28,29} with neutral recommendations had participants maintain a target of 50% to 70% and 50% to 75% respectively of their heart rate reserve.

Study duration. All studies with positive recommendations had a relatively short study duration (less or equal to 12 weeks). Deyle et al.²³ involved the shortest duration of only four weeks. The study durations for the other four trials with positive recommendations ranged from eight to 12 weeks²⁴⁻²⁷ for at least one of the three outcomes of interest. These two studies with neutral recommendations had longer interventions. In fact, Ettinger et al.²⁸ had a three-month facility-based and then a 15-month home-based intervention. In Messier et al.,²⁹ the first four months of the 18-month intervention was facility-based. The third study with neutral recommendations, Wang et al.,³⁰ had a short intervention of 12 weeks.

Total amount of weekly exercise. The intensity of each intervention varied amongst the trials. The

frequencies varied from two to six times a week for four trials^{23,24,26,27} while the total duration of exercise ranged between 20 and 60 minutes per session. Hay et al.²⁵ presented the smallest frequency of 20 minutes, three to six times over a 10-week period. Only one study²⁶ followed the American College of Sports Medicine's recommendation for patients with knee osteoarthritis which is a minimum of 150 minutes per week.⁵ All the studies with neutral recommendations²⁸⁻³⁰ included one-hour sessions three times per week and therefore, these studies followed the American College of Sports Medicine's recommendation for patients with knee osteoarthritis.

Attrition rate and adherence rate. Several of the included high-quality trials with positive recommendations presented drop-out rates ranging from 7% to 24%.²³⁻²⁷ The trials with neutral recommendations had drop-out rates ranging from 7% to 20%.²⁸⁻³⁰ More importantly, exercise adherence/compliance was reported in Péloquin et al.²⁶ and Salacinski et al.²⁷ for the studies with positive recommendations, with respective rates of 84% and 68%. For the studies with neutral recommendations, exercise adherence/compliance was reported in Ettinger et al.²⁸ which observed an overall rate of 68% in the aerobic training group. Further, exercise adherence/compliance was reported in all three trials²⁸⁻³⁰ which observed respective overall rates of 68%, 60%, 86% in the exercise training groups.

Sample size. Three trials with positive recommendations²⁴⁻²⁶ had a large sample size ($n > 100$). However, two trials^{23,27} had a relatively small sample size ($n < 100$). Two studies with neutral recommendations,^{28,29} had sample sizes of greater than 100 participants. Wang et al.³⁰ had a smaller sample size ($n < 100$).

Ottawa Panel Grades. There were no high-quality trials with negative recommendations in our analysis for aerobic exercises but there were neutral recommendations (13 recommendations with a Grade C; one recommendation with a Grade D).

Among these five high-quality trials²³⁻²⁷ which obtained positive recommendations (five for Grade

A; four for Grade B; one for Grade C+), three²³⁻²⁵ also had neutral recommendations (eight for Grade C and none for Grade D) (supplementary file).

The three additional high-quality trials involving aerobic exercise²⁸⁻³⁰ with only neutral grades (five for Grade C and one for Grade D) did not negatively influence or did not contradict the Ottawa Panel recommendations.

Discussion

This Ottawa Panel clinical practice guideline, based on high-quality trials ($n = 5$) having a minimum total PEDro score of six, identified a total of 10 high-quality positive recommendations for aerobic exercise with²³⁻²⁶ or without²⁷ muscle strengthening exercises either for pain relief, improved physical function or quality of life. This guideline recommends aerobic exercises (i.e. brisk walking, running, spinning cycling, etc) as a component of an overall exercise program with or without muscle strengthening exercises as promising non-pharmacological intervention for pain relief, improved physical function and quality of life amongst individuals with knee osteoarthritis. No strong recommendation can be made at the present time about the clinical use of aerobic-only exercise programs for the management of knee osteoarthritis, due to the lack of high-quality trials with a proper sample size (>100) which examine the specific short-term and long-term benefits.

Indeed, the results of the trials with neutral recommendations²⁸⁻³⁰ could be explained by the following reasons that some studies have: 1) low methodological quality,²⁸ 2) limited descriptions of the therapeutic application of the exercise programs³⁰ or 3) used educational programs as control intervention.^{28,29}

To facilitate aerobic exercise prescription, an in-depth examination of the nature of the aerobic exercises programs (i.e. brisk walking, running and spinning cycling, etc), its combination with strengthening exercise (e.g. resistance vs. functional vs. mixed [resistance and balance and coordination]), exercise intensity, program duration, modes of supervision, exercise progression, and delivery mode (e.g. home vs. clinic) should be performed.

This could determine whether aerobic exercise programs can be effective for at least one of the three outcomes of interest (pain relief, physical function or quality of life) compared to control.

Based on the positive recommendations identified by the Ottawa Panel, this guideline offers a variety of promising land-based exercise programs involving an aerobic component for healthcare professionals as well as for individuals with knee osteoarthritis.

Comparisons with previous clinical practice guidelines

This updated Ottawa Panel guideline provides recommendations regarding specific exercise program types involving aerobic exercise only or as a component, compared to more global recommendations about therapeutic exercises at large such as land-based exercises. Due to heterogeneity, each high-quality trial was individually graded to offer end-users the opportunity to apply with confidence the unique content of each specific aerobic exercise program identified as being effective or promising by the Ottawa Panel. Similar to Fransen et al.,⁸ the pooling of several trials with diverse strengthening exercise programs will lead the end-user to a better generalisation of land-based therapeutic exercises. This guideline leads to a better specificity in the clinical application of the existing aerobic exercise programs.

This updated Ottawa Panel guideline on aerobic exercise agrees with previously published guidelines^{12–21,36} and systematic reviews^{8–11} for the management of knee osteoarthritis, which unanimously recommended land-based exercise programs, including aerobic exercises.

There is a need to conduct additional trials on short-term as well as long-term clinical effects of specific aerobic exercises for the management of knee osteoarthritis since there was only one high-quality trial,²⁷ with less than 100 participants, in the present systematic review which solely used an aerobic exercise program (i.e. 12-week cycling program). Additionally, more trials should be developed using behavioral interventions to favor continued regular exercise participation of individuals with knee osteoarthritis.²⁸

Physiological effects of therapeutic exercises

This review revealed that certain aerobic exercises with or without other types of therapeutic exercises are promising for pain relief as well as improving physical function and quality of life for individuals with knee osteoarthritis.

In healthy individuals, aerobic exercises with an intensity of 70 % VO₂ max, considered as vigorous aerobic exercise, produced pain inhibition (i.e. exercise-induced hypoalgesia) for up to 30 minutes post-exercise.³⁷ Furthermore, Naugle et al.³⁸ also observed exercise-induced hypoalgesia immediately after a 25-minute vigorous aerobic exercise of stationary cycling at 70% heart rate reserve as well as after a moderate aerobic exercise consisting of stationary cycling at 50% heart rate reserve amongst healthy subjects. Exercise-induced hypoalgesia may function through the activation of the endogenous opioid system.³⁹ The observations also suggest the presence of a dose–response effect since the vigorous aerobic exercises produced larger physiological effects than moderate aerobic exercise, which produced a hypoalgesic effect. The results of Vierck et al.⁴⁰ also showed that aerobic exercises reduced the magnitude of late pain sensations.

Only two trials reported a target heart rate amongst participants with knee osteoarthritis during their aerobic exercise program. Targets were 70–75%²⁴ and 50–60%²⁷ of maximum heart rate. However, participants in both studies obtained significant pain relief when compared to a control. The results of a recent systematic review of trials on high-intensity versus low-intensity therapeutic exercise for knee osteoarthritis revealed that there was insufficient evidence to determine whether different intensity levels of exercise programs influenced the clinical benefits of reduced pain and improved physical function.⁴¹

Limitations

Limitations of the Ottawa Panel clinical practice guideline

The recommendations of this guideline are limited to land-based exercises. Other types of therapeutic

exercises such as aquatics were not considered. Furthermore, this guideline is based only on high quality trials (having a minimum total PEDro score of six and equal). Potential selection bias may have been present, considering that participants in trials on physical interventions cannot be blinded. A detailed description of the differences between the Ottawa Panel grading methodology and the Cochrane Grade approach can be found in Brosseau et al.²²

In addition, an important limitation of this guideline is that of the five high-quality trials included, only one²⁷ examined the effect of aerobic exercise alone (i.e. cycling). The other four trials²³⁻²⁶ were a combination of aerobic and muscle strengthening exercise programs and as a consequence the specific effects of aerobic exercise cannot be determined.

Limitations of the primary included randomised controlled trials

Better reporting of the characteristics of the exercise programs, especially those which incorporate multiple types of exercise interventions (e.g. aerobic exercise combined to strengthening, balance and motor control exercises etc), is needed.^{42,43} The recently developed Consensus on Exercise Reporting Template (CERT) checklist⁴⁴ can be useful to encourage researchers to precisely describe the content of exercise programs to facilitate the clinical replication of effective interventions by end-users. Liu and Latham⁴⁵ also recommended mandatory reporting of adverse events during the exercise program.

The additional effect of adjunctive therapies such as manual therapy²³ to aerobic exercises is unclear,⁴⁶ especially if it is combined with other types of land-based exercises. While this reflects usual physiotherapy practice, these therapies are often not applicable as part of self-management strategies.

Based on the results of the review by Kroon et al.,⁴⁷ self-management educational programs have no or only limited benefits. The use of health education might also be problematic. Indeed, Ettinger et al.²⁸ used health educational video presentations on topics not only related to knee osteoarthritis disease information but also including physical activity and

exercise. Messier et al.²⁹ also provide educational materials regarding knee osteoarthritis, obesity and exercise to the control group. Patient education has some beneficial effect amongst individuals with osteoarthritis^{47,48} depending on the content of the education program which may have potentially biased the effect size. This situation could have led to neutral Ottawa Panel recommendations instead of positive recommendations for the three outcomes of interest in this review.

Participants in the control group of Hay et al.²⁵ received advice, an information leaflet in addition to one telephone call as reinforcement, which can be considered a behavioral intervention. However, both groups were exposed to this active intervention.

In conclusion, aerobic exercises with or without strengthening exercises seem to have beneficial short-term effects on knee osteoarthritis for pain relief, improvements in physical function and quality of life. The Ottawa Panel found preliminary evidence supporting the use of aerobic exercises for knee osteoarthritis management, especially for those between 58 and 69 years old, who have at least one knee affected by osteoarthritis and the capacity to exercise. It is recommended that these exercise interventions be individualized with the assurance that they are safe and obtain a maximal benefit. Lastly, it would be interesting to explore the long-term specific effects of aerobic exercises for the management of knee osteoarthritis to determine if significant lasting improvements can be made with regular practice of specific types of land-based exercises.

Clinical messages

- A short-term aerobic exercise program with or without strengthening exercises is promising for reducing pain, as well as improving physical function and quality of life for individuals with knee osteoarthritis.
- No strong conclusions can be drawn at the present time about the specific and potential beneficial effects of aerobic exercise programs alone in the management of knee osteoarthritis.

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