Ottawa Panel Evidence-Based Clinical Practice Guidelines for Strengthening Exercises in the Management of Fibromyalgia: Part 2

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Background and Purpose. The objective of this study was to create guidelines for the use of strengthening exercises in the management of adult patients (>18 years of age) with fibromyalgia (FM), as defined by the 1990 American College of Rheumatology criteria.

Methods. Following Cochrane Collaboration methods, the Ottawa Methods Group found and synthesized evidence from comparative controlled trials and formed the Ottawa Panel, with nominated experts from key stakeholder organizations. The Ottawa Panel then developed criteria for grading the recommendations based on experimental design (I for randomized controlled trials, II for nonrandomized studies) and strength of evidence (A, B, C+, C, D+, D, or D−). From the rigorous literature search, 5 randomized controlled trials were selected. Statistical analysis was based on Cochrane Collaboration methods. Continuous data were calculated with weighted mean differences between the intervention and control groups, and dichotomous data were analyzed with relative risks. Clinical improvement was calculated using absolute benefit and relative difference in change from baseline. Clinical significance was attained when an improvement of 15% relative to a control was found.

Results. There were 5 positive recommendations: 2 grade A and 3 grade C+. All 5 were of clinical benefit.

Discussion and Conclusion. The Ottawa Panel recommends strengthening exercises for the management of fibromyalgia as a result of the emerging evidence (grades A, B, and C+, although most trials were rated low quality) shown in the literature.

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Fibromyalgia (FM), as defined by the 1990 American College of Rheumatology criteria, is a chronic, generalized, musculoskeletal pain disorder with the presence of at least 11 out of 18 tender-point sites on physical examination.[1] Additional symptoms frequently include fatigue, muscle pain and weakness, memory problems, paresthesia, headaches, depression, and insomnia.[2,3] Fibromyalgia symptoms can become exacerbated from humidity and cold weather, overactivity, and fatigue,[2] but considerable symptom variability exists (ie, frequency and intensity).[4]

Fibromyalgia is 2 to 5 times more prevalent than rheumatoid arthritis (RA)[5] and affects 2% to 4% of the American population, the majority of whom are women.[6] Prevalence of FM is likely higher due to misdiagnosis by physicians of other systemic and psychiatric disorders.[5] People of all ages are susceptible to developing FM, but people aged 35 to 50 years are most at risk.[5]

According to some researchers,[7] the disability rate among people with FM is as high as 46%. On average, the direct cost (eg, medications, physician visits, imaging and laboratory procedures) and indirect cost (eg, work wage, household work) for a person with FM were CAN $2,298 and CAN $5,035, respectively, over a 6-month period.[8]

Successful management of FM remains difficult because little is known of its etiology.[9] Evidence-based clinical practice guidelines (EBCPGs) are precise statements on recommended interventions that are based on scientific literature and include a graded strength of evidence as well as detail on the specific joints affected, outcomes, and length of intervention. The Ottawa Panel, which has published EBCPGs on RA,[10] osteoarthritis (OA),[11] and stroke,[12] collaborated to assess the strength of scientific evidence regarding the efficacy of physical exercise for FM. Other researchers[5,13–15] have published general clinical recommendations for the management of FM; however, these recommendations cannot be regarded as guidelines because they relied, in most cases, on studies that did not follow rigorous methods. Furthermore, all recommendations failed to provide specific statements on the therapeutic exercise utilized and its strength of evidence.

Given the volume of literature found, the Ottawa Panel decided to produce a series of 2 EBCPGs for FM: EBCPGs for aerobic fitness exercises (part 1 of the series)[16] and EBCPGs for strengthening exercises (part 2 of the series). Neither exercise type has been universally effective or wholeheartedly endorsed by all patients with FM.[17] Patients frequently are noted anecdotally to have difficulty performing and sustaining strengthening exercises, which are traditionally a component of musculoskeletal injury training programs. Additionally, 83% of patients with FM do not engage in aerobic exercise, and 65% have below-average aerobic fitness.[18] The EBCPGs in parts 1 and 2 of the series aim to assist patients with FM and health care professionals in identifying the most effective exercise specific to the patients' needs. Exercise has the potential to decrease inactivity and deconditioning, a common cause of pain associated with FM, and to provide multiple beneficial physical and psychological outcomes. The purpose of the part 2 study was to provide effective strengthening exercise guidelines for patients, physiatrists, rheumatologists, physical therapists, occupational therapists, family physicians, kinesiologists, and other health care professionals to assist in the overall management of FM.

Methods

The Ottawa Methods Group, a panel of 9 methodologists with extensive backgrounds in developing EBCPGs, contacted professional associations that specialize in the management of patients with FM to nominate experts with clinical experience. The Ottawa Methods Group chose 9 experts with specialties in rheumatology, physiatry, psychology, psychiatry, occupational therapy, and physical therapy. The Ottawa Methods Group and the chosen experts then formed the Ottawa Panel, who were responsible for the EBCPGs in this report. The Ottawa Methods Group also assembled a research team with expertise in meta-analysis, research methods, and the development and evaluation of EBCPGs.

The Ottawa Methods Group established inclusion criteria for the study design, subject sample, intervention, and outcomes used for conducting separate, systematic literature reviews (Tab. 1). The research team was responsible for reading and analyzing the articles as well as drafting several evidence tables to which the Ottawa Panel made final corrections and reached a consensus.

The EBCPGs were created according to Appraisal of Guidelines Research and Evaluation (AGREE) criteria (www.agreecollaboration.org).[19] The Ottawa Panel graded the recommendations based on their level (I for randomized controlled trials [RCTs], II for nonrandomized studies) and their strength of evidence (A, B, C, C+, D, D+, or D−). As an illustration, to receive a grade A recommendation, an RCT needed an outcome that was both statistically significant and clinically important (an improvement of >15% relative to a control, based on panel expertise and empiric results). Table 2 provides a summary of the EBCPG grading system. For further details on Ottawa Panel methods, refer to the EBCPGs for aerobic fitness in the management of fibromyalgia[16] in this issue.

Literature Search

A structured a priori literature search was performed by a library scientist using modified search strategies[20] recommended by the Cochrane Collaboration.[21] The main focus of the search was the methods used and interventions of the study, rather than the outcomes. Potential for bias was minimized through a systematic approach to the search, study selection, and data extraction and synthesis.

This search was further widened through the inclusion of case-control, cohort, and nonrandomized studies. The following electronic databases were utilized: MEDLINE, EMBASE (Current Contents), the Cumulative Index to Nursing and Allied Health (CINAHL), AMED, the Cochrane Controlled Trials Register up to December 2006, the registries of the Cochrane Field of Rehabilitation and Related Therapies and the Cochrane Musculoskeletal Group, and the Physiotherapy Evidence and Database (PEDro). The library scientist updated the literature search every 6 months from the first week of October 2004 to the last week of December 2006.

Study Inclusion/Exclusion Criteria

Type of interventions. Therapeutic exercises related to strengthening were included. Examples of specific interventions that were excluded were surgery of all joints, medications, thermal biofeedback, and exercises combined with an educational program (Tab. 1).

Type of study designs. Comparative controlled studies with comparison groups that assessed strengthening exercises and patients with FM were included: RCTs, controlled clinical trials (CCTs), cohort studies, and case-control studies. Controlled clinical trials are similar to RCTs, except that CCTs are either not randomized or not appropriately randomized.[21] Head-to-head studies (eg, strengthening exercises versus flexibility exercises) also were included.

Studies were excluded if they lacked a comparison group (eg, uncontrolled cohort studies), were case studies, had a dropout rate of >20%, or had a sample of fewer than 5 participants per group. Abstract-only studies were excluded because they did not have sufficient data for analysis. Studies published in a language other than English or French also were excluded due to time constraints and translation costs (Tab. 1).

Type of participants. Studies of adult patients (>18 years of age) with FM, as defined by the 1990 American College of Rheumatology criteria,[1] were included. Participants had to be medically stable and mentally competent. Because FM is a chronic illness, the amount of time since disease onset is not a requirement of FM diagnostic criteria. Although some would argue that there is difficulty in differentiating symptoms of other rheumatologic conditions such as chronic pain syndrome, chronic fatigue syndrome, or myofascial pain syndrome from FM, these rheumatologic conditions were excluded. Studies were excluded if participants had any of the following conditions: (1) cancer or other oncological conditions, (2) cardiac conditions, (3) dermatologic conditions, (4) serious cognitive deficits or severe communication problems, (5) major medical problems that could interfere with the rehabilitation process or incapacitate functional status, or (6) primary psychiatric conditions (Tab. 1).

Type of outcomes. Studies were included if they assessed any of the

Table 1.
Inclusion and Exclusion Criteria[a]

Inclusion	Exclusion
Interventions • Eligible control groups: untreated and active physical therapy treatments and educational pamphlets (no surgery, drugs, or injections) • Eligible interventions: therapeutic exercise related to strength training	**Interventions** • Surgery of all joints • Medication (eg, phonophoresis with medications) • Thermal biofeedback • Acupuncture • Assistive devices • Conservation of energy/sleep strategies • Electroanalgesia and other electrotherapy, including electrical stimulation, TENS, ultrasound, laser therapy and diathermy, EMG biofeedback • Manual therapy/massage • Patient education • Splinting and orthoses • Thermotherapy, including balneotherapy • Sensory intervention • Psychosocial interventions • Multidisciplinary team intervention • Cognitive-behavioral intervention • Multiple interventions ("physiotherapy," including ice, heat, massage, TENS, ultrasound, and so on and combinations of interventions) • Exercises combined with an education program
Study Designs • Randomized controlled trials • Controlled clinical trials • Cohort studies • Case-control studies • Head-to-head comparison of strength and flexibility studies	**Study Designs** • Case series/case reports • Uncontrolled cohort studies • Data (graphics) without a mean and SD • Sample size of fewer than 5 patients per treatment group • Studies with more than 20% dropout rate
Participants • Outpatients or inpatients • Diagnosis of fibromyalgia • Age groups >18 y • Mixed population only if patients with fibromyalgia are in the majority	**Participants** • OA • RA • Cancer (and other oncologic conditions) • No known pathology or impairments • Pulmonary conditions • Neurologic conditions • Pediatric conditions (no juvenile arthritis) • Juvenile arthritis • Cardiac conditions • Dermatologic conditions • Psychiatric conditions • Myofascial pain syndrome • Chronic fatigue syndrome • Multiple conditions

(Continued)

following outcomes: quality of life, pain, fatigue, sleep, global perceived effect, depression, muscle strength (force-generating capacity), endurance, and power. Excluded outcomes were biochemical measures and serum markers (Tab. 1).

Study selection. After receiving Cochrane process training by the Ottawa Panel, 2 independent reviewers separately evaluated the studies provided by the literature search. Each reviewer drafted a list of included and excluded articles with justification by applying the inclusion and exclusion criteria created by the Ottawa Panel (Tab. 1). If uncertainty occurred, the reviewer reread the article in question. The level of agreement between the reviewers was tested for interrater reliability (ie, kappa statistic) in a previous Ottawa Panel guidelines article.[12] A senior methodologist and a clinical expert compared the reviewers' lists of included and excluded studies, and a final judgment was made by the Ottawa Panel through consensus.

Data Extraction and Methodological Quality Assessment

Using predetermined extraction forms, the reviewers independently recorded details from the selected articles. Information regarding population characteristics, interventions, study design, allocation concealment, comparative outcomes, and period of measurement were recorded. The methodological quality of the potential studies also was assessed using the Jadad scale,[22] a 5-point scale with reported reliability

Table 1.
Continued

Inclusion	Exclusion
Outcomes • Absenteeism, sick leave, return to work (if available) • Balance status • Cardiopulmonary function • Coordination status • Costs (economics) • Disease activity • Edema • EMG activity • Fatigue • Flexibility • Functional status, activities of daily living (self-care activities) • Gait status • Global perceived effect • Girth, volume • Inflammation • Joint imaging • Medication intake (if reported) • Muscle strength, endurance, and power • Pain • Patient adherence • Patient satisfaction • Postural assessment • Quality of life • Range of motion, flexibility, mobility • Side effects (if reported) • Sleep • Swelling • Psychosocial measures such as depression, home and community activities, leisure, social roles, and sexual functions	**Outcomes** • Biochemical measures • Serum markers

[a] TENS=transcutaneous electrical nerve stimulation, EMG=electromyographic, OA=osteoarthritis, RA=rheumatoid arthritis.

and validity that assigns 2 points for randomization, 2 points for double blinding, and 1 point for description of participant withdrawals. The senior reviewer was consulted to resolve discrepancies in data extraction and scoring of methodological quality.

Studies with a Jadad scale score of ≥3 are characteristically seen as having higher methodological quality; however, the Ottawa Panel agreed that trials with a Jadad scale score of <3 could still be included because the Jadad scale was initially developed for medical interventions (eg, medications, placebos), not exercise interventions. Thus, more consideration was given to the randomization component of the Jadad scale because most exercise trials cannot obtain points with the double-blind experiment category (ie, it is not possible to blind participants to an exercise intervention). Quality scores from the Jadad scale were used to interpret the results.

Studies that failed to meet methodological criteria described in the inclusion and exclusion table (Tab. 1) and that were determined by the Ot-

Table 2.
Grading for Recommendations[a]

Grade	Clinical Importance	Statistical Significance	Study Design
A	≥15%	$P<.05$	RCT (single or meta-analysis)
B	≥15%	$P<.05$	CCT or observational (single or meta-analysis)
C+	≥15%	Not significant	RCT/CCT or observational (single or meta-analysis)
C	<15%	Not significant	Any study design
D	<15% (favors control)	Not significant	Any study design
D+	<15% (favors control)	Not significant	RCT/CCT or observational (single or meta-analysis)
D−	≥15% (favors control)	$P<.05$ (favors control)	Well-designed RCT with >100 patients (if <100 patients, becomes grade D)

[a] RCT=randomized controlled trial, CCT=controlled clinical trial.

tawa Panel to be of poor methodological quality were transferred to the list of excluded studies.

Data Analysis

Statistical analysis was based on Cochrane Collaboration methods.[23] Continuous data were calculated with weighted mean differences (WMDs) between the intervention and control groups. A WMD is "a method of meta-analysis used to combine measures on continuous scales (such as weight), where the mean, standard deviation, and sample size in each group are known."[24] For the present analysis, data could not be pooled because many key study characteristics (eg, population, intervention, control, outcomes) were not comparatively similar. For example, the outcomes (eg, pain) may have been identical across studies that were compared, but the measurement methods used (eg, type of questionnaire) were different. Due to the extent of dissimilarity among studies, WMDs were calculated as opposed to standard mean differences.

Dichotomous data (ie, data that can be divided into 2 categories) were calculated using relative risks. A *relative risk* is "the ratio of risk in the intervention group to the risk in the control group. The risk (proportion, probability, or rate) is the ratio of people with an event in a group to the total in the group."[24]

Data in the present study were illustrated according to Cochrane Collaboration methods[24] (see Figs. 1 and 2 for examples of illustrations of data). The horizontal line in the illustrations of data is the standard deviation of the WMD, and the square represents the WMD between the 2 groups when measured for a particular outcome. When the standard deviation line touches the central vertical line, the confidence interval is 0 and the 2 groups are not statistically different.

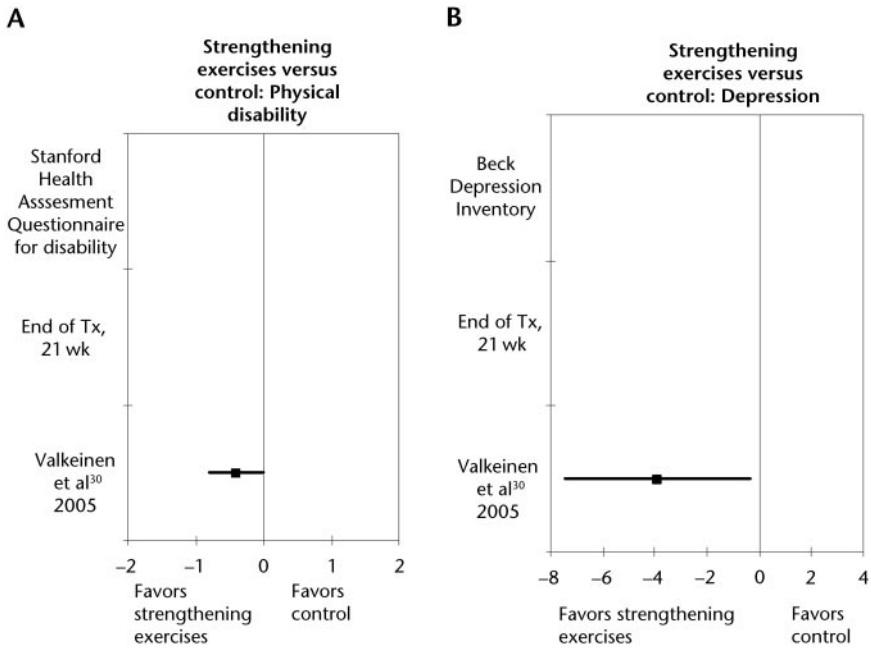

Figure 1.
Strengthening exercises versus control: (A) physical disability, (B) depression. Tx=treatment.

Clinical improvement was calculated using absolute benefit and relative difference (RD) in change from baseline. *Absolute benefit* is the improvement in the treatment group minus the improvement in the control group. *Relative difference* is absolute benefit divided by the baseline mean (weighted for the intervention and control groups).[12] Clinical significance was attained when an improvement of 15% relative to a control was found. With dichotomous data, the percentage of improvement was calculated as the difference in the percentage of improvement between the intervention and control groups.[25] The 15% value was chosen by the Philadelphia Panel,[24] who are experts in musculoskeletal practice, and was approved by the rheumatology and biostatistics experts of the Ottawa Panel. For greater detail of the statistical analysis, see our previous Ottawa Panel publication.[10]

Results

Literature Search

Our literature search strategy found 1,005 articles on various therapeutic exercises (eg, aerobic, fitness, relaxation) and FM. Using the inclusion and exclusion criteria (Tab. 1), 114 articles were found to be potentially relevant, and ultimately 5 studies on strengthening exercises and FM were selected.[26–30] A *strengthening exercise* was defined as an isometric, isokinetic, or concentric/eccentric resistance exercise with the purpose of increasing the maximal force generated by a specific muscle or muscle group.[31]

A total of 109 studies were excluded (results not shown) for the following reasons: the absence of a control group in 19 studies[32–50]; the main therapy was fitness exercise in 14 studies[51–64]; the main therapy was aerobic exercise in 13 studies[65–77]; 11 studies[78–88] had insufficient statistical data (ie, mean and standard deviation were not provided or could

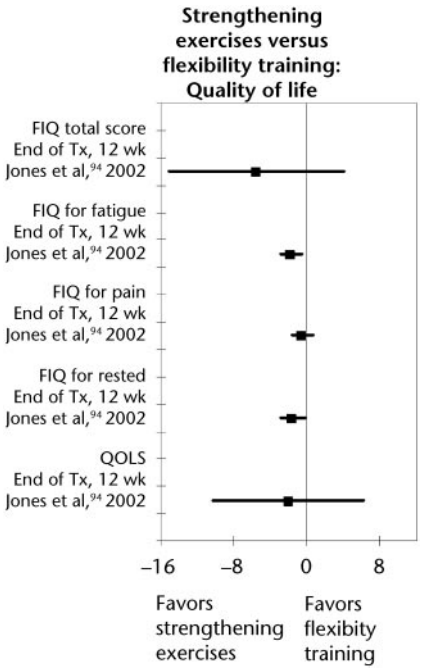

Figure 2.
Strengthening exercises versus flexibility training. Tx=treatment, FIQ=Fibromyalgia Impact Questionnaire, QOLS=Quality of Life Scale.

not be calculated with the information provided); 9 studies[89–97] were literature reviews; 9 studies[98–106] had an attrition rate of >20%; 8 studies[107–114] were abstracts only; 8 studies[104,115–121] included control groups of subjects who were healthy; reports of 4 studies[122–125] were written in a foreign language; 3 studies[126–128] did not have interventions; 2 studies[129,130] were case reports; and the remaining studies[131–139] were excluded for various other reasons, such as the study was only descriptive.[137]

Methodological Quality

Results from the Jadad scale showed that 4 out of the 5 RCTs received low scores (<3)[26,27,29,30] and, consequently, were of poor methodological quality. The remaining trial[28] was of higher methodological quality, with a score of 3 out of 5. None of the studies received points under the "double-blind" category, and only the study of higher quality[28] received a point for description of participant withdrawals and dropouts.

Summary of Trials

Five trials (N=150)[26–30] measured strengthening exercises for the management of FM. Two different exercises were used to measure muscle strength: maximal concentric leg extensor force and maximal isometric knee extensor and flexor force. Using a dynamometer, concentric leg extensor force (in newtons) was measured with the participant sitting with hip and knee joints at 110 and 70 degrees, respectively, and attempting a full knee extension of 180 degrees against resistance. The load was progressively increased after each extension until the participant was not able to perform the exercise correctly. The last acceptable trial with the heaviest load was determined as 1 repetition maximum. Two trials (N=47)[26,30] implemented this measurement.

Another measure of muscular strength utilized was calculating the maximal isometric force (in newtons) of the knee extensors and flexors using a dynamometer. Participants in a seated position with knee joints at 107 degrees were instructed to exert their maximal force as quickly as possible for 3 to 4 seconds. Each participant was given 3 trials, and the best result was used for analysis. Four trials (N=94)[26,27,29,30] measured isometric strength, and the remaining trial (N=56)[28] measured isokinetic strength following a very similar procedure.

Four trials (N=94)[26,27,29,30] compared strengthening exercises with a control, and total program duration was 21 weeks. The remaining trial (N=56)[28] compared strengthening exercises with flexibility exercises, and total program duration was 12 weeks. Participants in all treatment groups[26–30] performed strengthening exercises twice a week.

Strengthening Exercises

Strengthening exercises versus control (4 RCTs, N=94, all low quality)[26,27,29,30] showed clinically important benefits with statistical significance for muscle strength (maximal concentric leg extensor force [RD=157%], maximal isometric knee extensor force [RD=160%], and maximal concentric leg extensor force [RD=31%]),[30] pain relief (visual analog scale [VAS] for general pain [RD=117%], back pain [RD=72%], neck pain [RD=36%], and general health [RD=91%])[26] (results not shown), physical disability (Stanford Health Assessment Questionnaire for disability [RD=46%]),[26] and depression (Beck Depression Inventory [RD=57%])[26] at the end of treatment at 21 weeks (Fig. 1). Clinical significance without statistical significance was found for muscle strength (maximal isometric knee extensor force [RD=15%][27] and maximal isometric knee flexor force [RD=16%])[29] (results not shown) and quality of life (VAS for fatigue [RD=33%])[26] at the end of treatment at 21 weeks (results not shown). Clinically important benefits favoring control without statistical significance (RD=18%) were found for pain relief (VAS for leg pain)[26] at the end of treatment at 21 weeks (results not shown). No other benefits were found (results not shown).

Strengthening exercises yielded clinically important and statistically significant benefits compared with flexibility training (1 RCT, N=56, high quality)[28] for quality of life (Fibromyalgia Impact Questionnaire for fatigue [RD=23%] and feeling rested [RD=23%]) at the end of treatment at 12 weeks (Fig. 2). Depression (Beck Depression Inventory [RD=17%]) and anxiety (Beck Anxiety Inventory [RD=23%]) at the end of treatment at 12 weeks did not

Table 3.
Evidence-Based Clinical Practice Guidelines for Strengthening Exercises[a]

Authors	Description of Trial	Study Design and N	Grade A[b]	Grade C+	Grade C	Grade D+	Grade D
Häkkinen et al (2001)[26] Jadad scale score: 1	2 ×/week for 21 wk	RCT N=21	Pain relief Physical disability Depression	Quality of life	Pain relief Sleep quality	Pain relief	Pain relief
Häkkinen et al (2002)[27] Jadad scale score: 1	2 ×/week for 21 wk	RCT N=21	N/A	Muscle strength	Pain relief Muscle strength	N/A	N/A
Jones et al (2002)[28] Jadad scale score: 3	60 min 2 ×/week for 12 wk	RCT N=56	Quality of life	Depression Anxiety Flexibility	Pain relief Muscle strength Shoulder strength Quality of life Self-efficacy	N/A	N/A
Valkeinen et al (2004)[29] Jadad scale score: 1	60–90 min 2 ×/week for 21 wk	RCT N=26	N/A	Muscle strength	Pain relief	N/A	N/A
Valkeinen et al (2005)[30] Jadad scale score: 1	2 ×/week for 21 wk	RCT N=26	Muscle strength	N/A	N/A	N/A	N/A

[a] RCT=randomized controlled trial, N/A=not available.
[b] There were no grade B or grade D− guidelines for these selected studies.

show statistically significant results (results not shown). Clinical benefits and statistical significance were found in favor of flexibility training for flexibility (hand-to-neck [RD= 165%] and hand-to-scapula [RD= 18%]) at the end of treatment at 12 weeks (results not shown). No other outcomes showed any benefits (results not shown). Table 3 provides an overview of the results. See the Appendix for more detailed results.

Discussion

Through an extensive, systematic review of strengthening exercises, the Ottawa Panel produced 2 EBCPGs, with 5 positive recommendations of clinical importance: 2 grade A and 3 grade C+ recommendations. The remaining recommendations were 2 grade C, 1 grade D, and 1 grade D+. More research is needed on the effectiveness of strengthening exercises for pain relief, muscle strength, quality of life, self-efficacy, and sleep quality, which made up the grade C, D, and D+ recommendations.

The Ottawa Panel concluded that strengthening exercises are beneficial for the overall management of FM. Clinical benefits were shown for muscle strength (maximal concentric leg extensor force, maximal isometric knee extensor force, and maximal concentric leg extensor force), pain relief, physical disability, depression at end of treatment at 21 weeks, and quality of life at end of treatment at 12 weeks. Clinically important benefits without statistical significance were found for muscle strength (maximal isometric knee extensor force[27] and maximal isometric knee flexor force), quality of life at end of treatment at 21 weeks, and depression and anxiety at end of treatment at 12 weeks.

Encouraging results were found for both middle-aged women[26–28] and elderly women[29,30] (ie, 55+ years of age) who had no previous experience with strengthening exercises and trained only twice per week. Patients with FM gained overall improvements in daily physical functioning, perceived fatigue, and mood compared with a control condition.[26,27,29,30]

One study[28] showed no statistically significant differences between the experimental (strengthening exercises) and control (flexibility) groups. Using flexibility exercises as a control condition is a possible explanation. Given that both groups were relatively sedentary at baseline (ie, 87% were defined as completely sedentary), any moderate exercise would have led to overall health improvements.[28] Minimum education (eg, in the form of a pamphlet) on FM disease management without reference to specific exercises would be a more appropriate control group intervention.

Another possible explanation for the lack of between-group differences is that participants in the treatment group were not required to progressively increase their exercise intensity.[28] Researchers were concerned that demanding an increase in load (ie, weight) would have aggravated participants' symptoms of muscle soreness and stiffness, possibly resulting in high subject withdrawal.[28,60,61] There are several ways to maintain a low attrition rate without

potentially compromising exercise intensity: personalizing the exercise instruction to patients with FM, using an exercise specialist with clinical FM experience, implementing self-efficacy as a guiding theoretical framework, providing an encouraging and supportive exercise instructor, and administering the exercise plan within relatively close distance of the participants' homes.[28] Additionally, researchers who worked with patients with OA found that, when exercise programs included behavioral components (eg, face-to-face visits, social/peer support and positive feedback, patient education, use of pedometer), lower dropout rates and higher adherence rates occurred.[140–142] Further research is needed on designing exercise programs that patients with FM will find relatively easy to adhere to in the long term.

Most studies showed that patients with FM can successfully engage in an intensive, progressive strengthening program without experiencing an exacerbation of exercise-induced or FM symptoms.[26,28–30] The function and trainability of muscles in patients with FM were found to be similar to that of participants serving in a "healthy" control condition.[29] Thus, although issues of disability were beyond the scope of this project, it is likely that patients with FM can achieve health benefits from strengthening exercises similar to those achieved by people who are healthy.[29] Furthermore, strength gains in major muscle groups may assist patients in more easily completing aerobic exercises, which also have been shown to alleviate some FM symptoms.[28]

Although the causes of FM remain largely unknown, clinicians and researchers continue to advocate a multimodal approach to the management of FM.[55] Medications (eg, to improve sleep quality and mood) and psychosocial interventions (eg, cognitive-behavioral therapy) combined with exercise seem to produce the most positive health effects.[53] Further research is needed to determine the mechanisms involved in how specific muscle strengthening exercises of the lower limbs over 21 weeks have a general benefit on widespread myalgia, fatigue, psychological state, and quality of life. Undocumented psychosocial interventions (eg, unstructured behavioral interventions, positive expectations of the therapists) would need to be addressed as potential confounding factors. Moreover, the long-term therapeutic outcome on psychosocial functioning and, specifically, work capability, should be assessed.[53]

Limitations

A recurrent problem, as found when studying therapeutic exercises for patients with RA,[10] OA,[11] and stroke,[12] is that researchers often fail to give thorough descriptions of the type of exercise used or its duration, intensity, and frequency. Information on the study sample such as participant level of physical fitness or level of depression (if applicable), both factors that have implications for treatment success, also usually is not provided. A lack of exercise and sample detail presents challenges to researchers who want to replicate a study and to practitioners and other health care professionals who want to prescribe effective strengthening exercises. The Ottawa Panel recommends that researchers provide as much study detail as possible.

The rehabilitation community could recommend that researchers provide more study detail in the form of an appendix (so as to not lengthen the article itself), or they could construct a standardized EBCPG form on study characteristics to be voluntarily filled out by researchers for the potential future development of EBCPGs.

A limitation inherent in the construction of EBCPGs is the occurrence of conflicting evidence. For strengthening exercises versus a control condition, statistical and clinical significance (grade A) was found for maximal isometric knee extensor force in one study,[30] but only clinical significance (grade C+) was found for the same outcome of a different study.[27] The reason for the discrepancy is not known; however, it is most likely the result of different samples, exercise outcomes, exercise interventions, or study designs used, which is why the study data could not be pooled. The heterogeneity of studies selected can lead to the above conflicting evidence, which, consequently, prevents sound conclusions from being drawn. In future studies, the Ottawa Panel will select studies, if possible, that can be pooled more easily.

Finally, another inherent weakness of the EBCPGs was that the recommendations were based on single trials of relatively low methodological quality across multiple outcomes. Four out of the 5 RCTs had a score of less than 3 on the Jadad scale. This finding should be noted when referring to the guidelines, in particular the grade A and C+ recommendations.

Implications for Practice

The Ottawa Panel has found emerging evidence to support the use of strengthening exercises as part of the overall management of FM. Most improvements were shown for muscle strength, quality of life, and decreases in depression. However, the lack of detail regarding the strengthening exercises and study sample was a significant weakness. Due to the vast variability in FM symptoms, patients would likely function best with a highly individualized program that incorporates multiple treatment regimens.

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Appendix.

Evidence-Based Clinical Practice Guidelines (EBCPGs) Related to Strengthening Exercises[a]

EBCPG Related to Strengthening Exercises Versus Control

Strengthening exercises versus control, level I (4 RCTs, N=94, all low quality)[26,27,29,30]: grade A for muscle strength[b] (maximal concentric leg extensor force, maximal isometric knee extensor force, and maximal concentric leg extensor force),[30] pain relief (VAS for general pain, back pain, neck pain, and general health[c]),[26] physical disability (Stanford Health Assessment Questionnaire for disability),[26] and depression (Beck Depression Inventory)[26] at end of treatment at 21 weeks (clinically important benefit); grade C+ for muscle strength (maximal isometric knee extensor force[27] and maximal isometric knee flexor force)[29] and quality of life (VAS for fatigue)[26] at end of treatment at 21 weeks (clinically important but not statistically significant benefit); grade C for pain relief (number of tender points[27,29] and VAS for abdomen pain),[26] sleep quality (VAS for sleep),[26] and muscle strength (maximal isometric knee flexor force)[27] at end of treatment at 21 weeks (no benefit); grade D for pain relief (VAS for arm pain)[26] at end of treatment at 21 weeks (no benefit demonstrated but favoring control); grade D+ for pain relief (VAS for leg pain)[26] at end of treatment at 21 weeks (clinically important benefit favoring control).

EBCPG Related to Strengthening Exercises Versus Another Type of Exercise

Strengthening exercises versus flexibility training, level I (1 RCT, N=56, high quality)[28]: grade A for quality of life (Fibromyalgia Impact Questionnaire for fatigue and rested) at end of treatment at 12 weeks (clinically important benefit favoring muscle strengthening); grade C+ for depression (Beck Depression Inventory) and anxiety (Beck Anxiety Inventory) at end of treatment at 12 weeks (clinically important but not statistically significant benefit); grade C+ for flexibility (hand-to-neck and hand-to-scapula) at end of treatment at 12 weeks (clinically important benefit favoring flexibility training without statistical significance); grade C for pain relief (total myalgic score and number of tender points), muscle strength (maximal isokinetic knee extensor and flexor force), shoulder strength (internal and external rotation), quality of life (Quality of Life Questionnaire and Fibromyalgia Impact Questionnaire total score and pain), and self-efficacy (Arthritis Self-efficacy Scale for pain, symptom and function) at end of treatment at 12 weeks (no benefit).

[a] RCT=randomized controlled trial, VAS=visual analog scale.
[b] Two exercises were used to measure muscle strength for the leg. For a description of these exercises, see "Summary of Trials" section.
[c] General health: expressed in a VAS, with end descriptions of "best possible condition" (score of 0) and "worst possible condition" (score of 100).