

Physical activity and exercise in patients with pediatric rheumatic disease: A systematic search and review

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ABSTRACT

Childhood rheumatic diseases are a group of diseases that can affect many organs and systems, resulting in pain, joint stiffness, muscle atrophy and weakness. Physical inactivity has been reported in many childhood rheumatic diseases. There are many studies in the literature comparing the effectiveness of exercise programs in children with juvenile idiopathic arthritis. Exercise and physical activity are considered major parts of the treatment of children with rheumatic disease. The aim of this review is to systematically present studies on physical activity and exercise programs in children with rheumatism from the last 5 years. An internet-based search of three databases-PubMed, PEDro and Medline- was conducted to find relevant studies. Two reviewers individually identified studies on the basis of their title, abstract or full text-as necessary-to determine their eligibility. Differences of opinion between the two examiners were resolved by discussion. Scientific studies of children with different rheumatic diagnoses have shown that physical activity and exercise have a significant effect on reducing the symptoms of the disease. However, the duration, frequency, method and evaluation of the exercises are still being discussed in the literature.

Keywords: Exercise, juvenile dermatomyositis, juvenile idiopathic arthritis, physical activity

Introduction

Childhood rheumatic diseases of unknown causes can affect many organs and systems, resulting in pain, joint stiffness, muscle atrophy, and weakness (1, 2). Children and adolescents with rheumatic diseases may experience significant short- and long-term disability because of pain, muscle weakness, fatigue, restricted joint motion, and reduced functional ability (3, 4).

Physical inactivity has been reported in many childhood rheumatic diseases (4-7). The combination of physical inactivity and sedentary behavior aggravates the problems common in pediatric rheumatic diseases, such as weakness, atrophy and muscle dysfunction, chronic pain, fatigue, bone loss, dyslipidemia, arterial hypertension, insulin resistance, and decreased health-related quality of life (QoL). Conversely, some of these symptoms-along with a disproportionate fear that physical activity might induce a flare-up in the disease-can be important barriers precluding the attainment of minimum levels of physical activity (8).

Evaluating physical activity and sedentary behavior is important in children with rheumatism. Objective and subjective methods can be used. Pedometers, the most common objective method, are relatively simple electronic devices used to estimate the number of kilometers walked or steps taken in a period of time (9). Accelerometers, which are electronic devices more complicated than pedometers, measure the acceleration produced by the motion of the body. It is a convenient and reliable method for evaluating physical activity in children (10).

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Other methods of assessing physical activity are subjective. In one of them, a physical activity log, individuals are asked to record the type, intensity, and start and end time of their activities. A metabolic equivalent of task score list is then used to calculate intensity according to the activity list (11).

Surveys can be used when the number of samples to be evaluated is large and in studies where manpower is limited. Questionnaires and interviews are often a method of collecting data on physical activity in epidemiological studies (12).

The most important way to reduce physical inactivity in children is directing them to structured exercise programs. Participating in structured physical activity programs early in life is key to preventing complications from chronic disease in adulthood by ensuring an active lifestyle (13). There are different opinions about the intensity, duration, and type of exercises used in children with rheumatism.

The aim of this review is to systematically present studies in the literature, conducted over the last 5 years, on physical activity and exercise programs in children with rheumatism.

Material and Methods

Data Sources and Searches

The study consists of two parts. Part 1 is a review of the literature on physical activity and exercise therapy used in the treatment of pediatric rheumatic diseases. Part 2 describes the indications for the type and amount of effective physical activity and exercise programs in any pediatric rheumatic disease.

The eligibility criteria for the studies included in this review were that they had to 1) be conducted on children and adolescents with a rheumatic disease (aged 0-18 years); 2) involve physical therapy and exercise training; 3) be randomized controlled trials (RCTs), a controlled study, or pre-post studies; and 4) be published in the English language. Studies in which the population investigated were non-human; that combined physical activity with other interventions such as electrotherapy, medication, and nutrition; reviews; guidelines; interviews; comments; or case studies were excluded.

An internet-based search of three databases-PubMed, PEDro, and Medline-was conducted for studies from the last 5 years. The following search terms were used: ("Arthritis, Juvenile" [Mesh] AND "Physical Activity" [Mesh]); ("juvenile idiopathic arthritis" AND "physical exercise" OR exercise* OR "physical activity" OR "physical activities"), (Juvenile dermatomyositis/Juvenile systemic lupus/juvenile fibromyalgia/Juvenile scleroderma/Juvenile spondyloarthritis AND "physical activity" OR "exercise"). Two reviewers (EPK and AA) individually identified studies for their eligibility based on their titles, abstracts, or full text as necessary. Differences of opinion between the two examiners (ET and NA) were resolved by discussion.

Results

Study Selection

The primary search produced 695 results, including 165 duplicates. A total of 530 studies were identified as possibly relevant and underwent a full-text critical appraisal, resulting in 456 exclusions because of title, abstract, and study design incon-

sistencies. A total of 74 studies were assessed in full text, and 55 trials were excluded because they were not RCTs ($n=16$), because they were systematic reviews or meta-analyses ($n=15$), and because of their publication date ($n=24$). Therefore, 19 studies were included in the study. Figure 1 shows a flow chart of the study selection progress.

Study Characteristics

The trials were published between 2015 and 2020, and 12 of them were RCTs, 2 were controlled trials, and 5 were pre-post studies. All studies including physical activity and exercise therapy used in the treatment of pediatric rheumatic diseases are shown in Table 1.

Juvenile Idiopathic Arthritis

Studies on juvenile idiopathic arthritis (JIA) have shown that physical activity and exercise programs can improve physical activity level, function, and QoL. There are many studies in the literature that compare the effectiveness of exercise and physical activity programs in children with JIA.

In a study conducted by Baydogan et al. (14), the effects of strengthening exercises were compared with balance and proprioception exercises in children with JIA, regardless of lower extremity involvement. After a 12-week planned exercise program, the range of motion (ROM), balance, muscle strength, and functional ability increased and pain decreased in both groups. In addition, proprioception and balance exercises increased lower extremity function. Houghton et al. (15) assessed the safety and feasibility of a group and home exercise program for children with JIA and reported that these children participated safely in a home-based exercise program planned to improve bone and muscle strength. Participation in physical activity can increase as fatigue improved.

Sule et al. (16) assessed the feasibility, safety, and effects of slow-speed resistance exercise for polyarticular JIA. Those in the intervention group performed individualized slow-speed resistance exercises 1-2 days per week for 12 weeks compared with those in the control group, who performed home-based aerobic exercise 3 days a week for 12 weeks. When the results were compared, there was no important difference between

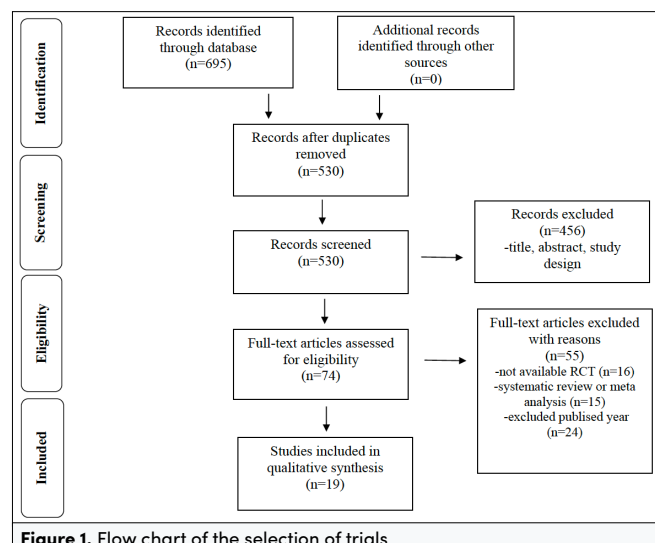


Figure 1. Flow chart of the selection of trials

Table 1. Studies on physical activity and exercise as treatments for pediatric rheumatologic diseases

Study	Type of research	Sample size (age)	Outcome measures	Intervention	Results
JIA					
Baydogan et al. (14) 2015; Turkey	RCT	30 (6-18)	Pain (NRS), passive range of motion (goniometer), muscle strength (handheld dynamometer), and balance and functional abilities (Flamingo Balance Test, Functional Reach Test, 10-meter walking test, 10-stair climbing test, and CHAQ)	12-week strengthening exercise program versus balance-proprioceptive exercise program	Both groups: ↑ in range of motion, muscle strength, balance, and functional abilities and ↓ in pain. Balance-proprioceptive group: ↑ in lower extremity function.
ElNaggar et al. (18) 2016; Egypt	RCT	30	Peak torque of the quadriceps and hamstrings (Isokinetic System), and pain (VAS)	12-week traditional physical therapy program versus resistive underwater exercises and interferential current therapy	Both groups: ↑ in peak torque of the quadriceps and hamstrings, ↓ in pain. Resistive underwater exercises and interferential current therapy group: ↑ in peak torque of both quadriceps and hamstrings and ↓ in pain.
Armbrust, et al. (22) 2017; Netherlands	RCT	49 (8-13)	Physical activity level (7-day activity diary and accelerometer), exercise capacity (maximum endurance time with Bruce treadmill protocol), quality of life (PedsQL), disease activity (VAS), functional ability (CHAQ), pain and well-being (VAS), and participation in school and physical education classes (questionnaire)	14-week Internet-based intervention program (physical activity and cognitive-behavioral program)	Both groups: ↑ in physical activity level. Internet program group: ↑ in physical activity level, exercise capacity, and participating in school and physical education classes. Control group: ↑ in quality of life. No exacerbation of disease status.
Houghton et al (15) 2018; Canada	Pre-post study	24 (8-16)	Pain intensity (VAS), function (CHAQ), physical activity levels (PAQ-C, PAQ-A), fatigue (PedsQL-Multidimensional Fatigue Scale), quality of life (JAQQ), general physical self-worth (CYPSP), bone mineral density (DXA), bone microarchitecture and bone strength (HR-pQCT), grip strength, and peak power and force (Ground Reaction Force Plate), and isokinetic strength (Biodex)	24-week home- and group-based exercise program	↓ in fatigue and ↔ in physical activity levels, bone mineral density, bone microarchitecture and bone strength, grip strength, knee extensor peak torque, average power, and total joint work.
El-Shamy, (23) 2018; Egypt	RCT	34 (8-12)	Handgrip strength (handheld dynamometer), hand function (DHI), and quality of life (PedsQL)	12-week Xbox training plus conventional treatment versus conventional treatment only	Xbox training plus conventional treatment group: ↑ in grip strength, hand function, and quality of life.
Bayraktar et al. (19) 2019; Turkey	CT	42 (8-18)	Pain (VAS), range of motion (pEPM-ROM), aerobic exercise capacity (cycle ergometer), anaerobic exercise capacity (Wingate Test), and anaerobic/aerobic power ratio	8-week water-based running exercise program versus no exercise training	Water-based running exercise group: ↑ in anaerobic exercise capacity parameters Both groups: ↔ in aerobic capacity, pain level, and range of motion.
Arman et al. (24) 2019; Turkey	RCT	62 (8-18)	Activity performance and participation (CHAQ, DHI, and COPM), pain severity (NRS), upper limb muscles strength (handheld dynamometer), grip strength (Jamar Plus + Hand dynamometer), and pinch strengths (hydraulic pinch gauge).	8-week video games-based task-oriented activity training versus task-oriented activity training in daily living	Both groups: ↑ in muscle strength, grip strength, activity performance, and participation. Video games-based task-oriented activity training group: ↑ in all upper limb muscle strengths, palmar pinch strength, and COPM satisfaction and ↓ in DHI.

Table 1. Studies on physical activity and exercise as treatments for pediatric rheumatologic diseases (Continued)

Study	Type of research	Sample size (age)	Outcome measures	Intervention	Results
Sule, (16) 2019; United States	RCT	33 (10-16)	Total body lean and fat mass (DXA), aerobic fitness (cycle ergometry), muscle strength (Biodex), pain (Wong-Baker FACES Pain Rating Scale), fatigue (Kids Fatigue Severity Scale), functional ability, and quality of life (CHAQ)	12-week slow-speed resistance exercise training versus home-based aerobic exercise program	Both groups: ↑ in body fat and ↔ in aerobic fitness, isometric muscle strength, pain, fatigue, functional ability, and quality of life.
Perez et al (20), 2019; Chile	RCT	46 (8-18)	Quality of life (PedsQL), functional health status (CHAQ), sensation of pain (CHAQ), and range of motion (GROMS)	10-week Watsu therapy versus conventional hydrotherapy	Watsu therapy group: ↑ in physical functioning, ↓ in disability index, discomfort index, health status index, total CHAQ score, and ↔ in range of motion. No adverse events related to therapeutic interventions.
Osama et al. (21) 2020; Egypt	RCT	70 (8-12)	Pain (Verbal Rating Scale), peak oxygen uptake (VO2) (instrumental treadmill exercise testing), cardiopulmonary function (engospirometry), heart rate and blood pressure (ECG), and isokinetic muscular performance (isokinetic dynamometer)	12-week exercise training protocol (bicycle ergometer, treadmill, and strengthening exercises) plus hydrotherapy versus exercise training protocol alone	Both groups: ↑ in VO2 peak, peak torque of knee extensors and flexors, and peak torque of wrist extensors and flexors. Exercise training protocol plus hydrotherapy group: ↑ in aerobic conditioning and muscle strength.
Tarakcı et al. (25) 2020; Turkey	RCT	43 with JIA, 30 with CP, and 19 with BPBI (5-17)	Hand ability (DHI), hand function (JTHFT), Nine-Hole Peg Test, functional ability (CHAQ), grip strength (Jamar Plus + Hand Dynamometer), pinch strengths (tip, key, and palmar pinch) [hydraulic pinch gauge]	8-week Leap Motion Controller-based training (LMCBT) versus conventional rehabilitation program	Both groups: ↑ in hand ability, hand function, functional ability, grip, and pinch strength.
Ellnaggar et al. (18) 2020; Egypt	RCT	33 (10-14)	Bone densitometry (DXA) and functional capacity (6 MWT)	12-week core stabilization exercises plus conventional therapy versus conventional therapy alone	Core stabilization exercises plus conventional therapy group: ↑ in bone mineralization of the lumbar spine and femoral neck regions and functional capacity.
JDM					
Habers et al. (26) 2016; Netherlands	RCT	26 (8-18)	Aerobic fitness (treadmill-based maximal exercise test); endurance time, peak VO2, VAT, isometric muscle strength (handheld dynamometer); perception of fatigue (PedsQL Multidimensional Fatigue Scale); pain (VAS); muscle function (Bruininks-Oseretsky Test of Motor Proficiency and CMAS); functional capacity (6 MWT); physical activity enjoyment (Physical Activity Enjoyment Scale); quality of life (PedsQL Generic Core Scale); functional ability (CHAQ); VAS pain and VAS global disease activity; and physical activity (accelerometry)	12-week home-based aerobic and strengthening exercise program	↑ in aerobic fitness, endurance time, standing long up distance, number of push-ups and situ-ups in 30 seconds, and parent CHAQ ↔ in isometric muscle strength, perception of fatigue, VAS pain, VAS global disease severity, CMAS, distance of 6-minute walk test, quality of life, physical activity enjoyment, and physical activity.
Samhan et al. (27) 2020; Egypt	Controlled-crossover trial	14 (10-16)	JDM scores (PGA and DAS-Skin), isometric muscle strength (Handheld dynamometer), muscle strength (Make test), and fatigue (PedsQL-Multidimensional Fatigue Scale)	4-week AQBE and LBE program	Both groups: ↑ in shoulder flexors' and abductors' muscles strength. AQBE: ↑ in hip flexors' and abductors' muscle strength, ↓ in general fatigue, and DAS-Skin score. No aggravation of disease activity.

Table 1. Studies on physical activity and exercise as treatments for pediatric rheumatologic diseases (Continued)

Study	Type of research	Sample size (age)	Outcome measures	Intervention	Results
JFM					
Sherry et al. (28) 2015; Philadelphia	Pre-post study	64 (13-18)	Aerobic capacity (Bruce Treadmill Protocol), function (Bruininks-Oseretsky Test of Motor Performance), disability (FDI), pain (VAS and PSOCQ-A), and quality of life (PedsQL-teen report)	Intensive physical therapy (aerobics, strengthening, functional activities) and occupational and cognitive-behavioral therapy	↑ in aerobic capacity, function, and quality of life and ↓ in pain.
Kashikar-Zuck et al (29) 2016; United States	Pre-post study	17 (12-18)	Feasibility, tolerability, safety, content, and format of the neuromuscular training and CBT (interview; open-ended questions) and pain (VAS)	8-week group-based integrative neuromuscular training and cognitive-behavioral therapy	↑ in self-efficacy, strength and motivation to exercise, and energy levels and ↓ in pain.
Tran et al. (30) 2016; United States	Pre-post study	11 (12-18)	Gait analysis (3D motion system), isokinetic knee strength (flexion-extension) and peak torques (Biodex System II), hip abduction strength and peak torque (Biodex System III), functional performance (drop vertical jump test), and dynamic postural stability (Star Excursion Balance Test)	8-week group-based integrative neuromuscular training and CBT	↑ in walking gait, stride length, peak torques in knee extension, hip abduction strength, functional performance, and dynamic postural control and ↔ in gait velocity.
Tran et al. (31) 2017; United States	Pre-post study	22 (13-18)	Pain intensity (VAS), functional disability (FDI), depression (CDI), fear of movement (TSK-11), pain catastrophizing (PCS-C), and pain stages of change (PSOQ-A)	8-week group-based integrative neuromuscular training and cognitive-behavioral therapy	↑ in readiness to change and action/maintenance and ↓ in functional disability, depression, fear of movement, and pain catastrophizing.
Kashikar-Zuck et al (32) 2018; United States	RCPT	40 (12-18)	Pain intensity (VAS), functional disability (FDI), depressive symptoms (CDI), fear of movement (TSK-11), pain catastrophizing (PCS-C), and monitoring of adverse events.	8-week group-based integrative neuromuscular training and CBT versus alone CBT	NMT group: ↓ in pain, functional disability, depressive symptoms, pain catastrophizing, fear of movement.

↑: increase; ↓: decrease; ↔: no change; 6MWT: 6-Minute Walk Test; AQBE: aquatic-based exercise; BPBI: brachial plexus birth injury; CASE: Children's Arthritis Self-Efficacy Scale; CBT: cognitive-behavioral therapy; CDI: Childhood Depression Inventory; CHAQ: Childhood Health Assessment Questionnaire; CMAS: Childhood Muscle Assessment Scale; COPMP: Canadian Occupational Performance Measure; CP: cerebral palsy; CT: controlled trial; CYPSP: child and youth physical self-perception profile; DAS: disease activity score; DHI: Duruoz Hand Index; DXA: dual-energy X-ray absorptiometry; ECG: electrocardiography; FDI: Functional Disability Inventory; FIQ: Fibromyalgia Impact Questionnaire; GROMS: The 10-joints Global Range of Motion Scale; HR-PqCT: high-resolution peripheral quantitative computed tomography; JAQQ: Juvenile Arthritis Quality of Life Questionnaire; JDM: juvenile dermatomyositis; JFM: juvenile fibromyalgia; JIA: juvenile idiopathic arthritis; JTHT: Jebson Taylor Hand Function Test; LBE: land-based exercise; LMCBT: Leap Motion Controller-based training; NMT: neuromuscular training; NRS: numerical rating scale; PAQ-A: Physical Activity Questionnaire for Adolescents; PAQ-C: Physical Activity Questionnaire for Older Children; PCS-C: Pain Catastrophizing Scale for Children; PedsQL: Pediatric Quality of Life Inventory; pEPM-ROM: The Paediatric Escola Paulista de Medicina Range of Motion Scale; PGA: Physician Global Assessment of Disease Activity; PSOCQ-A: Pain Stages of Change Questionnaire, adolescent version; PSOQ-A: The Pain Stages of Change Questionnaire; RCPT: randomized controlled pilot trial; RCT: randomized controlled trial; TSK-11: Tampa Scale for Kinesiophobia; VAS: visual analog scale; VAT: ventilatory anaerobic threshold; VO2: peak oxygen uptake.

pre- and post-intervention evaluation in any category in the exercise groups. As a result, researchers claim that resistance exercise protocols are safe for children with JIA to participate in (16). Ellnaggar et al. (17) investigated the effect of core stabilization exercises on functional capacity and bone mineralization in children with polyarticular JIA. There was a significant difference in the functional capacity of the group that performed core stability exercises in addition to conventional physical therapy compared to that of the group that received only conventional physical therapy. This showed that core stabilization exercises are an effective integrated treatment to improve functional capacity and bone health status in children with polyarticular JIA.

Several studies focused on underwater exercises. Ellnaggar et al. (18) assessed 30 children with polyarticular JIA in a randomized controlled study that confirmed the effects of combined resistive underwater exercises and interferential current (study group) compared with that of traditional physical therapy programs (control group). There were significant differences in the variables assessed for both groups. There were statistically significant differences in the peak torque of the hamstring of those in the control group. There were statistically significant differences for all parameters measured in the study group before and after treatment. The researchers claim that the combination of interferential current therapy and resistive underwater exercises would have positive results for children with JIA. Bayraktar et al. (19) assessed the effects of an 8-week

water-based exercise program on exercise capacity in children with JIA. They found that the anaerobic capacity of children who exercise in water increased compared to that of children who did not exercise at all. This study emphasized that a water-running program might be helpful to improve anaerobic exercise capacity but noted that it was not enough to increase the aerobic exercise capacity in children with JIA. Perez et al. (20) compared the effectiveness of Watsu therapy with that of conventional therapy on physical function, disability, health status, and range of motion. They reported that 10 weeks of Watsu therapy improved health-related QoL (HRQoL), pain sensations, and functional health status compared to conventional hydrotherapy. Another randomized controlled study conducted by Osama et al. (21) purposed to determine the effect of underwater exercise programs on the muscular strength and aerobic capacity of children with oligoarticular JIA. Control groups received an exercise training protocol while the study group received the same exercise training protocol in addition to hydrotherapy exercise treatment. In the study group, there was a significant improvement in the mean values of the muscle strength and peak oxygen uptake measured. As a result, the researchers suggested that underwater exercises may increase QoL in children with JIA.

Using technology in the rehabilitation of those with JIA is an increasingly popular treatment approach. Armbrust et al. (22) applied a 14-week, internet-based intervention program, *Rheumates@Work*, that included physical activity and a cognitive-behavioral program. The intervention group received internet-based intervention while the control group received standard care and no restrictions on their activities. Exercise capacity, moderate-to-vigorous physical activity, and participation in school and physical education classes improved significantly in the intervention group while HRQoL improved in the control group. When the groups were compared, no significant differences were found. El-Shamy (23) investigated the effectiveness of Xbox Kinect system training on hand function and QoL in children with JIA. Children were selected randomly and divided into two groups. Participants in the study group were given Xbox training involving playing 5 games for 50 minutes a day 3 times a week for 12 weeks in addition to conventional treatment. Participants in the control group were only given traditional treatment. After the intervention, the grip strength, hand function, and QoL of the participants in the study group showed significant improvement compared to those in the control group.

As a result, researchers advised that Xbox Kinect system training plus conventional treatment increases hand function, grip strength, and QoL in children with JIA. Arman et al. (24) compared the effects of two different task-oriented activity training programs on participation and activity performance in children and adolescents with JIA. In group I, activities important to daily life were practiced using real materials and in group II, such activities were experienced using video-based games (Xbox 360 Kinect) for 3 days a week for 8 weeks. The researchers claimed that video game-based task-oriented activity training is a feasible and alternative treatment for children with JIA. Tarakcı et al. (25) compared the potential effectiveness of the 8-week Leap Motion Controller-based training (LMCBT) program with the effectiveness of the traditional rehabilitation

program in children with physical disabilities such as JIA, cerebral palsy, and brachial plexus birth injury. When compared, the groups showed similar results across all parameters. This study showed that LMCBT can be used as an effective treatment in adolescents and children with physical disabilities.

Juvenile Dermatomyositis

Habers et al. (26) conducted the first RCT to investigate the effectiveness of an exercise program in patients with juvenile dermatomyositis (JDM). Patients in the intervention group participated in a 12-week home-based aerobic plus strengthening exercise program whereas patients in the control group maintained their usual care routine. An individually tailored home-based program resulted in significant improvements aerobic conditioning, functional ability, and muscle function in the intervention group. In addition, the exercise training was safe and no conditions required hospitalization or additional treatment after the intervention. As a result, the authors emphasized that exercise is a key component in the management of patients with JDM (26). Samhan et al. (27) recently published a trial comparing the clinical effects of a 4-week aquatic-based exercise (AQBE) program with those of a land-based exercise (LBE) program in patients with JDM. Both groups experienced significantly improved shoulder flexor and abductor muscle strength; however, the effects of AQBEs on hip flexor and abductor muscle strength, general fatigue, and disease activity scores were superior to those from LBEs. Although there was no difference in starting the exercise training program in water or land, it has been demonstrated that aquatic-based exercises were safe and better tolerated by patients. Although it was believed that exercise would increase muscle inflammation and aggravate disease activity, these studies confirmed that exercise training programs is safe for patients with JDM and provides health-related benefits without increasing disease activity.

Juvenile Fibromyalgia

There are many studies in the literature investigating the effectiveness of exercise programs in patients with juvenile fibromyalgia (JFM). Sherry et al. (28) aimed to present the short- and long-term results of intensive physical therapy, occupational therapy, and psychotherapy in patients with JFM. They reported that aerobic capacity, QoL, pain, and functional status improved in patients who participated in the program and that these effects can be sustained in the long term. In addition, they underlined that with exercise therapy, normal function and health-related QoL could be maintained without the need for medication.

Considering the complex nature of pain, many studies investigated the effectiveness of cognitive-behavioral therapies (CBTs) in addition to exercise therapy, particularly in recent years. According to these studies, 8 weeks of group-based integrative neuromuscular training and CBT could be effective in improving function, increasing motivation to exercise, and decreasing pain and fear of movement (29-31). In 2018, Kashikar-Zuck et al. (32) investigated a new approach, Fibromyalgia Intensive Training for Teens (FIT Teens) involving neuromuscular training and CBT in patients with JFM. The FIT Teens group showed greater improvements in pain and functional disability at 3-month follow-up. Furthermore, there were improvements

in depressive symptoms, pain catastrophizing, and fear of movement although these were not statistically significant. The FIT Teens program can be implemented for patients with JFM, particularly for reducing pain levels.

Discussion

This article has discussed physical activity and exercise in patients with pediatric rheumatic disease. Physical activity and exercise are effective treatments at all phases of the disease in children with rheumatism. Studies in the literature regularly show that increased levels of activity and exercise in children can restore normal mechanical, physical, and biochemical processes (33). Previous studies of children with different rheumatic diagnoses have shown that physical activity and exercise have a significant effect on reducing the symptoms of the disease regardless of the type of exercise. It was seen that 8-12 weeks of strengthening, aerobic, underwater, and balance-proprioception exercises were frequent preferences. However, the duration, frequency, method, and evaluation of these exercises are still being discussed.

There are many studies in the literature comparing the effectiveness of exercise programs for children with rheumatic disease. Exercise and physical activity are considered major parts of treating these children. Research on this has shown that exercises can improve physical fitness, QoL, and functioning such as walking and running. In these studies, the effects of physical activity programs were investigated mostly in patients with JIA, JFM, and JDM. There was no study in the literature about physical activity and exercise in children with juvenile systemic lupus erythematosus (JSLE), juvenile scleroderma (JS), and juvenile spondyloarthritis.

In the previous studies, exercise programs conducted both on land and in water have been shown to relieve pain and fatigue and improve the ROM, muscle strength, functional ability, and aerobic capacity of patients with JIA. However, because there are very few comparative studies investigating the superior effects of exercise programs on disease-specific problems, it is difficult to make inferences regarding the effects of exercise types on patients with JIA.

However, there are a limited number of studies on the impact of exercise in JDM, a less common pediatric rheumatic disease. Aerobic and strengthening exercises can be part of treatment programs for patients with JDM as a way to improve their aerobic fitness and functioning. In addition, aquatic exercises can be considered an alternative therapy for these groups to reduce fatigue levels and strengthen the proximal muscle groups in the shoulder and hip.

Although it is believed that exercise will increase muscle inflammation and aggravate disease activity, studies have confirmed that exercise training programs for patients with JDM are safe and provide health-related benefits without increasing disease activity.

A few of the studies included in this analysis investigated the effectiveness of exercise programs in patients with JFM, and they reported that aerobic exercises helped reduce pain and similar symptoms. Furthermore, applying CBT in addition to exercise therapy may also result in better health outcomes in patients with JFM.

Increasing physical activity and/or exercise can be beneficial and simultaneously impact different disease-related symptoms and systemic manifestations of pediatric rheumatic disease. However, implementing physical activity in routine practice has always been a challenge for physiotherapists working on those with such diseases because of unfounded patient-specific barriers. Implementation of physical activity in clinical practice can be led by a physiotherapist, in a pragmatic manner, during routine patient visits and supported by social innovation. However, its general and cost effectiveness should be tested in appropriately designed trials.

Difficulties in coming to the clinic are common owing to time management obstacles as a result of school attendance and parents' work obligations, difficulty in accessing rehabilitation services, and costs related to participating in a rehabilitation program in a hospital or private clinic (34). Thus, home exercise programs are more commonly preferred because they can be performed in a more flexible and personalized timeframe and can be cost effective. The current increase in time spent at home due to the COVID-19 pandemic has made these problems more pronounced. This means that there is a greater need to plan home exercise programs. New technologies based on virtual reality and/or information and communication technologies offer exciting perspectives for enhancing adherence to home-based exercise programs. Such technologies are interactive and playful; they can make it possible to monitor patient performance and provide direct feedback including reminders and motivation strategies (35). Therefore, such technologies can be used, particularly as part of telerehabilitation, to increase physical activity levels in children and adolescents with rheumatic diseases. However, the extent to which this kind of technology fulfills their expectations as a way help them exercise at home is currently unknown.

Conclusion

There are many studies in the literature comparing the effectiveness of exercise programs for children with rheumatic disease, however we recommend for future research include a comparative study of the superior features and cost effectiveness of exercise programs and an evaluation of the eligibility of rehabilitation technologies for exercise management in pediatric rheumatic disease. In addition, more studies should focus on physical activity and exercise for patients with JS, JSLE, juvenile spondyloarthritis, and other childhood rheumatic diseases.

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