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REVIEW

The benefits of physical therapy in juvenile idiopathic arthritis

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Abstract
Juvenile idiopathic arthritis (JIA) is the most common chronic rheumatic disease in children and an important cause of short-term and long-term disability. Recommended physiotherapy activity programs are essential for controlling JIA associated complications such as stiffness, deformity, muscle contractures, and cramps. It is uncertain if physiotherapy (PT) can significantly enhance prognosis and quality of life (QOL). In this review we focused on the specific effects of various PT on JIA manifestations. To conduct a literature review, the databases PubMed, Scopus, and DOAJ (last access in June 2023) were searched. The PubMed search returned a total of 952 articles, Scopus returned 108, and DOAJ returned no results. After screening, the final list included 18 papers on PT treatment for JIA patients. In children with JIA, targeted PT exercise may have the ability to improve strength, posture, aerobic conditioning, gait, functional mobility, and reduce pain.

Keywords Pediatrics · Rheumatology · Physiotherapy · Rehabilitation · Juvenile idiopathic arthritis

Methods and results

Search strategy

The objective of this narrative review is to discuss the benefit of physiotherapy in children with JIA. A literature search through Medline/Pubmed, Scopus, and DOAJ (last accessed in June 2023) on physiotherapy in JIA was carried out for the period 01 October, 2022–01 June, 2023. We used the following keywords for the literature search: 'physiotherapy', 'physical therapy', 'juvenile idiopathic arthritis', 'children', 'rehabilitation', 'JIA'. We included original studies and reviews which were relevant to our objectives. Other types of articles, duplicates, and reports published in languages other than English were excluded. The PubMed search returned a total of 952 articles, Scopus returned 108, and DOAJ returned no results. We checked the titles and abstracts and eliminated any duplicates. The remaining 58 papers were then subjected to a second screening; of these, 40 were eliminated because they did not match the inclusion criteria (not dealing specifically with physiotherapy of children with JIA). The final selection included 18 articles on physiotherapeutic treatment for patients with JIA (Table 1). The selected studies investigated various physiotherapy techniques for improving strength, posture, aerobic conditioning, gait, and functional mobility, as well as reducing pain. Finally, the information was synthesized in a logical sequence with expert inputs from the senior authors.

Introduction

Juvenile idiopathic arthritis (JIA) is the most prevalent chronic rheumatic disease in children [1]. Damage to joint surfaces and their associated structures can lead to subluxation, fusion, and irreversible changes of the joints. In addition to joint involvement, muscular weakness, atrophy, poor endurance, gait abnormalities, decreased exercise capacity, and reduced function and quality of life (QOL) are also observed [2]. The most commonly affected joints are the hips, knees, and ankles with many requiring later joint replacement [3]. Therefore, continuous PT could benefit all children with JIA, and, ideally, should be started before significant functional disability and joint deformity occur. The primary objective of PT is the recovery of normal or optimal joint function, and therefore it is crucial to design individualized rehabilitation programs based on

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Table 1 Characteristics of the included studies

Study	Participants	Interventions	Outcomes
Azab 2022 [9]	40 children with JIA (10–14 years)	3 months of conventional PT (group 1: $n=20$) vs conventional PT + pilates (group 2: $n=20$)	Group 2: improvements in VAS, peak VO_2, HRmax, CHAQ
Elnaggar 2021 [33]	33 children with JIA (10–14 years)	3 months of conventional PT (group 1: $n=16$) vs conventional PT + core stability exercise (group 2: $n=17$)	Group 2: improvements in bone mineralization of lumbar spine and femoral neck region, and in 6MWT
Arman 2019 [29]	62 children with JIA (6–18 years)	Activity of daily living using real materials from daily life (group 1: $n=31$) vs using video-based games (group 2: n = 31) for 3 d/wk for 8 weeks	Group 2: improvements in upper limb muscle strengths, palmar pinch strength, COPM, and DHI
Bayraktar 2019 [23]	42 children with JIA (8–18 years)	8 weeks of water-based exercise program (group 1: $n=21$) vs no exercise (group 2: $n=21$)	Group 1: improvements in anaerobic exercise
El-Shamy 2018 [11]	30 children with JIA (8–12 years)	3/week for 4 weeks of HILT laser therapy (group 1: $n=15$) vs placebo group (group 2: $n=15$)	Group 1: improvements in VAS and gait parameters
Houghton 2018 [28]	24 children with JIA (8–16 years)	6 months of 2 sessions/week home-based exercise of jumping and handgrip exercises, resistance training (pre- vs post-training)	Post-training: improvements in fatigue
Elnaggar 2016 [10]	30 children with JIA (8–11 years)	3 months of conventional PT (group 1: $n=15$) vs resistive underwater exercise + interferential current therapy (group 2: $n=15$)	Group 2: improvements in peak torque of quadriceps and in hamstrings pain levels
Baydogan 2015 [18]	30 children with JIA (6–18 years)	3 months of strengthening exercise (group 1: $n=15$) vs proprioceptive-balance exercise (group 2: $n=15$)	Group 2: improvements in walking, climbing stairs, and balance
Sandstedt 2013 [27]	54 children and adolescents with JIA (9–21 years)	3/week for 12 weeks of strength training with free weights and rope skipping (group 1: $n=27$) vs no exercise group (group 2: $n=27$)	Group 1: increasing in hip and knee extensor muscle strenght
Van Brussel 2009 [19]	62 children with JIA (7–16 years) and 50 healthy children (8–16 years)	To examine mean and peak of anaerobic-to aerobic power ratio in children with JIA vs healthy peers	Development of the anaerobic-to-aerobic power ratio is not statistically different between children with JIA and healthy peers
Singh-Grewal 2007 [22]	80 children with JIA (8–16 years)	RCT comparing the effectiveness of high-intensity aerobic training vs low-intensity training (Qigong) for 12-week, 3 times weekly	No difference in any exercise testing measures between the groups. Both groups showed significant improvements in CHAQ
Epps 2005 [41]	78 children with JIA (4–19 years)	RCT comparing the effects of combined hydrotherapy and land-based PT vs land-only PT	Improvement in disease status (CHAQ, physicians measures at baseline, after 2-month follow-up, and after 6-month follow-up)
Brostrom 2004 [42]	10 children with JIA and 10 healthy peers	To compare lower-leg strength of young girls with JIA with healthy peers	Girls with JIA had significantly less plantar- and dorsiflexion strength than age-matched, healthy peers
Takken 2003 [7]	54 children with JIA (5–13 years)	6 months of aquatic exercise program 1 h/week (group 1: $n=27$) vs no exercise (group 2: $n=27$)	Group 1: improvements in CHAQ, JAFAS
Fredriksen 2000 [15]	5 children with JIA (1–6 years)	Static night traction and orthoses (periods B) vs periods without intervention (periods A)	Improvement in active and passive extension ROM in periods B
Klepper 1999 [8]	25 children with JIA (8–17 years)	8-week, 24 session weight-bearing physical conditioning program (pre- vs post-training)	Post-training: improvements in ASI, VAS, 9 min run-walk test

Table 1 (continued)

Study	Participants	Interventions	Outcomes
Field 1997 [12]	20 children with JIA (5–15 years)	15-min massage for 30 days (pre- vs post-session and first day vs last day assessments)	Anxiety and cortisol hormone levels immediately decreased by the massage and over the 30-day period
Giannini 1993 [20]	28 children with JIA (7–17 years) and 28 healthy peers (7–15 years)	Case-comparison study comparing differences between child with JIA vs healthy peers, in peak isometric knee extensor torque generated during an isometric contraction	Peak isometric knee extensor torque was significantly lower among the children with JIA (Chattecx, Chattanooga score)

ASI anxiety sensitivity index, *CHAQ* Childhood Health Assessment Questionnaire, *COPM* Canadian Occupational Performance Measure, *DHI* Duruoz Hand Index, *HR* heart rate, *JAFAS* Juvenile Arthritis Functional Assessment Scale, *JIA* juvenile idiopathic arthritis, *PT* physical therapy, *RCT*: randomized controlled trial, *VAS* visual analog scale, VO_2 volume of oxygen

patient disease characteristics and need. These programs should take into account different aspects of social adaptation depending on the child's age, such as integration into school life, integrating parents into the therapeutic program for younger children, or allowing older children to become independent through self-care training [4]. In this review, we aim to highlight the fundamental therapeutic benefit of various forms of PT as they relate to pain relief, muscle relaxation, joint mobility improvement, aerobic/anaerobic conditioning, muscle strength, gait, posture, QOL, and prevention of decreased bone mineral density (BMD).

Muscle relaxation and pain relief

In an acutely inflamed joint, the initial phase of treatment is passive-assistive movement with the joint relieved of gravity. Slow and regular movements within the normal range of motion without discomfort decreases muscular tension and reduces joint pain [5]. When joints develop persistent contractures, a "stabilizer splint" should be utilized as an orthosis. Orthoses are used to stretch and stabilize flexion contractures in patients. In addition, gradual casting can be of great help for this purpose. The recommended strategy is to remove the cast at 24- to 48-h intervals and administer rigorous stretching for 20 min, before repositioning the cast to force maximum extension. The cast should stay in place for a minimum of 23 h [6].

Hydrotherapy is another modality commonly prescribed for muscle relaxation and, as part of a stretching regimen, can prevent or treat contractures and build strength. Hip hydrotherapy exercises may incorporate flexion, extension, and abduction. Knee workouts may include walking or hopping underwater, in addition to swimming or leg kicking. Supervised hydrotherapy, performing lower limb exercises, can be done two to three times per week. Each joint can be actively moved 30 times maximum, with sufficient rest periods between joint exercises [7]. Two RCTs have assessed the efficacy of hydrotherapy exercises in JIA patients. Although research reached no statistical or clinical significance, hydrotherapy exercises were well tolerated and did not increase pain symptoms [7]. Aquatic activities have also been shown to reduce discomfort and prevent muscle spasms, and are recommended over sports such as basketball, football, and gymnastics that involve substantial ankle use [6].

Despite recommendations in the literature for low-intensity exercises to prevent worsening pain, Klepper studied the effects of an 8-week, 24-session weight-bearing physical conditioning program of low-impact exercise on pain and symptoms of chronic arthritis in children. No significant differences in visual analog scale (VAS) scores before and after exercise sessions were found, although mean pain scores decreased from study entry to the post-exercise test [8]. According to Azab et al., even combining Pilates

movements with standard physical treatment is likely more effective than standard physical treatment alone for reducing pain intensity [9].

Elnaggar validated the effects of combined resistive underwater exercises and interferential current on the maximal torque of the quadriceps and hamstrings and associated pain levels in 30 children with JIA randomly assigned to one of two groups: group A ($n=15$) received conventional PT programs, while group B ($n=15$) received resistive underwater exercises and interferential current therapy. Using the HUMAC NORM, Central Sensorimotor Integration (CSMI) Testing and Rehabilitation Isokinetic System, and VAS, maximal torque of the quadriceps and hamstrings and pain levels were measured prior to therapy, and 1 and 3 months after therapy [10]. Except for peak torque of the left quadriceps and pain levels, all other measures favored the underwater group. Therefore, patients with JIA may benefit from a combination of resistive underwater workouts and interferential current therapy [10].

Heat therapy is particularly useful for reducing joint stiffness, increasing the flexibility of fibrous tissue in joint capsules and tendons, and alleviating pain and muscle spasms. The effect of heat depends on multiple variables, including the optimal temperature (40–45.5°C), the duration of heating (3–30 min), the rate of temperature change, and the area treated. A hot shower may alleviate morning stiffness, while a soak before bed may alleviate nighttime aches [6]. Ultrasound as a source of deep heat is especially useful in the hip joint [6].

El-Shamy et al. assessed the long-term effectiveness of a pulsed neodymium-doped yttrium aluminum garnet (Nd:YAG) laser [high-intensity laser therapy (HILT)] in the treatment of 30 children with JIA. Fifteen children in the treatment group received HILT three times per week for 4 weeks in addition to a standard exercise program. HILT scanned each knee with a total of 750 J, comprising 600 J in two phases and 15 J at ten specific locations. The placebo group (15 children) was administered a placebo form of HILT along with an identical exercise routine. Pain level, assessed by VAS score, showed improvement in the treatment group at 4 and 12 weeks of follow-up [11].

According to Cakmak et al., acutely inflamed joints could benefit from cold therapy to help with pain and vasoconstriction. Side effects may include cold urticaria, cryoglobulinemia, Raynaud's phenomenon, or frostbite. Typically, cold therapy is administered for 20 min for a hyperemic reaction to ensue. However, since many children do not tolerate cold, it is not utilized frequently [6].

Field et al. evaluated 20 children with mild to moderate JIA who received 15 min of daily massage from their parents for 30 days (and a control group engaged in relaxation therapy). The massage instantly decreased children's anxiety and cortisol levels, and throughout a 30-day period, their self-reported, parent-reported, and physician-assessed pain (both the incidence and severity) and pain-limiting activities decreased [12].

Joint mobility

An additional form of PT consists of reducing muscle tone and carefully stretching muscle spasms in an effort to restore their physiological range of motion [5]. Treating pain in JIA is essential considering its impact on QOL may have negative implications not only during childhood, but also throughout adulthood [13].

Lower limb flexion contractures can develop when the range of motion is gradually restricted by pain or inflammation [14]. Hip and knee flexion contractures are most prevalent in children with oligo-articular JIA subtype, typically affecting lower extremities [14]. Hip flexion contractures result in an increase in lumbar lordosis, which manifests as an abnormal gait with a projected abdomen and buttocks. Bacon et al. revealed that hip rotation angles and other ranges of motion were considerably improved in children who trained in water for 6 weeks [6]. One study with a single-group design and a small sample size suggested that static night traction may supplement PT in reducing knee flexion contractures in JIA. When the knee is flexed over a long period of time, the hamstring muscles may contract [15]; in this situation, static stretching may be beneficial, especially as it increases active range of motion [15]. Stretches should be held for at least 15 s, with three repetitions per session and up to four sessions per day [16]. However, the effectiveness of these non-invasive techniques, as well as their long-term impact on JIA patients is unclear and requires additional study.

Resting splints are used in the acute phase to place the affected joint in neutral extension. As ankylosis develops more rapidly in children than in adults, placement is essential for preservation of joint function. For this purpose, wrist splints, ring splints for fingers, and splints that prevent knee flexion contracture are widely employed [17]. In contrast, dynamic splints exert force on the joint causing a degree of hyperextension. Care must be taken that the degree of force does not result in subluxation, but also guarantee that the splint is worn long enough to achieve the desired outcome. Therefore, splints that exert lower force for longer duration (10–12 h) are preferred [17].

Stretching is the primary exercise used to enhance range of motion (ROM). Stretches should be held for at least 10 s, five to ten times per session, twice a day (10-s hold, 20-s relax). The most ideal stretching exercise is one that employs the “contract–relax” technique. The patient's joint is positioned in a passive stretch and then the patient begins to actively flex the joint against resistance. After holding this

position for a few seconds, the therapist relaxes the joint back to neutral [17].

Baydogan et al. compared the efficacy of muscle-strengthening and proprioceptive exercise on the lower extremities of children with juvenile idiopathic arthritis. In terms of pain, muscle strength, and postural balance control, statistical significance was achieved [18]. The quadriceps femoris muscles were strengthened by isometric knee extensor exercises followed by active range of motion exercises. Active range of motion exercises included eight to ten repetitions of straightening the knee from a contracted position with weight (small sandbags) attached distally to the ankle [18]. Over 12 weeks, the exercise program progressively increased repetitions from 8–10 to 10–15, with one set performed daily. Additionally, massage treatment combined with these exercises was found to be effective in reducing joint swelling and stiffness [12].

Aerobic and anaerobic conditioning

Many studies have revealed lower aerobic and anaerobic capacity in children with JIA [7]. Localized muscular weakness and atrophy around inflamed joints is likely a main contributor to these deficits [20]. Exercise treatment programs have been shown to prevent deconditioning and break the vicious cycle of inactivity and deteriorating functional ability seen in these children [21]. Improvements in aerobic capacity is especially seen with moderate-intensity exercises performed for 30 min per day [6].

It is recognized that high-intensity interval training (HIIT) also improves cardiovascular health. Singh- Grewal compared HIIT to low-intensity training in terms of energy cost of movement, peak oxygen consumption, peak power, and self-reported physical function in children with juvenile idiopathic arthritis (JIA) [22]. JIA patients aged 8 to 16 years were enrolled in a single-blind, randomized, controlled trial. Children were engaged in a 12-week, three-times-weekly training regimen consisting of vigorous cardiovascular exercise for the experimental group and qigong for the control group [22]. The primary result was submaximal oxygen intake at 3 km/h (VO2submax), whereas maximal oxygen uptake and peak power were measured at the beginning and conclusion of the program. The Childhood Health Assessment Questionnaire (CHAQ) was utilized to evaluate physical function. The exercise program was well tolerated by both groups. Throughout the trial period, neither VO2submax nor any other exercise testing metrics differed between groups, nor were there any signs of improvement. The CHAQ improved significantly in both groups, with no significant difference between them. Findings demonstrated that activity programs with or without aerobic training component are safe and may lead to a significant improvement in physical function [22]. The intensity of aerobic training did not appear to provide any additional benefits; however, results of those with higher adherence in the qigong program suggest that less rigorous regimens are easier for children with JIA to adhere to and provide equal benefit compared to more intensive programs [22].

Bayraktar assessed the impact of an 8-week water-based exercise program on the exercise capacity of 42 children with JIA [23]. Anaerobic exercise capacity increased in the exercise group after the training program; however, no changes were detected in the control group. None of the groups displayed any differences in aerobic exercise ability ($p > 0.05$). An 8-week water-running program may enhance anaerobic exercise capacity, but did not improve aerobic exercise capacity in children with JIA [23].

According to Gualano, a combination of hydrotherapy and land-based exercise was comparable to land-based exercise alone in terms of aerobic fitness [24]. Moreover, another study [22] found comparable clinical benefits in JIA patients who participated in either a low- to moderate-intensity exercise program or a vigorous exercise program. Importantly, none of these trials found any negative side effects from exercise training.

Muscle strength

Children and adolescents with JIA commonly display movement and balance abnormalities, partly because of muscle atrophy and functional joint changes, but also because they have decreased physical activity and spend more time sleeping than their peers [25].

Therefore muscle-strengthening exercises are essential especially in the chronic phase of the disease.

At the time of diagnosis 30–50% of oligo-articular JIA patients exhibit knee involvement characterized by unilateral discomfort, swelling, soreness, and bursitis [26]. Knee involvement may result in quadriceps atrophy in the affected leg with associated weakness, which directly inhibits overall physical activity in children with JIA [26]. A single-blinded, randomized control experiment found that less intensive physical exercise may be more suited for JIA patients and appears to produce comparable physical advantages to more demanding training program [22].

Children with hip involvement can benefit from hydrotherapy and muscle-strengthening activities [7]. A randomized controlled experiment assessed the efficacy of a 12-week fitness program for JIA patients [22]. The activities included skipping rope and core, hip, and arm muscle building exercises. For 12 weeks, the workout regimen was completed three times per week. The results suggested an increase in leg muscular strength with no worsening of pain [27].

Home-based exercise programs can safely help to strengthen muscles and bones and may also reduce fatigue.

Home-based exercise program may include jumping exercises, handgrip exercises, and resistance training progressively implemented over several weeks [28].

Armand examined the impact of two task-oriented activity training programs on the activity performance and involvement of children and adolescents with JIA. Sixty-two patients were randomly assigned to two groups for task-oriented activity training [29]. The first group's activities of daily living were conducted using real-life materials, whereas in group 2, activities of daily living were practiced using virtual reality (Xbox 360 Kinect) 3 days per week for 8 weeks [29]. Pain was measured using the numeric rating scale (NRS). Upper limb muscle grip and pinch strengths were measured using a dynamometer, and activity performance and participation were measured using the CHAQ, the Canadian Occupational Performance Measure (COPM), and the Duruoz Hand Index (DHI). After therapy, NRS, muscle strength, grip strength, CHAQ, COPM, and DHI changed significantly in both groups [29]. However, the VR group outperformed in almost all upper limb muscular strength, COPM, and DHI scores [29].

Gait and posture improvement

While any joint can be affected by JIA, the lower extremity joints, such as knees and ankles, are more commonly involved [30]. Arthritis modifies the kinetic chains [31] and systemic gait motion characteristics such as trunk lean and posture. The long-term implications of these modifications include joint pain, difficulty in physical activities or early onset of fatigue during physical activity [32].

Therapeutic treatments to improve or maintain gait and mobility in JIA are therefore recommended. Elnaggar investigated whether the addition of core stability exercises to traditional PT would improve functional capability in children with polyarticular JIA (poly-JIA). Thirty-three children with poly-JIA (age; 10–14 years) were randomly assigned to two groups: control group ($n = 16$) received conventional PT, while the study group ($n = 17$) received conventional PT with core stability exercises. Core stability and traditional PT activities continued for three months. A six-minute walk test was used to assess functional ability at baseline and immediately after therapy. Results revealed significant differences between groups in favor of PT with core stability exercises (P 0.05), with the study group walking more than 20 m further, on average, during their walk test. Therefore, the authors concluded that core stability exercises promote increased muscle strength and balance around the lumbo-pelvic–hip complex [33].

Kuntze compared the gait kinematics of youth with JIA with normally developing youth during fixed-speed treadmill walking using a 12-camera system (Motion Analysis) [34]. Youth with JIA had low disease activity, pain, and disability scores. Bilateral joint angle deviations were observed. Youth with juvenile idiopathic arthritis walked with increased initial hip flexion, knee extension, and hip extension during terminal posture. Youth with JIA avoided the close-packed knee position, which is commonly associated with joint inflammation and discomfort, despite low disease activity. These findings emphasize secondary JIA effects and inform physical therapy management goals for JIA patients [34].

Thirty JIA patients were randomly assigned to the strengthening training group (group 1, $n = 15$) or the proprioceptive-balance exercise group (group 2, $n = 15$), in a study conducted by Baydogan et al., to evaluate their effects on lower extremity function. The study revealed that balance-proprioceptive activities are more beneficial than strengthening exercises for improving lower extremity function such as walking, stair climbing, and balance in JIA patients [18].

Bone density increasing

Low BMD and fragility fractures are well-known long-term consequences of JIA associated with severe morbidity [35]. JIA patients who fail to attain their optimal peak BMD in early to middle adulthood are at increased risk of developing osteoporosis in later life when their BMD falls. Male and female adult patients with a history of JIA are known to have higher bone turnover and decreased BMD as compared to age-, sex-, height-, and weight-matched healthy control subjects [36]. In addition, it was observed that prolonged administration of glucocorticoids may reduce calcium absorption in the intestines and increase calcium excretion through renal tubules, which may result in a negative calcium balance. It appears that pro-inflammatory cytokines (specifically TNF-), an excess of glucocorticoids, and reduced gonadal hormonal stimulation can influence the RANKL/RANK/OPG system and potentially disrupt the balance between osteoclastic apoptosis and osteoblastic matrix formation [37].

Elnaggar et al. investigated whether the addition of core stability exercises to traditional PT would improve bone mineralization in children with poly-JIA. Children with poly-JIA (age; 10–14 years) were randomly assigned to receive conventional PT ($n = 16$) versus conventional PT with core stability exercises ($n = 17$) for 3 months. Dual-energy X-ray absorptiometry (DXA) was used to assess bone mineralization at baseline and immediately after therapy. Results revealed significant differences between groups in favor of core stability exercises for improved bone mineralization of the lumbar spine and femoral neck

(P 0.05), with the exception of volumetric bone mineral density (vBMD) of the lumbar spine ($P > 0.05$) [32].

Gannotti et al. assessed the literature pertinent to establishing an effective and safe weight-bearing exercise program to lower the risk of low BMD in JIA children [38]. Three highly rated studies confirmed the multifactorial nature of low BMD in JIA, and two supported the efficacy of weight-bearing interventions for increasing BMD in healthy children, with one moderately rated study demonstrating the safety of low-impact exercise for children with JIA. Therefore, weight-bearing activities should be included into exercise regimens for patients with JIA; however, additional study is required to identify the quantity, duration, and frequency of weight-bearing activity required to lower the risk for low BMD.

Quality of life

There is limited evidence to suggest an improvement in QOL as a result of an exercise program in children and adolescents with JIA at this time [25].

According to Takken et al., providing opportunities for exercise in which patients with JIA can participate, is essential for improving physical fitness considering that lacking physical fitness has significant negative effects on health and quality of life [39]. From the second decade of life forward, VO2peak drops by 0.41 ml/kg/min annually, indicating that a lack of physical fitness may result in an inability to conduct activities of daily living in old age [40]. Epps et al. compared the effects of combined hydrotherapy and land-based physiotherapy versus land-only physiotherapy and found that QOL improved more in the combined group [41].

Brostrom et al. compared the plantar- and dorsiflexor strength of young girls with poly-JIA to that of healthy, age-matched controls and found that girls with JIA had considerably lower plantar- and dorsiflexor strength than healthy peers of the same age. These findings suggest that these patients would be likely to engage in less physical activity, which has a negative impact on their ability to do daily tasks, and subsequently decrease their quality of life [42].

The wrist and hand joints are often affected in JIA, resulting in a decline in hand function, thus reducing ability to conduct daily living activities. Rashed et al. investigated the association between hand grip strength (HGS) and JIA disease activity, disability, and quality of life using a dynamometer to measure HGS in 23 patients with JIA and 46 age- and sex-matched healthy controls. The hand grip strength of children and adolescents with JIA was substantially weaker than that of matched controls (p 0.001) and had a significant direct association with a lower QOL. In clinical practice, examination of HGS could be a simple non-invasive method to determine disease activity, disability, and QOL in JIA patients [[[43]]].

Conclusions

Physiotherapist is a member of the rehabilitation team (rheumatologist, physiatrist, occupational therapist, orthotist) that applies the treatments following the rehabilitation program made by the physiatrist specialist, to whom the rheumatologist may turn. Therefore, the physiotherapist, plays a key role in the treatment and management of children with JIA throughout the disease's progression with serial examinations which serve as a barometer of disease activity.

Despite the great variability of exercise interventions, research outcomes, and JIA illness features, it is possible to identify commonalities among exercise regimens with improved outcomes (Fig. 1). Passive-assisted mobilizations, the use of static splints, hydrotherapy, exercises performed while an interferential current is being applied, weight-bearing activities, Pilates, and heat treatment are all suggested methods for relaxing the muscles and reducing pain. Stretching, the use of dynamic splints, proprioceptive exercises, proprioceptive aerobic training, static night traction, and heat therapy are all advised for the improvement of joint mobility. Enhancing aerobic and anaerobic conditioning can be performed through high-intensity interval training and land exercises alone or in combination with hydrotherapy. Muscle strength can be improved by hydrotherapy, rope skipping, exercises for the core, hips, and arms, at-home exercise equipment (such as jumpers, hand grippers, and resistance trainers), and task-oriented activity training with real-world materials and computer games. Strengthening exercises for the handgrip, plantar/dorsiflexor, and weight-bearing muscles, as well as core stability exercises, are the key ways to improve gait/posture, quality of life, and bone density, respectively.

Summarizing, exercise programs emphasizing strength, flexibility, and balance with supervised or partially supervised training sessions were frequently associated with improvements in pediatric activity, body function and structure, and QOL, whereas high-impact exercise was associated with exercise-induced pain and would not be recommended (Table 2).

To conclude, despite the wide range of physiotherapeutic techniques, development of proven neuromuscular training programs must continue to address the multiple health implications associated with JIA and implementation of exercise intervention strategies and reevaluation of core outcomes are essential for the development of evidence-based information to guide therapeutic decision-making and optimize clinical decision pathways, and improve patient health.

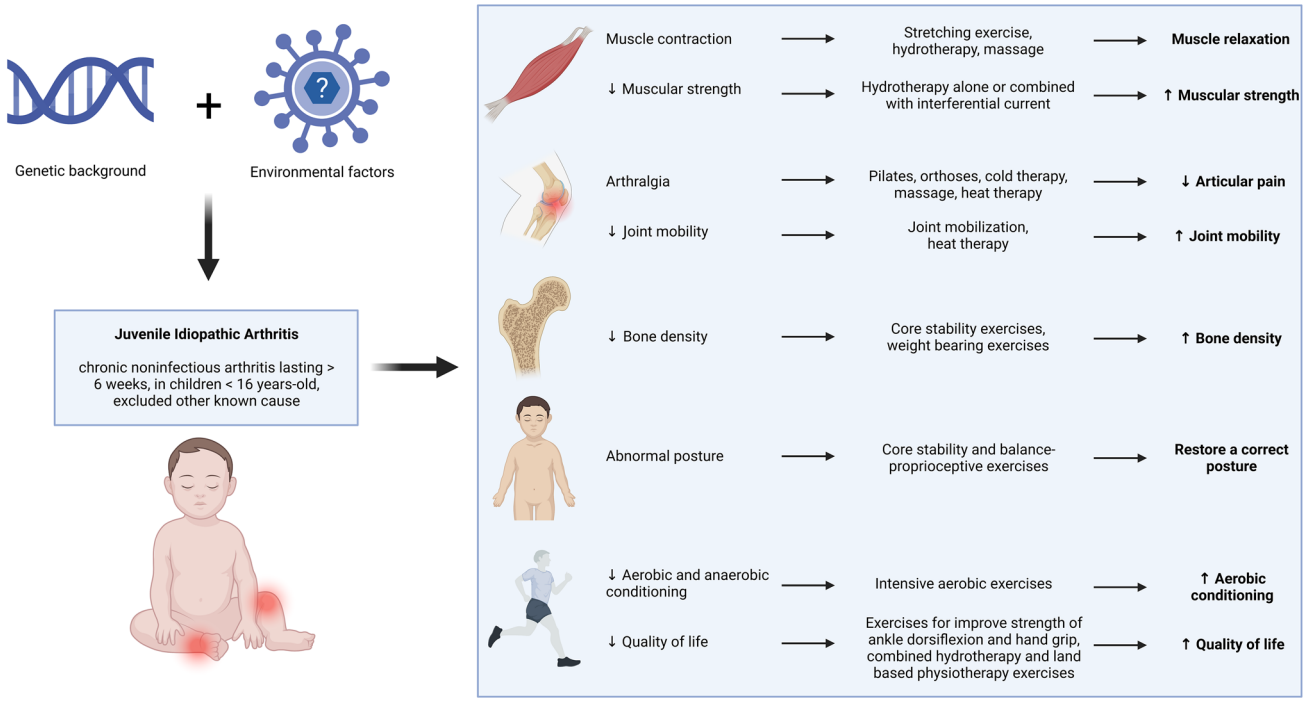

Fig. 1 Physiotherapy interventions in juvenile idiopathic arthritis

Table 2 Recommended interventions in children with juvenile idiopathic arthritis

Purpose	Recommended interventions
Muscle relaxation and pain relief	Passive-assistive movement; stabilizer splint; hydrotherapy; combined resistive underwater exercises and interferential current; weight-bearing exercises; Pilates; heat therapy (ultrasound and LASER therapy); massage
Joint mobility	Static night traction; stretching; dynamic splints; intensive aerobic exercise program; proprioceptive exercises; heat therapy
Aerobic and anaerobic conditioning	High-intensity interval training; land-based exercises alone or in combination with hydrotherapy
Muscle strength	Hydrotherapy; rope skipping; core, hip, and arm muscle building exercises; home-based exercises (jumping, handgrip, and resistance training exercises); task-oriented activity training using real-life materials and video games
Gait and posture improvement	Core stability exercises; proprioceptive-balance exercises
Increased Bone Density	Conventional physiotherapy exercises combined with core stability exercises; weight-bearing exercise program
Quality of life improvement	Plantar and dorsiflexor strength exercises; handgrip strength exercises; combined hydrotherapy and land-based physiotherapy exercises

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