JUVENILE IDIOPATHIC ARTHRITIS: EXPLORING PATIENT, PARENT, AND PHYSICAL THERAPIST PERSPECTIVES ON PHYSICAL ACTIVITY, KINESIOPHOBIA AND PHYSICAL THERAPY INTERVENTION

by

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To my loving mother, Mrs. Purnima, father, Mr. Hiralal, husband, Ashish and my sisters, Mayuri and Mahima.

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ABSTRACT

JUVENILE IDIOPATHIC ARTHRITIS: EXPLORING PATIENT, PARENT, AND PHYSICAL THERAPIST PERSPECTIVES ON PHYSICAL ACTIVITY, KINESIOPHOBIA, AND PHYSICAL THERAPY INTERVENTION

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Juvenile Idiopathic Arthritis (JIA) is the most common rheumatic condition with an unknown etiology affecting children and adolescents under the age of 16. It can lead to short-term and long-term disabilities. Despite having a low disease activity score, children with JIA often exhibit low levels of physical activity, and pain. This is a significant concern for these children. While physical therapy is well-documented to improve physical activity and function in adults with arthritis, there is insufficient evidence to support its benefits specifically for JIA. To explore physical activity, kinesiophobia and physical therapy intervention two survey-based studies were conducted: one focusing on the perspectives of parents and children, and the other on the perspectives of physical therapists. In the first study, parents reported that their children had reduced levels of physical activity, and only a few children received physical therapy. These findings confirm previous research reporting reduced physical activity in children with JIA. The parents expressed varying degrees of willingness—neutral, likely, or very likely—to consider physical therapy as a treatment option for their child. Additionally, this study is one of the few that explored kinesiophobia in these children; however, the results were inconclusive. The positive response from parents regarding the

potential of physical therapy highlights their openness to non-pharmacological management and their recognition of the potential value of physical therapy in improving their child's physical activity levels. When parents are actively involved and supportive of physical therapy, children are more likely to adhere to treatment plans and engage consistently in physical activity leading to better outcomes and long-term benefits. In the second study, physical therapists noted that their knowledge of pediatric rheumatology is limited, which affects their ability to effectively treat the patients. To address pain-related questions, therapists utilized a combination approach, considering input from both the parents/guardians and the child. Parents/guardians will be referred to as “parents” from this point forward. The PTs and PTAs used various treatment strategies to improve physical function and quality of life, including manual therapy. Early referral to physical therapy may enhance physical activity, manage pain, and improve the overall quality of life for children with JIA.

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LIST OF ABBREVIATIONS

ACR	American College of Rheumatology
ARA	American Rheumatism Association
ANA	Antinuclear Antibodies
BMD	Bone Mineral Density
CDC	Centers For Disease Control and Prevention
DMARD	Disease-Modifying Antirheumatic Drugs
EULAR	European League Against Rheumatism
FABQ	Fear Avoidance Belief questionnaire
ILAR	International League of Associations of Rheumatology
IAC	Idiopathic Arthritis of Children
JIA	Juvenile Idiopathic Arthritis
JRA	Juvenile Rheumatoid Arthritis
JCA	Juvenile Chronic Arthritis
JADAS	Juvenile Arthritis Disease Activity Score
MAS	Macrophage Activation Syndrome
NSAID	Non-Steroidal Anti-Inflammatory Drugs
OT	Occupation Therapy
PA	Physical Activity
PT	Physical Therapist
PTA	Physical Therapist Assistant
PRINTO	Pediatric Rheumatology International Trials Organization

PROMIS	Patient-Reported Outcomes Measurement Information System
pJIA	Polyarthritis
PsJIA	Psoriatic JIA
RF	Rheumatoid Factor
sJIA	Systemic Arthritis
WHO	World Health Organization

LIST OF DEFINITIONS

Juvenile idiopathic arthritis	Term used to describe all forms of childhood arthritis
Kinesiophobia	Fear of pain with movement
Physical activity	Any activity performed by the body that utilizes energy

CHAPTER ONE

INTRODUCTION

1.1: JIA defined; chronic pain

Juvenile Idiopathic Arthritis (JIA) is a term used to describe all forms of childhood arthritis. It is the most common rheumatic condition, begins before 16 years of age, and lasts for more than 6 weeks.[1] The main characteristics of JIA include fever, redness, swelling in the joints, and stiffness. Fatigue, malaise, and most importantly, pain, are also experienced.[2] Chronic pain is pain that lasts for more than 3 months. [3] Children with JIA experience neurobiological changes to pain stimuli. MRI studies detected alterations in the regions of the brain that are involved in pain processing and increased central nervous system response to pain stimuli. These changes may lead to chronic pain that persists independent of joint pathology.[2]

1.2: Physical activity (PA): definitions and recommendations

PA is defined as any activity performed by the body that utilizes energy [4] The World Health Organization (WHO) [5] and Centers for Disease Control and Prevention (CDC)[6] recommend that, children ages 3-4 years engage in functional play throughout the day that helps develop their gross and fine motor skills while children and adolescents aged 5 to 17 years should engage in 60 minutes of moderate to vigorous PA daily, and aerobic and strengthening activities at least three times a week.

1.3: JIA and reduced PA

Various studies suggest that children with JIA, regardless of whether their disease is active or inactive, have reduced PA compared to healthy peers. [4,7–10] Chronic pain and fatigue, both common in JIA, are major barriers to PA in this population. PA levels further decline with age.[8,9] There is conflicting evidence regarding the association of pain and limited PA. Some studies suggest lower PA in JIA is associated with increased swelling, inflammation, fear of pain, fatigue, and increased psychological stress.[2,7–9,11] In contrast, some studies found no correlation between lower PA, and pain or number of joints involved.[10,12,13]

1.4: Other variables that may contribute to reduced activity levels

Research has indicated that several other variables, such as fatigue, stiffness, fear avoidance, socioeconomic status, and stress may contribute to the reduced activity levels of children diagnosed with JIA. Children experiencing high levels of fatigue are less likely to participate in moderate-to-vigorous PA.[11] A study by Heale LD et al.[9] found that socioeconomic status and stress affect PA levels in children with JIA. Additionally, fear of pain may lead to avoidance behavior, which may cause disability and reduce quality of life in children with JIA.[14] Conversely, Wilson et al.[15] found a correlation between high fear avoidance beliefs with greater activity limitations, independent of pain intensity and depressive symptoms in children and adolescents with chronic pain. Despite the improvement of biologic treatments, children with JIA continue to have low PA compared to their healthy peers.[16] Tarakci E et al.,[10] found that depression is significantly related to anxiety, functional ability, and overall well-being in children and adolescents with JIA. PA limitation in JIA may be multifactorial. Currently, there is no consensus on

which symptom is most likely to limit PA. While pain may dominate in the active stage of the disease, other factors such as stiffness, fear of movement, stress, and anxiety may become more prominent during the inactive stage of the disease leading to limited PA. The first study in this dissertation explores fear of movement, which may also limit PA, although current evidence supporting this remains inconclusive.

1.5: PA and the immune system

Rochette E et al.[17] noted that PA can positively influence inflammation and immune responses in children with JIA. Moderate-intensity activity can reduce systemic inflammation and enhance immune function and joint mobility when tailored to individual conditions.[17,18] However, in this population, there is no consensus about the recommended frequency and duration of physical activities for improving quality of life, pain, fatigue, sleep, and inflammation.

1.6: Exercise recommendation

A review article by the Ottawa Panel recommends that children with JIA should perform organized exercises and activities like Pilates, cardio karate, and aquatic exercises for disease management. Home exercise programs (HEP) should include strengthening, stretching, postural, and functional exercises to enhance ability and quality of life. [19] The American College of Rheumatology (ACR) 2019 and 2021 guidelines state that the evidence to support physical therapy is low; hence, they are "conditionally recommended."[20,21]

1.7: Parent and family influences on children

Parents significantly influence their child's pain experience and functioning.[22] Some may exaggerate pain, leading to protective behaviors that can harm the child's well-being. [23–25]Wilson et al. states overprotective parental behaviors may reinforce adolescents' fear-avoidance beliefs, leading to decreased PA.[15] Psychological flexibility in children and parents fosters resilience, with pain acceptance reducing perceived pain intensity.[25] Families with minimal conflict cope better with recurrent pain. Pain treatment should address both child emotions and parental influences.[23] Parents of children with JIA see their child as more vulnerable than those with healthy children or other chronic conditions, often leading to overprotection.[26] Hence it is important to address fear-avoidance beliefs and parental responses to intervention in children with chronic pain.[15]

1.8: Referral patterns and misconceptions

There are significant deficiencies in referral patterns to ophthalmologists and physical therapists, and misconceptions among healthcare providers regarding care for children with JIA. Referral rates to specialists like physiotherapists, ophthalmologists, and orthopedic surgeons are low worldwide. However, children in non-Western countries tend to visit physiotherapists more than those in Western countries. In non-western countries, only a small number of children have access to pain, fatigue management, support groups, age-appropriate education, psychological support, and counseling. An increase in physical therapy referrals may prove beneficial to children with JIA, who show moderate to severe developmental delays. [27,28] JIA requires a multidisciplinary team for treatment. This team should consist of pediatric rheumatologists, ophthalmologists,

physical therapists (PT), occupational therapists, orthopedic surgeons, dermatologists, gastroenterologists, social workers, psychologists, and others. [29]

1.9: Pain assessment and communication

Understanding pain assessment, communication, and emotional support for children with JIA is important for improving healthcare experiences for children and adolescents. PTs believe they are best equipped to assess pain due to their skills and frequent interactions, but children are scared to share their pain levels with the PTs due to fear of exercise.[30] Rheumatologists (69.23%) are the primary contacts for children with whom they discuss pain (53.85%), while only 15.38% seek advice from physiotherapists.[31] Healthcare professionals, including pediatric rheumatologists and therapists, often lack proper training in assessing chronic pain in children with JIA. Hence, there may be a need for better pain management training. [30] Children feel disconnected during healthcare encounters, which can lead to misrepresentation of their health status.[32] Building strong relationships between children, parents, and healthcare professionals contributes to providing comprehensive care. Effective communication with PTs is important for personalized pain management. According to Lee et al. (2022),[31] the involvement of parents in pain communication with healthcare professionals was perceived differently by children and adolescents. Some expressed concern about healthcare professionals directing pain-related questions to their parents, finding it problematic, especially when they did not wish to disclose the full extent of their pain. Family support and personal commitment are necessary for achieving an active lifestyle. However, physical difficulties can hinder adherence to exercise programs, which emphasizes the need for tailored support and guidance from healthcare professionals.[33]

The first study in this dissertation examined whether children with JIA experience kinesiophobia (fear of movement) related to PA, levels of PA, and family willingness to consider physical therapy as a treatment option. Building upon the findings from the first study, the second study focused on surveying PTs to explore their treatment strategies, understanding children's pain communication, assessing therapy compliance, and identifying barriers to treatment, providing insights into the challenges healthcare professionals face in managing this condition. The findings from the first and second studies will help us understand several important aspects regarding children with JIA. To our knowledge, this was the first study to utilize the Patient-Reported Outcomes Measurement Information System (PROMIS) parent proxy to assess PA across a wider age range of children with JIA, the Fear Avoidance Belief Questionnaire (FABQ) to evaluate the fear associated with PA in these children, and to survey licensed PTs and PTAs currently practicing in Nevada, Arizona, and Utah who have treated children with JIA.

CHAPTER TWO

BACKGROUND

2.1: Global perspectives on JIA

JIA is an umbrella term used for all forms of childhood arthritis that begin before age 16, with the signs and symptoms lasting more than six weeks.[1] Classification and nomenclature of childhood arthritis have been an issue since 1800.[34] The field of pediatric rheumatology was established in 1896 after George Frederic Still published an article highlighting the need for a classification system for childhood arthritis. Nearly 50 years later, a unit for Juvenile Rheumatism was created near London in Taplow. Each country initially used different terminology for childhood arthritis.[34] In 1932, the American Rheumatism Association (ARA) was established, now known as the American College of Rheumatology (ACR). Barbara Ansell defined Still's disease in 1962 as rheumatoid arthritis that starts before the 16th birthday.[35] It is characterized by arthritis in four or more joints for at least three months, or in some cases, by specific biopsy characteristics. In 1963, a group selected by the ARA examined the potential for establishing a classification system for juvenile rheumatoid arthritis (JRA). This marked one of the initial endeavors to formally classify the condition. ARA defined the term JRA as arthritis present for at least six weeks with an onset before 16 years of age. ARA's definition did not include psoriatic arthritis and juvenile ankylosing spondylitis. ARA classified JRA into Systemic, Polyarticular and Pauciarticular.[35] Juvenile Chronic Arthritis (JCA) was first defined in 1977 at the European League Against Rheumatism (EULAR) meeting in Oslo, and it was characterized as arthritis present for more than 12 weeks. JCA was classified into Systemic, Polyarticular, JRA, Pauciarticular, and Juvenile

psoriatric.[35] The term JRA was also used in Europe to describe childhood arthritis with positive rheumatoid factor in the blood and multiple affected joints. It was initially considered distinct from juvenile chronic arthritis but was often treated as a form of it. The use of the term Still's disease started to decline over time. EULAR and ARA systems were used during the 1980s and early 1990s, but there were apparent differences between both systems. Due to classification discrepancies, a classification task force was created within the Pediatric Standing Committee of the International League Against Rheumatism. The task force was committed to proposing a new classification for idiopathic arthritis in childhood.[36] The term "Juvenile Idiopathic Arthritis" was initially proposed by the International League of Associations of Rheumatology (ILAR) in Santiago in 1994.[37] In 1995, the World Health Organization (WHO) and the ILAR proposed the term "idiopathic arthritis of children" (IAC) to replace JCA and JRA, aiming to provide internationally acceptable and applicable classification criteria for childhood arthritis. IAC refers to arthritis present for 6 weeks with onset before the 16th birthday. It comprises seven subgroups, including oligoarthritis, extended oligoarthritis, polyarthritis rheumatoid factor positive, polyarthritis rheumatoid factor negative, systemic arthritis, enthesitis-related arthritis, and psoriatic arthritis. The criteria maintain the division of four or fewer affected joints for oligoarthritis and more than four for polyarthritis, and eliminates the term "pauciarticular."[34] ILAR used the term JIA instead of IAC, JCA, and JRA.[1,38] The ILAR classification was revised in Durban in 1997, published in 1998, and revised in Edmonton in 2001.[37] According to the revised classification by ILAR, JIA is defined as arthritis that is present for six weeks before the 16th birthday and has no known cause.[34] The ILAR classification is also known as the

Durban classification. The changes in the classification made in Edmonton included the establishment of a clear definition of the category, enhancement of the consistency between inclusion and exclusion criteria, elimination of the necessity for a dermatologist to diagnose psoriasis, removal of the requirement for medical confirmation of HLA-B27, and improvement in the structural consistency.[38] Seven diseases are categorized based on their features presented in the first six months of the condition.[1] The category of oligoarthritis is split into two groups after 6 months of disease: persistent or extended oligoarthritis.[34]

2.2: Durban classification of JIA is as follows:[1]

2.2.1: Systemic arthritis (sJIA)

SJIA differs significantly from other subtypes of JIA, characterized by unique clinical features, complications, and therapeutic interventions.[39] This type of JIA does not have significant association with any specific age, gender, or HLA group.[35] It affects both boys and girls equally.[1] The typical onset of symptoms is between 1 and 5 years old, but may also present throughout childhood and adolescence.[39,40] To diagnose sJIA, there should be arthritis present accompanied by persistent fever lasting for at least 2 weeks along with at least one of the following: a erythematous rash that coincides with fever, generalized lymphadenopathy, hepatomegaly and/or splenomegaly, and serositis.[1] However, these classic features may not always be evident at the onset of the disease.[39] Children may also experience intense myalgias and abdominal pain during fever peaks. This is a symmetrical polyarticular arthritis which may not be evident at first but may develop later.[1] Some children may only have extra-articular presentation and may not develop arthritis for months.[35] The nonspecific nature of signs and symptoms overlap

with other inflammatory and non-inflammatory conditions which can complicate the diagnosis of sJIA.[39] Unlike other JIA subtypes, children with sJIA often require hospitalization for severe systemic symptoms or aggressive treatment, and they tend to experience more disease-related morbidity.[39] Laboratory findings typically include leukocytosis and thrombocytosis, elevated erythrocyte sedimentation rate (ESR) and C-reactive protein concentration, as well as microcytic anemia, which is often more severe than in other forms of arthritis.[1]

Clinical features

Fever

Children with sJIA typically present with a consistent fever pattern, characterized by spiking temperatures above 39°C once or twice a day, followed by a rapid return to normal or below baseline temperatures. Despite feeling unwell during peak fever episodes, children may appear remarkably well when the fever subsides.[35,39,41]Their temperature is monitored and recorded to effectively track the fever pattern (Fig 1). Sustained high fevers could indicate the possibility of macrophage activation syndrome (MAS) occurring at disease onset.[39]

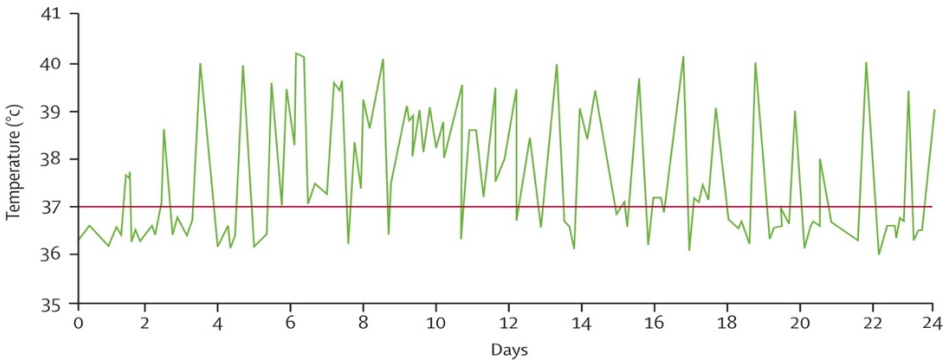


Fig 1: A 3-year-old child with sJIA with high-spiking intermittent fever. (Image from Ravelli A, Martini A. JIA. Lancet. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)

Cutaneous presentations

The rash (Fig 2) associated with sJIA appears in more than 80% of children and typically presents as a transient, salmon-colored macular or maculopapular rash. In some cases, the rash may be urticarial. This rash is a distinctive feature of sJIA as it is often only seen during episodes of fever and tends to fade as the fever resolves. The rash is commonly found on the trunk, neck, and proximal extremities, but it can also be more widespread. The macules are usually less than 5 mm in diameter, but larger ones with central fading can also occur. They are usually nonpruritic and can exhibit variable erythema within the same individual. Additionally, applying mild pressure on the skin may evoke the Koebner phenomenon, where linear maculopapular lesions appear. Stress or a warm bath may worsen the rash. The rash is rarely itchy and never purpuric.[35,39,41,42]

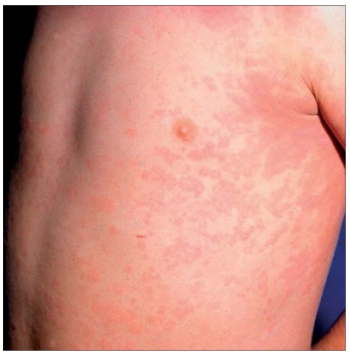


Fig 2: Rash seen in children with Systemic JIA (Image from Ravelli A, Martini A. JIA. Lancet. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)

Musculoskeletal presentation

Confirmation of the presence of arthritis is essential to meet the classification criteria. While arthralgias are usually present initially, arthritis may not be immediately present and can develop later. Many children will develop arthritis within the first 3 months of disease onset. Common joint sites include the wrists, knees, and ankles.[39,40] Before the availability of current biologics the most concerning presentation of sJIA was rapid joint destruction, loss of joint space, and erosions particularly affecting the wrists and hips. Myalgias and tenosynovitis may also occur.[40,43,44]

Other system presentation**:**

Generalized lymphadenopathy and hepatosplenomegaly are common in children with this condition. Chest pain, particularly when it is too painful to lie down, may indicate acute pericarditis, which can progress rapidly. Other less frequent symptoms include sore throat, aseptic meningitis, nasal septal perforation, pulmonary hypertension, interstitial lung disease, and pulmonary alveolar proteinosis.[39,40]

Macrophage activation syndrome

Macrophage activation syndrome (MAS) is a rare but life-threatening complication of sJIA. It is characterized by increased activation and histiophagocytosis in

the bone marrow (Fig 3). Triggers may include viral illness and certain medications.[39,45] Children with MAS are acutely ill, with symptoms such as hepatosplenomegaly, lymphadenopathy, purpura, mucosal bleeding and may have multiple organ failure. Pancytopenia, prolonged prothrombin time and partial thromboplastin time, elevated fibrin split products, high ferritin levels, and high triglycerides are common. The sedimentation rate is often low, due to low fibrinogen caused by blood clotting and liver dysfunction, which can help distinguish between macrophage activation syndrome and exacerbation of sJIA.[35,46–48] Pathogenesis of MAS is defined by an exaggerated inflammatory response resulting from an uncontrolled and dysfunctional immune reaction involving sustained activation and proliferation of T lymphocytes and macrophages. This cascade leads to the excessive secretion of proinflammatory cytokines.[49]

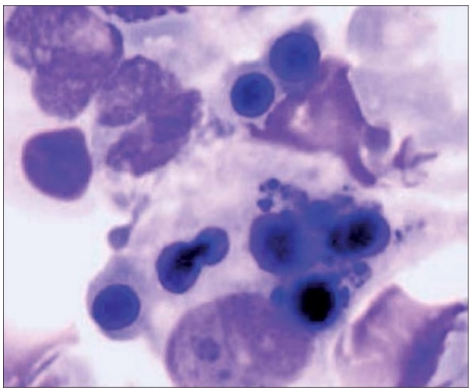


Fig 3: A bone marrow specimen of macrophage haemophagocytosis seen in systemic JIA and MAS. (Image from Ravelli A, Martini A. JIA. Lancet. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)

Laboratory investigation:

Children with systemic JIA may experience a variable disease course, with most going into remission or dormancy, although some develop chronic, destructive

polyarthritis. The disease activity period is 6 years.[35,50] Laboratory findings in active sJIA may include anemia, leukocytosis, thrombocytosis, elevated liver enzymes, and elevated acute-phase reactants.[35,51] Predictors of a poor prognosis include an age less than 6 years at diagnosis, disease duration longer than 5 years, high IgA levels, and persistent systemic symptoms. [35,52–54] Radiographic changes indicating disease progression are linked to a poor prognosis, and untreated individuals are more likely to develop amyloidosis.[35,50] The mortality rate in children with systemic JIA is less than 0.3% in North America, and most deaths are secondary to MAS, infection resulting from immunosuppression, or cardiac complications.[35,55]

The differential diagnosis of systemic JIA is challenging, especially at the onset. It includes bacterial or viral infection, malignancy, and other rheumatic diseases. A definitive diagnosis is not possible until arthritis symptoms appear following systemic features.[1]

2.2.2: Oligoarthritis

Oligoarthritis represents the most common form of JIA, constituting 40% to 50% of affected children in most studies.[56] Oligoarthritis is defined as a form of arthritis characterized by the inflammation of four or fewer joints within the initial six months of the disease.[1] Oligoarthritis is likely diverse, but most children exhibit a distinct form of JIA characterized by asymmetric arthritis, early onset (before 6 years old), a higher prevalence in females, a high frequency of positive antinuclear antibodies (ANA), and a significant risk of iridocyclitis. Iridocyclitis is a chronic, non-granulomatous, anterior uveitis that affects the iris and ciliary body and can lead to severe visual impairment.[1] According to the ILAR classification, children meeting the specified criteria are not

considered to have oligoarthritis if they have psoriasis, a family history of psoriasis, a first-degree relative with an HLA-B27 associated disease, a positive rheumatoid factor test, or if the disease occurs in a male older than 6 years.[1,38] Oligoarthritis mainly affects the lower extremities, particularly the knees and ankles (Fig 4). Around 30-50% of cases initially involve only one joint. Involvement of the wrists and ankles may indicate a risk for progression to polyarthritis.[56] Acute-phase reactant levels are usually normal or slightly increased, but in some cases, ESR levels can be quite high. Positive ANAs are found in about 70-80% of individuals and are a risk factor for iridocyclitis.[1] The prevalence of oligoarthritis is higher among children of European descent compared to other populations.[56]

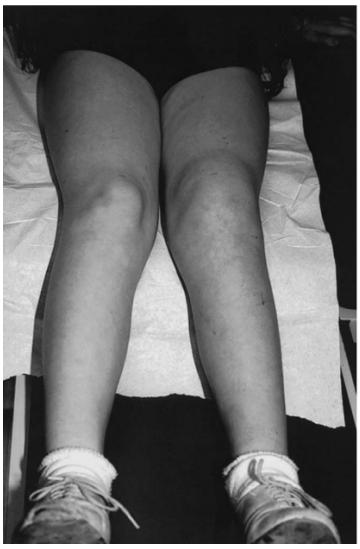


Fig 4: Swollen left knee in a child with oligoarticular JIA with quadriceps atrophy. (Image from Weiss JE, Ilowite NT. JIA. Rheum Dis Clin North Am. 2007;33(3):441-vi. doi:10.1016/j.rdc.2007.07.006 with permission)

The ILAR classification system identifies two categories within the oligoarthritis subtype. These are persistent oligoarthritis, where the disease affects four or fewer joints, and extended oligoarthritis, where arthritis involves more than four joints after the first 6

months of the disease.[1] Children with arthritis that affects 5 or more different joints within the first 6 months of the disease are not considered to have oligoarthritis.[56] Individuals identified as ANA-positive and categorized within these two groups have demonstrated a homogeneity in several clinical characteristics, encompassing age at onset, gender ratio, asymmetry of joint involvement, and frequency of iridocyclitis (Table 1). These observed similarities imply that extended oligoarthritis represents a more severe manifestation of the same disease observed in persistent oligoarthritis.[1] Iridocyclitis is a common ocular complication in oligoarthritis, affecting around 30% of children (fig 5).[1,57,58] It can be asymptomatic and is often discovered around the time of arthritis diagnosis. Children usually develop iridocyclitis within the first 5-7 years after arthritis onset.[1] Individuals with positive ANA are at the highest risk. Regular slit-lamp examinations are recommended for early detection of ocular complications.[1]

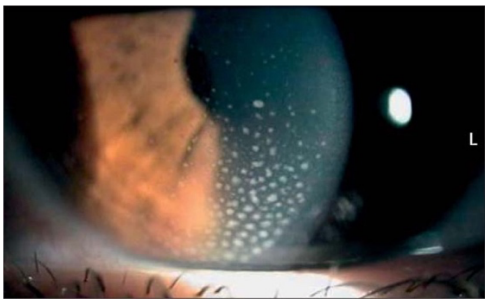


Fig 5: Iridocyclitis seen in Oligoarthritis (Image from Ravelli A, Martini A. JIA. Lancet. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)[1]

Clinical highlights of oligoarthritis and polyarthritis	
Common Features	Uncommon Features
Joint stiffness • Most pronounced in mornings • Worse with prolonged inactivity • Improves throughout the day Joint swelling Joint warmth Decreased range of motion Pain with range of motion	Joint erythema Significant pain at rest Rash Systemic features (eg, fever, weight loss) Bone pain Acute onset

Table 1: Clinical highlights of oligoarthritis and polyarthritis (Table from Crayne CB, Beukelman T. JIA: Oligoarthritis and Polyarthritis. Pediatr Clin North Am. 2018;65(4):657-674. doi:10.1016/j.pcl.2018.03.005 with permission)[56]

2.2.3: Polyarthritis

Polyarthritis represents 25% of JIA diagnoses, with 85% of individuals being Rheumatoid factor (RF) negative. (Table 1) It is characterized by arthritis in 5 or more joints within the first 6 months of disease onset. The ILAR criteria classify polyarthritis into 2 categories based on RF presence or absence due to its impact on disease manifestations and treatment response. Unlike oligoarthritis, active polyarthritis may manifest with systemic symptoms such as fatigue and weight loss.[1,38,56]

Rheumatoid factor (RF)-positive polyarthritis

The prevalence of this category is quite low, with occurrence in less than 5% of children with JIA in most published cohorts.[56] RF-positive polyarthritis is characterized by the presence of Immunoglobulin M (IgM) RF and affects five or more joints within the first 6 months of disease onset. It mainly affects adolescent girls and shares

similarities with adult RF-positive rheumatoid arthritis,[1] and exhibits distinct disease phenotypes in children due to their ongoing skeletal development.[1] The typical presentation includes symmetrical polyarthritis affecting small joints, with the potential involvement of large joints.[1,56] Articular disease frequently leads to erosion of the adjacent bone, resulting in considerable morbidity if not promptly managed.[56] The temporomandibular joint (TMJ) and cervical spine can both be significant factors contributing to morbidity.[56,59] Rheumatoid nodules manifest in about a third of children in the first year of the disease, and severe extraarticular manifestations that include aortic regurgitation that requires aortic valve replacements are rare.[1,60] Some children with oligoarticular-onset asymmetric JIA have elevated and persistent levels of RF, and have shown signs of early erosive disease. It is unclear whether this subset of individuals belongs to polyarticular seropositive JIA or represents a separate entity.[1]

Rheumatoid factor negative polyarthritis

RF-negative polyarthritis is characterized by arthritis affecting five or more joints within the first 6 months of the disease in the absence of IgM RF. This type of arthritis is less clearly defined than RF-positive polyarthritis and is likely the most diverse subtype.[1] RF-negative polyarthritis has three distinct subsets.[1]

i. The first subset closely resembles early-onset oligoarticular JIA but with differences in the number of affected joints in the initial 6 months of the disease. It shares similarities such as asymmetric arthritis, early age at onset, higher prevalence in females, frequent positive ANAs, increased risk of iridocyclitis, and association with HLA-DRB1*0801 (HLA gene variation), leading to the belief that this subset and early-onset oligoarthritis are the same disease. ANA-positive

oligoarthritis and ANA-positive RF-negative polyarthritis share similar clinical features but differ from ANA-negative RF-negative polyarthritis.[1,61]

ii. The second subset of RF-negative polyarthritis closely resembles adult-onset RF-negative rheumatoid arthritis. It is characterized by evident symmetric synovitis affecting both large and small joints that typically begins during school age. Children may exhibit an elevated ESR, negative ANA, and the disease outcome can be variable.[1]

iii. The third subset is known as dry synovitis, presenting with minimal joint swelling, accompanied by stiffness, flexion contractures, and normal or slightly elevated erythrocyte sedimentation rate (ESR).[1,62] It is often unresponsive to treatment and can follow a destructive course.[1]

RF-negative polyarthritis primarily involves the joints and may be accompanied by chronic anterior uveitis in about 14% of cases. A positive ANA may increase the risk of uveitis. TMJ involvement is common, especially in RF-negative cases. Onset can occur at any age before 16, but often presents in early childhood or adolescence, predominantly in females. [56,63]

2.2.4: Enthesitis-related arthritis

Enthesitis-related arthritis predominantly affects males above the age of 6 and is distinguished by the concurrent occurrence of enthesitis and arthritis.[1] It is typically mild and follows a remitting course. It affects four or fewer joints in about half of individuals.[1] Enthesitis refers to the inflammatory condition occurring at the attachment sites of tendons, ligaments, or joint capsules to the bone. It is distinguished by tenderness, warmth, and swelling. The disease is characterized by pain, stiffness, and eventual loss of

back mobility.[35] Predominantly manifesting in the lower extremities, enthesitis in children with enthesitis-related arthritis commonly localizes at the iliac crest, posterior and anterior superior iliac spine, femoral greater trochanter, ischial tuberosity, patella, tibial tuberosity, Achilles tendon, and plantar fascia insertions.[64] Enthesitis-related arthritis should be considered in children with chronic arthritis of the axial and peripheral skeleton, enthesitis, and negative RF and ANA. Peripheral arthritis usually precedes axial involvement, and sacroiliac joint arthritis may develop over time presenting clinical manifestations consistent with ankylosing spondylitis.[35] Some children develop ankylosing spondylitis within 10 to 15 years of disease onset.[64] A strong genetic predisposition is indicated by positive family history and the high presence of HLA-B27 in affected children.[35] In children, extra-axial symptoms are more frequent, and the condition falls under spondyloarthropathies, including juvenile ankylosing spondylitis and undifferentiated spondyloarthritides. This encompasses isolated peripheral arthritis, enthesitis, tendonitis, dactylitis, and what was formerly known as seronegative enthesitis and arthritis syndrome.[1] The ILAR criteria for enthesitis-related arthritis have been criticized for excluding psoriatic and reactive arthritis from juvenile spondyloarthritides and for narrowly defining arthritis associated with inflammatory bowel disease.[1] Arthropathy in inflammatory bowel disease can be challenging to diagnose, as it may precede other manifestations of the disease.[35] Clinical indicators suggestive of the diagnosis encompass gastrointestinal manifestations, unexplained weight loss or failure to thrive, and mucocutaneous anomalies such as erythema nodosum, aphthous stomatitis, and pyoderma gangrenosum. Inflammatory disease-related arthritis exists in two distinct forms. The first form, characterized by acute polyarticular symptoms, usually reflects the

activity of the bowel disease; typically, arthritis improves when the gastrointestinal disease is inactive. In the second form, more commonly seen in ERA, the arthritis develops independently of the bowel disease.[35] Additional manifestations may include anterior uveitis, aortic insufficiency, aortitis, muscle weakness, and low-grade fever. Acute uveitis, distinct from the chronic form in oligo- and polyarticular disease, may develop in up to 27% of children. It typically presents as a red, painful, light-sensitive eye, often without lasting effects.[35,47] Radiographic findings indicative of sacroiliac joint pathology encompass joint space narrowing, erosions, sclerosis, pelvic osteoporosis, and eventual fusion, which is typically observed in the advanced stages of the disease.[35,65] Laboratory findings may reveal mild anemia, a white blood cell count within the normal to moderately elevated range, as well as thrombocytosis and an elevated sedimentation rate.[35,65,66]

2.2.5: Psoriatic arthritis:

Psoriatic Arthritis is a form of chronic inflammatory arthritis characterized by an onset typically occurring in mid-childhood.[35] The guidelines for diagnosing juvenile psoriatic arthritis, as per ILAR criteria, dictate that both arthritis and a typical psoriatic rash must be present simultaneously. In the absence of a rash, the diagnosis necessitates the presence of arthritis and at least two of the following: a family history of psoriasis in a first-degree relative, dactylitis (fig 6) (swelling of fingers extending beyond the joint margins, sausage-like fingers), nail changes (including pitting, onycholysis, oil-drop sign) and uveitis.[1,35,67] Inflammation commonly affects the proximal and distal interphalangeal joints, knees, ankles, and the associated tendon sheath.[35,67] The precise delineation of juvenile psoriatic arthritis remains a subject of controversy.[1] Diagnosing psoriatic

arthritis can be challenging as the arthritis symptoms often manifest years before the appearance of the associated rash.[35] Approximately one third of individuals diagnosed with psoriasis will experience the characteristic rash by the age of 15.[35,68] Up to 17% of children may have asymptomatic anterior uveitis.[35,69] Psoriatic arthritis is further divided into 2 groups. The first subgroup exhibits striking similarities to oligoarticular JIA, predominantly affecting young girls who test positive for ANA. These individuals face a heightened risk of developing asymptomatic anterior uveitis but may also experience dactylitis and involvement of small joints, distinguishing this subgroup from typical oligoarticular JIA presentations.[64] The second subgroup mirrors enthesitis-related arthritis (ERA) and is prevalent in older children and adolescents, predominantly boys, with a heightened susceptibility to spondyloarthritis.[64,70,71] Psoriasis and arthritis may not occur at the same time, and arthritis may develop many years before psoriasis. In children, psoriasis may be subtle and require a thorough examination. It can affect the extensor surfaces in the limbs, scalp, posterior auricular, axilla, umbilicus, or gluteal fold.[64] The laboratory findings reveal elevated acute-phase reactants, anemia consistent with chronic disease, and thrombocytosis. with the possibility of a positive result for ANA.[35]

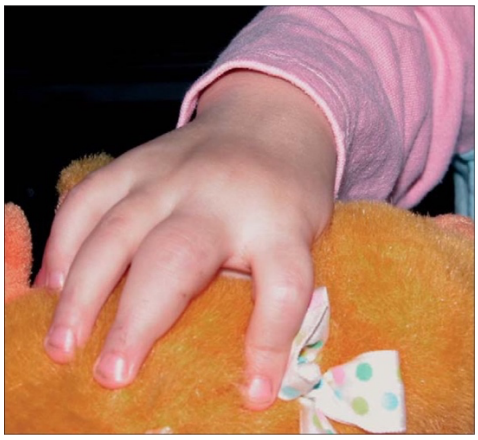


Fig 6: Dactylitis in a child with psoriatic arthritis (Image from Ravelli A, Martini A. JIA. *Lancet*. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)[1]

2.2.6: Undifferentiated arthritis

Undifferentiated arthritis does not constitute a distinct subset; rather, it encompasses children who do not meet the inclusion criteria for any specific category or who meet the criteria for more than one category. Notably, research indicates that several individuals with no clear diagnosis may be classified within this category.[1,72,73] Various recommendations have been proposed to amend the exclusion criteria with the aim of reducing the number of individuals classified as such.[1,72–74] Some of these proposals have been integrated into the second revision of the ILAR criteria.[1]

2.3: Complexities associated with JIA.

2.3.1:Uveitis

JIA is associated with a significant complication known as anterior uveitis, which is a chronic nongranulomatous inflammation of the anterior chamber of the eye involving the iris and ciliary body.[64] It occurs in up to 21% of children oligoarticular JIA and 10% of children polyarticular JIA.[35,75] Uveitis is typically asymptomatic, but can present with

symptoms such as conjunctivitis, unequal pupils, eye pain, and headache.[31] The risk of developing uveitis in JIA is influenced by the JIA subtype, age at disease onset, and ANA status. The demographic most susceptible to uveitis are female individuals with oligoarticular JIA, ANA-positive test results and under 4 years of age. Uveitis disease activity does not necessarily correlate with the course of arthritis.[64] The management of uveitis is provided by an ophthalmologist or optometrist, in collaboration with a pediatrician or pediatric rheumatologist.[64] Uveitis is typically treated with corticosteroid eye drops and a pupil-dilating medication. In some cases, corticosteroids may need to be taken orally, injected around the eye, or administered intravenously to reduce inflammation and prevent posterior synechiae. Children with severe uveitis may also need additional medications like methotrexate, cyclosporine A, and a sub-tenon injection of steroids or biologic agents such as infliximab and etanercept have been shown to be beneficial in treating refractory uveitis in children and adults.[35,64,76–78] Complications of uveitis include band keratopathy, cataracts (occurring in 42%–58% of individuals), glaucoma (19%–22% of individuals),[64,76] posterior synechiae, and visual impairment (up to 30% of cases).[35,79] A study conducted over a period of 1 to 5 years which included children with JIA found that in those with oligoarticular arthritis, 13% had uveitis, with 4% experiencing vision loss in one eye and 17% suffering some vision loss in both eyes. In children with polyarticular arthritis, 5% had uveitis, and 17% experienced vision loss. No individuals with sJIA were diagnosed with uveitis.[35,80]

2.3.2: Nutritional impairments

Children with rheumatic diseases often experience nutritional impairments, with studies indicating that their caloric intake falls significantly below their estimated

needs.[35] Those with JIA may also exhibit changes in body composition, including decreased lean muscle mass and increased fat mass, along with heightened resting energy expenditure, particularly in children with systemic-onset JIA.[35,81–83] These effects are associated with elevated levels of certain inflammatory markers.[35,84] It is important for pediatricians to follow dietary guidelines tailored for healthy children based on sex and age, rather than relying solely on actual weight, and to involve a dietician or nutritionist in cases of significant malnutrition.[35,83]

2.3.3: Growth alteration

Children with JIA frequently experience generalized growth retardation and delayed puberty.[35] Children with chronic active disease, especially children with polyarticular or sJIA, may experience linear or localized growth disturbance. Multiple factors contribute to poor linear growth in children with JIA.[35,64] Chronic inflammation and high levels of proinflammatory cytokines in the bloodstream can slow down growth by affecting the growth plate and reducing the effects of insulin-like growth factor 1 (IGF-1).[64,85–87] Children with sJIA and long-term polyarticular disease are at high risk for reduced linear growth, which is an undesirable and permanent outcome.[35,82,83,88] The occurrence of severe growth restriction has diminished, possibly due to the implementation of immunomodulatory therapy employing disease-modifying antirheumatic drugs (DMARDs) and biologic agents.[64] Growth hormone is administered in instances of significant growth retardation. The presence of inflammation at the ossification center can lead to accelerated growth, causing limb length discrepancy in which the affected limb grows longer than the unaffected limb. In the later course of the disease, premature fusion of the growth plates due to persistent inflammation may lead to

limb shortening on the affected side.[64] TMJ arthritis can lead to issues like micrognathia, hypoplasia, and asymmetry. Early diagnosis of TMJ involvement is important for individuals experiencing symptoms such as jaw pain, jaw deviation, or limited jaw opening. Joint and mandibular condyle destruction can cause growth retardation at the TMJ, while reduced masseter muscle development due to pain may also be a contributing factor in TMJ disease.[64]

2.3.4: Bone density

Children with JIA are at an increased risk for osteopenia and osteoporosis due to the disease itself and corticosteroid treatment. Both conditions lead to decreased bone mineral density (BMD) and an increased risk of fractures. Low BMD in children with JIA has been associated with factors such as severe chronic active disease, persistent inflammation, inadequate sunlight exposure, corticosteroid treatment, younger age, lower body mass index, decreased intake of calcium and vitamin D, and decreased physical activity.[35,64,89] Inflammation plays a significant role in impacting the balance between osteoclasts and osteoblasts in bone remodeling and homeostasis.[90] In the inflammatory state associated with arthritis, there are increased levels of TNF-a, IL-1b, and IL-6. These elevated levels promote the production of osteoclasts and inhibit the differentiation of osteoblasts, which leads to increased bone resorption and the development of osteopenia/osteoporosis.[90–93] Cholecalciferol, also known as vitamin D3, is essential for bone health. It is synthesized in the skin through UV-B radiation. Its deficiency can lead to osteoporosis and affect calcium, parathyroid hormone, and blood phosphorus levels. Vitamin D impacts both the innate and acquired immunity.[63,90,94–96] Increased immune activation is linked to a deficiency in vitamin D.[90] In children with autoimmune disease,

joint mobility limitations and reduced energy due to inflammation may lead to osteopenia.[63] Glucocorticoid treatment increases the risk of avascular necrosis of bone, often leading to femoral head collapse, loss of the normal articular surface, pain, and the need for hip replacement.[90] The use of appropriate caloric and calcium intake, optimal management of inflammatory disease, promotion of weight-bearing exercise, minimal use of steroids, and promotion of physical activity are important for managing these complications. Supplementation with calcium and vitamin D is recommended for individuals receiving oral corticosteroid treatment. Bisphosphonates can be considered for individuals who develop osteoporosis, but there are concerns about their safety in children.[35]

2.4: Towards new classification

The initial ILAR classification and its subsequent revisions have been widely embraced by physicians and researchers around the globe. Nevertheless, they have also been subject to various criticisms. Some of these criticisms include the arbitrary selection of age at disease onset, the duration of disease required to define a category, the number of inflamed joints that define oligoarticular and polyarticular categories, and the reliance on clinical rather than ultrasound or MRI definitions of joint inflammation. Additionally, there are criticisms that are specific to particular categories.[36]

The six new categories for JIA, as proposed by the Pediatric Rheumatology International Trials Organization (PRINTO), align well with the overall understanding of the condition. According to these criteria, JIA encompasses a range of inflammatory disorders that begin before the age of 18 and persist for at least 6 weeks, diagnosed after ruling out other known conditions. These categories include "systemic JIA," which is

thought to be equivalent to adult-onset Still's disease, "RF-positive JIA," which is considered comparable to seropositive RA, "enthesitis/spondylitis-related JIA," which is equated to undifferentiated spondyloarthropathy (SpA), and "early-onset ANA-positive JIA," a form distinct to children and not found in adults. The new criteria maintain categories for "other JIA" for forms that do not fit the criteria for the other categories, and "unclassified JIA" for forms that meet the criteria for more than one category. Formal validation of these criteria is ongoing, and further studies will contribute to a more precise classification of childhood arthritis in the future.[36,97] A significant number of individuals with arthritis may not fit into the proposed PRINTO JIA criteria. It is necessary to refine the criteria, develop additional disorders within the PRINTO JIA classification system, and validate the criteria in different populations. Currently, it seems that the ILAR JIA classification system is more aligned with the clinical subtypes compared to the PRINTO JIA classification system.[98]

2.5: Epidemiology/incidence/prevalence

JIA can cause short-term and long-term disability and is considered the most common chronic rheumatic disease in children. The estimated global incidence rates span from 1.6 to 23, and the prevalence varies from 3.8/100,000 to 400/100,000. In the United States, the estimated incidence exceeds 14 children per 100,000, and a prevalence of 305 children/100,000 in the US during 2017-2021 (approx. 220,000 children and adolescents).[90,99–101102] Worldwide prevalence rates vary more than incidence rates. This may be due to differences in access to rheumatologists and variations in study designs for data collection and reporting.[103] Higher prevalence is observed among females compared to males, with a ratio of 0.57:1 male-to-female.[99] However, this pattern is not observed in

all subtypes; for example, in enthesitis related arthritis, males have a higher risk compared to females.[104] The incidence rate of JIA in caucasian children is 8.3 per 100,000.[99,103] The distribution of JIA subtypes varies depending on geographic location and ethnic background.

In Western countries, oligoarthritis is the most common subtype, while polyarthritis is predominant in Costa Rica, India, New Zealand, and South Africa. Systemic arthritis has a higher prevalence in Asia, and enthesitis-related arthritis is more frequent in India, Mexico, and Canada due to the high frequency of the human leukocyte antigen (HLA)-B27 in these populations. Rheumatoid factor (RF)-positive polyarthritis is less commonly observed.[105]

2.6: Etiology

The etiology of JIA is not yet fully understood. The disease is characterized by synovial inflammation and joint tissue destruction.[106,107] The complexity of the disease indicates that genetics, environmental factors, and infectious agents all likely contribute to its pathophysiology and origin.[108–110]

2.6.1: Genetics

Genetics accounts for up to a third of the risk of developing JIA. [103,111,112] There is a significant prevalence of JIA among monozygotic twins[113,114] and individuals with a strong family history of autoimmune disease, particularly psoriatic JIA and enthesitis related arthritis.[103] There are studies that indicate that siblings and first cousins of affected individuals are at a higher risk of developing JIA.[113,114] The HLA region on chromosome 6 contains common genetic risk alleles, such as HLA-A, HLA-B (especially HLA-B27), and Class II genes.[103] While HLA associations are important in

understanding subtypes, disease course, and clinical outcomes, they only explain a small portion of JIA susceptibility.[103,112,115,116] Additionally, genes outside of the HLA, such as PTPN22 and CTLA4, as well as genes coding for cytokines like IL-1, IL-2, IL-6, and anti-TNF, are associated with JIA.[103,116–119]

2.6.2: Environmental factors

There are many studies that have explored the risk of prenatal environment as a possibility of developing JIA,[103] but there are not enough studies to support it. A case-control study done in Sweden found no link between maternal age, birth weight, and the risk of JIA.[103,120] Studies have found a connection between smoking and rheumatoid arthritis due to increased production of citrullinated proteins, but there is no established association between maternal smoking and its risk of JIA in their children.[103,120,121] There is no evidence to link passive smoking and JIA postnatally.[122] High levels of air pollution was reported to increase the risk of JIA but the findings have not been consistent.[103,122-124]

Breast milk contains immune components that help establish a specific microbiome in the digestive system which may play a protective role in predisposing the development of JIA.[103,125] There are conflicting results regarding the risk of JIA. Studies in UK have found that children who are breast-fed were more likely to develop JIA at a younger age but have lower disease severity markers.[103,126] The relationship between breastfeeding and JIA risk is currently unclear.[121,125,127–129] Additionally, social deprivation, which includes factors such as living conditions, working standards, tobacco smoking, reduced breast feeding, and family size, are predictors of poor health.[103,130–134]

2.6.3: Infectious agents

The link between infections and JIA is complex and still unclear. Various viral and bacterial infections can trigger JIA development or flare-ups. Various studies indicate that in genetically predisposed individuals, infections may initiate or exacerbate JIA through mechanisms like molecular mimicry or immune system activation. Infectious agents that may provoke JIA are viruses such as Epstein-Barr virus and parvovirus B, rubivirus, hepatitis B virus, and bacteria like Salmonella, Shigella, Campylobacter, M pneumoniae, and Streptococcus pyogenes. However, studies have yielded mixed results, and the precise role of these pathogens is still being explored.[106,109,135]

2.6.4: Antibiotic treatments

Various studies in this area are observational and cannot provide definitive evidence. The risk of JIA was found to be highest within one year of antibiotic exposure. Children with JIA are more likely to have received prior antibiotics, especially multiple courses and clindamycin, which significantly alter the gut microbiome. There has been a potential link between antibiotic use and JIA, but the relationship is still unclear.[109]

2.6.5: Cesarean section delivery

Studies have found that elective C-sections can increase the risk of developing JIA due to alterations in neonatal immunity, characterized by reduced circulating cytokine levels, diminished leukocyte responsiveness, and decreased gut microbial diversity. The relationship between C-sections and JIA is still unclear.[109]

2.7: Pathophysiology/pathogenesis

Genetics plays a significant role in various subtypes of JIA. JIA involves an abnormal activation of various immune cells, from T and B cells to macrophages and

neutrophils, causing a release of pro-inflammatory mediators that cause the destruction of joints and sometimes the entire body. This dysregulation manifests differently across JIA subtypes. For example, enthesitis-related arthritis, linked to HLA-B27, is associated with inflammation in the axial skeleton. Oligoarticular and polyarticular JIA are driven by specific immune cells (T-cells) and antibodies that mistakenly attack the joints. A particular gene type (HLA class II) is often involved, and a protein called IL-17 causes much joint damage. In systemic JIA, there is an overreaction of the body's initial immune defenses, leading to a flood of inflammatory chemicals (cytokines like IL-1, IL-6, and IL-18) throughout the body. HLA class I and II alleles play an important role in shaping the disease's trajectory.[106,108]

2.8: Clinical outcome measures in JIA

It is important to measure disease activity levels to provide effective therapeutic interventions. The Juvenile Arthritis Disease Activity Score (JADAS) was the first composite disease activity tool developed in 2009. It has good construct validity and high reliability. It includes the following four measures: physician's global assessment of disease activity, parent's global assessment of well-being measured using a visual analog scale (VAS) where 0= no activity and 10= maximum activity; and parent assessment as 0= very well and 10= very poor; the erythrocyte sedimentation rate (ESR); and a count of joints with active disease. The three types of JADAS are JADAS10, JADAS27 and JADAS71. JADAS10 measures activity in up to 10 active joints with a maximum score of 40; JADAS27 includes 27 selected joints, with a maximum score of 57; and JADAS71 includes all possible joints (up to 71), with a maximum score of 101. There are two variants of JADAS: JADAS-CRP, which uses C-reactive protein (CRP) instead of ESR

with similar scoring ranges, and cJADAS, a clinical version that excludes CRP/ESR levels, making it more feasible for routine clinical practice. Disease activity is classified as inactive, low, moderate, or high based on the JADAS score. The disease is classified inactive when there is a total absence of signs and symptoms in the joints, no systemic manifestation, no active uveitis, normal CRP/ESR levels, and the physician's global assessment indicates no activity. Low disease activity is defined as a score of JADAS10 (1.1-2), JADAS27 (1.1-2), cJADAS10 (1.1-1.5); moderate disease activity is defined as a score of JADAS10 (2.1-4.2), JADAS27 (2.1-4.2), cJADAS10 (1.51-4) and high disease activity is defined as a score of JADAS10 (>4.2), JADAS27 (>4.2), cJADAS10 (>4).[136]

2.9: Medical treatment

Treatment of JIA typically follows a stepwise approach, beginning with non-steroidal anti-inflammatory drugs (NSAIDs) to manage pain and inflammation through cyclooxygenase inhibition.[137] When NSAIDs prove insufficient, intra-articular corticosteroids are often employed, particularly in oligoarthritis, while systemic corticosteroids are reserved for short-term management of severe symptoms, notably in sJIA, due to their potential for long-term adverse effects. DMARDs, especially methotrexate, are recommended early as the first-line option for oligo- and pJIA. For progressive cases, or children who do not respond to the first line treatment option, particularly in psoriatic JIA (PsJIA) and those with axial involvement, biological agents such as TNF-alpha inhibitors (etanercept, adalimumab) are highly effective, often in combination with methotrexate. In cases that do not respond to TNF-alpha inhibitors, abatacept or IL-6 receptor inhibitors like tocilizumab they are offered alternative pathways. Tocilizumab is also a primary treatment for sJIA, while IL-1 inhibitors

(anakinra, canakinumab) are effective in sJIA and macrophage activation syndrome (MAS). Early, aggressive intervention with biologics is important to achieve disease control and reduce the use of steroids.[137]

2.10: Remission

There has been a lot of progress in treating JIA over the last three decades. Clinical outcomes and the possibility of disease control and remission have improved for most children with JIA. However, many children still experience ongoing disease activity, with about half requiring active treatment into adulthood and only 20–25% achieving complete remission.[106,138,139] The introduction of biological agents has reduced JIA mortality rates from 1–4% in the 1970s to 0.3–1% in 2016, and physical disability has decreased.[106,107] Remission rates increase with disease duration, but less than 50% of individuals achieve drug-free remission after 10 years, with rates varying by disease subtype: oligoarticular JIA has the highest remission rate (~50%), while polyarticular JIA has the lowest (~15%). Long-term studies show that 59% of children achieve clinical remission off medication, 7% on medication, and 34% have active disease after 30 years.[103,139–142] Remission estimates vary due to differing outcome definitions, including the inclusion or exclusion of parent-reported assessments. The disease process is considered in remission with medication if children meet inactive disease criteria for at least six months while on treatment. Remission without medication is defined as maintaining inactive disease for at least 12 months after discontinuing treatment.

Despite medical advances, 14% of individuals still experience severe joint destruction that requires surgical intervention.[106,143] Hence, it is important to start aggressive treatment early. Systemic manifestations, such as MAS, impact outcomes,

with an 8% fatality rate in severe cases. JIA-associated uveitis, the most frequent extra-articular manifestation, remains a leading cause of childhood vision loss, with half of affected individuals continuing to experience active uveitis in adulthood.[106,144] Additionally, even in remission, individuals with JIA have a higher risk of osteoporosis and fractures in early adulthood.[145] Long-term outcomes vary by JIA subtype and disease activity, with about half of individuals having active disease and 30% experiencing some form of disability in early adulthood. While there is a 59% remission rate after 30 years, many adults with JIA have a reduced quality of life. Comorbidities and complications highlight JIA as a lifelong condition characterized by remissions and flares, leading to connective tissue impairment and reduced quality of life.[106]

In summary, JIA is the most common rheumatic condition affecting children and adolescents under 16 years of age. It is characterized by symptoms such as fever, pain, swelling, and reduced range of motion for a duration of at least six weeks. There are seven types of JIA, with oligoarthritis being the most common form, particularly affecting females more than males. The etiology of JIA is unknown, and various factors can influence its pathophysiology. However, advancements in pharmacological management have significantly improved the outcomes for children and adolescents with JIA.

CHAPTER THREE

PHYSICAL ACTIVITY, KINESIOPHOBIA, AND AWARENESS OF PHYSICAL THERAPY IN PARENTS AND THEIR CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS

3.1: Introduction

Juvenile Idiopathic Arthritis (JIA) refers to a group of childhood arthritic conditions that begin before the age of 16 and last for at least 6 weeks.[1,38] The International League of Associations for Rheumatology (ILAR) classified JIA into seven categories (Table 2). Each category has distinct clinical presentations, signs, and symptoms.

	Frequency*	Onset age	Sex ratio
Systemic arthritis	4–17%	Throughout childhood	F=M
Oligoarthritis	27–56%	Early childhood; peak at 2–4 years	F>>>M
Rheumatoid-factor-positive polyarthritis	2–7%	Late childhood or adolescence	F>>M
Rheumatoid-factor-negative polyarthritis	11–28%	Biphasic distribution; early peak at 2–4 years and later peak at 6–12 years	F>>M
Enthesitis-related arthritis	3–11%	Late childhood or adolescence	M>>F
Psoriatic arthritis	2–11%	Biphasic distribution; early peak at 2–4 years and later peak at 9–11 years	F>M
Undifferentiated arthritis	11–21%	..	..

*Reported frequencies refer to percentage of all juvenile idiopathic arthritis.

Table 2: Types of JIA (from Ravelli A, Martini A. Juvenile idiopathic arthritis. *Lancet*. 2007;369(9563):767-778. doi:10.1016/S0140-6736(07)60363-8 with permission)[1]

JIA is characterized by chronic joint pain, swelling, and limited range of motion.[146] It is the most common chronic rheumatic condition in children.[147] The National Survey of Children's Health (NSCH) reported the prevalence of arthritis among U.S. children and adolescents from 2017 to 2021 to be approximately 220,000, resulting in a prevalence rate of about 305 cases per 100,000.[102] The exact cause and pathogenesis

of JIA remains unclear. Different types of JIA exhibit various clinical and laboratory findings that may be triggered by environmental factors and genetics, indicating distinct immunogenic processes.[64]

Several studies report that children with JIA are less physically active compared to their peers.[7,105,148] Reduced mobility can lead to muscle weakness, decreased flexibility, diminished cardiovascular reserve, and lower exercise capacity.[105,149] Children with JIA often have low bone mineral density (BMD), linked to factors like severe chronic disease, persistent inflammation, corticosteroid treatment, younger age, and decreased physical activity.[35,64,89] They tend to spend less time engaged in lower-level physical activities and significantly less time participating in moderate to vigorous physical activities. Instead, they often spend more time in sedentary activities, despite encouragement to be active. As a result, these children risk losing the benefits associated with regular physical activity (PA).[13,16,150,151]

Active disease, involvement of multiple joints, and increased severity of disease activity may contribute to reduced PA levels. However, even when the disease is not in an acute stage and without the presence of synovitis or flexion contractures, children with JIA still engage in fewer physical activities and experience difficulties with physical functioning compared to their peers.[151,152] Children with JIA have been observed to spend more time sleeping and sitting than typically developing peers.[13,153]

Pain is the most common complaint among children with JIA, significantly affecting quality of life.[8] Emotional and behavioral responses can exacerbate chronic pain in children. Children with JIA often experience kinesiophobia (pain related fear of movement) and have lower self-reported and performance-based scores in mobility and

body weight transfer.[146] In addition to reduced PA, fear of pain can lead to avoidance behaviors and limited social interaction.[154]

The most common musculoskeletal complications of JIA are leg-length discrepancies and joint contractures. Due to the addition of biologics to pharmacological management, the need for surgical treatments has become rare in childhood. Clinical outcomes for children with JIA have significantly improved. Surgical intervention may still be necessary in severe cases or when there is a delay in beginning the medical care that could stabilize the condition.[11,147,155]

Di Ludovico et al. stated that physical therapy plays an important role in the comprehensive care of children and adolescents with JIA. It helps improve joint function, strengthen muscles, alleviate pain, and improve physical fitness and overall quality of life.[156] In contrast, the American College of Rheumatology guidelines for the treatment of JIA[21] suggested there is inadequate evidence supporting the importance of physical therapy in children and adolescents with JIA who have or are at risk of functional limitation, hence physical therapy is "conditionally recommended".[20,21] To date, no survey-based studies have been found that focus on kinesiophobia, PA levels and physical therapy awareness in children and adolescents with JIA and their families.

Therefore, this study aims to explore whether children diagnosed with JIA experience kinesiophobia related to PA and physical function, assess their levels of PA, and the willingness of families to consider physical therapy as a treatment option for their child.

3.2: Methods

3.2.1: Study development

The study was a paper-based, cross-sectional survey conducted at Kids Arthritis Care-Juvenile Arthritis and Rheumatology Care and Research Center in Nevada. The study was approved by the Oakland University Institutional Review Board and permission was obtained from the clinic owner. At the time of data collection, this clinic was the only facility in Nevada that offered medical care to children with rheumatologic conditions. The clinic has children of Hispanic ethnicity, so survey questions were created in both English and Spanish. The survey consisted of 26 questions; 15 demographics (age, gender, JIA diagnosis, types of treatments received); the Patient-Reported Outcomes Measurement Information System (PROMIS) Parent Proxy Short Form v1.0—PA 8a; the PA subset of the Fear Avoidance Belief questionnaire (FABQ) scale; and two open-ended questions that focused on PA participation and exercises. Males and females ages 3 to 16 years with a physician diagnosis of JIA and their parents were invited to participate. Individuals with no physician diagnosis of JIA, less than 3 years of age, or more than 16 years of age were excluded from the study. Parent(s) or guardian(s) completed a consent form to participate and gave permission for their child to participate. Children under seven years of age gave oral assent to participate; parents were advised to read the assent form to their child, before signing the assent on behalf of their child. Children aged 8 to 16 were provided with an assent form to read and sign themselves.

3.2.2: PA levels and fear of pain measurement:

The 8-question PROMIS Parent Proxy PA-Short Form 8a v1.0 includes questions about the child's PA from the parent's perspective, focusing on short bouts (10 minutes) of activity. It shows moderate construct and content validity; excellent reliability over 0.90 for full-item banks and short forms.[157] PROMIS computer adaptive tests for mobility and fatigue correlate significantly with disease activity in JIA,[158] confirming its validity and reliability in assessing children's PA experiences.

The FABQ PA subset was used to assess fear and belief of pain with PA. It is primarily utilized for fear and avoidance of PA with lower back pain. The word "low back" was replaced with "joints" for the purpose of this study. The FABQ-PA subscale has good validity in children and a moderate reliability of 0.69 for adolescents with chronic pain and has been used in one study for adolescents with knee pain.[15,198]

3.2.3: Procedures:

Over a six-month period, data was collected by a medical assistant. The primary researcher was not present during the data collection process. Before data collection began, the researcher met with the medical assistant to explain the process, how to answer study questions, and provided the questionnaires, assent, and consent forms. The medical assistant provided each prospective parent-child dyad with the questionnaire, consent, and assent forms, and envelopes, and explained the process to the parents. Specific instructions were provided in the survey for parents to work together with the child while answering the FABQ-PA questions forming a parent-child dyad. The survey was completed in a closed examination room while waiting for the physician. Completed questionnaires and consent forms were sealed in separate envelopes by parents, collected

by the medical assistant, and stored in a secure cabinet in the clinic. The researcher collected the documents twice each month.

Statistical analysis was done in R studio. Descriptive statistics of frequencies and percentages were calculated. Wilcoxon rank sum tests were used to compare the total PROMIS scores and FABQ scores of male and female subjects. Kruskal-Wallis tests were used to compare the total PROMIS and FABQ scores of various age groups. as well as times of diagnosis. Pairwise comparisons of FABQ scores with different age groups were done by Wilcoxon rank sum tests with Bonferroni adjustments. Spearman correlation coefficient was calculated between total PROMIS and FABQ scores. T score was calculated using the PROMIS scoring tool.

3.3: Results

A total of 81 children diagnosed with JIA and their parents living in Nevada participated. Among the respondents, 69.1% identified as female and 29.6% as male. The respondents in the age groups were as follows: 3 to 6 years (14.8%), 7 to 12 years (35.8%), and 13 to 16 years (49.4%). The ethnicity of children was as follows: White/Caucasian (49.38%), Hispanic/Latino (27.16%), a combination of races (12.35%), Asian/Pacific Islander (6.17%), and Black/African American (4.94%). The longest period since being diagnosed with JIA was 6 months to 2 years ago (33.33%). (Table 3). Oligoarthritis was reported as the most common type of JIA (16%), and 48.1% were unaware of the child's JIA type. The most painful joint reported was the knee (70.3%). (Table 3)

The most common treatments received were medication (87.7%) followed by infusion (30.9%), and the least common treatments were physical (8.6%) and

occupational therapy (4.9%). Seven out of 81 children reported previously receiving physical therapy to manage their condition. Thirty seven percent of parents were neutral about considering physical therapy, 34% were very likely, 11. % were likely, 9.9% were very unlikely, and 4.9% were unlikely to consider physical therapy

Most participants (69.13%) had a low PROMIS score and 28.39% had a high FABQ score. (Table 4 and Figure 7)

Table 3: Demographics of study 1

Variable	**Frequency (n,%)**
Sample size	**N = 81**
Types of JIA	
Not Aware	39 (48.1%)
Oligoarthritis	13 (16%)
Rheumatoid Factor-Positive Polyarthritis	9 (11.1%)
Systemic Arthritis	7 (8.6%)
Enthesitis Related Arthritis	6 (7.4%)
Rheumatoid Factor-Negative Polyarthritis	4 (4.9%)
Undifferentiated Arthritis	2 (2.5%)
JIA diagnosis time	
6 months -2 years ago	27 (33.33%)
3-5 years ago	25 (30.86%)
More than 5 years ago	22 (27.16%)
Less than 6 months ago	7 (8.64%)

Table 3: Demographics of study 1 continued

Variable	**Frequency (n,%)**
Sample size	**N = 81**
Joints involved	
Shoulder	12 (14.8%)
Elbow	12 (14.8%)
Hand/Wrist	29 (35.8%)
Wrist only	6 (7.4%)
Hip	16 (19.8%)
Knee	57 (70.3%)
Foot/Ankle	42 (51.9%)
Head	1 (1.2%)
Neck	11 (13.6%)
Back	15 (18.5%)

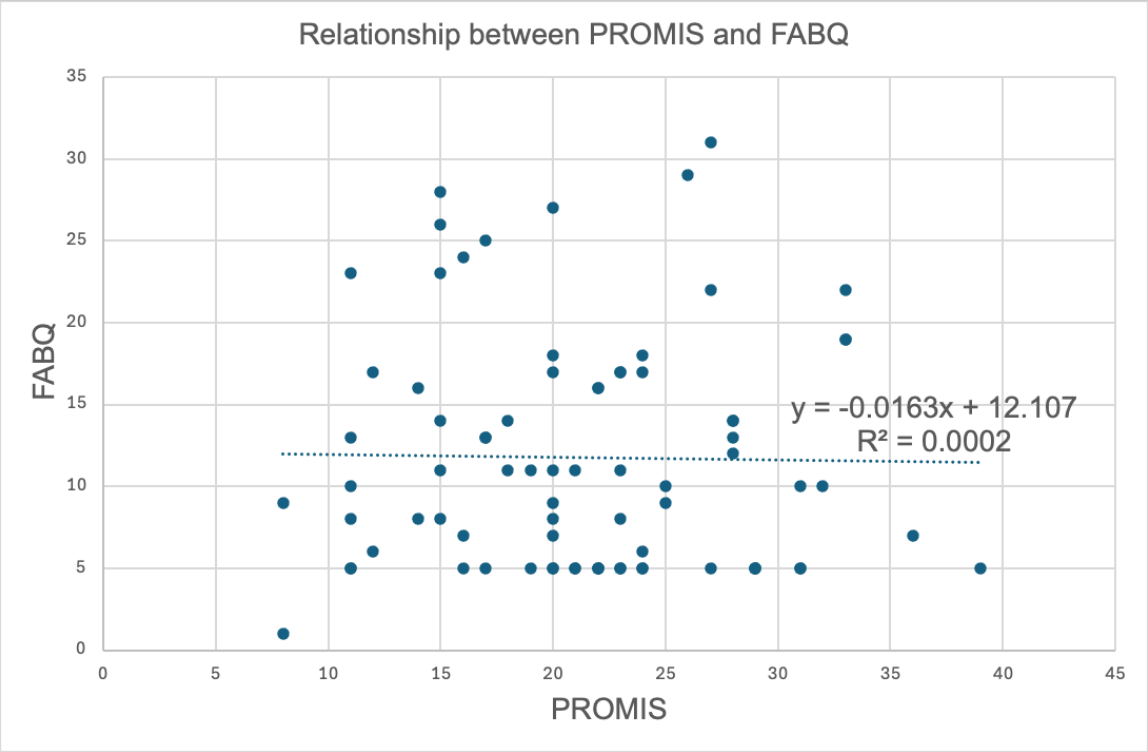
Table 4: Statistical analysis of study 1

	Mean	Median	Mode	range
PROMIS	21.1 ± 6.92	21	20	8-39
FABQ	11.76 ± 7.13	10	5	1-31
PROMIS lowest possible score: 8; highest possible score = 40 FABQ lowest possible score: 1; highest possible score = 35				

	3-6y/7-12y	3-6y/13-16y	7-12y/13-16y
FABQ age group comparisons	p = 0.0054	p = 0.0658	p = 0.9528
PROMIS age group comparisons	p = 0.7824		
PROMIS/FABQ spearman correlation coefficient	r = 0.1312		
PROMIS/time since diagnosis	p = 0.8336		
FABQ/time since diagnosis	p = 0.0780		
PROMIS/gender	p = 0.421		
FABQ/gender	p = 0.3294		

Y = years

Fig 7: PROMIS/FABQ relationship



3.4: Discussion

The purpose of this study was to explore whether children diagnosed with JIA experience kinesiophobia related to PA and physical function, the PA levels of these children, and the willingness of their families to consider physical therapy as a treatment option. To our knowledge, this is the first study to assess kinesiophobia using the FABQ in children with JIA, PA levels in JIA using the PROMIS across a wider age range, as well as the families' willingness to consider physical therapy

The main findings of the study were: 1) Children with JIA had lower than average levels of PA (69.13%); 2) fear of PA was expressed by 28.39% of children; and 3)

families (45.7%) were positively inclined towards considering physical therapy as a treatment.

3.4.1: Prevalence by age, gender, race and types of JIA

The demographics in this study were similar to previous studies of JIA, strengthening the generalizability of our findings. This study had 49.4% of children in the age group of 13-16 years and 14.8% in the age group of 3-6 years. This reflects the reported prevalence of JIA to be highest among adolescents aged 12 to 17 years at 592 per 100,000, compared to 77 cases per 100,000 in children aged 0 to 5 years (77 per 100,000).[102] While the youngest age group in the current study was 3 to 6 years old, JIA has been reported in a child as young as 21 days old.[160] Most children were diagnosed between 6 months - 2 years prior to the study. Consistent with previous research,[102] our study observed a higher representation of females (56) than males (24), aligning with the established female predominance in JIA (335 vs. 276 per 100,000).[102] Similar to the findings of Lites et al.,[102] the racial distribution of our study included a majority of White/Caucasian children, followed by Hispanic/Latino, and fewer Black/African American children. This pattern reflects Nevada's demographics, with 71.5% White/Caucasian, 29.9% Hispanic or Latino, and 11% Black or African American residents. As reported in prior studies,[1,90,161] oligoarthritis was the most common type of JIA found in this study, it affected females more than males, and pain was most commonly reported in the knee, foot/ankle, and hands. The hip, back, shoulder, and neck were less commonly reported.[1,90,161] The demographics of our sample align with existing literature on JIA, increasing confidence in the broader applicability of our findings.

3.4.2: Pharmacological and non-pharmacological management

Recent medical advances have decreased the need for surgery in JIA.[90] In this study, only two children had surgery, and did not specify the procedure. JIA treatment includes nonsteroidal anti-inflammatory drugs (NSAIDs), intraarticular corticosteroids, conventional disease-modifying antirheumatic drugs (DMARDs), and biologic DMARDs, which have improved the quality of life of children with JIA.[70,147,155,162,163] Effective management of JIA requires a multidisciplinary approach combining pharmacological and non-pharmacological strategies.[147,162] In this study, most children (87.7%) received prescribed medications, and only a few engaged in physical (8.6%) and occupational (4.9%) therapy. While our findings suggest higher pharmacological interventions, they reinforce the need to bridge the gap between current practice and evidence-based recommendations of including non-pharmacological intervention to improve JIA management.

3.4.3: PROMIS scores

Using a parent proxy is recommended when children cannot verbalize pain or have developmental or cognitive impairments, and it is valid and reliable for children as young as 2.[164–167] Children with JIA often hold back or have difficulty sharing their pain experiences.[32] For these reasons, we used the parent proxy method to explore PA levels and kinesiophobia.

The PROMIS scores of our children ranged from 8 to 39. Most children (69.13%) scored below a raw score of 25 which is considered a below average PA level. An average PROMIS T-score of 50 and SD of 10 is typical for the U.S. population .[168] Our

study found an average PROMIS T-score of 46.6 (standard error of 2.5), indicating a lower PA compared to the healthy population, consistent with prior research.

3.4.4: FABQ scores

In this study, 28.39% of children reported fear of pain. FABQ scores ranged from 1 to 31, (mean = 11.76, SD = 7.13), indicating the presence of some fear-avoidance beliefs about PA in this population. The higher standard deviation reflects variability among children. Some showed significant fear avoidance while others had minimal. Although no studies have specifically examined FABQ in children with JIA, Woolnough et al.[146] used the Tampa scale. This scale is used in the adult population to assess kinesiophobia, but due to a lack of child friendly kinesiophobia assessment tool, Woolnough et al, may have chosen to use the Tampa scale. Their study reported that children with JIA experience higher levels of kinesiophobia, impacting their PA. While our study did not provide conclusive evidence on kinesiophobia using the FABQ, our study might be the second study to assess kinesiophobia related to PA in this population pointing to critical area for future research.

3.4.5: PA and JIA

PA is any activity like exercise, swimming, running, walking, playing sports, and climbing stairs that is performed by the body and utilizes energy.[4,169] Physical therapy aims to enhance these movements, and ultimately PA. Although pain is a common barrier to PA for these children,[2,7,8,30] none of the parents reported that their child's pain prevented them from considering physical therapy. The children in this study reported reduced PA levels, which is consistent with the existing literature that suggests, despite encouragement, children with JIA have lower PA compared to healthy peers.[4,7,10] Some

studies indicated no direct link between pain, PA levels and disease activity.[10,12] Most research in this area has been conducted outside of the United States. Our study, one of the few studies on PA done in the US using the PROMIS parent proxy in children with JIA, confirms the existing evidence and suggests that this PA challenge is consistent across different healthcare systems, cultures, and chronic conditions. Children with other chronic conditions such as type 1 diabetes mellitus, cystic fibrosis, congenital heart disease, osteogenesis imperfecta, and cancer also have lower PA and reduced exercise capacity.[12,170–173]

3.4.6: PROMIS, FABQ, age and gender

Gender did not significantly impact PROMIS and FABQ scores in this group, likely because both genders face similar challenges in this chronic condition. Age did not affect the overall PROMIS scores, as JIA symptoms are consistent across different age groups. However, FABQ scores differed notably between age groups: 3-6 years vs. 7-12 years ($p=0.0054$). Fear of pain with activity may evolve with age, maturity level and disease activity. Our study did not find any correlation between the PROMIS and FABQ scores. It is possible that the children in our study were dealing with other health issues that we did not account for, which may have influenced their PA levels without necessarily instigating fear of pain during activity. Additionally, parents were instructed to read the FABQ questions to their children to assist them in answering, and we cannot be certain that these instructions were followed correctly. Parents may have completed the survey themselves, interpreting their child's fear of activity based on their own perceptions. The reliability of our FABQ results is compromised due to the use of parent proxy. There is no evidence supporting the use of FABQ for children under 11, although

it is effective for assessing fear avoidance in children aged 11-17.[15] Due to the lack of a kinesiophobia assessment tool for children, there is a need to develop a child-friendly tool that aligns with their reading levels. In this regard, FABQ-PA stands out to be the next best alternative tool that could be used.

3.4.7: Physical therapy management in JIA

While exploring physical therapy management may not be the primary goal of this study, we did attempt to gather insights on the types of treatments these children might be receiving. Di Ludovico et al. (2023),[156] in a narrative review, emphasized the importance of range of motion, strengthening, and aerobic exercises for children with JIA. In our study, children who previously received physical therapy (7) reported engaging in stretching and strengthening exercises. Studies suggest that well-organized aerobic and neuromuscular training can improve exercise capacity, muscle strength, balance, quality of life, and functional performance in these children and in adults with rheumatoid conditions.[174–181] The common physical therapy interventions for JIA include hydrotherapy, interferential current therapy, weight-bearing and Pilates exercises, stretching, dynamic splints, proprioceptive training, core strengthening, and task-oriented activities.[156] The main objectives of physical therapy treatment for children with JIA are to 1) manage pain, 2) restore range of motion 3) improve muscle strength, 4) increase endurance for daily activities, 5) reduce inflammation, and 6) ensure normal growth and development.[19,149]

3.4.8: Clinical implications

Physical therapy is important for managing arthritis, reducing pain, and improving function in adults with rheumatoid and osteoarthritis.[182,183] Exercise therapy can be as

effective as pain medication and should be customized to meet individual needs.[183] The ACR strongly recommends exercise as a vital choice for adults with rheumatoid arthritis, emphasizing early physical therapy referrals. Prioritizing movement over inactivity can improve quality of life and promote resilience in managing the condition.[182] However, Van Dijkhuizen et al. [27] reported that among 25 countries (22 in Europe), there are low physiotherapy referral rates for children with JIA, and non-Western countries show higher utilization of physical therapy services. In our study, we found that only 7 children (8.6%) had previously utilized physical therapy, and 4 children (4.9%) were currently receiving physical therapy. Additionally, waitlists in pediatric clinics can lead to delays; one participant mentioned they were awaiting a physical therapy appointment. Given the potential for progressive functional limitations in JIA, early intervention through physical therapy is essential. Fazaa A et al.[4] recommended that pediatric rheumatologists encourage exercise and PA for children with JIA. Children with JIA have decreased BMD and are at risk for osteopenia and osteoporosis due to the disease, corticosteroid treatment, and reduced PA.[35,64,89] Once children are stabilized and not in the acute stage, prioritizing early referrals to physical therapy may be beneficial. This approach could help establish healthy movement patterns, promote activity, reduce the long-term impact of the disease, and optimize outcomes by addressing fears related to movement through targeted exercise and education.

3.4.9: Limitations and future research

Our study had several limitations. First, we used parent proxy responses. Although there is good support for the use of parent proxy in the literature,[159] it is possible that a parent may perceive their child as more vulnerable.[23–26] Future research

studies may use child self-report and parent proxy reports together to examine the relationship between parent and child report. Second, is the use of FABQ as a parent proxy report. Though the FABQ offered valuable information, developing valid tools to measure children's fear of movement is important. Third, the addition of a disease activity score, such as the Juvenile Arthritis Disease Activity Score (JADAS), in future studies would enhance our understanding of the relationship between PA, disease activity, and kinesiophobia. Finally, our participants were recruited from one rheumatologist in Nevada, which limited our understanding of JIA management and different treatment outcomes that may influence PA levels. But this enables us to gain valuable insights into the clinical practices in this region and their impact on PA levels. Future studies may recruit participants across various healthcare providers, such as pediatricians, rheumatologists, and pediatric nurse practitioners or physician assistants in different geographic locations.

3.4.10: Conclusion

In summary, this survey-based research was conducted at a pediatric rheumatology clinic in Nevada, including 81 children with JIA and their parents. Oligoarthritis was the predominant diagnosis in this cohort. Children had lower level of PA, the findings on kinesiophobia were inconclusive and families were positively inclined towards physical therapy.

CHAPTER FOUR

EXPLORING THE CLINICAL PRACTICES AND CHALLENGES OF PHYSICAL THERAPISTS WHO TREAT CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS (JIA): A SURVEY-BASED STUDY

4.1: Introduction

Juvenile Idiopathic Arthritis (JIA) consists of various forms of childhood arthritis that occur in children under 16 and persist for a minimum of 6 weeks.[1,38] The International League of Associations for Rheumatology (ILAR) has identified seven distinct classifications of JIA, characterized by unique clinical features, signs, and symptoms.[1,38]

JIA is a chronic autoinflammatory condition that affects joints, causing stiffness, limited range of motion, pain and swelling; resulting in muscular imbalances, gait, and postural impairments.[1,184,185] As movement specialists, physical therapists (PT) treat these impairments to improve function and quality of life (APTA). [199] While physical therapy is "conditionally recommended" for JIA due to low-quality evidence,[21] the Ottawa panel suggests structured exercises and activities like Pilates, cardio-karate, and aquatic activities for management.[19] Various studies support personalized physical therapy, including therapeutic exercises, aquatic therapy, and balance training, as being safe and effective for children with JIA.[19,174–181] PTs provide interventions beyond therapeutic exercises, balance, and functional activity training. They use hands-on manual therapy techniques to reduce pain and improve function, although there is limited evidence of manual therapy in pediatrics. However, a case report indicated that orthopedic manual physical therapy (OMPT) improved mobility in a child with JIA.[178] One of the most impactful aspects of physical therapy is time. PTs often spend more one-on-one time with

their patients than physicians. This enables them to provide personalized care, track subtle changes in progress, and build strong relationships.

Pain is the most common complaint and significantly affects quality of life in children with JIA.[8] Understanding the methods used by parents, children and healthcare providers to communicate with one another about pain is important for improving care for children with JIA. Lee et al. reported that many healthcare professionals, including physical and occupational therapists, lack adequate training in assessing chronic pain in children.[31] Children with JIA have reported feeling disconnected during healthcare visits, which may lead to misreporting their health status.[30–32] Some barriers reported by healthcare providers while treating children in pain are: 1) the myth that infants do not feel pain like adults; 2) lack of pain assessment and reassessment; 3) difficulties in quantifying subjective reports; 4) limited knowledge of pain management; and 5) the belief that treating pain requires excessive time and effort.[186] Hence, understanding the pain communication techniques of treating therapists is important.

Pediatricians in Spain report that knowledge gaps delay referrals to rheumatologists for children with JIA.[28] A similar situation is reported in the US, where only 2% of the general pediatric board exam addresses pediatric rheumatology.[187] Costello et al.[187] reported that clinicians lacked confidence in musculoskeletal exams, leading to missed early signs and inappropriate differential diagnoses, causing delayed referrals and treatment.[187] The median wait time from symptom onset to seeing a pediatric rheumatologist is around 23 weeks, with some patients waiting up to a year.[188] Families often see multiple providers before a diagnosis, and the shortage of pediatric rheumatologists in the US further delays care for children with JIA.[187] Families report

that the journey can be "turbulent," marked by misdiagnosis and emotional distress. Persistent parents often seek referrals after doing online research.[187] Studies recommend a multidisciplinary approach for effective care for children with JIA[147,162], but referral rates for physical therapy remain low in Western countries.[27]

Managing chronic pain in children has been a major concern for healthcare professionals. No published studies were identified that explore PT's knowledge about JIA, pain communication techniques, and challenges they face while treating children with JIA. We aim to explore the clinical practices and challenges faced by PTs/PTAs who treat children with JIA in Nevada, Arizona and Utah.

4.2: Methods

4.2.1: Study development

This pilot cross-sectional study aimed to gather preliminary data from Nevada, Arizona, and Utah prior to conducting a national survey. The study was exempt by the Institutional Review Board (IRB) of Oakland University, Michigan.

Licensed PTs and physical therapist assistants (PTA) from all clinical specialty areas who have treated children with JIA were included in the study. Individuals who did not hold a PT or PTA license and those not practicing in Nevada, Arizona, or Utah were excluded. There was one question to filter responses from participants in Nevada, Arizona, and Utah, and one consent question.

The Qualtrics survey included a total of 28 questions: seven demographic questions, and 21 multiple-choice and open-ended questions related to JIA treatment, challenges, pain communication, and kinesiophobia.

4.2.2: Procedures

After the IRB approval, communication was made with APTA of Nevada, Arizona and Utah. An email blast containing a brief overview of the study, a Qualtrics survey link, and a flyer was sent by APTA Nevada to its members. APTA Arizona included the study information in their newsletter. The flyer with the Qualtrics link was posted in Facebook's pediatric PT group after receiving approval from the group administrator. Participants were encouraged to share the survey link with their peers who treat children with JIA, even if those peers were not APTA members or part of the Facebook groups. The principal investigator visited outpatient clinics in Nevada to distribute the flyer personally. Data collection was conducted for 7 months. For data analysis, SPSS statistics 30.0 was used, and descriptive statistics, including frequencies and percentages, were calculated.

4.3: Results

There were 56 responses to the survey, and 27 who treated children with JIA were included in the data analysis. Responses from PT/PTA not practicing in Nevada, Arizona and Utah, and who have never treated children with JIA were excluded from data analysis. Table 5 provides the demographic information of the study participants.

Table 5: Demographics of study 2

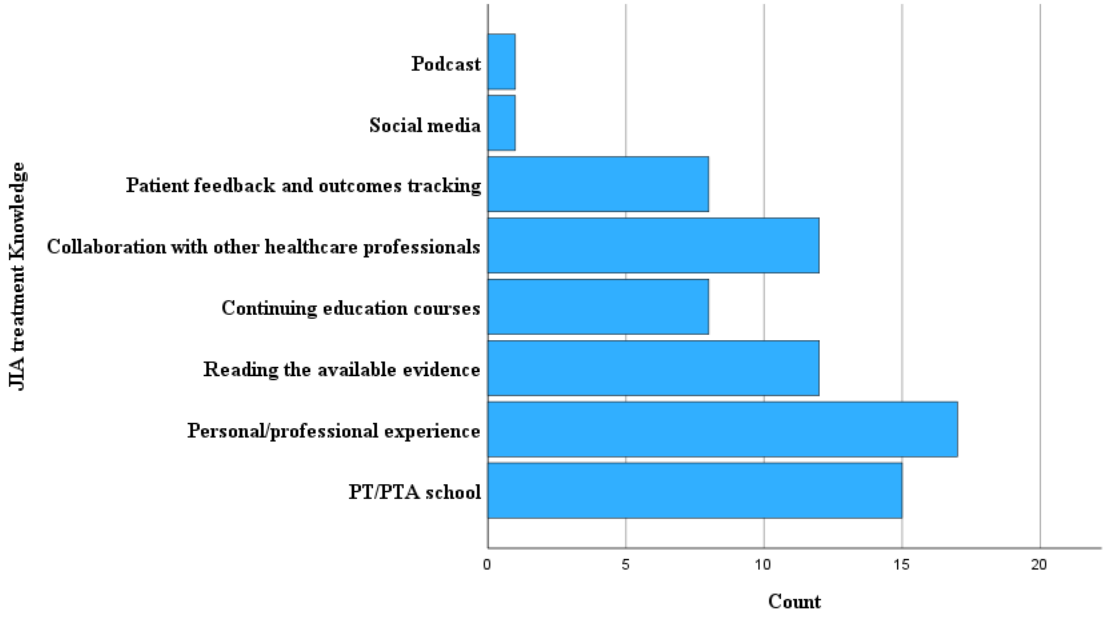
Variable	**Frequency (n, %)**
Sample size	**N = 27**
State of Practice	
Nevada	19 (70.4%)
Arizona	3 (11.1%)
Utah	1 (3.7%)
Unknown	4 (14.8%)
Provider Type	
PT	21(77.8%)
PTA	6 (22.2%)
Practice Area	
Pediatric	13 (48.1%)
Orthopedic	11 (40.7%)
Neuro	1 (3.7%)
Other	2 (7.4%)
Practice Setting	
Outpatient Clinics	26 (96.3%)
Hospital	3 (11.1%)
School	2 (7.4%)
Home Health	2 (7.4%)
Rehabilitation Center	1 (3.7%)
Clinical Experience	
<1 year	1 (3.7%)
1-3 years	6 (22.2%)
4-7 years	8 (29.6%)
8-10 years	4 (14.8%)
>10 years	8 (29.6%)

Twenty percent of participants reported having children with JIA on their schedule at the time of survey completion, and 80% reported that they were not currently treating any children with JIA but had treated them in the past. The age groups treated were 3 to 6 years (18.5%), 7 to 12 years (70.4%), and 13 to 16 years (44.4%). Most of the participants (63%) were unaware of the type of the JIA, but the most frequently treated

JIA type was undifferentiated JIA (25.9%), followed by systemic JIA (22.2%), psoriatic JIA (11.1%), rheumatoid factor-positive polyarthritis (14.8%), oligoarticular JIA (11.1%), and rheumatoid factor-negative polyarthritis (3.7%). None of the participants reported treating enthesitis-related JIA.

Participants reported gaining knowledge about treating JIA primarily through personal/professional experience (63%) (Fig 8)

Fig 8: JIA treatment knowledge



Most (80.8%) participants did not treat children with JIA post-operatively; 15.4% occasionally encountered JIA patients post-operatively, and 3.8% had seen them post-operatively before but not recently. Table 6 presents the physical therapy intervention provided.

Table 6: Physical therapy interventions of study 2

Variable	**Frequency (n, %)**
Sample size	**N = 27**
Physical Therapy Intervention	
Stretching	23 (85.2%)
Strengthening	23 (85.2%)
ROM	22 (81.5%)
Balance/Coordination	22 (81.5%)
Patient education	21 (77.8%)
Family education	19 (70.4%)
Pain management	15 (55.6%)
Assistive device recommendation	8 (29.6%)
Aquatic therapy	7 (25.9%)
Manual therapy application	
Occasionally	11 (44%)
Regularly	6 (24%)
Never	8 (32%)
Manual therapy techniques	
Soft tissue mobilization	15 (55.6%)
Joint mobilization	11 (40.7%)
Myofascial release	8 (29.6%)
Trigger point	5 (18.5%)
Muscle energy techniques	5 (18.5%)

Sixty eight percent of participants indicated that children expressed pain, whereas 32% reported they did not. Pain communication techniques used were as follows (fig 9): 40.7% verbally expressed pain intensity; 29.6% showed discomfort through gestures or signs; 25.9% communicated non-verbally via facial expressions or body language; 7.4% used all the methods to communicate; and none of the participants specifically used pain scales for communication. Most of the participants (54.2%) directed their pain related questions using a combination approach of asking both the parent/guardian and the child, 29.2% prioritized asking the child directly while involving parents for confirmation, and

16.7% changed their approach based on the child's age. Limited knowledge about pediatric rheumatology (63%) was the challenge most frequently reported by the participants (Fig 10).

Fig 9: Types of communication

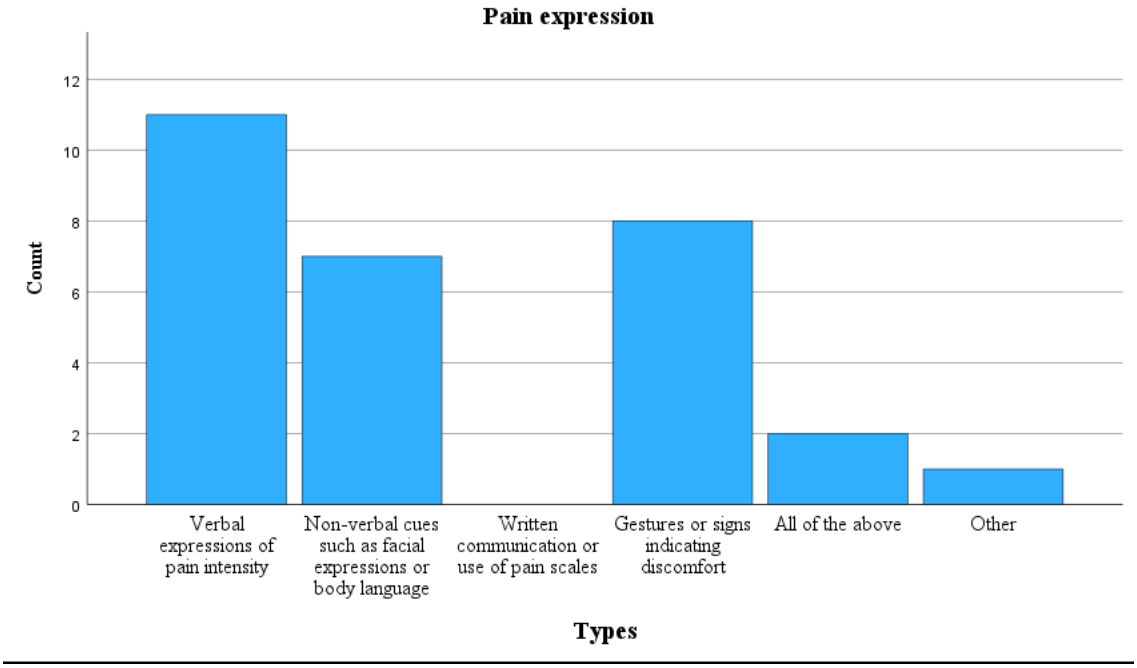
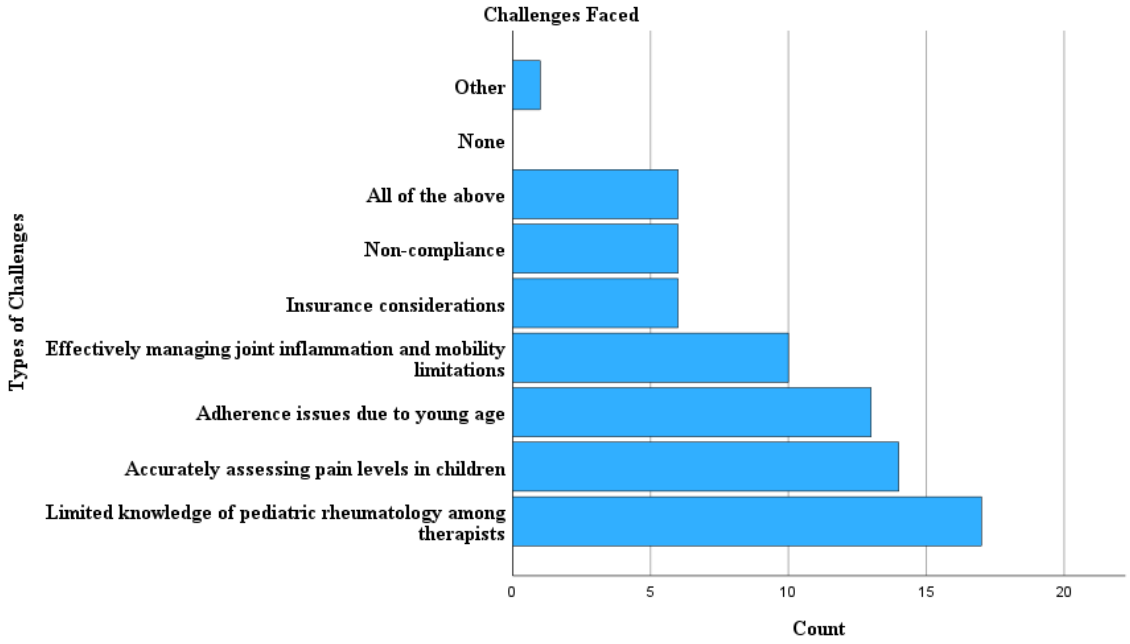


Fig 10: Types of challenges faced



4.4: Discussion

This pilot study aimed to gain insights from PTs and PTAs treating children with JIA in Nevada, Arizona, and Utah. We explored their JIA caseload, how children communicate pain, and how providers engage with parents or guardians. Additionally, we examined where PTs and PTAs gain their knowledge of JIA, the treatment interventions they use, and the challenges they face. To our knowledge, this is the first survey study of its kind in this field.

The study's key findings are: 1) Only 20% of the participants had children with JIA on their schedule at the time of survey completion. 2) A majority (63%) learned about treating JIA through personal experience. 3) None of the participants used pain scales specifically for communication. 4) Strengthening and stretching exercises were

used by 85.2%, and 44% of participants occasionally used manual therapy techniques. 5) Limited knowledge of pediatric rheumatology was cited as a challenge by 63% of the participants in treating JIA.

4.4.1: Demographics:

The most recently published APTA demographic report (2023) indicates an approximate 3:1 ratio of PTs to PTAs licensed in the states included in this study, which is consistent with the ratio encountered in our survey respondents. (Table 5)[189] Most participants (70.4%) were from Nevada, likely due to the primary researcher's in-person survey distribution. This limits the generalizability of the data beyond the tri-state area. Regarding practice area, most of our participants reported pediatric or orthopedic practice settings (Table 5), which is logical considering that JIA is primarily an orthopedic condition so children may be more likely to seek treatment in these settings. Our findings align with literature showing JIA prevalence in ages 12-17 [102], with 70.4% of respondents treating 7-12 years old, and 44.4% treating 13-16 years old. Advanced medical management of JIA has decreased the need for surgical procedures; 80.8% of respondents did not treat children post-operatively. Most participants had more than 10 years of experience as a PT, but 63% were unaware of the specific type of JIA. This suggests a possible knowledge gap, which limits PTs' understanding of the condition.

4.4.2: Physical therapy interventions

In this study, physical therapy interventions included strengthening and stretching exercises (85.2% each), followed by range of motion (ROM) and balance/coordination exercises (81.5% each), patient education (77.8%), family education (70.4%), pain management (55.6%), assistive device recommendations (29.6%), and aquatic therapy

(25.9%). This aligns with the recommendations of Di Ludovico et al.[156], which emphasize the importance of ROM, strengthening, and aerobic exercises for children with JIA. These interventions, combined with medication, can improve joint mobility, reduce pain, and enhance strength in children with JIA.[105,190] Most of the recommendations for physical therapy intervention are exercise based.[105,156,190,191] However, a comprehensive physical therapy approach may also include manual therapy. With this in mind, we asked participants in our study whether they had utilized manual therapy when treating children with JIA. The responses indicated that 44% of participants used it occasionally, 24% used it regularly, and 32% had not applied it. While manual therapy can help reduce pain and improve mobility, research on its broader benefits in pediatrics is limited.[178,192] Field et al. found that children with JIA reported less pain after receiving massages from parents for 30 days[193] and OMPT successfully reduced pain and improved mobility in a child with JIA.[178] If children benefit from parental massages, they may gain even more benefits from skilled manual therapy by PTs. Therefore, cautious application of manual therapy may also be useful for children with JIA.

4.4.3: Pain communication

Pain is the most common complaint of children with JIA. In this study, 68% of participants reported that children expressed pain, while 32% did not. This may be due to controlled disease activity, remission, or fear of increasing exercise if they share their pain. According to Lee et al. (2022), 53.85% of pain communication occurs with rheumatologists, while only 15.38% happens with PTs.[31] Effective communication with therapists is important for personalized care. In this study, 40.7% of therapists learned about pain through verbal descriptions, 29.6% through gestures, and 25.9% through non-

verbal cues. None of the participants reported primarily using pain scales for communication, and 7.4% chose all options for communication. There are several potential reasons for this, such as potential lack of time, lack of access to age-appropriate tools or knowledge about pain assessment. The American Academy of Pediatrics recommends using validated pain assessment tools like FLACC, Faces Pain Scale-Revised, and Wong-Baker FACES.[186] A standardized scale provides a shared understanding and language for pain assessment. Therefore, depending on the understanding and communication capabilities of the child, pain scales can be used to accurately document children's pain experiences.

4.4.4: Parental involvement in pain communication

Parental involvement is important for children and adolescents with JIA, influencing their management. In this study, participants used a combination method to gain insight about pain from parents and children (54.2%). By understanding both perspectives, clinical decision-making improves. Some participants engaged with the child (29.2%) while also confirming with parents, which makes the child feel acknowledged. A small group (16.7%) adjusted their approach based on the child's age, reflecting a flexible strategy for understanding pain presentation. Findings indicate that most participants value caregiver input but increasingly recognize children's ability to share their pain experiences. Studies show that parents perceive their children with JIA as more vulnerable compared to those with other chronic illnesses or healthy peers.[26] Lee et al. found that children expressed concerns when healthcare professionals ask parents about their child's pain, as the child may not share symptoms openly.[30,31]Therefore, to manage care for children with JIA effectively, it is essential to integrate insights from

both parents and children. This approach can help provide personalized treatment for children with JIA.

4.4.5: JIA knowledge and referrals

In this study, 80% of respondents reported not currently having children with JIA on their caseload, although they had treated them before. Only 20% had 1-5 children with JIA at the time of data collection. This may be linked to lower referral rates for physical therapy; Van Dijkhuizen et al. [27] reported that children in non-Western countries see PTs more frequently (76.7%) than those in Western countries (64.3%). Additionally, the shortage of pediatric rheumatologists—only 2 in Nevada, 3 in Arizona, and 7 in Utah—may contribute to the issue.[187] Pediatricians and orthopedists may ~~l~~ack knowledge about JIA subtypes, therefore miss signs and symptoms, and delay referrals to other specialists [187,194] Children referred from orthopedics to rheumatology face the longest wait, 24 weeks, compared to 12 weeks when referred from primary care. Many children do not see a PT until after their rheumatology assessment. [187,194] Children with JIA have reduced physical activity, affecting function and quality of life. Research shows that physical therapy can improve physical activity and well-being in children with JIA.[190,195,196] Preschoolers may face developmental delays due to late referrals to physical therapy.[27] Thus, early diagnosis and better education can improve clinical outcomes.

In addition to lower referral rates, several other factors may affect PT caseloads, such as, lower incidence/prevalence of JIA compared to other conditions commonly seen in outpatient pediatric physical therapy clinics. It is also possible that parents are unaware that physical therapy could help, or they have had a bad experience with physical therapy, such as over exercising their child during a disease flare up as mentioned by one of our

participants in the first study. Most participants (63%) learned to treat JIA through personal experience, but limited exposure may hinder their clinical decision-making. Participants reported gaining knowledge from Physical therapy/Physical therapy assistant school (55.6%), reading evidence (44.4%), collaborating with other healthcare professionals (44.4%), continuing education (29.6%); outcome tracking (29.6%); and social media was utilized by 3.7%. The lack of social media use may indicate there is a limited amount of online information, or they are unaware of available online resources.

4.4.6: Challenges and obstacles

The primary challenge reported was limited knowledge of pediatric rheumatology (63%), highlighting the need for continued education. Fifty-two percent of participants reported difficulty assessing pain levels, and 37% faced challenges managing joint inflammation and mobility limitations, which may suggest a knowledge or confidence gap in accurately assessing pain and providing care to children with JIA. Adherence to treatment plans was also a significant concern (48.1%), a difficulty reported by various studies[33,197] reporting long-term compliance in pediatric care. Some participants (22.2%) reported insurance-related issues and non-compliance, suggesting systemic and socioeconomic barriers affecting care. Financial strain from poverty can hinder families' ability to afford out-of-pocket costs for specialist visits, and caregivers in low-income households may have jobs with limited flexibility to attend appointments.[188] This suggests multifaceted challenges in treating children with JIA and emphasizes the need for improved education, effective pain assessment, strategies to improve adherence, and support for socioeconomic barriers. Addressing these issues holistically can improve the quality and consistency of care for children with JIA.

4.4.7: Clinical implication

PTs play an important role in caring for children with JIA. Participants (63%) reported learning about JIA through personal/professional experience, which highlights the need for comprehensive training in pediatric rheumatology for PTs. To address this, including pediatric rheumatology content into entry-level PT/PTA programs and offering continuing education may improve their confidence in treating children with JIA. Utilizing age-appropriate pain assessment tools may also improve chronic pain assessment in these children and ensure consistent, high-quality care. Fostering open communication and personalized approaches can further support effective pain management for children with JIA. Finally, raising awareness among pediatricians and rheumatologists about the role of physical therapy could improve referral rates and help reduce long-term PA limitations in children with JIA.

4.4.8: Limitation and future direction

Our study had several limitations. It was a pilot study that included only three states—Nevada, Arizona, and Utah—which may limit the generalizability of our findings. In the future, we may conduct a national survey to address this issue and gain insights into PT's knowledge of pediatric rheumatology, pain assessment techniques with children who have chronic pain, and the related challenges. Since this was a survey study, reaching participants in different states to maximize responses was challenging, causing a low sample size. Additionally, many of our participants were not currently treating children with JIA, so they may not accurately recall their past clinical experiences. Utilizing a combination of surveys and interviews to collect data from PTs/PTAs, caregivers, and children with JIA may be helpful. Understanding pediatricians' and

rheumatologists' views of referring children with chronic pain and JIA to PTs could be valuable.

4.4.9: Conclusion

In conclusion, our pilot study, conducted across Nevada, Arizona, and Utah, provided insights into the care provided by PTs/PTAs for children with JIA. We focused on PTs/PTAs caseload of children with JIA, communication about pain, the physical therapy interventions utilized, their understanding of JIA, and the challenges they face. Our study found that treatment plans also included manual therapy in addition to stretching and strengthening exercises. Our results suggest several concerns: referral rates for physical therapy were low, and pain scales were seldom used. Additionally, we identified a limited understanding of JIA among PTs and PTAs as one of the challenges they face. Our results highlight the need for resources to support PTs treating children with JIA and the importance of improving their knowledge and pain assessment strategies to improve JIA care.

CHAPTER FIVE

FUTURE DIRECTION

The current studies provide valuable information about the PA levels of children with JIA, and parents' willingness to consider physical therapy for their children with JIA. PTs report their challenges and obstacles to providing care for these children. Based on the findings and limitations of the two studies, this chapter provides information about future direction.

The first study discovered that children with JIA exhibit reduced physical activity. The second study revealed that few PTs regularly see these children in clinical practice. Knowing that physical therapy can improve PA levels in children with JIA, it will be beneficial to raise awareness among referring providers, such as pediatricians, pediatric rheumatologists, and pediatric nurse practitioners, about the benefits of physical therapy interventions.

The inconclusive findings of kinesiophobia suggest a need for an assessment tool that is child-friendly and tailored to children's reading and cognitive levels. I intend to create a scale and assess its reliability and validity. Using this new scale, I plan to conduct another study to determine kinesiophobia and PA levels in children with JIA, utilizing the Parent Proxy PROMIS PA and the PROMIS pediatric pain interference short form, as well as child self-reports.

Currently, there are only two pediatric rheumatologists in Nevada, and I plan to conduct the study at both of their offices to see if there are differences in clinical practices and outcomes. I want to refine my survey and add questions such as, "Is your child currently in pain?" and "Are there any other medical conditions?". I would also try

to collect disease activity scores for each participant. Exploring PA levels and kinesiophobia in children receiving treatment by other rheumatologists in different states would also improve our understanding of other factors that may influence children's PA behaviors, enhancing the reliability of the data.

The second study was limited to only three geographic locations, affecting the generalizability of this study. Hence, I plan to expand this survey internationally and nationally to explore physical therapy practices across various healthcare systems with different cultural, geographical, and socioeconomic backgrounds. This will help us understand the differences in physical therapy training and treatment approaches around the world and improve the validity of the data and care for children with JIA.

A longitudinal study can be conducted, in which children with JIA are enrolled in an eight-week individualized physical therapy treatment. PA levels and kinesiophobia can be assessed before and after the treatment interventions. Interventions may include school-based programs, family-centered strategies, or technology-enhanced approaches like gamified exercises.

Furthermore, I would like to conduct interviews with families and children with JIA and their referring providers. This qualitative approach could provide us with a better understanding of fear-related barriers to PA. It will help understand the emotional side of PA limitation that the quantitative data might miss. Relying on parent and child self-reports of PA may not be enough; hence, a tracker that provides continuous data on the intensity, frequency, and duration of the PA may be used. Tracking children's PA patterns throughout the day may help evaluate PA behaviors and their association with fear, which can help in providing customized intervention.

I plan to develop a continuing education course for PTs who treat children with JIA. Due to the sparse presence of JIA in social media, I hope to create educational content that is easily accessible to all the PTs. Creating awareness about the benefits of physical therapy among pediatricians could be very helpful. To address this, I plan to conduct in-services at their offices, providing information about how a PT can help improve PA levels in children with JIA. This may increase physical therapy referrals and reduce treatment delays.

In summary, I plan to address the limitations and build upon the findings from the two studies. By expanding geographically, enhancing data collection methods, and creating longitudinal research, in the future, I hope to contribute much stronger evidence and more reliable knowledge about PA limitation and its relationship with kinesiophobia, as well as promoting PA in children with JIA.

APPENDIX A

Study 1 IRB approval

Date: August 14, 2023

Study #: IRB-FY2023-297

Study Tile: Physical activity and awareness of physical therapy in children with Juvenile Idiopathic Arthritis

Submission Type: Initial

IRB Decision: Approved

Research Team:
Meghna Nautiyal
Melodie Kondratek
Lindsay Brandt

Based on applicable federal regulations, the above referenced study has been determined to involve no more than minimal risk to participants and to be Approved, with the following expedited categories:
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Letter and Consent Documents:
This letter along with the four IRB approved (date-stamped) consent documents can be found in Cayuse in the Submission Details page under Letters and Attachments, respectively.

The IRB approved version of the consent documents must be used in consenting participants. Federal regulations require that each participant receive a copy of the consent document unless a waiver is granted by the IRB. Signed consent forms must be retained for a minimum of three years after the completion of the project. Please remember that informed consent is a process that continues throughout the project, starting with recruitment and assurance of participant understanding of the project, and followed by a signed consent form when applicable.

Permission from Research Sites:
Please note the following:

- This IRB approval letter means that the research has met the federal criteria for approval per 45 CFR 46.111 Criteria for IRB Approval of Research.
- Before the research is initiated, permission to conduct research at a given site must be obtained from all research locations listed in the IRB submission. You must keep copies of all such permission letters for your records.
- It is the responsibility of each researcher to follow all applicable policies and procedures of any outside institution where the research will be conducted.

Modifications:
Any changes to the approved project must be approved by the IRB prior to initiation by submitting a
MODIFICATION request. Do not collect data while the changes are being reviewed. Data collected during this time cannot be used in research.

Incidents:
All unanticipated problems involving risks to participants or others, serious and unexpected adverse events, non-compliance issues and/or serious complaints regarding this project must be reported promptly to the IRB by submitting an INCIDENT report.

You are approved to start the research. Please retain a copy of this notification for your records.

If you have any questions, please contact the IRB office.

Thank you.

The Oakland University IRB

APPENDIX B

Oral Assent Script for Children Under 7 Years Old

Physical activity and awareness of physical therapy in children with Juvenile Idiopathic Arthritis

Hi, my name is Meghna Nautiyal, and I am a student.

I am working on a project about joint pain in children.

I am asking if you want to help because you have pain in the joints of your body.

Your parents said it is ok for you to help me with the project, but you can say no. It is up to you.

If you help me with this project, your parents will ask you some questions about the pain you have.

It is okay to say "No" if you do not want to be in the study. If you say "Yes" you can change your mind and stop any time, and no one will be upset.

Do you have any questions? Do you want to think about it?

Would you like to help me with this project?

Yes ____ (Mark here if s/he agrees to participate.)

Write child's name here if s/he says "yes." _____

APPENDIX C

Child Assent Form
Approximately 7-12 years old
Physical activity and awareness of physical therapy in children with Juvenile Idiopathic Arthritis

My name is Meghna Nautiyal. I am a student at Oakland University, Michigan.

I am doing a research study to find out if you are aware of physical therapy as a treatment for your joint pain, and if you have problems with your daily activities due to your pain. I am asking you to help because your doctor has diagnosed you with arthritis

If you agree to be in this study, you will be asked to help your parents answer questions regarding your joint pain.

This will help us better understand the pain you feel.

You may ask me any questions about this study at any time. Here is my information
Name: Meghna Nautiyal
Cell number: 248-413-7433
Email:

My faculty advisor's information
Name: Melodie Kondratek
Email: mdkondra@oakland.edu

You may talk with your parents, friends, or anyone else before you make up your mind.

You do not have to be in this study if you do not want to be. You do not have to answer any question you do not want to answer. Your parents know about the study too. But being in the study is up to you, and no one will be upset if you do not sign this paper or if you change your mind later.

Agreement to be in the study (7-12 years old)

If you would like to be in this research study, please write your name below.

_____ _____

Signature or printed name of participant **Date**

Child Assent Form
Approximately 13-17 years old
Physical activity and awareness of physical therapy in children with Juvenile Idiopathic Arthritis

My name is Meghna Nautiyal. I am a student at Oakland University, Michigan.

I am conducting a research study to learn about arthritis in children. I want to find out if you are aware of physical therapy as a treatment for your joint pain, and if you have problems with your daily activities due to your pain.

I am asking you to help because your doctor diagnosed you with arthritis.

There are some things about the study you should know:

- Procedures: If you agree to be in this study, you will be asked to help your parents fill out a survey that talks about your joint pain and your physical activity.
- Benefit or good things that might happen: This will help us better understand joint pain in children and improve the treatment approach.

Your responses will be kept safe and private. Your name will never be used when I write or talk about what I learned from the study.

You may ask me any questions about this study at any time. Here is my information

Name: Meghna Nautiyal
Cell number: 248-413-7433
Email: mhchowdhary@oakland.edu

My faculty advisor's information
Name: Melodie Kondratek
Email: mdkondra@oakland.edu

You may talk with your parents, friends, or anyone else you would like before you make up your mind.
You do not have to be in this study if you do not want to be. You do not have to answer any question you do not want to answer. Your parents know about the study too. But being in the study is up to you, and no one will be upset if you do not sign this paper or if you change your mind later.

Agreement to be in the study (13-17 years old)
If you would like to be in this research study, please write your name below. You will be given a copy of this form.

Signature of participant	**Date**

Printed name of participant

APPENDIX D

Parental Permission to Participate in Research
And Consent for the parent to Participate

Physical activity and awareness of physical therapy in children with Juvenile Idiopathic Arthritis

Introduction

You are being asked to give permission for your child and your consent as a parent to participate in a research study that is being done by Meghna Nautiyal, PT, MS, OMPT, under the direction of Dr. Melodie Kondratek, PT, MS, DScPT, OMPT, the faculty advisor for this project from the department of physical therapy.

Your decision to participate and give permission for your child and your consent as a parent to participate in this study is voluntary. You and Your child does not have to be in this study. Your decision will not affect your or your child's present or future relationship with Oakland University, the researcher, the physical therapy department, or the Kids Arthritis Care - Juvenile Arthritis and Rheumatology Care and Research Center.

If you do not allow your child to participate in this project, there is no penalty or loss of benefits to you or your child.

What is the purpose of this study?

The purpose of this research study is to identify whether children with juvenile idiopathic arthritis have reduced physical activity and function due to pain, awareness of physical therapy in children diagnosed with juvenile idiopathic arthritis, and if parents would consider physical therapy as a treatment option for their child's condition.

Who can participate in this study?

Your child and you are being asked to participate in the study because your child's age is between 3 years to 16 years and is diagnosed with juvenile idiopathic arthritis.

How long will my child and I be in the study?

Participation in the study will not require extra time beyond this questionnaire provided to you today.

Where will this study take place?

This study will take place at Kids Arthritis Care - Juvenile Arthritis and Rheumatology Care and Research Center during your child's follow-up visit with Dr. Robert Lowe.

What will my child and I be asked to do?

To help answer the questions, you will need to ask your child the questions stated in the questionnaire. The survey questionnaire will be provided to you during your visit with Dr. Robert Lowe.

Are there any risks to my child and me?

The are no potential risks that we know about.
With many research studies, there is a risk that someone who is not part of this research may accidentally see your child's personal information. Safeguards will be in place to minimize this risk by keeping your research records as confidential as possible. When the results of this research are published or presented at conferences, no information will be included that personally identifies your child.

Are there any benefits to my child and me?

There is no direct benefit to you or your child. But if you and your child participate in the research study it may help us understand the pain experienced by children with juvenile idiopathic arthritis and help improve the physical therapy treatment approach.

Will I/my child receive anything for participating?

You/your child will not receive anything for participating in this study.

Who could see my child's and my information?

Your child's and your research records may be shared and reviewed by the following groups:

- Representatives of the Oakland University Institutional Review Board and/or other regulatory compliance staff, whose job is to protect people who are in research studies.
- Regulatory authorities who oversee research (Office for Human Research Protections, or other federal, state, or international regulatory agencies)

De-identified data may be used or distributed to another investigator for future research use without additional permission from you.

Who do I contact if I have questions about this study?

Primary Investigator:
Name: Meghna Nautiyal
Cell number: 248-413-7433
Email: mhchowdhary@oakland.edu

My faculty advisor's information
Name: Melodie Kondratek

Email: mdkondra@oakland.edu

For questions regarding your child's rights as a participant in human subject research, you may contact the Oakland University Institutional Review Board, 248-370-4898.

Signing the parental or legal guardian permission form
Your signature below means that you have read this form, or someone has read it to you, and you agree to give your child permission to participate in the study.

You are not giving up any legal rights by signing this parental permission and consent form. You will be given a copy of this form.

Print name of participant/child _____

Print name of parent or other person authorized person to provide permission for participant/child

Signature of parent or another authorized to provide permission for participant/child

---

Print name of Parent Participant

Signature of Parent Participant

Relationship to participant/child

Date

APPENDIX E

JIA Survey for Parents/Guardians- Study 1

Please check the box next to each statement that applies to you. Select all that apply

1. Please select the category that includes your child's age.

- 3-6 years
- 7-12 years
- 13-16 years

2. Please indicate your child's gender.

- Male
- Female
- Prefer not to answer

3. What is your child's ethnicity?

- Asian / Pacific Islander
- Black / African American
- White / Caucasian
- Hispanic / Latino
- Native American / American Indian
- Other

4. Please write the name of your state in the space below.

_____

5. When was your child diagnosed with Juvenile Idiopathic Arthritis?

- Less than 6 months ago
- 6 months -2 years ago
- 3-5 years ago
- More than 5 years ago

Please check the box next to each statement that applies to you. Select all that apply

6. What type of Juvenile Idiopathic Arthritis does your child have?

- Systemic arthritis
- Oligoarthritis
- Rheumatoid factor-positive polyarthritis
- Rheumatoid factor-negative polyarthritis
- Enthesitis related arthritis
- Psoriatic arthritis
- Undifferentiated arthritis
- I am not aware

7. Where does your child feel pain? Select all that apply.

- Shoulder
- Elbow
- Hand
- Hip
- Knee
- Foot/Ankle
- Neck
- Back
- Other: _____

8. What treatments is your child undergoing? Select all that apply

- Prescribed Medications
- Infusion Therapy
- Surgery
- Physical Therapy
- Occupational Therapy
- Other: _____

9. Is your child currently receiving Physical Therapy?

- Yes
- No

Please check the box next to each statement that applies to you. Select all that apply

10. If Yes, is your child showing improvements?

- Minimal improvement
- Moderate improvement
- Significant improvement
- None

11. If No, why?

- The doctor did not recommend physical therapy
- My child is in too much pain
- I don't think physical therapy will work for my child's condition
- Other: _____

12. What kind of treatments does your child get in physical therapy? Select all that apply (skip if not receiving physical therapy)

- Stretching
- Strengthening
- Balance training
- Massage
- Joint mobilization
- Heat pack/Cold pack
- I am not aware

13. Is your child doing exercises at home given by the physical therapist? (skip if not receiving physical therapy)

- Yes
- No

14. If not performing home exercises, why? (skip if not receiving physical therapy)

_____

Please check the box next to each statement that applies to you. Select all that apply

15. How likely are you willing to try Physical Therapy for your child's condition?

- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

16. In the past seven days, how many days did your child exercise or play so hard that his/her body got tired?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

17. If No days, why?

_____

18. In the past seven days, how many days did your child exercise really hard for 10 minutes or more?

- No days
- One day,
- 2-3 days
- 4-5 days,
- 6-7 days

Please check the box next to each statement that applies to you. Select all that apply

19. In the past seven days, how many days did your child exercise so much that he/she breathed hard?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

20. In the past seven days, how many days was your child so physically active that he/she sweated?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

21. In the past seven days, how many days did your child exercise or play so hard that his/her muscles burned?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

22. In the past seven days, how many days did your child exercise or play so hard that he/she felt tired?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

Please check the box next to each statement that applies to you. Select all that apply

23. In the past seven days, how many days was your child physically active for 10 minutes or more?

- No days
- One day
- 2-3 days
- 4-5 days

- 6-7 days

24. In the past seven days, how many days did your child run for 10 minutes or more?

- No days
- One day
- 2-3 days
- 4-5 days
- 6-7 days

For each statement below, please circle any number from 0 to 6 to say how much physical activities affect your child's joint pain
To assist in finding the answer, kindly pose the following questions to your child:

25.

	COMPLETELY DISAGREE	UNSURE					COMPLETELY AGREE
My pain was caused by physical activity	0	1	2	3	4	5	6
Physical activity makes my pain worse	0	1	2	3	4	5	6
Physical activity might harm my joints	0	1	2	3	4	5	6
I should not do physical activities, which (might) make my pain worse	0	1	2	3	4	5	6
I cannot do physical activities, which (might) make my pain worse	0	1	2	3	4	5	6

26. If you would like to share any other additional comments regarding your child's condition, please mention them below (optional)

_____

APPENDIX F

Study 2 IRB approval

Date: August 8, 2024

Study #: IRB-FY2024-379

Study Tile: Exploring the Clinical Practices and Challenges of Physical Therapists who Treat Children with Juvenile Idiopathic Arthritis (JIA): A Survey-Based Study

Submission Type: Initial

IRB Decision: Exempt

Research Team:
Meghna Nautiyal
Melodie Kondratek
Lindsay Brandt

Based on applicable federal regulations, the above referenced study has been determined to be Exempt, with the following categories:
Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

Notes for Researcher(s):
This submission includes the following approved documents

- Recruitment advertisement
- JIA Survey for PT/ PTAs
- Date Stamp Approved Information Sheet_v08.08.24

Letter and Consent Document:
This letter along with the IRB approved (date-stamped) consent document can be found in Cayuse in the Submission Details page under Letters and Attachments, respectively. Please make sure to use the most recent IRB approved version of the consent form in consenting participants.

Permission from Research Site(s):
Please note the following:

- This IRB exemption determination letter means that this research has met one or more of the federal criteria for exemption per 45 CFR 46.104- Exempt Research.
- Before the research is initiated, permission to conduct research at a given site must be obtained from all research locations listed in the IRB submission. You must keep copies of all such permission letters for your files.
- It is the responsibility of each researcher to follow all applicable policies and procedures of any outside institution where the research will be conducted.

Modifications:
Any changes to this exempt project must be reviewed by the IRB prior to initiation by submitting a
MODIFICATION request. Do not collect data while the changes are being reviewed. Data collected during this time cannot be used in research.

Record Retention:
Exempt projects will be retained by the IRB office for three years after the last action on the project.

You are approved to start the research. Please retain a copy of this notification for your records.

If you have any questions, please contact the IRB office.

Thank you.

The Oakland University IRB

APPENDIX G

Juvenile Arthritis Survey for PTs and PTAs

Start of Block: Consent

Are you a practicing Physical Therapist or Physical Therapist Assistant in Nevada, Arizona or Utah?

○ Yes (1)

○ No (2)

Skip To: End of Survey If Are you a practicing Physical Therapist or Physical Therapist Assistant in Nevada, Arizona or Utah? = No

Display this question:

If are you a practicing Physical Therapist or Physical Therapist Assistant in Nevada, Arizona or Utah? = Yes

You are being asked to participate in a research study conducted by Meghna Nautiyal, PT, MS, OMPT, PHD(c) under the direction of Dr. Melodie Kondratek, PT, OMPT, DScPT, the faculty advisor for this project from the Physical Therapy Program, Associate Professor, Oakland University, Michigan. Your decision to participate in this study is voluntary. You can choose to stop your participation at any time or skip any part of the study if you are not comfortable. Your decision will not affect your present or future relationship with Oakland University, the researcher, and the physical therapy department.

What is the purpose of this study?
The purpose of this research study is to explore physical therapists' approaches to treating children with Juvenile Idiopathic Arthritis (JIA), identify challenges they face,

understand how children communicate pain, and investigate therapists' perspectives on treatment effectiveness and areas for improvement in JIA management.

Who can participate in this study?
You are being asked to participate in the study because you are a licensed physical therapist or a physical therapy assistant practicing in either Nevada, Arizona, or Utah.

What do I have to do?
You will be asked to complete a survey about children with JIA and current treatment approaches. The survey will be done online and will take 10 minutes to complete.

Are there any risks to me?
Potential risks for the study are minimal. The survey is anonymous; no identifiable data that can directly be linked to you will be collected.

Are there any benefits to me?
There may be no direct benefits to you, however, the results of this study may benefit others in the future.

Will I receive anything for participating?
No

What if I want to stop participating in this study?
If you want to stop participating, close your browser before completing and submitting the survey. If the survey is submitted, it will not be possible to withdraw your data from the study.

Who can I contact if I have questions about this study?
Primary Investigator:
Name: Meghna Nautiyal
Cell number: 248-413-7433
Email: mhchowdhary@oakland.edu

My faculty advisor's information
Name: Melodie Kondratek
Email: mdkondra@oakland.edu
For questions regarding your rights as a participant in human subject research, you may contact the Oakland University Institutional Review Board, 248-370-4898. Please provide a response below if you agree or disagree to participate.

○ I agree to participate in this study. (1)

○ I do not agree to participate in this study (2)

Skip To: End of Survey If You are being asked to participate in a research study conducted by Meghna Nautiyal, PT, MS, OMPT... = I do not agree to participate in this study

End of Block: Consent

Start of Block: Demographic

Q1 In which state do you primarily practice?

_____

Q2 What is your title?

- Physical Therapist (1)
- Physical Therapy Assistant (2)

Q3 In which country did you receive your entry-level physical therapist or physical therapy assistant training?

_____

Q4 What is your primary area of practice?

- ○ Pediatric Physical Therapist (1)
- ○ Orthopedic Physical Therapist (2)
- ○ Neuro Physical Therapist (3)
- ○ Cardiopulmonary Physical Therapist (4)
- ○ Other (5) _____

Q5 How long have you been practicing?

- ○ Less than 1 year (1)
- ○ 1-3 years (2)
- ○ 4-7 years (3)
- ○ 8-10 years (4)
- ○ More than 10 years (5)

Q6 What setting do you primarily work? (Select all that apply)

- [ ] Hospital (1)
- [ ] Outpatient clinic (2)
- [ ] School (3)
- [ ] Rehabilitation center (4)
- [ ] Home health (5)
- [ ] Other (please specify) (6) _____

Q7. Have you treated a child who has been diagnosed with Juvenile Idiopathic Arthritis (JIA)?

- ○ No (1)
- ○ Yes (2)

Skip To: End of Survey If Have you treated a child who has been diagnosed with Juvenile Idiopathic Arthritis (JIA)? = No

Skip To: End of Block If Have you treated a child who has been diagnosed with Juvenile Idiopathic Arthritis (JIA)? = Yes

End of Block: Demographic

Start of Block: Block 1

Q8 How many children diagnosed with JIA do you have on your schedule currently?

- ○ None right now, but I have treated them in the past (1)
- ○ 1-5 (2)
- ○ 6-10 (3)
- ○ More than 10 (4)

Q9 What age group of children diagnosed with JIA do you commonly see in your practice? (Select all that apply)

- ☐ 3-6 years (1)
- ☐ 7-12 years (2)
- ☐ 13-16 years (3)

Q10 What types of JIA do you commonly encounter in your practice? (Select all that apply)

- [ ] Oligoarticular JIA (1)
- [ ] Rheumatoid factor positive polyarthritis (2)
- [ ] Rheumatoid factor negative polyarthritis (3)
- [ ] Systemic JIA (4)
- [ ] Enthesitis-related JIA (5)
- [ ] Psoriatic JIA (6)
- [ ] Undifferentiated JIA (7)
- [ ] Unknown (8)
- [ ] Other (please specify) (9)

_____

Q11, Do you encounter children diagnosed with JIA post-operatively in your practice?

- ○ Yes, I frequently see JIA patients post-operatively. (1)
- ○ Occasionally, I encounter JIA patients post-operatively. (2)
- ○ No, I do not see JIA patients post-operatively. (3)
- ○ I used to before but have not seen any lately (4)

Skip To: End of Block If Do you encounter children diagnosed with JIA post-operatively in your practice? = No, I do not see JIA patients post-operatively.

Q12 If seen postoperatively, please indicate the type of surgery.

_____

End of Block: Block 1

Start of Block: Block 2

Q13 Where does your knowledge about PT interventions for JIA primarily come from? (Select all that apply)

- [ ] PT/PTA school (1)
- [ ] Personal/professional experience (2)
- [ ] Reading the available evidence (3)
- [ ] Continuing education courses (4)
- [ ] Collaboration with other healthcare professionals (5)
- [ ] Patient feedback and outcomes tracking (6)
- [ ] Social media (7)
- [ ] Podcast (8)

Q14 What types of physical therapy intervention do you typically provide for children diagnosed with JIA? (Select all that apply)

- [ ] Range of motion exercises (1)
- [ ] Strengthening exercises (2)
- [ ] Stretching exercises (3)
- [ ] Balance and coordination exercises (4)
- [ ] Aquatic therapy (5)
- [ ] Assistive device recommendation (e.g., braces, splints) (6)
- [ ] Pain management techniques (7)
- [ ] Patient education (8)
- [ ] Parent/Family education (9)
- [ ] Other (10) _____

Q15, Do you incorporate manual therapy techniques in the treatment of children diagnosed with JIA?

- ○ Yes, regularly (1)
- ○ Yes, occasionally (2)
- ○ Yes, only on post operative patient (3)
- ○ No, I have never tried using manual therapy techniques for JIA patients (4)
- ○ No, I do not think it is effective (5)

Skip To: End of Block If Do you incorporate manual therapy techniques in the treatment of children diagnosed with JIA? = No, I have never tried using manual therapy techniques for JIA patients

Skip To: End of Block If Do you incorporate manual therapy techniques in the treatment of children diagnosed with JIA? = No, I do not think it is effective

Q16 If you answered "Yes" to incorporating manual therapy techniques for children diagnosed with JIA, please specify the types of manual therapy techniques you commonly utilize (Select all that apply)

- [ ] Joint mobilizations (1)
- [ ] Soft tissue mobilization (2)
- [ ] Myofascial release (3)
- [ ] Trigger point therapy (4)
- [ ] Muscle energy techniques (5)
- [ ] Other (please specify) (6) _____

End of Block: Block 2

Start of Block: Block 3

Q17 In your experience, how frequently have you observed kinesiophobia (fear of movement) among children diagnosed with JIA?

- ○ Yes, kinesiophobia is frequently observed among JIA patients (1)
- ○ Occasionally, I encounter instances of kinesiophobia in JIA patients. (2)
- ○ No, kinesiophobia is not commonly observed among JIA patients in my practice (3)

Q18 Do children diagnosed with JIA commonly express pain during therapy sessions?

- ○ Yes (1)
- ○ No (2)

Skip To: Q20 If Do children diagnosed with JIA commonly express pain during therapy sessions? = No

Display this question:

If Do children diagnosed with JIA commonly express pain during therapy sessions? = Yes

Q19 If yes, in what ways do you typically observe children diagnosed with JIA expressing pain during these sessions? (Select all that apply)

- ☐ Verbal expressions of pain intensity (1)
- ☐ Non-verbal cues such as facial expressions or body language (2)
- ☐ Written communication or use of pain scales (3)
- ☐ Gestures or signs indicating discomfort (4)
- ☐ All of the above (5)
- ☐ Other (please specify) (6) _____

Q20 Do you direct pain-related questions to parent/guardian or ask directly to the child?

- ○ I ask questions directly to the parent/guardian only (1)
- ○ I ask questions directly to the child only (2)
- ○ I use a combination approach of asking parent/guardian and child (3)
- ○ Depending on the age and comfort of the child I change my approach (4)
- ○ I prioritize asking directly to the child and involve parents for confirmation (5)

End of Block: Block 3

Start of Block: Following three questions will ask about your engagement with parents/caregivers

Q21a How do you engage with parents/caregivers in the treatment and management of children diagnosed with JIA, particularly in ages less than 5-year-old (select all that apply)?

- [ ] Regular updates during sessions (1)
- [ ] Providing educational materials (2)
- [ ] Demonstrating exercises to parents/caregivers (3)
- [ ] I engage with the child only (4)
- [ ] NA, I do not treat this age group (5)
- [ ] Other (please specify) (6) _____

Q21b How do you engage with parents/caregivers in the treatment and management of children diagnosed with JIA, particularly in ages 5-12 year-old (select all that apply)?

- [ ] Regular updates during sessions (1)
- [ ] Providing educational materials (2)
- [ ] Demonstrating exercises to parents/caregivers (3)
- [ ] I engage with the child only (4)
- [ ] NA, I do not treat this age group (5)
- [ ] Other (please specify) (6)

_____

Q21c How do you engage with parents/caregivers in the treatment and management of children diagnosed with JIA, particularly in ages 12 year and older (select all that apply)?

- [ ] Regular updates during sessions (1)
- [ ] Providing educational materials (2)
- [ ] Demonstrating exercises to parents/caregivers (3)
- [ ] I engage with the child only (4)
- [ ] NA, I do not treat this age group (5)
- [ ] Other (please specify) (6)

_____

End of Block: Following three questions will ask about your engagement with parents/caregivers

Start of Block: Block 4

Q22. Do you collaborate with other healthcare professionals in the treatment of children diagnosed with JIA?

- ○ No (1)
- ○ Yes (2)

Display this question:

If do you collaborate with other healthcare professionals in the treatment of children diagnosed with... = Yes

Q22 Please specify the types of professionals you collaborate with (e.g., pediatricians, rheumatologists, occupational therapists, etc.)

_____

Q23 What specific challenges and obstacles do you commonly face when treating children diagnosed with JIA? (Select all that apply)

- [ ] Limited knowledge of pediatric rheumatology among therapists (1)
- [ ] Challenges in accurately assessing pain levels in children (2)
- [ ] Adherence issues with treatment plans due to the young age of patients (3)
- [ ] Effectively managing joint inflammation and mobility limitations during therapy sessions (4)
- [ ] Insurance considerations (5)
- [ ] Non-compliance (6)
- [ ] All of the above (7)
- [ ] None (8)
- [ ] Other (please specify) (9)

_____

Q24. Do you believe pediatric rheumatologists rely more on medication than physical therapy interventions?

- ○ Yes (1)
- ○ No (2)
- ○ Unsure (3)

Q25 In your experience, what are some effective strategies for improving the overall well-being and quality of life of children diagnosed with JIA?

_____

Q26 Is there any additional information or insight you would like to share regarding your experience in treating children diagnosed with JIA?

_____

End of Block: Block 4

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