

ASSESSMENT OF POSTURAL STABILITY IN PEDIATRIC POPULATION WITH JUVENILE IDIOPATHIC ARTHRITIS: A CROSS-SECTIONAL STUDY

Amina Ashfaq¹, Somia Faisal¹, Sarfraz Ahmad², Amina Liaquat¹, Sajal Rehman Nawaz¹, Fatima Ali¹

How to cite this article

Ashfaq A, Faisal S, Ahmad S, Liaquat A, Nawaz SR, Ali F. Assessment of Postural Stability in Pediatric Population With Juvenile Idiopathic Arthritis: A Cross-Sectional Study. J Gandhara Med Dent Sci. 2026;13(4):108-113. <http://doi.org/10.37762/jgm.13-4.925>

Date of Submission: 28-04-2026

Date Revised: 14-09-2026

Date Acceptance: 14-09-2026

²Associate Professor, Department of Physical Medicine & Rehabilitation, The Children's Hospital, University of Child Health Sciences, Lahore, Pakistan

Correspondence

¹Somia Faisal, Physiotherapist, Department of Physical Medicine & Rehabilitation, The Children's Hospital, University of Child Health Sciences, Lahore, Pakistan
 ☎: +92-320-4996487
 ✉: somia786faisal@gmail.com

ABSTRACT

OBJECTIVES

The study aimed to determine the postural stability of children with Juvenile Idiopathic Arthritis (JIA).

METHODOLOGY

A cross-sectional study was conducted from June 2024 to January 2025 at Children's Hospital Lahore. Seventy children aged 6- 15 years with JIA and active joint involvement were recruited through convenience sampling. The Pediatric Balance Scale (PBS) was used to evaluate postural stability, and the Childhood Health Assessment Questionnaire (CHAQ) was used to assess functional status. We used SPSS version 26 to analyse the data. Chi-square tests and descriptive statistics were applied.

RESULTS

The mean age was 11.6 (± 2.8) years, with 41 females (58.6%) and 29 males (41.4%). PBS scores showed 42 children (60%) with poor balance (score 0-20), 16 (22.9%) with moderate balance (21- 40), and 12 (17.1%) with good balance (41- 56). According to the CHAQ, 50 children (71.5%) reported much difficulty or were unable to perform everyday activities, while a further 9 (12.9%) reported some difficulty. A significant association was found between CHAQ functional level and PBS balance category ($\chi^2 = 15.42$, $p = 0.017$), and a moderate negative correlation was observed between CHAQ and PBS total scores ($r = -0.41$, $p < 0.001$). No significant association was found between age and balance ($p = 0.087$).

CONCLUSION

A substantial proportion of children with JIA scored in the lower ranges of the PBS, and poorer balance was moderately correlated with greater functional disability. These findings support integrating balance assessment into routine clinical evaluation in pediatric JIA.

KEYWORDS: Juvenile Idiopathic Arthritis, Postural Stability, Balance, Pediatrics, Rheumatology, Health Status Indicators

INTRODUCTION

Juvenile Idiopathic Arthritis (JIA) is the most prevalent chronic rheumatic disease in children and is defined by persistent joint inflammation of unidentified etiology lasting six weeks or more in children under 16 years of age.¹ The nomenclature and classification of the pediatric rheumatoid disorders have changed significantly, with the International League Against Rheumatism (ILAR) now identifying seven different subtypes of JIA, which are determined by the clinical presentation in the first six weeks of the disease.² The prevalence of JIA in different parts of the world is between 1.6 and 23 cases per 100,000 children, with combined estimates showing an approximate 8.3 cases per 100,000 in Caucasian populations. JIA prevalence rates differ substantially worldwide and depend on genetic, environmental, and healthcare access factors.³ Females are often more often affected than males, with the estimated ratio of males to females being 0.57:1. Sex distribution differs among JIA subtypes.⁴ Although

the children with JIA have improved clinical remission rates in most cases, they still suffer significant functional limitations, reduced physical activity, and poorer quality of life than their healthy peers.⁵ JIA etiology is not fully understood but is thought to involve multifaceted interactions among genetic susceptibility, immune dysregulation, and environmental triggers.⁶ HLA as well as non-HLA genetic markers can help to increase susceptibility to the disease, whereas socioeconomic factors like the lack of access to rheumatology care promptly are linked with worse outcomes and higher disease severity.⁷ One of the most crucial but underestimated areas of JIA is postural stability, or the ability to maintain or regulate body position during static and dynamic activities. Balance depends on coordinated activity of the sensory, musculoskeletal, and neuromuscular systems, with proprioception playing a significant role. These systems are susceptible to disruption in JIA, causing quantifiable postural control impairments due to chronic synovitis, pain, joint stiffness, muscle

weakness, and impaired proprioception.⁸ Children with JIA often have gait deviations, decreased range of motion, compensatory movement patterns, and abnormal biomechanics, all of which lead to balance dysfunction. Such impairments can heighten the risk of falls, restrict physical activity, and worsen functional outcomes, as children with JIA may be less active and more sedentary than their healthy peers.⁹ Although biologic therapies have increased the rates of clinical remission, children with JIA usually become less physically active and more sedentary, compared to their healthy peers.¹⁰ This physical deconditioning can trigger a vicious cycle of further joint pain, lack of activity, and a further increase in disease activity, which increases the likelihood of developing comorbid metabolic and mental health issues.¹¹ JIA has a great influence on many aspects of the life of a child, such as psychological well-being, social participation, functional independence, and quality of life, which means that effective management should be a holistic process that includes education, lifestyle modification, social support, pain management, and self-efficacy and communication improvement strategies.¹² In children with JIA, physical activity is necessary to maintain functional capacity as well as overall health. Nevertheless, evidence-based guidelines for exercise prescription remain limited, and barriers such as individual, interpersonal, and program-related factors often obstruct long-term involvement.¹³ Despite growing recognition of balance deficits in JIA, clinicians rarely evaluate postural stability, potentially leaving trunk control and gait abnormalities unidentified. This study aimed to evaluate postural stability in children with JIA using standardised measures to inform targeted rehabilitation interventions and improve clinical monitoring of functional status in this vulnerable population.

METHODOLOGY

This cross-sectional study was conducted over eight months, from June 2024 to January 2025, at Children's Hospital Lahore. A non-probability convenience sampling method was used to enrol 70 children diagnosed with Juvenile Idiopathic Arthritis by a pediatric rheumatologist. The sample size was calculated based on the primary objective of estimating the correlation between PBS and CHAQ scores. Using G*Power 3.1 (two-tailed, $\alpha = 0.05$, power = 0.80) and assuming a moderate correlation of $r = 0.30$ between PBS and CHAQ, a minimum of 67 participants was required. Allowing for approximately 5% missing data, we aimed to recruit 70 children, and 70 completed the

study. Inclusion criteria included children aged 6 to 15 years with active joint involvement and at least 1 year of disease duration who could follow verbal instructions. Exclusion criteria included visual or hearing impairments, orthopedic injuries in the recent past, or cognitive impairments that may affect balance measurement. The two standardised assessment tools were the Pediatric Balance Scale (PBS) and the Childhood Health Assessment Questionnaire (CHAQ). PBS is a 14-item performance-based scale designed to measure functional balance in children. All items are rated on an ordinal scale from 0 (unable to perform) to 4 (normal performance), producing a total score of 0–56, with higher scores reflecting better balance. CHAQ is a parent-reported questionnaire assessing functional ability in daily living. It comprises 30 items across eight domains, scored from 0 (without difficulty) to 3 (unable to do), with an overall score of 0 to 3. Higher scores indicate greater disability (higher score = more disability). After ethical approval and signed informed consent from parents or guardians, a trained physiotherapist conducted the PBS assessment for each child, while parents completed the CHAQ independently. The study followed the principles of the Declaration of Helsinki. The Institutional Review Board approved the Study (Approval No. 706/SAHS). We obtained written informed consent from all parents or legal guardians before participation. The data were analysed using SPSS version 26.

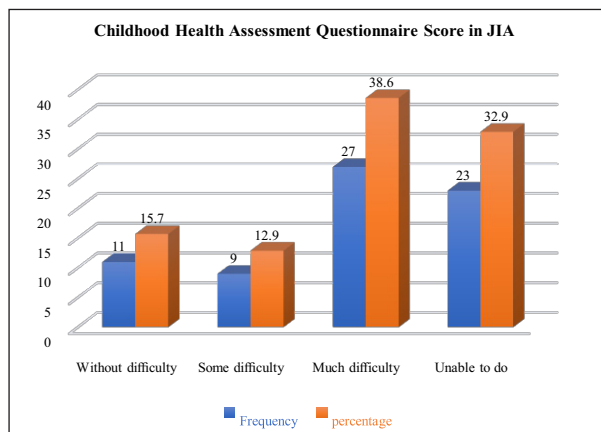
RESULTS

This cross-sectional study included 70 children with Juvenile Idiopathic Arthritis (JIA). The mean age was $11.6 (\pm 2.8)$ years, with a higher proportion of females ($n = 41$, 58.6%) than males ($n = 29$, 41.4%). The distribution across age groups was as follows: 6–9 years ($n = 17$, 24.3%), 10–12 years ($n = 21$, 30.0%), and 13–15 years ($n = 32$, 45.7%). Table 1 summarises the cohort's clinical characteristics. The most common JIA subtype was oligoarticular ($n = 28$, 40.0%), followed by polyarticular RF-negative ($n = 22$, 31.4%) and systemic ($n = 6$, 8.6%). The mean disease duration was 3.4 ± 1.8 years, and the mean age at diagnosis was 8.2 ± 2.6 years. Children had a mean of 6.1 ± 3.9 affected joints and 3.2 ± 2.1 active joints at assessment. Mean disease activity scores were JADAS-27 12.6 ± 5.4 , ESR 18.3 ± 9.7 mm/h, and CRP 8.1 ± 6.2 mg/L. At assessment, 52 children (74.3%) were receiving conventional DMARDs, 18 (25.7%) biologics, 41 (58.6%) NSAIDs, and 12 (17.1%) corticosteroids. ANA was positive in 21 children (30.0%), and 7 (10.0%) had a history of uveitis.

Table 1: Clinical Characteristics of Children with JIA (N = 70)

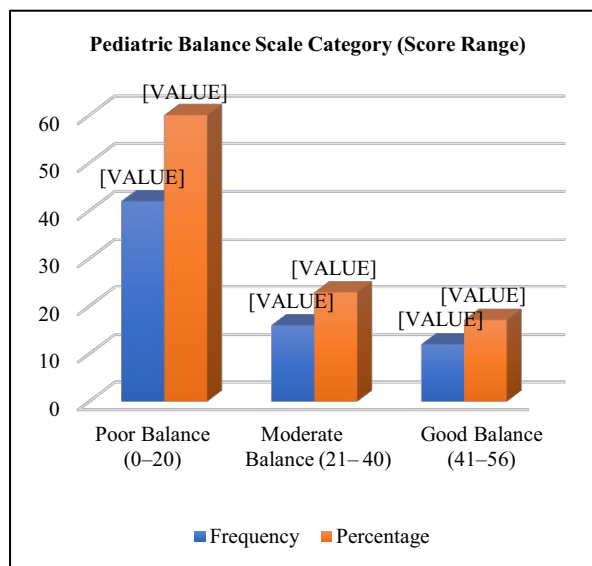
Characteristic	n (%age)
JIA subtype, n (%)	
Oligoarticular	28 (40.0%)
Polyarticular (RF-negative)	22 (31.4%)
Polyarticular (RF-positive)	4 (5.7%)
Systemic	6 (8.6%)
Enthesitis-related	5 (7.1%)
Psoriatic	3 (4.3%)
Undifferentiated	2 (2.9%)
Disease duration, years, mean $\pm$ SD	3.4 $\pm$ 1.8
Age at diagnosis, years, mean $\pm$ SD	8.2 $\pm$ 2.6
Number of affected joints, mean $\pm$ SD	6.1 $\pm$ 3.9
Number of active joints, mean $\pm$ SD	3.2 $\pm$ 2.1
Disease activity	
JADAS-27 score, mean $\pm$ SD	12.6 $\pm$ 5.4
ESR, mm/h, mean $\pm$ SD	18.3 $\pm$ 9.7
CRP, mg/L, mean $\pm$ SD	8.1 $\pm$ 6.2
Medication status, n (%)	
NSAIDs	41 (58.6%)
Conventional DMARDs	52 (74.3%)
Biologics	18 (25.7%)
Corticosteroids	12 (17.1%)
No DMARD	9 (12.9%)
ANA positive, n (%)	21 (30.0%)
Uveitis, n (%)	7 (10.0%)

Functional assessment using the Childhood Health Assessment Questionnaire (CHAQ) showed that only 11 children (15.7%) could perform activities of daily living without difficulty, while the majority reported functional limitations: 9 (12.9%) had some difficulty, 27 (38.6%) had much difficulty, and 23 (32.9%) were unable to perform tasks independently (Figure 1).

**Figure 1: CHAQ Score Distribution in Children with JIA (N=70).**

We used the Pediatric Balance Scale to assess postural stability. PBS total scores were analysed as a continuous variable (mean 24.3 ± 12.7). For descriptive purposes, 42 children (60.0%) scored in the 0–20 band (poor balance), 16 (22.9%) in the 21–40 band (moderate balance), and 12 (17.1%) in the 41–56 band (good balance) (Figure 2); these bands are not validated cut-offs. Performance on specific PBS tasks highlighted

functional deficits. During the sitting-to-standing task, 21 children (30.0%) needed moderate to max assistance, while only 4 (5.7%) could stand without any hand assistance. In unsupported standing, 13 (18.6%) were unable to maintain the position for 10 seconds, and only one child (1.4%) could stand safely for 30 seconds. In the single-leg stance, 10 children (14.3%) did not attempt the task, and only 5 (7.1%) stayed in position for 10 seconds.

**Figure 2: Pediatric Balance Scale (PBS) Total Score Distribution in Children with JIA (N = 70).**

We observed a significant association between functional disability (CHAQ score) and balance category (PBS total score) ($\chi^2 = 15.42$, $df = 6$, $p = 0.017$). Children reporting greater difficulty in daily activities were more likely to have poor balance. For example, among those who were "unable to do" activities on the CHAQ, 52.2% ($n = 12$) had poor balance on the PBS (Table 2).

Table 2: Association Between CHAQ Functional Level and PBS Balance Category

CHAQ Functional Level	Poor (0-20)	Moderate (21-40)	Good (41-56)	Total
Without difficulty	3	5	3	11
Some difficulty	5	2	2	9
Much difficulty	22	4	1	27
Unable to do	12	5	6	23
Total	42	16	12	70

* $\chi^2 = 15.42$, $df = 6$, $p = 0.017$ *

No significant association was found between age group and balance category ($\chi^2 = 8.124$, $df = 4$, $p = 0.087$). Table 4 presents the distribution of balance

categories across age groups. Similarly, Table 3 shows no significant association between gender and balance category ($\chi^2 = 0.82$, $df = 2$, $p = 0.664$).

Table 3: Association Between Age Group and PBS Balance Category

Age Group	Poor Balance(0-20)	Moderate Balance(21-40)	Good Balance(41-5)	Total
6-9 years	7	8	2	17
10-12 years	14	4	3	21
13-15 years	21	4	7	32
Total	42	16	12	70

* $\chi^2 = 8.124$, $df = 4$, $p = 0.087$.

However, we found a moderate negative correlation between CHAQ scores and PBS total scores ($r = -0.41$, $p < 0.001$), indicating that children with greater functional disability tended to have poorer postural stability (Table 4).

Table 4: Correlation Between CHAQ Scores and PBS Total Scores

Variable	Mean $\pm$ SD	Correlation with PBS (r)	p-value
CHAQ Score	2.1 (± 0.9)	-0.41	< 0.001
PBS Total Score	24.3(± 12.7)	–	–

Note: CHAQ Score Range 0–3 (Higher = More Disability), PBS Score Range 0–56 (Higher = Better Balance)

We also observed a significant association between age group and CHAQ functional level ($\chi^2 = 12.34$, $df = 6$, $p = 0.039$), with older children (13-15 years) reporting higher disability levels.

DISCUSSION

This cross-sectional study evaluated postural stability in children with Juvenile Idiopathic Arthritis (JIA) and its association with functional status, age, and sex. In this cohort, a substantial proportion of children with JIA scored in the lower ranges of the PBS, and balance performance was moderately associated with functional disability. Additionally, the association between functional disability and balance performance, as measured by the Childhood Health Assessment Questionnaire (CHAQ), was strong and significant, supporting the clinical importance of postural deficits in children. The high prevalence of balance impairment in this study is consistent with recent research highlighting motor and functional deficits in children with JIA. According to Yenil et al. (2024), children with JIA scored much lower on motor proficiency assessment tests than healthy children, with differences in both gross and fine motor movements.¹⁴ Similarly, Vincent

et al. (2022) observed that both active and inactive JIA children had slower walking speed, different gait kinematics, and impaired performance on load-bearing functional tasks, which indicated that children have continued to experience balance and mobility difficulties even after clinical remission.¹⁵ These results are consistent with our findings, as dynamic balance tasks (transfers, turning, and reaching) demonstrated stronger correlations with functional disability compared to the results of a static task. This could suggest that dynamic stability is more vulnerable to the functional restrictions that children with JIA experience and can be the goal of rehabilitative intervention. One major result was a significant association between functional disability (CHAQ score) and balance category, supporting the importance of postural control as an inseparable component of daily activity performance. This connection is also highlighted in recent studies; for example, Woolnough et al. (2021) found gait abnormalities and postural deviations in children with JIA related to low physical activity and participation.⁹ Additionally, Elnaggar et al. (2021) also confirmed that core stability exercises not only have a beneficial effect on balance but also on the functional capacity of the children with polyarticular JIA, which supports the idea that balance-based interventions may have a significant impact on a functional outcome of JIA patients.¹⁶ The fact that this study found that dynamic balance deficits correlated more with functional disability than static balance deficits. Hence, task-based and functional balance training could be especially advantageous. However, balance performance did not significantly correlate with age, contrary to our hypothesis. This observation is consistent with Sinem Yenil et al. (2024), who found that motor impairments among children with JIA were not age-dependent but were uniformly evident during both active and inactive disease.¹³ Nevertheless, this study reported a significant association between age and functional disability, and older children reported higher limitations. This can be a manifestation of the accumulated effect of chronic illness, of long-standing physical deconditioning, or of psychosocial adaptations that are acquired over the years as a recent study by Lupini et al. (2023) identified the process according to which adolescents with JIA tend to have identity difficulties, social inclusion, and physical insecurity.^{17,18} However, in a systematic review of physical activity interventions in JIA, Iversen et al. (2022) found no gender moderation of functional outcomes and suggested that disease-related factors might override sex-based disparities in balance and function in this clinical population.¹⁹ In this cohort, no gender-based balance difference was assessed.

LIMITATIONS

This study's findings are subject to several limitations that should be considered. The cross-sectional design could not support causal inferences about the relationship between balance and functional disability. Due to convenience sampling, the study findings may lack generalizability. In this study, participants were not stratified by JIA subtype or disease activity, which may influence balance outcomes. We excluded children with cognitive, visual, or orthopedic comorbidities, which may not be representative of the general JIA population. Lastly, the sample size was sufficient for the primary analyses but may have been underpowered to detect less pronounced associations, including gender-related ones. The PBS bands used for descriptive purposes in this study are not validated severity categories, and the primary analysis therefore treated PBS as a continuous variable. Future studies should establish validated PBS cut-offs for pediatric JIA populations.

CONCLUSIONS

In this cohort of children with JIA, a substantial proportion scored in the lower ranges of the Pediatric Balance Scale, and lower PBS scores were moderately correlated with greater functional disability on the CHAQ. These findings suggest that clinicians should assess balance as part of routine pediatric JIA evaluation and that targeted balance training may be a useful component of rehabilitation. However, because no healthy control group was included, these results cannot establish that postural stability is impaired relative to typically developing children. Future controlled, longitudinal studies are needed to confirm these findings and evaluate the effect of balance-focused interventions on functional outcomes.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

REFERENCES

- Long AM, Marston B. Juvenile idiopathic arthritis. *Pediatr Rev.* 2023;44(10):565-577. doi:10.1542/pir.2022-005623. PMID: 37777651.
- Lee JY, Eng SWM, Guzman J, Duffy CM, Tucker LB, Oen K, et al. A comparison of International League of Associations for Rheumatology and Pediatric Rheumatology International Trials Organization classification systems for juvenile idiopathic arthritis among children in a Canadian arthritis cohort. *Arthritis Rheumatol.* 2022;74(8):1409-1419. doi:10.1002/art.42113. PMID: 35289119.
- Beesley RP, Hyrich KL, Humphreys JH. POS0745 The incidence and prevalence of juvenile idiopathic arthritis differs between ethnic groups in England. *Ann Rheum Dis.* 2023;82(Suppl 1):663. doi:10.1136/annrheumdis-2023-eular.482.
- Zheng X, Liang Y, Cai J, Liu R. Childhood juvenile idiopathic arthritis combined with Klinefelter syndrome: a case report and literature review. *Am J Transl Res.* 2025;17(9):7300-7307. doi:10.62347/RAYG2315. PMID: 41113051.
- Ramos FO, Zinterl C, Fonseca JE. A lifelong journey: long-term perspectives on juvenile idiopathic arthritis. *Best Pract Res Clin Rheumatol.* 2024;38(3):101984. doi:10.1016/j.berh.2024.101984. PMID: 39068102.
- Ventura I, Meira-Blanco GC, Legidos-García ME, Pérez-Bermejo M, Murillo-Llorente MT. Is there a link between the molecular basis of juvenile idiopathic arthritis and autoimmune diseases? Systematic review. *Int J Mol Sci.* 2024;25(5):2803. doi:10.3390/ijms25052803. PMID: 38474052.
- La Bella S, Rinaldi M, Di Ludovico A, Di Donato G, Di Donato G, Salpietro V, et al. Genetic background and molecular mechanisms of juvenile idiopathic arthritis. *Int J Mol Sci.* 2023;24(3):1846. doi:10.3390/ijms24031846. PMID: 36768167.
- Chickermane PR, Panjikanan ND, Balan S. Role of rehabilitation in comprehensive management of juvenile idiopathic arthritis: when and how? *Indian J Rheumatol.* 2023;18(1 Suppl). doi:10.4103/injr.injr.55_22.
- Fazaa A, Sellami M, Ouenniche K, Miladi S, Kassab S, Chekili S, et al. Physical activity assessment in children and adolescents with juvenile idiopathic arthritis compared with controls. *Arch Pediatr.* 2021;28(1):47-52. doi:10.1016/j.arcped.2020.10.008. PMID: 33250332.
- Nesbitt C, Kuntze G, Toomey C, Esau S, Brooks J, Mosher D, et al. Secondary consequences of juvenile idiopathic arthritis in children and adolescents with knee involvement: physical activity, adiposity, fitness, and functional performance. *Rheumatol Int.* 2022;42(2):319-327. doi:10.1007/s00296-021-04920-5. PMID: 34132889.
- Rochette E, Saidi O, Merlin É, Duché P. Physical activity as a promising alternative for young people with juvenile idiopathic arthritis: towards an evidence-based prescription. *Front Immunol.* 2023;14:1119930. doi:10.3389/fimmu.2023.1119930. PMID: 36860845.
- Guerriero S, Palmieri R, Craig F, La Torre F, Albano V, Alessio G, et al. Psychological effects and quality of life in parents and children with JIA-associated uveitis. *Children (Basel).* 2022;9(12):1864. doi:10.3390/children9121864. PMID: 36553308.
- Liu WY, Li HM, Jiang H, Zhang WK. Effect of exercise training on health, quality of life, exercise capacity in juvenile idiopathic arthritis: a meta-analysis of randomised controlled trials. *Pediatr Rheumatol Online J.* 2024;22(1):33. doi:10.1186/s12969-024-00967-3. PMID: 38438855.
- Yenil S, Gür Kabul E, Başakçı Çalık B, Kılbaş G, Yüksel S. Investigation of motor skill in patients with juvenile idiopathic arthritis: a cross-sectional study. *Rev Colomb Reumatol.* 2025;32(1):36-42. doi:10.1016/j.rcreu.2023.11.005.
- Vincent HK, Sharififar S, Abdelmalik B, Lentini L, Chen C, Woolnough LU. Gait parameters, functional performance and physical activity in active and inactive juvenile idiopathic arthritis. *Gait Posture.* 2022;98:226-232. doi:10.1016/j.gaitpost.2022.09.080. PMID: 36191581.
- Elnaggar RK, Mahmoud WS, Moawd SA, Azab AR. Impact of core stability exercises on bone mineralisation and functional capacity in children with polyarticular juvenile idiopathic arthritis: a randomised clinical trial. *Clin Rheumatol.* 2021;40(1):245-253. doi:10.1007/s10067-020-05219-9. PMID: 32514677.

17. Di Ludovico A, La Bella S, Di Donato G, Felt J, Chiarelli F, Breda L. The benefits of physical therapy in juvenile idiopathic arthritis. *Rheumatol Int.* 2023;43(9):1563-1572. doi:10.1007/s00296-023-05380-9. PMID: 37382676.
18. Lupini F, Rubinstein TB, Mackey ER, Sule S. Behavioral health outcomes and social determinants of health in children with diabetes and juvenile arthritis. *Res Sq [Preprint]*. 2023 Nov 28.3.rs-3610878. doi:10.21203/rs.3.rs-3610878/v1. PMID: 38076886.
19. Iversen MD, Andre M, von Heideken J. Physical activity interventions in children with juvenile idiopathic arthritis: a systematic review of randomised controlled trials. *Pediatric Health Med Ther.* 2022;13:115-143. doi:10.2147/PHMT.S282611. PMID: 35444485.

AUTHORS CONTRIBUTION

Amina Ashfaq - Concept & Design; Data Acquisition; Critical Revision; Supervision; Final Approval

Somia Faisal - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Critical Revision; Final Approval

Sarfaraz Ahmad - Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Supervision; Final Approval

Amina Liaquat - Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Supervision; Final Approval

Sajal Rehman Nawaz - Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Supervision; Final Approval

Fatima Ali - Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Supervision; Final Approval
The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



LICENSE: JGMDS publishes its articles under a Creative Commons Attribution Non-Commercial Share-Alike license (CC-BY-NC-SA 4.0).

COPYRIGHTS: Authors retain the rights without any restrictions to freely download, print, share and disseminate the article for any lawful purpose.

It includes scholarly networks such as Research Gate, Google Scholar, LinkedIn, Academia.edu, Twitter, and other academic or professional networking sites.