INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

ASSESSMENT OF COGNITIVE FUNCTION AMONG ALDOLESCENTS WITH JUVENILE IDIOPATHIC ARTHRITIS

Original Research

Samama Abdul Rehman[1], Mahrukh Warraich[2], Shabah Surriya[3], M. Usama Sohail[4]*, Muhammad Sohaib Azeem[5], Khansa Farooq[6], Tarab Rasool[7]

[1]Physiotherapist, PCRS College of Rehabilitation Sciences, Lahore, Pakistan.
[2]Lecturer, Iqra University, Chak Shahzad Campus, Islamabad, Pakistan.
[3]Clinical Physiotherapist, Department of Physical Medicine and Rehabilitation, The Children's Hospital and University of Child Health Sciences, Lahore, Pakistan
[4]Senior Lecturer, Senior Physiotherapist, PSRD College of Rehabilitation Science, Lahore, Pakistan.
[5]Senior Physiotherapist, PSRD Hospital, Lahore, Pakistan.
[6]Physiotherapist, CMH Lahore Medical College, Pakistan.
[7]Consultant PT, Physiocure Fitness Clinic, Lahore, Pakistan.

Corresponding Author: M. Usama Sohail, Senior Lecturer, Senior Physiotherapist, PSRD College of Rehabilitation Science, Lahore, Pakistan, dr.usama51@gmail.com

Acknowledgement: The authors acknowledge the cooperation of all participating hospitals and the support of the parents and children involved in this study.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Juvenile idiopathic arthritis (JIA) is a chronic autoimmune condition that affects children and adolescents, primarily targeting synovial joints and causing inflammation, pain, and swelling. While its physical manifestations are well-documented, growing evidence indicates that chronic systemic inflammation may also impact cognitive development. Adolescents with JIA may experience impairments in memory, attention, and executive function, which can significantly influence academic performance and overall quality of life. Early identification of cognitive deficits is essential for timely interventions and holistic disease management.

Objective: To assess cognitive function in adolescents diagnosed with juvenile idiopathic arthritis using a standardized cognitive assessment tool.

Methods: A cross-sectional study was conducted over six months at three tertiary care hospitals in Lahore. Using purposive sampling, 100 adolescents aged 10–14 years with confirmed diagnoses of JIA were recruited. Inclusion criteria consisted of both male and female patients diagnosed with JIA, while those with systemic illnesses or developmental disorders were excluded. Cognitive function was evaluated using the Mini-Mental State Examination (MMSE), a structured tool administered by trained personnel. Data were recorded using a predesigned standardized questionnaire and analyzed descriptively.

Results: The mean age of participants was 11.95 ± 1.23 years, with a mean height of 4.91 ± 0.19 feet and mean weight of 48.20 ± 2.42 kg. Gender distribution was equal, with 50 males and 50 females. MMSE results indicated that 60% of participants scored in the normal range (30–26), whereas 40% demonstrated varying degrees of cognitive impairment, including mild to moderate deficits.

Conclusion: The study identifies a significant cognitive burden among adolescents with JIA, highlighting the importance of integrating cognitive assessment into routine clinical evaluation. Targeted cognitive interventions may improve long-term outcomes and enhance quality of life.

Keywords: Adolescent, Cognition, Cognitive Dysfunction, Juvenile Idiopathic Arthritis, MMSE, Neuropsychological Tests, Quality of Life.

INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Juvenile idiopathic arthritis (JIA) is the most common type of arthritis affecting children and adolescents, characterized by persistent joint inflammation involving the hands, knees, ankles, wrists, or elbows. Clinically, it presents with joint pain, swelling, and stiffness, often accompanied by systemic manifestations such as fatigue, rash, or fever (1). Also known as young-onset rheumatoid arthritis, JIA is an autoimmune or autoinflammatory condition in which the body's immune system erroneously targets its own tissues, particularly the synovium—the membrane responsible for lubricating and cushioning the joints—resulting in inflammation, pain, and reduced mobility. The International League of Associations for Rheumatology (ILAR) defines JIA as any arthritis of unknown origin that begins before the age of 16 and persists for more than six weeks and classifies the disease into seven distinct subtypes based on clinical features observed within the first six months (2,3). The pathophysiology of JIA is strongly linked to genetic predisposition, with both HLA Class I and II alleles implicated in disease onset and progression. One of the earliest identified genetic associations was between HLA-B27 and JIA, particularly in cases involving axial skeleton inflammation. Subsequent studies have reinforced this genetic link, demonstrating significant associations between HLA-DRB1*11 and HLA-DRB1*08 and the early-onset oligoarticular subtype, suggesting that immunogenetics plays a pivotal role in disease susceptibility and phenotype (4,5). Clinically, children may exhibit symptoms beyond joint involvement, including visual disturbances, anorexia, and cognitive changes. Elevated cytokines such as TNF-alpha and IL-6 have been found to contribute not only to joint inflammation but also to neuroinflammation, potentially impairing cognitive function, particularly during adolescence—a developmental period marked by crucial neurological maturation (6). JIA subtypes vary considerably, ranging from oligoarticular (affecting four or fewer joints initially) and polyarticular (involving five or more joints) to systemic forms, where arthritis is accompanied by prolonged fever, rash, lymphadenopathy, and organomegaly.

Other subtypes include psoriatic arthritis, enthesitis-related arthritis, and undifferentiated forms that do not neatly fit into the other categories. Each present with distinct clinical patterns, requiring individualized diagnostic and therapeutic approaches (7,8). Cognitive function is an emerging concern in adolescents with JIA, influenced by chronic inflammation, psychological stress, and long-term use of medications such as corticosteroids. These factors can collectively hinder academic performance and social integration, necessitating early evaluation and multidisciplinary management (9). Diagnosing JIA remains a clinical challenge due to the absence of a definitive test. The diagnosis is made when inflammatory symptoms persist for at least six weeks and other conditions have been excluded. Laboratory investigations such as antinuclear antibodies (ANA), rheumatoid factor (RF), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and complete blood count (CBC) aid in classification and monitoring of disease activity (10,11). Imaging modalities, including X-rays, MRI, CT scans, and bone scans, are employed to assess joint damage and inflammation. Treatment strategies encompass non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), corticosteroids, and biologic agents, complemented by lifestyle modifications involving physical therapy, occupational therapy, and nutritional counseling to preserve joint function and overall well-being (12,13). Given the potential neurological and psychosocial impact of chronic inflammation in JIA, assessing cognitive function in affected adolescents is vital. Early identification of cognitive impairments can inform personalized interventions, educational accommodations, and psychological support, enhancing both academic and psychosocial outcomes. Integrating cognitive evaluation into physiotherapeutic care allows for the development of holistic treatment plans, addressing motor function and cognitive domains in tandem. The objective of this study is to investigate the association between juvenile idiopathic arthritis and cognitive function in adolescents, with the aim of identifying early markers of cognitive decline and guiding comprehensive, multidisciplinary management strategies.

METHODS

This cross-sectional study was conducted over a six-month period from August to January following approval from the institutional review board (IRB). Ethical clearance was obtained prior to data collection, and informed consent was acquired from the parents or legal guardians of all participating children. The research was carried out across three major healthcare facilities in Lahore: the Pakistan Society for Rehabilitation of the Disabled (PSRD), Children's Hospital Lahore, and Fatima Memorial Hospital. A purposive sampling technique was employed to select participants who met the predefined eligibility criteria. The sample size was calculated to be 100, based on a 95% confidence level and a 5% margin of error, using the standard formula: $n = z^2 \times p(1-p)/d^2$, where n represents the

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

required sample size, *z* is the z-score corresponding to the desired confidence level, *p* is the estimated prevalence, and *d* is the precision. Participants included both male and female children aged between 10 and 14 years, all of whom had been previously diagnosed with juvenile idiopathic arthritis (JIA) by a certified rheumatologist. Children with any preexisting systemic illness, congenital mental disorders, or other developmental disorders were excluded to minimize confounding variables that could impact cognitive assessment outcomes. Cognitive function was assessed using the Mini-Mental State Examination (MMSE), a widely validated and standardized tool for screening cognitive status. The MMSE was administered in a consistent, structured format by trained personnel to ensure reliability of data. Responses were recorded on a predesigned, standardized questionnaire that captured both demographic and clinical variables relevant to the study objectives. The data collection process was carefully monitored to maintain uniformity across all study sites.

RESULTS

A total of 100 children diagnosed with juvenile idiopathic arthritis (JIA) participated in the study. The mean age of participants was 11.95 ± 1.23 years, with the minimum age being 10 and the maximum 14 years. The age distribution, as visualized by the histogram, indicated a fairly random spread across the range. The average height among the participants was recorded at 4.91 ± 0.195 feet, ranging from 4.5 to 5.2 feet. The distribution followed a normal curve, indicating consistent growth patterns across the cohort. Regarding weight, the mean value was 48.20 ± 2.42 kg, with individual weights ranging between 44 kg and 52 kg. The histogram of weight also displayed a relatively random distribution. Gender distribution was equal among the sample, with 50 males (50%) and 50 females (50%), ensuring gender balance in the analysis of clinical and cognitive parameters. Cognitive function, assessed using the Mini Mental State Examination (MMSE), revealed that 60% of the participants scored between 30 and 26, indicating normal cognitive function. Another 32% scored between 25 and 20, suggesting mild cognitive impairment. A smaller proportion, 5%, fell within the 19–10 range, while 3% scored below 10, indicating moderate to severe cognitive impairment. These findings highlight that although the majority of children maintained normal cognitive levels, a significant subset experienced measurable cognitive deficits.

Table 1: Age of patients

Variable	Mean± S.D
Age	11.95±1.23

Table 1: Mean of height in JIA patients

Variable	Mean± S.D
Height	4.91±.195

Table 2: Mean of weight (in Kgs) in JIA patients

Variable	Mean± S.D
Weight	48.20±2.42

Table 4: Frequency of gender in JIA patients

Gender	Frequency	Percent
Male	50	50
Female	50	50

Table 5: Mini Mental State Examination

MMSE	Frequency	Percent
30-26	60	60.0
25-20	32	32.0
9-20	5	5.0
9-0	3	3.0
Total	100	100.0

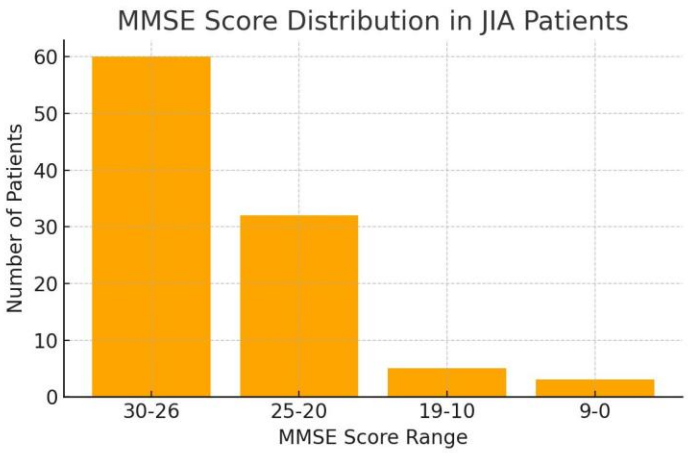

Figure 1 MMSE Score Distribution in JIA Patients

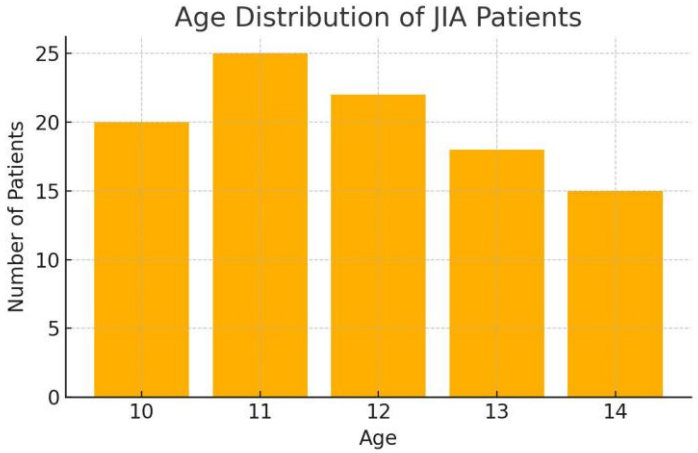

Figure 2 Age Distribution of JIA Patients

DISCUSSION

The findings of this study revealed that a significant proportion of adolescents with juvenile idiopathic arthritis (JIA) exhibited cognitive impairment, with 40% of participants scoring below the normal range on the Mini-Mental State Examination (MMSE). This observation aligns with prior research that has emphasized the broader neurocognitive and psychosocial burden of JIA, which extends beyond joint-related symptoms. Chronic inflammation, fatigue, and persistent pain—hallmarks of JIA—are increasingly being recognized as contributing factors to impairments in attention, memory, and executive function. These cognitive domains are critical for academic performance, emotional regulation, and overall social development during adolescence, a period of heightened neurological vulnerability. Multiple studies have underscored the potential influence of systemic inflammation and chronic disease states on cognitive functioning in pediatric populations (14,15). Evidence suggests that adolescents with JIA perform comparatively worse in cognitive assessments than their healthy peers, particularly in tasks requiring sustained attention and higher-order executive processing (16). These deficits may not always be readily apparent but can significantly hinder academic success and psychosocial adjustment over time. The current study reinforces the notion that cognitive decline can be an integral yet underrecognized component of the disease course, highlighting the need for its integration into routine clinical assessment and management protocols (17).

Neuropsychological evaluations conducted in similar cohorts have demonstrated that the long-term impact of JIA on school performance may persist into adulthood, suggesting a chronic trajectory of cognitive burden if left unaddressed (18). Furthermore, the cognitive dimension of pain has been explored in clinical trials using cognitive-behavioral frameworks, which support the concept that cognitive health is interdependent with pain perception and coping mechanisms (19). Integrative approaches that simultaneously address both physical and cognitive aspects of pain may offer enhanced therapeutic benefit in this patient population. Studies investigating physical activity levels among children with JIA have drawn associations between reduced mobility and compromised cognitive functioning, suggesting a bi-directional relationship between somatic and neurocognitive health (20). Reduced participation in physical activity not only exacerbates joint stiffness and deconditioning but may also limit neural stimulation and contribute to cognitive stagnation. Addressing this dual challenge through personalized exercise regimens and occupational interventions could have protective effects on cognitive trajectories. Psychosocial stressors further compound cognitive challenges in adolescents with JIA. Previous research has demonstrated that youth living with chronic autoimmune conditions are at increased risk for emotional dysregulation, social withdrawal, and depressive symptoms (21). These emotional burdens can potentiate cognitive dysfunction, emphasizing the necessity for multidisciplinary models of care that incorporate mental health screening and support.

This study contributes to the growing body of literature calling for comprehensive care frameworks that include cognitive assessment as a routine element in the management of JIA. The MMSE, while utilized in this study due to its accessibility and general application, may not be fully sensitive to the nuances of pediatric cognition. It is more frequently validated for adult populations, and its use in adolescents—especially those with variable developmental profiles—poses limitations. The reliance on MMSE alone may lead to

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

underestimation of subtle or domain-specific deficits, such as working memory or verbal fluency, which are crucial in academic contexts (22). Future studies should incorporate more developmentally appropriate neurocognitive tools to yield a more precise evaluation of deficits in this population. Additionally, the cross-sectional design restricts conclusions regarding the progression of cognitive impairment over time. Longitudinal studies are needed to determine whether cognitive decline in JIA stabilizes, worsens, or improves with treatment. Despite these limitations, the study's strength lies in its focus on a relatively neglected dimension of JIA care. By documenting a significant proportion of cognitive impairment among affected adolescents, it advocates for a paradigm shift toward more holistic care approaches. Integrating educational psychologists, neuropsychologists, and rehabilitation specialists into rheumatologic care teams can facilitate timely interventions. Tailored strategies such as cognitive training, academic accommodations, and behavioral therapies may mitigate the educational and psychosocial consequences of JIA-associated cognitive decline. In summary, the study reinforces the pressing need to expand clinical lens in JIA management beyond joint health, to encompass cognitive and functional well-being. Such an inclusive approach promises to enhance not only the health outcomes but also the quality of life and future potential of children and adolescents living with this chronic disease.

CONCLUSION

This study highlights the often-overlooked cognitive implications of juvenile idiopathic arthritis, emphasizing that the condition affects more than just physical health. The findings underscore the importance of recognizing and addressing cognitive challenges in adolescents with JIA as part of a comprehensive care approach. By bringing attention to the need for early assessment and supportive interventions, the study advocates for integrating cognitive health into routine clinical management. Such efforts can contribute meaningfully to enhancing academic performance, emotional well-being, and overall quality of life for affected individuals.

AUTHOR CONTRIBUTION

Author	Contribution
Samama Abdul Rehman	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Mahrukh Warraich	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Shabah Surriya	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
M. Usama Sohail*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Sohaib Azeem	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Khansa Farooq	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Tarab Rasool	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Fazaa, A., Sellami, M., Ouenniche, K., Miladi, S., Kassab, S., Chekili, S., Ben Abdelghani, K. & Laatar, A. 2021. Physical Activity Assessment In Children And Adolescents With Juvenile Idiopathic Arthritis Compared With Controls. Archives De Pédiatrie, 28, 47-52.
2. Granjon, M., Rohmer, O., Doignon-Camus, N., Popa-Roch, M., Pietrement, C. & Gavens, N. 2021. Neuropsychological Functioning and Academic Abilities In Patients With Juvenile Idiopathic Arthritis. Pediatric Rheumatology, 19, 53.

3. Iversen, M. D., Andre, M. & Von Heideken, J. 2022. Physical Activity Interventions in Children with Juvenile Idiopathic Arthritis: A Systematic Review Of Randomized Controlled Trials. Pediatric Health Med Ther, 13, 115-143.
4. Martini, A., Lovell, D. J., Albani, S., Brunner, H. I., Hyrich, K. L., Thompson, S. D. & Ruperto, N. 2022. Juvenile Idiopathic Arthritis. Nature Reviews Disease Primers, 8, 5.
5. Mena-Vázquez, N., Cabezudo-García, P., Ortiz-Márquez, F., Díaz-Cordovés Rego, G., Muñoz-Becerra, L., Manrique-Arija, S. & Fernández-Nebro, A. 2021. Evaluation Of Cognitive Function In Adult Patients With Juvenile Idiopathic Arthritis. International Journal Of Rheumatic Diseases, 24, 81-89.
6. Onel, K. B., Horton, D. B., Lovell, D. J., Shenoi, S., Cuello, C. A., Angeles-Han, S. T., Becker, M. L., Cron, R. Q., Feldman, B. M. & Ferguson, P. J. 2022. 2021 American College of Rheumatology Guideline for The Treatment of Juvenile Idiopathic Arthritis: Therapeutic Approaches For Oligoarthritis, Temporomandibular Joint Arthritis, And Systemic Juvenile Idiopathic Arthritis. Arthritis & Rheumatology, 74, 553-569.
7. Ortiz-Márquez, F., Padilla-Leiva, C., Cabezudo-García, P., Diaz-Cordobes, G., Muñoz-Becerra, L. & Mena-Vázquez, N. 2022. Ab1240 Prospective Evaluation of Cognitive Function In Patients With Juvenile Idiopathic Arthritis. Bmj Publishing Group Ltd.
8. Paroli, M., Spadea, L., Caccavale, R., Spadea, L., Paroli, M. P. & Nante, N. 2022. The Role of Interleukin-17 In Juvenile Idiopathic Arthritis: From Pathogenesis to Treatment. Medicina, 58, 1552.
9. Ruperto, N., Brunner, H. I., Synoverska, O., Ting, T. V., Mendoza, C. A., Spindler, A., Vyzhga, Y., Marzan, K., Grebenkina, L. & Tirosh, I. 2021. Tofacitinib In Juvenile Idiopathic Arthritis: A Double-Blind, Placebo-Controlled, Withdrawal Phase 3 Randomised Trial. The Lancet, 398, 1984-1996.
10. Zhao, W.-J., Deng, J.-H. & Li, C.-F. 2023. Lipid Profiles In Patients With Juvenile Idiopathic Arthritis: A Systematic Literature Review And Meta-Analysis. Lipids In Health and Disease, 22, 136.
11. Hinze CH, Foell D, Kessel C. Treatment of systemic juvenile idiopathic arthritis. Nat Rev Rheumatol. 2023;19(12):778-89.
12. Ambler WG, Nanda K, Onel KB, Shenoi S. Refractory systemic onset juvenile idiopathic arthritis: current challenges and future perspectives. Ann Med. 2022;54(1):1839-50.
13. Weiss JE. Prediction Model for Juvenile Idiopathic Arthritis: Challenges and Opportunities. J Pediatr. 2022; 251:46-9.
14. Stoustrup P, Resnick CM, Abramowicz S, Pedersen TK, Michelotti A, Küseler A, et al. Management of Orofacial Manifestations of Juvenile Idiopathic Arthritis: Interdisciplinary Consensus-Based Recommendations. Arthritis Rheumatol. 2023;75(1):4-14.
15. Zaripova LN, Midgley A, Christmas SE, Beresford MW, Baildam EM, Oldershaw RA. Juvenile idiopathic arthritis: from aetiopathogenesis to therapeutic approaches. Pediatr Rheumatol Online J. 2021;19(1):135.
16. Martini A, Lovell DJ, Albani S, Brunner HI, Hyrich KL, Thompson SD, et al. Juvenile idiopathic arthritis. Nat Rev Dis Primers. 2022;8(1):5.
17. De Benedetti F, Grom AA, Brogan PA, Bracaglia C, Pardeo M, Marucci G, et al. Efficacy and safety of emapalumab in macrophage activation syndrome. Ann Rheum Dis. 2023;82(6):857-65.
18. Schmidt C, Ertel T, Arbogast M, Hügle B, Kalle TV, Neff A. The Diagnosis and Treatment of Rheumatoid and Juvenile Idiopathic Arthritis of the Temporomandibular Joint. Dtsch Arztebl Int. 2022;119(4):47-54.
19. Towe C, Grom AA, Schulert GS. Diagnosis and Management of the Systemic Juvenile Idiopathic Arthritis Patient with Emerging Lung Disease. Paediatr Drugs. 2023;25(6):649-58.
20. Bansal N, Pasricha C, Kumari P, Jangra S, Kaur R, Singh R. A comprehensive overview of juvenile idiopathic arthritis: From pathophysiology to management. Autoimmun Rev. 2023;22(7):103337.
21. Huang HYR, Wireko AA, Miteu GD, Khan A, Roy S, Ferreira T, et al. Advancements and progress in juvenile idiopathic arthritis: A Review of pathophysiology and treatment. Medicine (Baltimore). 2024;103(13): e37567.
22. Onel KB, Horton DB, Lovell DJ, Shenoi S, Cuello CA, Angeles-Han ST, et al. 2021 American College of Rheumatology Guideline for the Treatment of Juvenile Idiopathic Arthritis: Recommendations for Nonpharmacologic Therapies, Medication Monitoring, Immunizations, and Imaging. Arthritis Care Res (Hoboken). 2022;74(4):505-20.

