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Physiotherapy-based rehabilitation in Autism Spectrum Disorder: A comprehensive review of motor-focused interventions

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Abstract
Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by impairments in social communication and restricted, repetitive behaviors. In addition to these core features, children with ASD frequently present with motor dysfunctions including delayed gross motor development, impaired balance, postural instability, hypotonia, and poor coordination. These motor impairments adversely affect functional independence, participation in physical activity, and quality of life. Physiotherapy plays a crucial role in addressing these deficits through structured motor training, balance exercises, strength conditioning, and physical activity-based interventions. This review synthesizes current evidence on physiotherapy-related rehabilitation in children with ASD. Findings from randomized controlled trials, systematic reviews, and observational studies indicate that physiotherapy interventions significantly improve gross motor skills, postural control, balance, and functional participation. Early, individualized, and multidisciplinary physiotherapy programs demonstrate superior outcomes. Despite growing evidence, challenges remain regarding standardization of intervention protocols and long-term outcome evaluation.

Keywords: Autism Spectrum Disorder, physiotherapy, motor development, balance training, rehabilitation, physical activity

Introduction

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental disorder with an increasing global prevalence, currently estimated at approximately 1 in 100 children worldwide [1, 2]. While diagnostic criteria primarily emphasize social communication deficits and restricted behaviors, growing evidence highlights motor impairment as a prominent associated feature of ASD [3, 4]. Motor difficulties such as delayed gross motor milestones, hypotonia, impaired balance, postural instability, dyspraxia, and poor coordination are reported in up to 80–90% of children with ASD [5, 7].

Motor impairments often appear early in development and persist into adolescence and adulthood, significantly affecting activities of daily living, play, school participation, and physical fitness [8, 9]. Reduced motor competence may further limit social interaction and participation, thereby exacerbating functional and behavioral challenges [10]. Physiotherapy interventions target these motor impairments and aim to improve functional independence, physical participation, and quality of life.

Motor Impairments in Autism Spectrum Disorder

Children with ASD demonstrate marked deficits in fundamental motor skills (FMS), including locomotor skills, object control, and balance [11]. Postural control deficits and sensory-motor integration problems contribute to reduced physical activity levels and increased sedentary behavior [12]. Neuroimaging and neurophysiological studies suggest atypical motor cortex connectivity and cerebellar dysfunction as underlying mechanisms for these motor impairments [13, 14].

Early identification of motor dysfunction is essential, as early physiotherapy intervention can utilize neural plasticity to positively influence motor development and long-term functional outcomes [15].

Role of Physiotherapy in ASD Rehabilitation

Physiotherapy plays a key role in ASD rehabilitation by addressing motor deficits that are often under-recognized in routine clinical practice. Physiotherapy interventions aim to:

- Improve gross motor development
- Enhance balance and postural stability
- Develop coordination and motor planning
- Improve muscle strength, endurance, and aerobic capacity
- Promote participation in play, sports, and daily activities

Common physiotherapy approaches include structured exercise programs, balance and coordination training, psychomotor rehabilitation, play-based therapy, and task-oriented motor training [16, 18].

Evidence from Physiotherapy-Related Interventions

1. Exercise and Motor Skill Training

Systematic reviews and meta-analyses consistently demonstrate that structured exercise interventions significantly improve fundamental motor skills in children with ASD, particularly locomotor and balance skills [19, 21]. Improvements in motor competence may also enhance participation in physical and social activities.

2. Balance and Postural Control Training

Balance-oriented physiotherapy interventions improve static and dynamic postural control, especially when sensory challenges such as altered visual input or unstable surfaces are incorporated [22, 24]. Psychomotor rehabilitation programs further enhance sensory integration and postural stability [25].

3. Multidisciplinary and Combined Physiotherapy Programs

Combined physiotherapy programs integrating strength training, coordination exercises, balance activities, and aerobic conditioning demonstrate superior outcomes compared to isolated interventions [26, 27].

Summary of Physiotherapy-Related Studies

Table 1: Physiotherapy-Based Rehabilitation Studies in Autism Spectrum Disorder

Study Title	Design & Sample	Results / Discussion	Conclusion
Effectiveness of exercise intervention on improving fundamental motor skills in children with ASD [19]	Systematic review & meta-analysis (13 studies, n=541)	Significant improvements in locomotor, object control, and balance skills	Exercise-based physiotherapy improves FMS in ASD
Two physiotherapy methods to improve physical condition in children with ASD [20]	Experimental study (children 4–6 yrs)	Balance and coordination improved in both intervention groups	Simple physiotherapy programs are effective
Motor skills and physical activity interventions in ASD [21]	Narrative review	Consistent improvements in gross motor development	Physiotherapy-led activity improves motor outcomes
Balance training intervention on postural control in ASD [22]	Intervention-based studies	Improved postural control under sensory challenges	Balance training is essential in ASD physiotherapy
Psychomotor rehabilitation and postural control [25]	Controlled intervention study	Enhanced postural stability and sensory integration	Psychomotor physiotherapy improves motor control
Motor impairment and PT utilization in ASD (SPARK study) [28]	Large observational study	High motor impairment, low PT utilization	Increased access to physiotherapy is needed

Discussion

The findings of this review strongly support the role of physiotherapy in addressing motor impairments associated with ASD. Structured exercise programs, balance training, and psychomotor interventions consistently demonstrate improvements in gross motor skills, postural control, and functional participation [19, 25]. Improved motor competence may also indirectly enhance social participation and engagement in peer activities [10, 29].

Despite positive outcomes, heterogeneity in intervention protocols, treatment duration, and outcome measures limits cross-study comparability [21]. Additionally, long-term follow-up studies are limited. Nevertheless, evidence supports early, individualized, and goal-oriented physiotherapy interventions integrated within multidisciplinary rehabilitation models [26, 27].

Clinical Implications

- Physiotherapy should be considered a core rehabilitation service for children with ASD
- Early intervention improves motor and functional outcomes
- Programs should be individualized, play-based, and task-oriented
- Standardized outcome measures are essential for monitoring progress

Limitations and Future Directions

Future research should emphasize:

- Large-scale randomized controlled trials
- Standardized physiotherapy intervention protocols
- Long-term follow-up and functional participation outcomes
- Technology-assisted physiotherapy interventions (VR, exergaming, telerehabilitation)

Conclusion

Physiotherapy-based rehabilitation is effective in improving motor skills, balance, postural control, and physical participation in children with Autism Spectrum Disorder. Evidence supports the integration of structured exercise, balance training, and psychomotor interventions into early, individualized, and multidisciplinary rehabilitation programs to optimize functional outcomes and quality of life.

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