

Music-Enhanced Physical Education and Its Contribution to the Inclusion of Children with Autism Spectrum Disorder: A Narrative Review

Η συμβολή της μουσικής στη Φυσική Αγωγή για τη συμπερίληψη των παιδιών με Διαταραχή Αυτιστικού Φάσματος (ΔΑΦ): Αφηγηματική ανασκόπηση

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Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by challenges in social communication, sensory processing, and behavioral flexibility. These characteristics often influence children's participation in physical education (PE) and group activities. Music-based strategies have increasingly been incorporated into PE interventions to enhance engagement, improve motor performance, and support social inclusion. This narrative review synthesizes evidence from studies examining music therapy, physical activity, and combined music-movement programs for children with ASD aged 4–12 years. Findings indicate that music facilitates attention, emotional expression, rhythm perception, and cooperative behavior, while structured PE programs improve motor competence, balance, coordination, and social interaction. Combined interventions—such as rhythmic movement, dance-based activities, taekwondo with musical accompaniment, and music-supported ball-handling tasks—demonstrate promising outcomes for both motor and social domains. Practical implications for PE teachers include the use of predictable routines, rhythmic cues,

sensory-friendly environments, and peer-mediated strategies. Integrating music into PE emerges as a low-cost, accessible, and inclusive approach that supports the holistic development of children with ASD.

Keywords: Autism Spectrum Disorder; Physical Education; Music Therapy; Inclusion; Motor Skills; Rhythmic Movement; Social Interaction

Περίληψη

Ο Αυτισμός (ASD) αποτελεί μια νευροαναπτυξιακή διαταραχή που χαρακτηρίζεται από δυσκολίες στην κοινωνική επικοινωνία, αισθητηριακή επεξεργασία και ευελιξία συμπεριφοράς. Τα χαρακτηριστικά αυτά επηρεάζουν σημαντικά τη συμμετοχή των παιδιών στο μάθημα της Φυσικής Αγωγής (ΦΑ) και σε ομαδικές δραστηριότητες. Η παρούσα αφηγηματική ανασκόπηση εξετάζει τον ρόλο της μουσικής και των μουσικοκινητικών παρεμβάσεων στη βελτίωση της κινητικής απόδοσης, της κοινωνικής αλληλεπίδρασης και της συναισθηματικής ρύθμισης παιδιών με ASD ηλικίας 4–12 ετών. Τα ευρήματα δείχνουν ότι η μουσική ενισχύει την προσοχή, τη μίμηση, την κοινωνική συμμετοχή και τη ρυθμική οργάνωση της κίνησης, ενώ τα δομημένα προγράμματα ΦΑ βελτιώνουν την ισορροπία, τον συντονισμό, τις δεξιότητες αντικειμένου και τη συνεργατική συμπεριφορά. Συνδυαστικές παρεμβάσεις, όπως ρυθμικά κινητικά προγράμματα, θεραπεία μέσω χορού, μουσικοκινητικές δεξιότητες με μπάλα και Taekwondo με μουσική συνοδεία, παρουσιάζουν ιδιαίτερα θετικά αποτελέσματα σε κινητικό και κοινωνικό επίπεδο. Η ενσωμάτωση της μουσικής στη ΦΑ αποτελεί μια οικονομική, προσβάσιμη και αποτελεσματική πρακτική που προάγει την ένταξη και την ολόπλευρη ανάπτυξη των παιδιών με ASD.

Λέξεις-κλειδιά

Αυτισμός; Φυσική Αγωγή; Μουσικοθεραπεία; Ένταξη; Κινητικές Δεξιότητες; Ρυθμική Κίνηση; Κοινωνική Αλληλεπίδραση

1. Introduction

Autism Spectrum Disorder (ASD) is often framed as a deviation from societal norms of communication and behavior, leading to misconceptions and stigmatization. Contemporary research emphasizes the need for inclusive, strengths-based approaches that support children's participation in educational and social environments. Physical education (PE) offers a unique context for inclusion, as it involves movement, cooperation, communication, and shared experiences. However, children with ASD often face barriers to participation due to motor coordination difficulties, sensory sensitivities, and challenges in social interaction (Shrinivasan et al., 2014; Fournier et al., 2010).

Music has emerged as a promising tool for enhancing motivation, attention, and emotional regulation in children with ASD. When integrated into PE settings, music may strengthen participation, facilitate movement learning, and promote social inclusion (Shi et al., 2024; Sharda et al., 2019). This narrative review examines the contribution of music-enhanced PE to the inclusion of children with ASD, synthesizing evidence from studies on music therapy, PE interventions, and combined approaches.

2. Methods (Search Strategy)

A narrative review methodology was adopted. Articles published between 2007 and 2024 were identified through Google Scholar, SportDiscus, and ScienceDirect using the keywords: *autism, ASD, physical education, music therapy, rhythmic movement, motor skills, inclusion, children.*

Inclusion criteria

- Participants aged 4–12 years
- Studies involving music, PE, or combined interventions
- Outcomes related to motor, social, emotional, or communicative development
- School, clinical, or community settings

Exclusion criteria

- Studies involving adolescents or adults
- Interventions unrelated to movement or music
- Non-peer-reviewed sources

3. Autism Spectrum Disorder: Diagnostic and Functional Characteristics

3.1 Diagnostic framework

ASD is defined as a neurodevelopmental condition characterized by persistent difficulties in social communication and interaction, alongside restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). Restricted and repetitive behaviors may include stereotyped movements, insistence on sameness, highly restricted interests, and hyper- or hypo-reactivity to sensory input (American Psychiatric Association,

2013). Each individual presents a unique constellation of behaviors and symptoms (Baena Beato et al., 2010).

DSM-5 conceptualizes ASD as a spectrum diagnosis, combining the previously separate pervasive developmental disorder (PDD) categories of DSM-IV (Holly et al., 2020). Concerns have been raised regarding reduced prevalence due to higher specificity and lower sensitivity of DSM-5 criteria (Kulage et al., 2014; Gibbs et al., 2012; Maenner et al., 2014; Miral et al., 2017).

3.2 Social interaction and communication

Children with ASD may struggle to initiate and maintain relationships, interpret social cues, and engage in reciprocal communication (Association & APA, 2013; Benson et al., 2019; Bo et al., 2019; Hamm & Yun, 2019). Difficulties include reduced eye contact, limited gesture use, and challenges in non-verbal communication (Woodman et al., 2018). Behavioral manifestations may include aggression, self-injury, and difficulty following rules (Lee & Haegele, 2016). Sensory processing difficulties further complicate participation in group activities (Wilmshurst & Brue, 2010; Habib et al., 2018).

3.3 Motor development

Children with ASD often present lower levels of manual dexterity and fine motor precision (Lourenço et al., 2020). Recent meta-analyses confirm that motor difficulties—including balance deficits, gait variability, and impaired coordination—remain significantly under-recognized and under-addressed (Licari et al., 2020; Fournier et al., 2022). Common motor characteristics include hypotonia, apraxia, reduced ankle mobility, delayed gross motor milestones, and toe-walking (Ming et al., 2007). Deficits in postural control, gait, lateralization, handwriting, and object control are well documented (Fournier et al., 2010; McIlipets et al.,

2014; Srinivasan et al., 2014). More recent studies highlight atypical gait variability and timing difficulties, which can be improved through rhythmic cueing (Whyatt & Craig, 2022). Psychiatric comorbidities such as anxiety and ADHD are also prevalent (Soke et al., 2018; Arnell et al., 2018).

4. Environmental Influences on Participation

Child development is shaped by interactions with the environment at multiple levels (Bronfenbrenner, 1997). Parents of children with disabilities often perceive the environment as less supportive and report more barriers compared to parents of typically developing children (Guichard & Grande, 2019; Egilson, 2017). Environmental characteristics such as noise levels and lighting can be particularly challenging for children with ASD (Egilson et al., 2018). The physical layout of spaces and the social and cognitive demands of activities may hinder social connections and participation (Egilson et al., 2018).

5. Music and Music Therapy as Tools for Inclusion

Music supports expression, communication, socialization, and stress regulation (Shi et al., 2024). Recent Cochrane evidence confirms that music therapy significantly improves social interaction, emotional engagement, and communication in ASD (Geretsegger et al., 2020). Long-term follow-up studies also show sustained improvements in social responsiveness and parent-child interaction (Bieleninik et al., 2021). Music therapy promotes joint attention, imitation, turn-taking, emotional understanding, and cooperative behavior (Hansen et al., 2018; Shi et al., 2024). Techniques include music listening, social stories embedded in music, structured music teaching, musical games, singing, and improvisation (Sharda et al., 2019). Music activates the mirror neuron system, supporting imitation and social cognition (Kim et al., 2009; McCleery et al., 2013). Recent neuroimaging studies show that music-movement synchrony enhances neural connectivity in ASD (Sharda et al., 2020).

5.1 Music as a social and emotional medium

Music has historically served as a medium for social bonding, emotional expression, and collective participation (Federici, 2004). Shared musical activities strengthen empathy, social bonding, and a sense of belonging (Rabinowitch, 2017). For children with ASD, music supports expression, communication, socialization, and stress regulation (Shi et al., 2024).

5.2 Music therapy

Music therapy promotes joint attention, imitation, turn-taking, emotional understanding, and cooperative behavior (Hansen et al., 2018; Shi et al., 2024). Techniques include music listening, social stories embedded in music, structured music teaching, musical games, singing, and improvisation (Sharda et al., 2019). Music activates the mirror neuron system, supporting imitation and social cognition (Kim et al., 2009; McCleery et al., 2013).

6. Physical Education Interventions

PE programs improve balance, coordination, locomotor skills, object control, and postural stability (Lourenço et al., 2020). Updated reviews confirm that motor skill interventions lead to improvements in adaptive behavior and participation (Bremer & Lloyd, 2020). Structured routines and visual supports enhance learning and reduce uncertainty. Recent evidence shows that PE participation improves executive function, emotional regulation, and social outcomes in ASD (Zhao et al., 2021; Healy et al., 2022). Peer-mediated activities, cooperative games, and predictable routines promote participation and reduce social isolation (Habib et al., 2018). Barriers such as sensory overload, unpredictable environments, and lack of teacher training remain significant (Obrusnikova & Dillon, 2021).

6.1 Motor skill development

PE programs improve balance, coordination, locomotor skills, object control, and postural stability (Lourenço et al., 2020). Structured routines and visual supports enhance learning and reduce uncertainty.

6.2 Social inclusion in PE

Peer-mediated activities, cooperative games, and predictable routines promote participation and reduce social isolation (Habib et al., 2018).

7. Combined Music and Physical Activity Interventions

Research indicates that music–movement interventions enhance attention, imitation, emotional regulation, and motor coordination, while also promoting social participation and reducing anxiety in children with ASD (Shi et al., 2024; Sharda et al., 2019). Recent studies further confirm that rhythmic movement interventions improve timing, gait stability, bilateral coordination, and social engagement (Srinivasan et al., 2021; Whyatt & Craig, 2022). These combined approaches appear more effective than single-modality interventions because they activate multisensory pathways and support learning through predictable rhythmic structures (Kim & Wigram, 2023; Sharda et al., 2020).

Integrating music into physical activity programs has shown significant benefits for children with ASD, as it simultaneously engages motor, sensory, cognitive, and socio-emotional systems. Music provides an external rhythmic cue that stabilizes movement patterns, reduces cognitive load, and increases engagement—an important advantage given that children with ASD often demonstrate difficulties in timing, bilateral coordination, visuomotor integration, and motor planning (Fournier et al., 2010; McIlipets et al., 2014; Srinivasan et al., 2014; Licari et al., 2020). Updated evidence also highlights that rhythmic auditory stimulation improves

gait variability and motor timing, offering a structured scaffold for movement execution (Srinivasan et al., 2021; Whyatt & Craig, 2022).

Taken together, these findings demonstrate that music-enhanced physical activity programs provide a powerful, multisensory framework that supports both motor and social development in children with ASD. The following subsections present evidence-based combined interventions that incorporate music into physical activity settings.

7.1 Rhythmic Movement Programs

Rhythmic movement programs typically include activities such as rhythmic walking, clapping sequences, stepping patterns, synchronized group movements, and the use of percussion instruments. These activities are designed to align movement with auditory cues, supporting motor timing and coordination.

Studies show that rhythmic movement:

- improves timing and rhythmic accuracy
- enhances bilateral coordination
- reduces stereotyped behaviors
- increases attention and task engagement
- strengthens group cohesion and social synchrony

Children with ASD often struggle with motor synchronization and temporal processing (Srinivasan et al., 2014). Rhythmic cues act as an external pacing mechanism, helping children regulate their movements more effectively.

Synchronizing movement with others has also been linked to increased empathy, cooperation, and prosocial behavior (Rabinowitch & Meltzoff, 2017; Cirelli et al., 2014). These findings suggest that rhythmic movement programs not only support motor development but also foster social inclusion. Recent evidence shows that rhythmic entrainment improves gait variability, timing, and bilateral coordination in ASD (Srinivasan et al., 2021; Whyatt & Craig, 2022).

7.2 Dance-Movement Therapy

Dance-Movement Therapy (DMT) is one of the most widely studied combined interventions for children with ASD. DMT integrates structured and improvisational movement with music to promote emotional expression, body awareness, and social interaction.

Evidence shows that DMT:

- enhances body awareness and postural control
- improves balance and motor planning
- reduces anxiety and sensory overload
- increases emotional expression and regulation
- strengthens imitation and non-verbal communication
- promotes social engagement through shared movement

Music plays a central role in DMT by providing predictable rhythmic patterns that help children anticipate movement sequences and regulate their arousal levels. Research demonstrates that musical movement activities activate the mirror neuron system, which is associated with imitation, empathy, and understanding others' intentions (Kim et al., 2009; McCleery et al., 2013). This is particularly relevant for children with ASD, who often experience challenges in these domains.

DMT reduces repetitive behaviors and increases responsiveness to social cues (Sharda et al., 2019). Group dance activities, such as circle dances or partner-based movement tasks, further enhance social participation and a sense of belonging.

Newer studies confirm improvements in emotional regulation, imitation, and social engagement (Zhou et al., 2022). Music-movement synchrony has been shown to enhance neural connectivity and social motivation (Sharda et al., 2020).

7.3 Music-Supported Ball-Handling and Coordination Tasks

Ball-handling tasks—such as dribbling, catching, throwing, and aiming—are essential components of physical education but can be challenging for children with ASD due to deficits in visuomotor integration and motor planning (Fournier et al., 2010; McIlipets et al., 2014).

Integrating rhythmic cues into these tasks has been shown to:

- improve timing and movement sequencing
- increase accuracy and stability
- reduce motor variability
- enhance focus and sustained attention
- support learning of complex motor patterns

Rhythmic auditory stimulation (RAS), such as a steady beat or metronome, provides a temporal structure that helps children coordinate their movements more effectively. Shi et al. (2024) highlight that rhythmic cues reduce cognitive load by externalizing timing demands, allowing children to focus on movement execution.

Music-supported ball activities also promote social interaction when implemented in group settings. For example, passing a ball in synchrony with music encourages turn-taking, joint attention, and cooperative behavior—skills that are often difficult for children with ASD (Benson et al., 2019; Hamm & Yun, 2019).

Recent studies show that music-supported motor training improves visuomotor integration, timing, and sustained attention in ASD (Pan et al., 2022). Rhythmic cues reduce cognitive load and improve accuracy in object-control tasks (Shi et al., 2024).

7.4 Taekwondo with Musical Accompaniment

Taekwondo is a structured martial art that incorporates sequences of movements (Poomsae), balance exercises, kicks, blocks, and jumps. For children with ASD, Taekwondo has been associated with improvements in:

- balance and postural control
- motor planning and sequencing
- self-discipline and emotional regulation
- attention and focus
- confidence and self-esteem

When Taekwondo is paired with music, the benefits become even more pronounced. Music helps children:

- synchronize their movements with external cues
- maintain focus during complex sequences
- regulate arousal and reduce anxiety

- experience the activity as more enjoyable and predictable

Srinivasan et al. (2014) emphasize that rhythmic auditory cues enhance motor timing and stability, which are essential for executing martial arts sequences. The structured, repetitive nature of Taekwondo aligns well with the strengths of many children with ASD, while the addition of music supports emotional engagement and reduces stress.

Recent evidence shows that martial arts interventions improve balance, focus, and emotional regulation in ASD, especially when rhythmic cues are incorporated (Huang et al., 2024).

8. Discussion

The findings of this narrative review highlight the significant potential of music-enhanced physical activity interventions to support the motor, social, emotional, and communicative development of children with Autism Spectrum Disorder (ASD). Across the reviewed studies, music consistently emerged as a powerful tool for increasing engagement, regulating sensory responses, and facilitating social interaction. When combined with structured physical activity, music appears to amplify the benefits of movement-based interventions by providing predictable rhythmic cues, enhancing motivation, and reducing anxiety (Shi et al., 2024; Sharda et al., 2019).

Motor difficulties—including deficits in timing, bilateral coordination, balance, and visuomotor integration—are well documented in children with ASD (Fournier et al., 2010; McIlipets et al., 2014; Srinivasan et al., 2014). Music-based interventions address these challenges by offering external rhythmic scaffolding that supports motor planning and execution. Rhythmic auditory stimulation has been shown to stabilize gait patterns, improve timing, and enhance coordination, making it particularly suitable for children who struggle with internal motor regulation (Srinivasan et al., 2014).

Social communication challenges, such as reduced eye contact, limited gesture use, and difficulty engaging in reciprocal interactions, also represent significant barriers to participation in physical education (Benson et al., 2019; Hamm & Yun, 2019). Music therapy and music-movement programs promote joint attention, imitation, and turn-taking—skills that are foundational for social inclusion (Hansen et al., 2018; Rabinowitch & Meltzoff, 2017). Group-based rhythmic activities, such as synchronized movement or dance, foster social bonding and increase prosocial behavior (Cirelli et al., 2014; Schellenberg et al., 2015).

Importantly, the reviewed evidence suggests that combined interventions—those integrating music with structured physical activity—may be more effective than either modality alone. This is likely due to the multisensory nature of these programs, which engage auditory, motor, cognitive, and emotional systems simultaneously. The activation of the mirror neuron system during musical movement activities may further support imitation and social understanding (Kim et al., 2009; McCleery et al., 2013), addressing core challenges in ASD.

Despite these promising findings, the literature is limited by small sample sizes, heterogeneous methodologies, and inconsistent intervention protocols. Few studies include long-term follow-up, making it difficult to determine the sustainability of observed gains. Nevertheless, the convergence of evidence across multiple domains—motor, social, emotional, and behavioral—strongly supports the integration of music into physical education for children with ASD.

9. Practical Implications for Physical Education Teachers

Based on the reviewed literature, several practical recommendations can guide physical education (PE) teachers in implementing music-enhanced interventions for children with ASD:

- **Use rhythmic cues to support motor learning**

Rhythmic auditory stimulation (e.g., steady beats, metronomes, simple musical patterns) can improve timing, coordination, and movement sequencing (Srinivasan et al., 2014).

- **Incorporate music into warm-ups and skill practice**

Music increases motivation, reduces anxiety, and enhances engagement, making it ideal for transitions, warm-ups, and repetitive skill drills (Shi et al., 2024).

- **Create predictable, structured routines**

Children with ASD benefit from clear expectations and consistent patterns. Using the same musical cues for specific activities can reduce uncertainty and improve participation (Egilson et al., 2018).

- **Use group-based rhythmic activities to promote social inclusion**

Synchronized movement, circle dances, and rhythmic games foster cooperation, joint attention, and peer interaction (Rabinowitch & Meltzoff, 2017).

- **Adapt sensory environments**

Soft, predictable music can reduce sensory overload, while loud or complex music should be avoided for children with hypersensitivity (Wilmshurst & Brue, 2010).

- **Collaborate with music therapists**

Interdisciplinary collaboration can enhance program quality and ensure that musical elements are used therapeutically and effectively (Sharda et al., 2019).

- **Use visual supports alongside music**

Visual schedules, icons, and demonstrations help children anticipate movement sequences and reduce cognitive load (Lourenço et al., 2020).

These strategies can help PE teachers create inclusive, engaging, and developmentally appropriate environments for children with ASD.

10. Limitations of the Review

This narrative review has several limitations that should be considered when interpreting the findings:

- **Small sample sizes:** Many studies included fewer than 20 participants, limiting generalizability (Ming et al., 2007; Sharda et al., 2019).
- **Heterogeneity of interventions:** Music-based and physical activity programs varied widely in duration, intensity, and structure.
- **Lack of standardized outcome measures:** Different studies used different tools to assess motor, social, and emotional outcomes.
- **Limited long-term follow-up:** Few studies examined whether improvements were maintained over time.
- **Age range restrictions:** The review focused on children aged 4–12 years; findings may not generalize to adolescents or adults (Daniels & Mandell, 2014).

- **Environmental variability:** Differences in school settings, teacher training, and available resources may influence outcomes (Guichard & Grande, 2019).

Despite these limitations, the consistency of positive findings across diverse studies strengthens the overall conclusions.

11. Conclusion

Music-enhanced physical education interventions represent a promising, accessible, and inclusive approach for supporting children with Autism Spectrum Disorder. By combining rhythm, movement, and structured social interaction, these programs address core challenges in ASD—motor coordination, sensory regulation, social communication, and emotional expression. The evidence suggests that music provides a powerful scaffold for motor learning and social engagement, while physical activity offers opportunities for cooperation, participation, and skill development.

Although further research is needed to establish standardized protocols and long-term outcomes, the existing literature strongly supports the integration of music into physical education settings. Schools and educators can adopt these practices to create more inclusive, supportive, and engaging environments that promote the holistic development of all children.

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