



Canadian Agency for
Drugs and Technologies
in Health

RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS



TITLE: Motor Interventions for Autism Spectrum Disorder in Children: Clinical Effectiveness and Guidelines

DATE: 19 August 2014

RESEARCH QUESTION

1. What is the clinical effectiveness of motor interventions for children with autism spectrum disorders?
2. What are the evidence-based guidelines regarding the use of motor interventions in children with autism spectrum disorders?

KEY FINDINGS

One systematic review, six randomized controlled trials, 22 non-randomized studies, and two evidence-based guidelines regarding the clinical effectiveness of motor interventions for children with autism spectrum disorders were identified.

METHODS

A limited literature search was conducted on key resources including PubMed, Ovid Medline, Ovid PsychINFO, EBSCOhost CINAHL, The Cochrane Library (2014, Issue 7), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2009 and July 31, 2014. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

Disclaimer: The Rapid Response Service is an information service for those involved in planning and providing health care in Canada. Rapid responses are based on a limited literature search and are not comprehensive, systematic reviews. The intent is to provide a list of sources of the best evidence on the topic that CADTH could identify using all reasonable efforts within the time allowed. Rapid responses should be considered along with other types of information and health care considerations. The information included in this response is not intended to replace professional medical advice, nor should it be construed as a recommendation for or against the use of a particular health technology. Readers are also cautioned that a lack of good quality evidence does not necessarily mean a lack of effectiveness particularly in the case of new and emerging health technologies, for which little information can be found, but which may in future prove to be effective. While CADTH has taken care in the preparation of the report to ensure that its contents are accurate, complete and up to date, CADTH does not make any guarantee to that effect. CADTH is not liable for any loss or damages resulting from use of the information in the report.

Copyright: This report contains CADTH copyright material and may contain material in which a third party owns copyright. **This report may be used for the purposes of research or private study only.** It may not be copied, posted on a web site, redistributed by email or stored on an electronic system without the prior written permission of CADTH or applicable copyright owner.

Links: This report may contain links to other information available on the websites of third parties on the Internet. CADTH does not have control over the content of such sites. Use of third party sites is governed by the owners' own terms and conditions.

RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and evidence-based guidelines.

One systematic review, six randomized controlled trials, 22 non-randomized studies, and two evidence-based guidelines regarding the clinical effectiveness of motor interventions for children with autism spectrum disorders were identified. No relevant health technology assessment reports were identified.

Additional references of potential interest are provided in the appendix.

OVERALL SUMMARY OF FINDINGS

One systematic review, six randomized controlled trials, and 22 non-randomized studies regarding the clinical effectiveness of motor interventions for children with autism spectrum disorders were identified. Evidence regarding a number of motor interventions was identified, including: hydrotherapy, massage therapy, movement and exercise-based interventions, exergaming, yoga, robotic technology, hippotherapy, martial arts, occupational therapy, and sensory integration therapy. Results are summarized in Table 1.

Table 1: Summary of Findings of Systematic Reviews, Randomized Controlled Trials, and Non-Randomized Studies			
First Author, Publication Year, Study Design	Population	Intervention	Study Findings and Conclusions
<i>Systematic Reviews</i>			
Mortimer, 2014 ¹	Children (3-12 y) with ASD	Halliwick-based hydrotherapy	The intervention successfully improved social interactions or behavior in all included studies.
<i>Randomized Controlled Trials</i>			
Schaaf, 2014 ²	Children (4-8 y) with autism (n = 32)	Occupational therapy (manualized intervention)	Improved Goal Attainment Scale scores, measures of caregiver assistance in self-care, and socialization compared with usual care.
Chan, 2013 ³	Children with ASD (n = 46)	Nei Yang Gong	Larger self-control improvements occurred in the treatment group compared with a Progressive Muscle Relaxation technique control group, parental reports of reduced autistic symptoms.
Pfeiffer, 2011 ⁴	Children (6-12 y) with ASD	Sensory integration	The intervention successfully reduced autistic mannerisms compared with fine motor intervention. Both groups showed improved Goal Attainment Scaling scores.
Silva, 2011 ⁵	Children with	Qigong massage	Improved measures of autism,

	autism (n = 47)		abnormal sensory responses, and self-regulation were reported in the treatment group.
Piravej, 2009 ⁶	Children (3-10 y) with autism (n = 60)	Thai traditional massage + sensory integration therapy	Relative to sensory integration alone, the intervention significantly improved stereotypical autistic behaviours as measured by several tools.
Silva, 2009 ⁷	Children (<6 y) with autism (n = 46)	Qigong sensory training (massage)	The intervention successfully improved social and language skills, and reduced autistic behavior compared with no treatment.
Non-Randomized Studies			
Hilton, 2014 ⁸ Uncontrolled longitudinal study	School-aged children with ASD	Exergaming (Makoto arena training)	Improved executive function (working memory and metacognition), and motor function (strength and agility) were reported.
Holm, 2014 ⁹ Uncontrolled longitudinal study	Children (6-8 y) with ASD (n = 3)	THR	The intervention successfully and sustainably improved parent-nominated targeted behaviors in a dose-dependent manner.
Lanning, 2014 ¹⁰ Case-control study	Children with ASD (n = 18)	EAA	Greater parent-reported improvements in physical, emotional, and social functioning were seen in the EAA group compared with the non-equine group.
Ajzenman, 2013 ¹¹ Uncontrolled pre/post-test study	Children (5-12 y) with ASD (n = 6)	Hippotherapy	Hippotherapy was associated with reduced postural sway, and increased overall adaptive behaviors (receptive communication and coping), participation in self-care, low-demand leisure, and social interactions based on the Vineland Adaptive Behavior Scales-II and the Child Activity Card Sort.
Jenkins, 2013 ¹² Case-control study	Children with autism	THR	Patients in the THR group did not display “systematic changes in affect, responding to others’ initiations, spontaneous initiations, off-task behavior, compliance, problem behavior, or performance on two standardized measures” ¹² compared with the waitlist control group.
Movahedi, 2013 ¹³ Case-control study	School aged children with ASD (n = 30)	Martial arts (kata techniques training)	Results showed sustainably improved social dysfunction in the kata techniques training group compared with the no-exercise group.
Ward, 2013 ¹⁴ Uncontrolled longitudinal study	Elementary school aged children with autism (n = 21)	THR	Social interaction, sensory processing, and reduced severity of symptoms associated with ASDs improved during but not post-treatment.
Yanardag, 2013 ¹⁵ Uncontrolled pre/post-test	Children with autism (n = 3)	Aquatic exercise training	Total motor performance scores improved after 12 weeks of training.

study			
Bahrami, 2012 ¹⁶ Case-control study	Children (5-16 y) with ASD (n = 30)	Martial arts (kata techniques training)	Sustainably reduced stereotypy was reported in the treatment group but not the control group.
Koenig, 2012 ¹⁷ Case-control study	Children with ASD	Yoga (Get Ready to Learn program)	Teacher ratings of maladaptive behavior (Aberrant Behavior Checklist) were lower in the yoga program group than in the control group.
Palsbo, 2012 ¹⁸ One uncontrolled within-subject pre/post-test study	Children with cerebral palsy, ASD, attention deficit disorder, attention deficit hyperactivity disorder, or other disorders	Robotic guided three dimensional repetitive motion	Writing speed and sustained legibility increased in all participants with ASD.
Anderson-Hanley, 2011 ¹⁹ Crossover study	Children with ASD (n = 22)	Exergaming: DanceDanceRevolution (n = 12), cyber cycling (n = 10)	Repetitive behavior decreased and performance on Digits Backwards improved relative to baseline in both exergaming groups.
Ennis, 2011 ²⁰ Uncontrolled longitudinal study	Children with ASD (n = 11)	Aquatic training sessions	Water-based skills improved following aquatic training.
Fragala-Pinkham, 2011 ²¹ Case-control study	Children with ASD (n = 12)	Group aquatic exercise program	No between group changes in swimming skills, cardiorespiratory endurance, muscular endurance, mobility skills, and participant and parent satisfaction were reported. Swimming skills improved in the intervention group but not the control group.
Kern, 2011 ²² Uncontrolled longitudinal pre/post-test study	Children with ASD	EAA	Reduced severity of autism symptoms, decreased CARS scores, and improved Mood and Tone (Timerlawn Parent-Child Interaction Scale) scores relative to baseline were reported at 3-6 months. Negative Regard scores were lower at 6 months compared with baseline.
Nicholson, 2011 ²³ Uncontrolled multiple-baseline study	Children with ASD (n = 4)	Physical activity	Academic engaged time increased in all participants.
Oriel, 2011 ²⁴ Crossover study	Children with ASD	Aerobic exercise (running or jogging)	The intervention was associated with improvements in correct responding, and no changes in on-task behavior or stereotypic behaviors.
Rosenblatt, 2011 ²⁵	Children (3-16 y) with ASD (n = 24)	Yoga, dance, and music therapy	Behavioral Assessment System for Children, Second Edition (BASC-2) scores increased following therapy.

Uncontrolled within-subject pre/post-test study			
Gutman, 2010 ²⁶ Uncontrolled longitudinal study	Adolescents with high-functioning autism (n = 2)	Motor-based social skills intervention	Relative to baseline, participants displayed significant, sustained improvements in targeted social skills behaviors following the intervention.
Pan, 2010 ²⁷ Crossover study	Children with ASD (n = 8)	Water exercise swimming program	The intervention was associated with improved aquatic skills and significant social improvements.
Wuang, 2010 ²⁸ Crossover study	Children (6 y 5 m to 8 y 9 m) with autism (n = 60)	Simulated developmental horse-riding program using Joba exercise equipment + occupational therapy	Results showed sustainably improved motor proficiency and sensory integrative functions in participants.
Bass, 2009 ²⁹ Case-control study	Children with autism (n = 34)	THR	THR participants displayed improved sensory seeking, sensory sensitivity, and social motivation, and reduced inattention, distractibility, and sedentary behaviors compared with wait-list controls.

ASD = autism spectrum disorders; CARS = Childhood Autism Rating Scale; CTQ = Conners' Teacher Questionnaire; EAA = Equine Assisted Activities; m = months; RCT = randomized controlled trial; SR = systematic review; THR = Therapeutic Horseback Riding; y = years

Two evidence based guidelines^{30,31} regarding the use of massage and exercise interventions for children with autism spectrum disorders were identified.

These guidelines report that:

- There is moderate evidence that occupational therapists should routinely provide touch pressure or deep pressure and massage to address touch aversion and improved responsiveness to sound in children with autism³⁰
- There is weak evidence that occupational therapists should routinely prescribe physical exercise to reduce self-stimulatory behaviors, movement therapy to decrease negative responses to touch, sensory integration to address play skills and engagement and improved social interaction and reduced disruptive behaviors, movement therapy for on-task passive behaviors for children with autism, and massage for social communication.³⁰
- There is insufficient evidence to recommend that occupational therapists routinely prescribe exercise for play behavior in children with autism.³⁰
- There is a lack of evidence for efficacy to recommend massage and other sensory-based interventions for routine management of children with autism spectrum disorders based solely on case reports and case series.³¹

REFERENCES SUMMARIZED

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

1. Mortimer R, Privopoulos M, Kumar S. The effectiveness of hydrotherapy in the treatment of social and behavioral aspects of children with autism spectrum disorders: a systematic review. *J Multidiscip Healthc* [Internet]. 2014 [cited 2014 Aug 14];7:93-104. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3917923>
[PubMed: PM24520196](#)

Randomized Controlled Trials

2. Schaaf RC, Benevides T, Mailloux Z, Faller P, Hunt J, van HE, et al. An intervention for sensory difficulties in children with autism: a randomized trial. *J Autism Dev Disord* [Internet]. 2014 Jul [cited 2014 Aug 14];44(7):1493-506. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4057638>
[PubMed: PM24214165](#)
3. Chan AS, Sze SL, Siu NY, Lau EM, Cheung MC. A chinese mind-body exercise improves self-control of children with autism: a randomized controlled trial. *PLoS ONE* [Internet]. 2013 [cited 2014 Aug 14];8(7):e68184. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3707921>
[PubMed: PM23874533](#)
4. Pfeiffer BA, Koenig K, Kinnealey M, Sheppard M, Henderson L. Effectiveness of sensory integration interventions in children with autism spectrum disorders: a pilot study. *Am J Occup Ther* [Internet]. 2011 Jan [cited 2014 Aug 14];65(1):76-85. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3708964>
[PubMed: PM21309374](#)
5. Silva LM, Schalock M, Gabrielsen K. Early intervention for autism with a parent-delivered Qigong massage program: a randomized controlled trial. *Am J Occup Ther*. 2011 Sep;65(5):550-9.
[PubMed: PM22026323](#)
6. Piravej K, Tangtrongchitr P, Chandarasiri P, Paothong L, Sukprasong S. Effects of Thai traditional massage on autistic children's behavior. *J Altern Complement Med*. 2009 Dec;15(12):1355-61.
[PubMed: PM20001837](#)
7. Silva LM, Schalock M, Ayres R, Bunse C, Budden S. Qigong massage treatment for sensory and self-regulation problems in young children with autism: a randomized controlled trial. *Am J Occup Ther*. 2009 Jul;63(4):423-32.
[PubMed: PM19708471](#)

Non-Randomized Studies

8. Hilton CL, Cumpata K, Klohr C, Gaetke S, Artner A, Johnson H, et al. Effects of exergaming on executive function and motor skills in children with autism spectrum disorder: a pilot study. *Am J Occup Ther*. 2014 Jan;68(1):57-65.
[PubMed: PM24367956](#)

9. Holm MB, Baird JM, Kim YJ, Rajora KB, D'Silva D, Podolinsky L, et al. Therapeutic horseback riding outcomes of parent-identified goals for children with autism spectrum disorder: An ABA' multiple case design examining dosing and generalization to the home and community. *J Autism Dev Disord*. 2014;44(4):937-47.
10. Lanning BA, Baier ME, Ivey-Hatz J, Krenek N, Tubbs JD. Effects of equine assisted activities on autism spectrum disorder. *J Autism Dev Disord*. 2014 Aug;44(8):1897-907.
[PubMed: PM24526337](#)
11. Ajzenman HF, Standeven JW, Shurtleff TL. Effect of hippotherapy on motor control, adaptive behaviors, and participation in children with autism spectrum disorder: a pilot study. *Am J Occup Ther*. 2013 Nov;67(6):653-63.
[PubMed: PM24195899](#)
12. Jenkins SR, Gennaro Reed FD. An experimental analysis of the effects of therapeutic horseback riding on the behavior of children with autism. *Research in Autism Spectrum Disorders*. 2013;7(6):721-40.
13. Movahedi A, Bahrami F, Marandi SM, Abedi A. Improvement in social dysfunction of children with autism spectrum disorder following long term kata techniques training. *Research in Autism Spectrum Disorders*. 2013;7(9):1054-61.
14. Ward SC, Whalon K, Rusnak K, Wendell K, Paschall N. The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. *J Autism Dev Disord*. 2013 Sep;43(9):2190-8.
[PubMed: PM23371511](#)
15. Yanardag M, Akmanoglu N, Yilmaz I. The effectiveness of video prompting on teaching aquatic play skills for children with autism. *Disabil Rehabil*. 2013 Jan;35(1):47-56.
[PubMed: PM22624856](#)
16. Bahrami F, Movahedi A, Marandi SM, Abedi A. Kata techniques training consistently decreases stereotypy in children with autism spectrum disorder. *Res Dev Disabil*. 2012 Jul;33(4):1183-93.
[PubMed: PM22502844](#)
17. Koenig KP, Buckley-Reen A, Garg S. Efficacy of the Get Ready to Learn yoga program among children with autism spectrum disorders: a pretest-posttest control group design. *Am J Occup Ther*. 2012 Sep;66(5):538-46.
[PubMed: PM22917120](#)
18. Palsbo SE, Hood-Szivek P. Effect of robotic-assisted three-dimensional repetitive motion to improve hand motor function and control in children with handwriting deficits: a nonrandomized phase 2 device trial. *Am J Occup Ther*. 2012 Nov;66(6):682-90.
[PubMed: PM23106988](#)
19. Anderson-Hanley C, Tureck K, Schneiderman RL. Autism and exergaming: Effects on repetitive behaviors and cognition. *Psychology Research and Behavior Management*. 2011; 4:129-137.

20. Ennis E. The effects of a physical therapy-directed aquatic program on children with autism spectrum disorders. *Journal of Aquatic Physical Therapy*. 2011;19(1):4-10.
21. Fragala-Pinkham MA, Haley SM, O'Neil ME. Group swimming and aquatic exercise programme for children with autism spectrum disorders: a pilot study. *Dev Neurorehabil*. 2011;14(4):230-41.
[PubMed: PM21732807](#)
22. Kern JK, Fletcher CL, Garver CR, Mehta JA, Grannemann BD, Knox KR, et al. Prospective trial of equine-assisted activities in autism spectrum disorder. *Altern Ther Health Med*. 2011 May;17(3):14-20.
[PubMed: PM22164808](#)
23. Nicholson H, Kehle TJ, Bray MA, Van Heest J. The effects of antecedent physical activity on the academic engagement of children with autism spectrum disorder. *Psychol Sch*. 2011;48(2):198-213.
24. Oriol KN, George CL, Peckus R, Semon A. The effects of aerobic exercise on academic engagement in young children with autism spectrum disorder. *Pediatr Phys Ther*. 2011; 23(2):187-93.
[PubMed: PM21552085](#)
25. Rosenblatt LE, Gorantla S, Torres JA, Yarmush RS, Rao S, Park ER, et al. Relaxation response-based yoga improves functioning in young children with autism: a pilot study. *J Altern Complement Med [Internet]*. 2011 Nov [cited 14 Aug 2014];17(11):1029-35. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3221508>
[PubMed: PM21992466](#)
26. Gutman SA, Raphael EI, Ceder LM, Khan A, Timp KM, Salvant S. The effect of a motor-based, social skills intervention for adolescents with high-functioning autism: two single-subject design cases. *Occup Ther Int*. 2010 Dec;17(4):188-97.
[PubMed: PM20672254](#)
27. Pan CY. Effects of water exercise swimming program on aquatic skills and social behaviors in children with autism spectrum disorders. *Autism*. 2010 Jan;14(1):9-28.
[PubMed: PM20124502](#)
28. Wuang YP, Wang CC, Huang MH, Su CY. The effectiveness of simulated developmental horse-riding program in children with autism. *Adapt Phys Act Q*. 2010 Apr;27(2):113-26.
[PubMed: PM20440023](#)
29. Bass MM, Duchowny CA, Llabre MM. The effect of therapeutic horseback riding on social functioning in children with autism. *J Autism Dev Disord*. 2009 Sep;39(9):1261-7.
[PubMed: PM19350376](#)

Guidelines and Recommendations

30. Watling R, Koenig KP, Davies PL, Schaaf RC. Occupational therapy practice guidelines for children and adolescents with challenges in sensory processing and sensory integration. Bethesda (MD): American Occupational Therapy Association Press; 2011. Summary available: <http://www.guideline.gov/content.aspx?f=rss&id=34041>
See: Table. Recommendations for Occupational Therapy Interventions for Children and Adolescents with Challenges in Processing and Integrating Sensory Information
31. Singapore Ministry of Health. Autism spectrum disorders in pre-school children. Singapore: Singapore Ministry of Health; 2010 Mar. Summary available: <http://www.guideline.gov/content.aspx?f=rss&id=39344>
See: Management: Complementary Alternative Therapies, "D - Massage and other sensory-based interventions are not recommended in the routine management of children with ASD because of insufficient evidence for efficacy. (Grade D, Level 3)"

PREPARED BY:

Canadian Agency for Drugs and Technologies in Health
Tel: 1-866-898-8439
www.cadth.ca

APPENDIX – FURTHER INFORMATION:

Systematic Reviews and Meta-analyses

Unclear Age Range

32. Miyahara M. Meta review of systematic and meta analytic reviews on movement differences, effect of movement based interventions, and the underlying neural mechanisms in autism spectrum disorder. *Front Integr Neurosci* [Internet]. 2013;7:16, 2013 [cited 14 Aug 2014]. Available from:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3607787>
[PubMed: PM23532374](#)
33. Lee MS, Kim JI, Ernst E. Massage therapy for children with autism spectrum disorders: a systematic review. *J Clin Psychiatry*. 2011 Mar;72(3):406-11.
[PubMed: PM21208598](#)

Mixed Population

34. Sowa M, Meulenbroek R. Effects of physical exercise on autism spectrum disorders: A meta-analysis. *Research in Autism Spectrum Disorders*. 2012;6(1):46-57.
35. Lang R, Koegel LK, Ashbaugh K, Regester A, Ence W, Smith W. Physical exercise and individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*. 2010;4(4):565-76.

Non-Randomized Studies

Unclear Age Range

36. Hillier A, Murphy D, Ferrara C. A Pilot Study: Short-term Reduction in Salivary Cortisol Following Low Level Physical Exercise and Relaxation among Adolescents and Young Adults on the Autism Spectrum. *Stress & Health: Journal of the International Society for the Investigation of Stress*. 2011 Dec;27(5):395-402.
37. Morrison H, Roscoe EM, Atwell A. An evaluation of antecedent exercise on behavior maintained by automatic reinforcement using a three-component multiple schedule. *J Appl Behav Anal* [Internet]. 2011[cited 14 Aug 2014];44(3):523-41. Available from:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3177334>
[PubMed: PM21941383](#)

Review Articles

38. Srinivasan SM, Pescatello LS, Bhat AN. Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. *Phys Ther* [Internet]. 2014 Jun [cited 14 Aug 2014];94(6):875-89. Available from:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4040426>
[PubMed: PM24525861](#)

39. Downey R, Rapport MJ. Motor activity in children with autism: a review of current literature. *Pediatr Phys Ther.* 2012;24(1):2-20.
[PubMed: PM22207460](#)
40. Mieres AC, Kirby RS, Armstrong KH, Murphy TK, Grossman L. Autism spectrum disorder: an emerging opportunity for physical therapy. *Pediatr Phys Ther.* 2012;24(1):31-7.
[PubMed: PM22207463](#)