

Gait Training: Overground, Treadmill and Early Intervention

A sampling of related articles published in peer-reviewed journals.

Note: Research references on robotic-assisted gait training are not included here.

Topics

Overground

- **Adult Rehab**
- **Comparison to Treadmill (Adult and Pediatric)**
- **Pediatric**
- **Postural Strength/Function/Activity**

Treadmill

- **Cerebral Palsy**
- **Spinal Cord Injury**
- **Stroke**
- **Systematic Reviews**

Early intervention

- **Cerebral Palsy**
- **Down Syndrome**
- **Implications for development**

Overground

Adult Rehab

Fox EJ, Tester NJ, Butera KA, Howland DR, Spiess MR, Castro-Chapman PL, Behrman AL. (2017) Retraining walking adaptability following incomplete spinal cord injury. *Spinal Cord Ser Cases*. Dec 14;3:17091. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5803746/>

Hamonet J, Daviet J, Bordes J, Cugy E, Dalmay F, Salle Chu Limoges J. (2011) Comparative study on post-effect after Gait Trainer and after over-ground training in gait symmetry in stroke patients. *Annals of Physical and Rehabilitation Medicine*. 54(Suppl 1):e235. Free Full Text <https://www.sciencedirect.com/science/article/pii/S187706571100412X>
Download PDF

McCain K, Shearin S. (2017) A Clinical Framework for Functional Recovery in a Person With Chronic Traumatic Brain Injury: A Case Study. *J Neurol Phys Ther*. 41(3):173-181 Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=28628551>

Peurala SH, Tarkka IM, Pitkanen K, Sivenius J (2005) The effectiveness of body weight-supported gait training and floor walking in patients with chronic stroke. *Arch Phys Med Rehabil* 86(8):1557-64. Free Full Text [http://www.archives-pmr.org/article/S0003-9993\(05\)00210-8/fulltext](http://www.archives-pmr.org/article/S0003-9993(05)00210-8/fulltext)

States RA, Salem Y, Pappas E. (2009) Overground Gait Training for Individuals with Chronic Stroke: A Cochrane Systematic Review. *Journal of Neurologic Physical Therapy*. 33(4):179-186. Free Full Text https://journals.lww.com/jnpt/Fulltext/2009/12000/Overground_Gait_Training_for_Individuals_with.3.aspx

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A sampling of related articles published in peer-reviewed journals.

Comparison to Treadmill (Adult and Pediatric)

Brown TH, Mount J, Rouland BL, Kautz KA, Barnes RM, Kim J. (2005) Body weight-supported treadmill training versus conventional gait training for people with chronic traumatic brain injury. *J Head Trauma Rehabil.* 20(5):402-15. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=16170249>

Combs-Miller SA, Kalpathi Parameswaran A, Colburn D, Ertel T, Harmeyer A, Tucker L, Schmid AA. (2014) Body weight-supported treadmill training vs. overground walking training for persons with chronic stroke: a pilot randomized controlled trial. *Clin Rehabil.* 28(9):873-84. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=24519922>

Dobkin BH, Duncan PW. (2012) Should body weight-supported treadmill training and robotic-assistive steppers for locomotor training trot back to the starting gate? *Neurorehabil Neural Repair.* 26(4):308-17. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4099044/>

Grecco LA, Zanon N, Sampaio LM, Oliveira CS. (2013) A comparison of treadmill training and overground walking in ambulant children with cerebral palsy: randomized controlled clinical trial. *Clin Rehabil.* 27(8):686-96. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=23503736>

Matsuno V, Camargo M, Palma G, Alveno D, Barela M. (2010) Analysis of partial body weight support during treadmill and overground walking of children with cerebral palsy. *Rev Bras Fisioter.* 14(5):404-10. Free Full Text http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-35552010000500009&lng=en&nrm=iso&tng=en

Musselman KE, Fouad K, Misiaszek JE, Yang JF. (2009) Training of walking skills overground and on the treadmill: case series on individuals with incomplete spinal cord injury. *Phys Ther.* 89(6):601-11. Free Full Text <https://academic.oup.com/ptj/article/89/6/601/2737652>

Su I, Chung K, Chow D. (2013) Treadmill training with partial body weight support compared with conventional gait training for low-functioning children and adolescents with nonspastic cerebral palsy: a two-period crossover study. *Prosthet and Orthot Int.* 37(6):445-53. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=23436693>

Swe NN, Sendhilnathan S, van Den Berg M, Barr C. (2015) Over ground walking and body weight supported walking improve mobility equally in cerebral palsy: a randomised controlled trial. *Clin Rehabil.* 29(11):1108-16. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/25636992>

Willoughby K, Dodd K, Shields N, Foley S. (2010) Efficacy of partial body weight-supported treadmill training compared with overground walking practice for children with cerebral palsy; a randomized controlled trial. *Arch Phys Med Rehabil.* 91(3):333-9. Free Full Text [http://www.archives-pmr.org/article/S0003-9993\(09\)00932-0/fulltext](http://www.archives-pmr.org/article/S0003-9993(09)00932-0/fulltext)

Pediatric

Altizer W, Noritz G, Paleg G. Use of a dynamic gait trainer for a child with thoracic level spinal cord injury. *BMJ.* Oct 10;2017. pii: bcr-2017-220756. doi: 10.1136/bcr-2017-220756
Free Full Text <http://casereports.bmj.com/content/2017/bcr-2017-220756.full>

Gharib NM, El-Maksoud GM, Rezk-Allah SS. (2011) Efficacy of gait trainer as an adjunct to traditional physical therapy on walking performance in hemiparetic cerebral palsied children: a randomized controlled trial. *Clin Rehabil.* 25(10):924-34. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=21427153>

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A sampling of related articles published in peer-reviewed journals.

Greiner BM, Czerniecki JB, Dietz JC. (1993): Gait parameters of children with spastic diplegia: A comparison of effects of posterior and anterior walkers. *Arch. Physical Med. Rehabil.* 74(4):381-5. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/8466419>

Levangie P, Chimera M, Johnston M, et al. (1989): Effects of posture control walker versus standard rolling walker on gait characteristics of children with spastic cerebral palsy. *Phy. Occpt. Ther. Ped.* 9(4):1-17. Abstract https://www.tandfonline.com/doi/abs/10.1080/J006v09n04_01

Levangie PK, Guihan MF, Meyer P, Stuhr K. (1989): Effect of altering handle position of a rolling walker on gait in children with cerebral palsy. *Phys. Ther.* 69(2):130-134. Abstract: <https://www.ncbi.nlm.nih.gov/pubmed/2913581>

Livingstone R, Paleg G. (2016) Review: Measuring Outcomes for Children with Cerebral Palsy Who Use Gait Trainers. *Technologies* 4(3):22. Free Full Text <http://mdpi.com/2227-7080/4/3/22/htm>

Logan L, Byers-Hinkley K, Ciccone C. (1990): Anterior vs. posterior walkers for children with cerebral palsy: A gait analysis study. *Dev. Med. Child Neurol.* 32(12):1044-1048. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/2149558>

Low SA, McCoy SW, Beling J, Adams J. (2011) Pediatric physical therapists' use of support walkers for children with disabilities: a nationwide survey. *Pediatr Phys Ther.* 23(4):381-9. Free Full Text https://journals.lww.com/pedpt/fulltext/2011/23040/Pediatric_Physical_Therapists_Use_of_Support.15.aspx

Mattsson E, Andersson C. (1997): Oxygen cost, walking speed, and perceived exertion in children with cerebral palsy when walking with anterior and posterior walkers. *Dev. Med. Child Neurol.* 39(10):671-676. Free Full Text <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1469-8749.1997.tb07361.x>

Critical Review:

Kelly S. (2002) Oxygen cost, walking speed, and perceived exertion in children with cerebral palsy when walking with anterior and posterior walkers *Pediatr Phys Ther.* Fall;14(3):159-61. Free Full Text Download PDF

https://journals.lww.com/pedpt/Citation/2002/14030/Oxygen_Cost,_Walking_Speed,_and_Perceived_Exertion.8.aspx

Paleg G, Livingstone R. (2015) Outcomes of gait trainer use in home and school settings for children with motor impairments: a systematic review. *Clin Rehabil.* 29(11):1077-91. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=25636993>

Paleg G, Huang M, Gabela S, Sprigle S, Livingstone R. (2016) Comparison of the Inertial Properties and Forces Required to Initiate Movement for Three Gait Trainers. *Assistive Technology.* 28(3):137-43. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/26820253>

Paleg G, Livingstone R. (2016) Evidence-informed clinical perspectives on selecting gait trainer features for children with cerebral palsy. *International Journal of Therapy and Rehabilitation* Sept 2016, Vol 23, No 8. Abstract <https://www.magonlineibrary.com/doi/abs/10.12968/ijtr.2016.23.9.444>
Free Full Text <https://primeengineering.com/wp-content/uploads/2017/08/Evidence-informed-clinical-perspectives-on-selecting-gait-trainer-features-for-children-with-cerebral-palsy.pdf>

Park ES, Park CI, Kim JY. (2001) Comparison of anterior and posterior walkers with respect to gait parameters and energy expenditure of children with spastic diplegic cerebral palsy. *Yonsi Med. Journal.* 42(2): 180-184. Free Full Text Download PDF <https://synapse.koreamed.org/DOIx.php?id=10.3349/ymj.2001.42.2.180>

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A sampling of related articles published in peer-reviewed journals.

Postural Strength/Function/Activity

Balzer J, Marsico P, Mitteregger E, van der Linden ML, Mercer TH, van Hedel HJA. (2017) Influence of trunk control and lower extremity impairments on gait capacity in children with cerebral palsy. *Disabil Rehabil.* 24:1-7. DOI: 10.1080/09638288.2017.1380719 Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=28944697>

Bjornson K. (2008) Activity limitations: what are they really doing? Commentary *Dev Med Child Neurol.* 50(3):166. Free Full Text <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1469-8749.2008.00166.x>

Bjornson KF, Belza B, Kartin D, Logsdon R, McLaughlin JF. (2007) Ambulatory physical activity performance in youth with cerebral palsy and youth who are developing typically. *Phys Ther.* 87(3):248-57. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1852474/>

Bjornson KF, Belza B, Kartin D, Logsdon R, McLaughlin J, Thompson EA. (2008) The relationship of physical activity to health status and quality of life in cerebral palsy. *Pediatr Phys Ther.* 20(3):247-53. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3644992/>

Day SM, Wu YW, Strauss DJ, Shavelle RM, Reynolds RJ (2007) Change in ambulatory ability of adolescents and young adults with cerebral palsy. *Dev Med Child Neurol* 49(9):47-53. Free Full Text <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1469-8749.2007.00647.x>

Eisenberg S, Zuk L, Carmeli E, Katz-Leurer M. (2009) Contribution of stepping while standing to function and secondary conditions among children with cerebral palsy. *Pediatr Phys Ther.* 2009;21(1):79–85. Free Full Text https://journals.lww.com/pedpt/fulltext/2009/02110/Contribution_of_Stepping_While_Standing_to.13.aspx

Farmer SE (2003) Key factors in the development of lower limb co-ordination: implications for the acquisition of walking in children with cerebral palsy. *Disabil Rehabil* 25(14):807-16. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=12959361>

Gibson BE, Teachman G, Wright V, Fehlings D, Young NL, McKeever P. (2012) Children's and parents' beliefs regarding the value of walking: rehabilitation implications for children with cerebral palsy. *Child Care Health Dev.* 38(1):61-9. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/21696426>

Your Therapy Source:

<https://www.yourtherapysource.com/blog1/2011/06/27/value-of-walking/>

Lauruschkus K, Nordmark E, Hallström I. (2015) "It's fun, but ..." Children with cerebral palsy and their experiences of participation in physical activities. *Disabil Rehabil.* 37(4):283-9. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/24786968>

Treadmill / Intensive Gait Training

Cerebral Palsy

Begnoche DM, Pitette KH. (2007): Effects of traditional treatment and partial body weight treadmill training on the motor skills of children with spastic cerebral palsy. A pilot study. *Pediatr. Phys. Therapy.* 19 (1): 11-19. Free Full Text https://journals.lww.com/pedpt/fulltext/2007/01910/Effects_of_Traditional_Treatment_and_Partial_Body.3.aspx

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A sampling of related articles published in peer-reviewed journals.

Chrysagis N, Skordilis EK, Stavrou N, et al. (2012) The effect of treadmill training on gross motor function and walking speed in ambulatory adolescents with cerebral palsy: a randomized controlled trial. *Am J Phys Med Rehabil.* 91(9):747–760. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=22902937>

Day JA, Fox EJ, Lowe J, Swales HB, Behrman AL. (2004): Locomotor training with partial body weight support on a treadmill in a nonambulatory child with spastic tetraplegic cerebral palsy: a case report. *Pediatr. Phys. Ther.* 16:106-113. Free Full Text
https://journals.lww.com/pedpt/Fulltext/2004/01620/Locomotor_Training_with_Partial_Body_Weight.5.aspx

Dodd KJ, Foley S. (2007). Partial body-weight –supported treadmill training can improve walking in children with cerebral palsy: a clinical controlled trial. *Dev. Med. Child Neurol.* 49 (2): 101-105. Free Full Text
<https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1469-8749.2007.00101.x>

Johnston TE, Watson KE, Ross SA, et al. (2011) Effects of a supported speed treadmill training exercise program on impairment and function for children with cerebral palsy. *Dev Med Child Neurol.* 53(8):742–750. Free Full Text
<https://onlinelibrary.wiley.com/doi/full/10.1111/j.1469-8749.2011.03990.x>

Kurz, Max J. PhD; Wilson, Tony W. PhD; Corr, Brad DPT; Volkman, Kathleen G. PT, MS. (2012) Neuromagnetic Activity of the Somatosensory Cortices Associated With Body Weight–Supported Treadmill Training in Children With Cerebral Palsy. *Journal of Neurologic Physical Therapy.* 36(4):166–172. Abstract
<https://www.ncbi.nlm.nih.gov/pubmed/?term=22743850>

Maltais D, Bar-Or O, Pierrynowski M, Galea V. (2003): Repeated treadmill walks affect physiologic responses in children with cerebral palsy. *Medicine and Science in Sports and Exercise.* 35(10):1653-1661. Free Full Text
https://journals.lww.com/acsm-msse/fulltext/2003/10000/Repeated_Treadmill_Walks_Affect_Physiologic.6.aspx

Mattern-Baxter K. (2009) Effects of partial body weight supported treadmill training on children with cerebral palsy. *Pediatr Phys Ther.* 21(1):12-22. Full Free Text
https://journals.lww.com/pedpt/Fulltext/2009/02110/Effects_of_Partial_Body_Weight_Supported_Treadmill.4.aspx

Mattern-Baxter K, McNeil S, Mansoor J. (2013) Effects of home-based locomotor treadmill training on gross motor function in young children with cerebral palsy: a quasi-randomized controlled trial. *Arch Phys Med Rehabil.* 94(11):2061-7. Free Full Text [http://www.archives-pmr.org/article/S0003-9993\(13\)00421-8/fulltext](http://www.archives-pmr.org/article/S0003-9993(13)00421-8/fulltext)

Ronan S, Bingham E, Mushkat S, Sedman E. (2015) Recommended treadmill training parameters for persons with cerebral palsy based on the GMFCS levels: a systematic review. *Dev Med Child Neurol.* S5: 67. Abstract [AACPDM 69th Annual Meeting October 2015] https://onlinelibrary.wiley.com/doi/full/10.1111/dmcn.109_12887

Visser A, Westman M, Otieno S, Kenyon L. (2017) A home based body weighted supported treadmill program for children with cerebral palsy: A Pilot Study. *Pediatr Phys Ther.* 29(3):223-229. Abstract
<https://www.ncbi.nlm.nih.gov/pubmed/28654490>

Spinal Cord Injury

Behrman AL, Bowden MG, Nair PM. (2006) Walking Recovery An Emerging Paradigm Shift in Rehabilitation and Neuroplasticity After Spinal Cord Injury and Training. *Phys Ther* 86(10):1406-25. Free Full Text
<https://academic.oup.com/ptj/article/86/10/1406/2805283>

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A sampling of related articles published in peer-reviewed journals.

Behrman AL, Harkema SJ. (2000) Locomotor training progression and outcomes after incomplete spinal cord injury. *Phys Ther* 80(7):688-700. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/10869131>

Behrman AL, Harkema SJ. (2007) Physical rehabilitation as an agent for recovery after spinal cord injury. *Phys Med Rehabil Clin N Am*. 18(2):183-202. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/17543768>

Leech KA, Kinnaird CR, Holleran CL, Kahn J, Hornby TG. (2016) Effects of Locomotor Exercise Intensity on Gait Performance in Individuals With Incomplete Spinal Cord Injury. *Phys Ther*. 96(12):1919–1929. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5131185/>

Leech KA, Hornby TG. (2017) High-Intensity Locomotor Exercise Increases Brain-Derived Neurotrophic Factor in Individuals with Incomplete Spinal Cord Injury. *J Neurotrauma*. 34(6):1240-1248 Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5359683/>

Lucareli PR, Lima MO, Lima FP, de Almeida JG, Brech GC, D'Andréa Greve JM. (2011) Gait analysis following treadmill training with body weight support versus conventional physical therapy: a prospective randomized controlled single blind study. *Spinal Cord*. 49(9):1001-7. Free Full Text <http://www.nature.com/articles/sc201137>

Stroke

Hesse S (2008) Treadmill training with partial body weight support after stroke: a review. *NeuroRehabilitation*. 23(1):55-65. Free Full Text <https://content.iospress.com/download/neurorehabilitation/nre00394?id=neurorehabilitation%2Ffre00394>

Lewek, MD. (2009) The Value of Overground Gait Training for Improving Locomotion in Individuals with Chronic Stroke. Clinical Point of View. *Journal of Neurologic Physical Therapy*. 33(4):187-188. Free Full Text https://journals.lww.com/jnpt/Fulltext/2009/12000/The_Value_of_Overground_Gait_Training_for.4.aspx

Mehrholz J, Thomas S, Werner C, Kugler J, Pohl M, Elsner B. (2017) Electromechanical-assisted training for walking after stroke. *Cochrane Database Syst Rev*. May 10;5:CD006185. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/28488268>

Sullivan KJ, Brown DA, Klassen T, Mulroy S, Ge T, Azen SP, Winstein CJ; Physical Therapy Clinical Research Network (PTClinResNet). (2007) Effects of task-specific locomotor and strength training in adults who were ambulatory after stroke: results of the STEPS randomized clinical trial. *Phys Ther*. 87(12):1580-602. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=17895349>

Visintin M, Barbear H. (1989) The effect of body weight support on the locomotor pattern of spastic paretic patients. *Canadian J. Neuro. Sci*. 16(3):315-25 Abstract <https://www.ncbi.nlm.nih.gov/pubmed/2766124>

Systematic Reviews

Damiano D, DeJong S. (2009) A systematic review of the effectiveness of treadmill training and body weight support in pediatric rehabilitation. *J Neurol Phys Ther*. 33(1):27-44. Free Full Text <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2982788/>

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A sampling of related articles published in peer-reviewed journals.

Paleg G, Romness M, Livingstone R. (2018) Interventions to improve sensory and motor outcomes for young children with central hypotonia: A systematic review. *Journal of Pediatric Rehabilitation Medicine* 11(1):57-70. Abstract <https://content.iospress.com/articles/journal-of-pediatric-rehabilitation-medicine/prm170507>

Valentín-Gudiol M, Mattern-Baxter K, Girabent-Farrés M, Bagur-Calafat C, Hadders-Algra M, Angulo-Barroso RM. (2017) Treadmill interventions in children under six years of age at risk of neuromotor delay. *Cochrane Database Syst Rev.* 2017, Issue 7. Art. No.: CD009242. DOI: 10.1002/14651858.CD009242.pub3. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/28755534> (Free Full Text Available to APTA members on PTNow <https://www.ptnow.org/ArticleSearch>)

Willoughby KL, Dodd KJ, Shields N. (2009) A systematic review of the effectiveness of treadmill training for children with cerebral palsy. *Disabil Rehabil.* 31(24):1971-9. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/19874075>

Zwicker JG, Mayson TA. (2010) Effectiveness of treadmill training in children with motor impairments. *Pediatr Phys Ther.* 22(4):361–377. Free Full Text https://journals.lww.com/pedpt/fulltext/2010/22040/Effectiveness_of_Treadmill_Training_in_Children.6.aspx

Early intervention

Cerebral Palsy

Bodkin AW, Baxter RS, Heriza CB. (2003) Treadmill training for an infant born preterm with a grade III intraventricular hemorrhage. *Pediatr. Ther.* 83(12):1107-1118. Free Full Text <https://academic.oup.com/ptj/article/83/12/1107/2805256>

Mattern-Baxter, Katrin; Bellamy, Sandra; Mansoor, Jim K. (2009) Effects of Intensive Locomotor Treadmill Training on Young Children with Cerebral Palsy. *Pediatric Physical Therapy.* 21(4):308-318, Free Full Text https://journals.lww.com/pedpt/Fulltext/2009/02140/Effects_of_Intensive_Locomotor_Treadmill_Training.3.aspx

Richards CL, Malouin F, Marcoux S, et al. (1997): Early and intensive treadmill locomotor training for young children with cerebral palsy: A feasibility study. *Pediatr. Phys. Ther.* 9(4):158-165. Free Full Text https://journals.lww.com/pedpt/Abstract/1997/00940/Early_and_Intensive_Treadmill_Locomotor_Training.2.aspx

Yang JF, Livingstone D, Brunton K, Kim D, Lopetinsky B, Roy F, Zewdie E, Patrick SK, Andersen J, Kirton A, Watt JM, Yager J, Gorassini M. (2013) Training to enhance walking in children with cerebral palsy: are we missing the window of opportunity? *Semin Pediatr Neurol.* 20(2):106-15. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/23948685>

Down Syndrome

Angulo-Barroso RM, Wu J, Ulrich DA (2008) Long-term effect of different treadmill interventions on gait development in new walkers with Down syndrome. *Gait Posture.* 27 (2):231-8. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/17499993>

Ulrich D, Lloyd M, Tiernan C, et al. (2008) Effects of intensity of treadmill training on developmental outcomes and stepping in infants with Down syndrome. *Phys Ther.* 88(1):114-22. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/?term=17940103>

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Ulrich DA, Ulrich DB, Angulo-Kinzler RM, Yun J. (2001) Treadmill training of infants with Down syndrome: evidence-based developmental outcomes. *Pediatrics*. 108(5): E84. Free Full Text

<http://pediatrics.aappublications.org/content/108/5/e84.long>

Ulrich DA, Lloyd MC, Tiernan CW, Looper JE, Angulo-Barroso RM. (2008) Effects of Intensity of Treadmill Training on Developmental Outcomes and Stepping in Infants With Down Syndrome: A Randomized Trial. *Physical Therapy*. 88(1):114-122. Abstract: <https://www.ncbi.nlm.nih.gov/pubmed/?term=17940103>

Implications for development

Anderson DI, Campos JJ, Witherington DC, Dahl A, Rivera M, He M, Uchiyama I, Barbu-Roth M. (2013) The role of locomotion in psychological development. *Front Psychol*. Jul 23;4:440. Free Full Text

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3719016/> and

<https://www.researchgate.net/publication/252325455> The role of locomotion in psychological development

Levinson ML. (2001) Impact on development using the stepping intervention model (SIM) for infants with motor delay. Abstract of Poster and Platform Presentation at 2002 Combined Sections Meeting. *Pediatric Physical Therapy*. 13(4):211 Download PDF

https://journals.lww.com/pedpt/Citation/2001/13040/IMPACT_ON_DEVELOPMENT_USING_THE_STEPPING.62.aspx

Lobo MA, Harbourne RT, Dusing SC, McCoy SW. (2013) Grounding early intervention: physical therapy cannot just be about motor skills anymore. *Phys Ther*. 93(1):94-103 Free Full Text

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3538987/>

Oudgenoeg-Paz O, Mulder H, Jongmans MJ, van der Ham IJM, Van der Stigchel S. (2017) The link between motor and cognitive development in children born preterm and/or with low birth weight: A review of current evidence. *Neurosci Biobehav Rev*. Sept 80:382-393. Abstract <https://www.ncbi.nlm.nih.gov/pubmed/28642071>

Uchiyama I, Anderson DI, Campos JJ, Witherington D, Frankel CB, Lejeune L, Barbu-Roth M. (2008) Locomotor experience affects self and emotion. *Dev Psychol*. 44(5):1225-31 Free Full Text

<https://www.researchgate.net/publication/23259203> Locomotor Experience Affects Self and Emotion