



## Jessica Rose

Professor of Orthopaedic Surgery at the Lucile Salter Packard Children's Hospital and the Stanford University Medical Center

### Bio

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#### ACADEMIC APPOINTMENTS

- Professor - Med Center Line, Orthopaedic Surgery
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Wu Tsai Neurosciences Institute

#### ADMINISTRATIVE APPOINTMENTS

- Faculty Senate, Stanford University School of Medicine, (2013-2019)
- Director, Motion & Gait Lab, Lucile Packard Children's Hospital Stanford, (1989- present)
- Chair, Research Committee, American Academy for Cerebral Palsy and Developmental Medicine, (2013-2015)

#### BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, NIH AACPDM Steering Committee on Common Data Elements for Cerebral Palsy (2018 - present)
- Board of Directors, Society for Brain Mapping and Therapeutics (2013 - present)
- Spectrum Child Health Research Institute Committee Member, Stanford University School of Medicine (2013 - present)
- Research Committee Member, American Academy for Cerebral Palsy and Developmental Medicine (2009 - 2015)
- Taskforce on Childhood Motor Disorders, NIH (2001 - 2012)

### Research & Scholarship

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#### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Dr. Rose directs the Motion & Gait Analysis Lab at Lucile Packard Children's Hospital, a multidisciplinary diagnostic service for patients with gait and upper limb movement disorders. Dr. Rose's research investigates early brain and motor development in preterm children and the neuromuscular mechanisms underlying motor deficits in children with cerebral palsy (CP).

Previous research has investigated energy cost of walking, muscle pathology, postural balance, and neuromuscular activation in CP. Recent research investigates neonatal micro-structural brain development on diffusion tensor MRI in relation to motor function in preterm children.

Initial research examined energetics of walking in CP and muscle pathophysiology in spastic CP (Rose et al, J Orthop Res, 1994). The histologic and morphometric study of spastic muscle in children with diplegia, revealed abnormal predominance of type 1 fibers and fiber size variability, suggesting reduced motor-unit firing

rates associated with impaired descending motor signals. Neuromuscular activation and motor-unit firing characteristics were investigated with EMG decomposition techniques in spastic lower limb muscles in CP (Rose and McGill, *Dev Med Child Neurol*, 2005) and found maximal voluntary neuromuscular activation (maximal voluntary EMG/ M-wave amplitude) was substantially reduced, while motor-unit recruitment was found normal at low-moderate levels of contraction. Extrapolation to maximal levels of neuromuscular activation suggested maximal motor-unit firing rates were reduced to approximately 50% of control values.

Four primary interrelated motor deficits of spastic CP: weakness, short muscle tendon unit, spasticity, and impaired selective motor control, were identified through these studies and through EMG studies of selective motor control. The EMG studies revealed obligatory muscle co-activation of gastrocnemius during quadriceps activation in spastic CP that contributes to gait deficits, in even mild CP (Rose et al, *J Ped Orthop*, 1999, Policy et al, *J Ped Orthop*, 2001). Postural balance was examined using force plate center-of pressure measures and found approximately 30% of children with spastic CP had balance impairment (Wolff et al, *J Orthop Res*, 1998, Rose et al, *Dev Med Child Neurol*, 2002).

Recent research examined neonatal micro-structural brain development on diffusion tensor MRI and motor function in very-low-birth-weight preterm children (Rose et al, *Ped Res*, 2005, Rose et al. *Dev Med Child Neurol* 2007; 2009). Related research investigated relations between cerebellar structure and postural balance in adults.

Ongoing research examines early regional brain development and perinatal risk factors at near-term age in relation to later motor deficits. This research aims to develop a neonatal prognostic index for motor function to guide early, more effective intervention.

Dr. Rose serves on the Neurophysiology section of the NH Taskforce on Childhood Motor Disorders, is a member and Chaired the Research Committee of the American Academy for Cerebral Palsy and Developmental Medicine (AACPD), serves on the Board of Directors of the Society for Brain Mapping and Therapeutics (SBMT), and leads the Research Network on Artificial Walking Technologies for multichannel NMES-assisted Gait for Children with CP. She is co-editor of the book, *Human Walking 3rd Edition*, (Rose J and Gamble JG, Editors, Lippincott, Williams and Wilkins, 2006) which offers a multidisciplinary perspective on human walking and gait analysis. She has served as course director of Anatomy of Movement (Ortho 222), a multidisciplinary course on musculoskeletal anatomy and clinical applications that offers perspectives from bioengineering, anthropology, and art history. She collaborates with professor Kazerooni of UC Berkely and US Bionics on development of a pediatric exoskeleton, which won the Robotics for Good international competition 2016.

## Teaching

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### STANFORD ADVISEES

#### Med Scholar Project Advisor

Sheun Aluko, Jake Mooney

#### Doctoral Dissertation Reader (NonAC)

Dan Sambor

### GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Bioengineering (Phd Program)

## Publications

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### PUBLICATIONS

- **Neonatal Brain Microstructure and Machine-Learning-Based Prediction of Early Language Development in Children Born VeryPreterm.** *Pediatric neurology*

- Vassar, R., Schadl, K., Cahill-Rowley, K., Yeom, K., Stevenson, D., Rose, J.  
2020
- **Prediction of Gait Impairment in Toddlers Born Preterm From Near-Term Brain Microstructure Assessed With DTI, Using Exhaustive Feature Selection and Cross-Validation** *FRONTIERS IN HUMAN NEUROSCIENCE*  
Cahill-Rowley, K., Schadl, K., Vassar, R., Yeom, K. W., Stevenson, D. K., Rose, J.  
2019; 13
  - **A Scoping Review of Neuromuscular Electrical Stimulation to Improve Gait in Cerebral Palsy: The Arc of Progress and Future Strategies** *FRONTIERS IN NEUROLOGY*  
Mooney, J. A., Rose, J.  
2019; 10
  - **The Pediatric Temporal-spatial Deviation Index: quantifying gait impairment for children with cerebral palsy.** *Developmental medicine and child neurology*  
Zhou, J. Y., Zhang, K., Cahill-Rowley, K., Lowe, E., Rose, J.  
2019
  - **Prediction of Gait Impairment in Toddlers Born Preterm From Near-Term Brain Microstructure Assessed With DTI, Using Exhaustive Feature Selection and Cross-Validation.** *Frontiers in human neuroscience*  
Cahill-Rowley, K., Schadl, K., Vassar, R., Yeom, K. W., Stevenson, D. K., Rose, J.  
2019; 13: 305
  - **Neuromuscular correlates of motor function in cerebral palsy: towards targeted treatment.** *Developmental medicine and child neurology*  
Rose, J.  
2018
  - **A common data language for clinical research studies: the National Institute of Neurological Disorders and Stroke and American Academy for Cerebral Palsy and Developmental Medicine Cerebral Palsy Common Data Elements Version 1.0 recommendations** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Schiariti, V., Fowler, E., Brandenburg, J. E., Levey, E., McIntyre, S., Sukal-Moulton, T., Ramey, S. L., Rose, J., Sienko, S., Stashinko, E., Vogtle, L., Feldman, R. S., Koenig, et al  
2018; 60 (10): 976+
  - **Golf Swing Rotational Velocity: The Essential Follow-Through.** *Annals of rehabilitation medicine*  
Steele, K. M., Roh, E. Y., Mahtani, G., Meister, D. W., Ladd, A. L., Rose, J.  
2018; 42 (5): 713–21
  - **Temporal-spatial reach parameters derived from inertial sensors correlate to neurodevelopment in toddlers born preterm** *JOURNAL OF BIOMECHANICS*  
Cahill-Rowley, K., Rose, J.  
2018; 72: 17–22
  - **Prediction of cognitive and motor development in preterm children using exhaustive feature selection and cross-validation of near-term white matter microstructure** *NEUROIMAGE-CLINICAL*  
Schadl, K., Vassar, R., Cahill-Rowley, K., Yeom, K. W., Stevenson, D. K., Rose, J.  
2018; 17: 667–79
  - **A common data language for clinical research studies: the National Institute of Neurological Disorders and Stroke and American Academy for Cerebral Palsy and Developmental Medicine Cerebral Palsy Common Data Elements Version 1.0 recommendations.** *Developmental medicine and child neurology*  
Schiariti, V., Fowler, E., Brandenburg, J. E., Levey, E., McIntyre, S., Sukal-Moulton, T., Ramey, S. L., Rose, J., Sienko, S., Stashinko, E., Vogtle, L., Feldman, R. S., Koenig, et al  
2018; 60 (10): 976–86
  - **Prediction of cognitive and motor development in preterm children using exhaustive feature selection and cross-validation of near-term white matter microstructure.** *NeuroImage. Clinical*  
Schadl, K., Vassar, R., Cahill-Rowley, K., Yeom, K. W., Stevenson, D. K., Rose, J.  
2018; 17: 667–79
  - **Artificial Walking Technologies to Improve Gait in Cerebral Palsy: Multichannel Neuromuscular Stimulation** *ARTIFICIAL ORGANS*  
Rose, J., Cahill-Rowley, K., Butler, E. E.  
2017; 41 (11): E233–E239

- **Corticoreticular tract lesion in children with developmental delay presenting with gait dysfunction and trunk instability** *NEURAL REGENERATION RESEARCH*  
Kwon, Y., Rose, J., Kim, A., Son, S.  
2017; 12 (9): 1465–71
- **Neurologic Correlates of Gait Abnormalities in Cerebral Palsy: Implications for Treatment** *FRONTIERS IN HUMAN NEUROSCIENCE*  
Zhou, J., Butler, E. E., Rose, J.  
2017; 11
- **Temporal-spatial reach parameters derived from inertial sensors: Comparison to 3D marker-based motion capture.** *Journal of biomechanics*  
Cahill-Rowley, K., Rose, J.  
2017; 52: 11-16
- **The Change of Intra-cerebral CST Location during Childhood and Adolescence; Diffusion Tensor Tractography Study** *FRONTIERS IN HUMAN NEUROSCIENCE*  
Kwon, Y. M., Kwon, H. G., Rose, J., Son, S. M.  
2016; 10
- **Toddle temporal-spatial deviation index: Assessment of pediatric gait.** *Gait & posture*  
Cahill-Rowley, K., Rose, J.  
2016; 49: 226-231
- **Temporal-spatial gait parameters and neurodevelopment in very-low-birth-weight preterm toddlers at 18-22 months.** *Gait & posture*  
Cahill-Rowley, K., Rose, J.  
2016; 45: 83-89
- **Neonatal Biomarkers of Inflammation: Correlates of Early Neurodevelopment and Gait in Very-Low-Birth-Weight Preterm Children** *AMERICAN JOURNAL OF PERINATOLOGY*  
Rose, J., Vassar, R., Cahill-Rowley, K., Hintz, S. R., Stevenson, D. K.  
2016; 33 (1): 71-78
- **Neonatal Biomarkers of Inflammation: Correlates of Early Neurodevelopment and Gait in Very-Low-Birth-Weight Preterm Children.** *American journal of perinatology*  
Rose, J., Vassar, R., Cahill-Rowley, K., Hintz, S. R., Stevenson, D. K.  
2016; 33 (1): 71–78
- **Biomechanical and Clinical Correlates of Stance-Phase Knee Flexion in Persons With Spastic Cerebral Palsy.** *PM & R : the journal of injury, function, and rehabilitation*  
Rha, D. W., Cahill-Rowley, K., Young, J., Torburn, L., Stephenson, K., Rose, J.  
2016; 8 (1): 11–18; quiz 18
- **Clinical motion analyses over eight consecutive years in a child with crouch gait: a case report.** *Journal of medical case reports*  
Butler, E. E., Steele, K. M., Torburn, L., Gamble, J. G., Rose, J.  
2016; 10: 157-?
- **Biomechanical and Clinical Correlates of Stance-Phase Knee Flexion in Persons With Spastic Cerebral Palsy** *PM&R*  
Rha, D., Cahill-Rowley, K., Young, J., Torburn, L., Stephenson, K., Rose, J.  
2016; 8 (1): 11-18
- **Neonatal brain microstructure correlates of neurodevelopment and gait in preterm children 18-22 mo of age: an MRI and DTI study** *PEDIATRIC RESEARCH*  
Rose, J., Cahill-Rowley, K., Vassar, R., Yeom, K. W., Stecher, X., Stevenson, D. K., Hintz, S. R., Barnea-Goraly, N.  
2015; 78 (6): 700-708
- **Biomechanical and clinical correlates of swing-phase knee flexion in individuals with spastic cerebral palsy who walk with flexed-knee gait.** *Archives of physical medicine and rehabilitation*  
Rha, D., Cahill-Rowley, K., Young, J., Torburn, L., Stephenson, K., Rose, J.  
2015; 96 (3): 511-517
- **Movement disorders due to bilirubin toxicity.** *Seminars in fetal & neonatal medicine*  
Rose, J., Vassar, R.

2015; 20 (1): 20-25

- **Identification of Neonatal White Matter on DTI: Influence of More Inclusive Thresholds for Atlas Segmentation** *PLOS ONE*  
Vassar, R. L., Barnea-Goraly, N., Rose, J.  
2014; 9 (12)
- **The 2014 ABJS Nicolas Andry Award: The Puzzle of the Thumb: Mobility, Stability, and Demands in Opposition** *CLINICAL ORTHOPAEDICS AND RELATED RESEARCH*  
Ladd, A. L., Crisco, J. J., Hagert, E., Rose, J., Weiss, A. C.  
2014; 472 (12): 3605-3622
- **The 2014 ABJS Nicolas Andry Award: The puzzle of the thumb: mobility, stability, and demands in opposition.** *Clinical orthopaedics and related research*  
Ladd, A. L., Crisco, J. J., Hagert, E., Rose, J., Weiss, A. C.  
2014; 472 (12): 3605-3622
- **Etiology of impaired selective motor control: emerging evidence and its implications for research and treatment in cerebral palsy.** *Developmental medicine and child neurology*  
Cahill-Rowley, K., Rose, J.  
2014; 56 (6): 522-528
- **Brain microstructural development at near-term age in very-low-birth-weight preterm infants: An atlas-based diffusion imaging study.** *NeuroImage*  
Rose, J., Vassar, R., Cahill-Rowley, K., Guzman, X. S., Stevenson, D. K., Barnea-Goraly, N.  
2014; 86: 244-256
- **Neonatal physiological correlates of near-term brain development on MRI and DTI in very-low-birth-weight preterm infants.** *NeuroImage. Clinical*  
Rose, J., Vassar, R., Cahill-Rowley, K., Stecher Guzman, X., Hintz, S. R., Stevenson, D. K., Barnea-Goraly, N.  
2014; 5: 169-177
- **Motor systems and postural instability.** *Handbook of clinical neurology*  
Vassar, R. L., Rose, J.  
2014; 125: 237-251
- **Identification of neonatal white matter on DTI: influence of more inclusive thresholds for atlas segmentation.** *PloS one*  
Vassar, R. L., Barnea-Goraly, N., Rose, J.  
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- **The Pediatric Upper Limb Motion Index and a temporal-spatial logistic regression: Quantitative analysis of upper limb movement disorders during the Reach & Grasp Cycle** *JOURNAL OF BIOMECHANICS*  
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- **Rotational Biomechanics of the Elite Golf Swing: Benchmarks for Amateurs** *JOURNAL OF APPLIED BIOMECHANICS*  
Meister, D. W., Ladd, A. L., Butler, E. E., Zhao, B., Rogers, A. P., Ray, C. J., Rose, J.  
2011; 27 (3): 242-251
- **Physiologic Correlates of T'ai Chi Chuan** *JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE*  
Iuliano, B., Grahn, D., Cao, V., Zhao, B., Rose, J.  
2011; 17 (1): 77-81
- **Definition and Classification of Hyperkinetic Movements in Childhood** *MOVEMENT DISORDERS*  
Sanger, T. D., Chen, D., Fehlings, D. L., Hallett, M., Lang, A. E., Mink, J. W., Singer, H. S., Alter, K., Ben-Pazi, H., Butler, E. E., Chen, R., Collins, A., Dayanidhi, et al  
2010; 25 (11): 1538-1549
- **Temporal-spatial parameters of the upper limb during a Reach & Grasp Cycle for children** *GAIT & POSTURE*  
Butler, E. E., Ladd, A. L., Lamont, L. E., Rose, J.  
2010; 32 (3): 301-306
- **Three-dimensional kinematics of the upper limb during a Reach and Grasp Cycle for children** *GAIT & POSTURE*  
Butler, E. E., Ladd, A. L., Louie, S. A., Lamont, L. E., Wong, W., Rose, J.  
2010; 32 (1): 72-77

- **Mechanisms of Postural Control in Alcoholic Men and Women: Biomechanical Analysis of Musculoskeletal Coordination During Quiet Standing** *ALCOHOLISM-CLINICAL AND EXPERIMENTAL RESEARCH*  
Sullivan, E. V., Rose, J., Pfefferbaum, A.  
2010; 34 (3): 528-537
- **Physiological and Focal Cerebellar Substrates of Abnormal Postural Sway and Tremor in Alcoholic Women** *BIOLOGICAL PSYCHIATRY*  
Sullivan, E. V., Rose, J., Pfefferbaum, A.  
2010; 67 (1): 44-51
- **Selective motor control in spastic cerebral palsy** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J.  
2009; 51 (8): 578-579
- **Neonatal brain structure on MRI and diffusion tensor imaging, sex, and neurodevelopment in very-low-birthweight preterm children** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J., Butler, E. E., Lamont, L. E., Barnes, P. D., Atlas, S. W., Stevenson, D. K.  
2009; 51 (7): 526-535
- **Postural sway reduction in aging men and women: Relation to brain structure, cognitive status, and stabilizing factors** *NEUROBIOLOGY OF AGING*  
Sullivan, E. V., Rose, J., Rohlfing, T., Pfefferbaum, A.  
2009; 30 (5): 793-807
- **Oral baclofen increases maximal voluntary neuromuscular activation of ankle plantar flexors in children with spasticity due to cerebral palsy** *JOURNAL OF CHILD NEUROLOGY*  
van Doornik, J., Kukke, S., McGill, K., Rose, J., Sherman-Levine, S., Sanger, T. D.  
2008; 23 (6): 635-639
- **Promotion of physical fitness and prevention of secondary conditions for children with cerebral palsy: Section on pediatrics research summit proceedings** *PHYSICAL THERAPY*  
Fowler, E. G., Kolobe, T. H., Damiano, D. L., Thorpe, D. E., Morgan, D. W., Brunstrom, J. E., Coster, W. J., Henderson, R. C., Pitetti, K. H., Rimmer, J. H., Rose, J., Stevenson, R. D.  
2007; 87 (11): 1495-1510
- **Neonatal microstructural development of the internal capsule on diffusion tensor imaging correlates with severity of gait and motor deficits** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J., Mirmiran, M., Butler, E. E., Lin, C. Y., Barnes, P. D., Kermoian, R., Stevenson, D. K.  
2007; 49 (10): 745-750
- **Definition and classification of negative motor signs in childhood** *PEDIATRICS*  
Sanger, T. D., Chen, D., Delgado, M. R., Gaebler-Spira, D., Hallett, M., Mink, J. W., Disorders, T. C.  
2006; 118 (5): 2159-2167
- **Postural equilibrium during pregnancy: Decreased stability with an increased reliance on visual cues** *26th Annual Meeting of the Society-for-Maternal-Fetal-Medicine*  
Butler, E. E., Colon, I., Druzin, M. L., Rose, J.  
MOSBY-ELSEVIER.2006: 1104-8
- **Effect of vision, touch and stance on cerebellar vermian-related sway and tremor: A quantitative physiological and MRI study** *CEREBRAL CORTEX*  
Sullivan, E. V., Rose, J., Pfefferbaum, A.  
2006; 16 (8): 1077-1086
- **Neuromuscular activation and motor-unit firing characteristics in cerebral palsy** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J., McGill, K. C.  
2005; 47 (5): 329-336
- **Classification and definition of disorders causing hypertonia in childhood** *PEDIATRICS*  
Sanger, T. D., Delgado, M. R., Gaebler-Spira, D., Hallett, M., Mink, J. W.  
2003; 111 (1)
- **Postural balance in children with cerebral palsy** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
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- **Electromyographic test to differentiate mild diplegic cerebral palsy and idiopathic toe-walking** *JOURNAL OF PEDIATRIC ORTHOPAEDICS*  
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2001; 21 (6): 784-789
- **Electromyographic differentiation of diplegic cerebral palsy from idiopathic toe walking: Involuntary coactivation of the quadriceps and gastrocnemius** *JOURNAL OF PEDIATRIC ORTHOPAEDICS*  
Rose, J., Martin, J. G., Torburn, L., Rinsky, L. A., Gamble, J. G.  
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- **The motor unit in cerebral palsy** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J., McGill, K. C.  
1998; 40 (4): 270-277
- **Postural balance measurements for children and adolescents** *JOURNAL OF ORTHOPAEDIC RESEARCH*  
Wolff, D. R., Rose, J., Jones, V. K., Bloch, D. A., Oehlert, J. W., Gamble, J. G.  
1998; 16 (2): 271-275
- **MUSCLE PATHOLOGY AND CLINICAL MEASURES OF DISABILITY IN CHILDREN WITH CEREBRAL-PALSY** *JOURNAL OF ORTHOPAEDIC RESEARCH*  
Rose, J., Haskell, W. L., Gamble, J. G., Hamilton, R. L., Brown, D. A., Rinsky, L.  
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- **A COMPARISON OF OXYGEN PULSE AND RESPIRATORY EXCHANGE RATIO IN CEREBRAL-PALSIED AND NONDISABLED CHILDREN** *ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION*  
Rose, J., Haskell, W. L., Gamble, J. G.  
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- **THE ENERGY-EXPENDITURE INDEX - A METHOD TO QUANTITATE AND COMPARE WALKING ENERGY-EXPENDITURE FOR CHILDREN AND ADOLESCENTS** *JOURNAL OF PEDIATRIC ORTHOPAEDICS*  
Rose, J., Gamble, J. G., Lee, J., LEE, R., Haskell, W. L.  
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- **ENERGY-EXPENDITURE INDEX OF WALKING FOR NORMAL-CHILDREN AND FOR CHILDREN WITH CEREBRAL-PALSY** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
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- **ENERGY-COST OF WALKING IN NORMAL-CHILDREN AND IN THOSE WITH CEREBRAL-PALSY - COMPARISON OF HEART-RATE AND OXYGEN-UPTAKE** *JOURNAL OF PEDIATRIC ORTHOPAEDICS*  
Rose, J., Gamble, J. G., Medeiros, J., Burgos, A., Haskell, W. L.  
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- **BACK PAIN AND SPINAL DEFORMITY IN CYSTIC-FIBROSIS** *AMERICAN JOURNAL OF DISEASES OF CHILDREN*  
Rose, J., Gamble, J., Schultz, A., LEWISTON, N.  
1987; 141 (12): 1313-1316
- **A comprehensive exercise program for persons with cystic fibrosis.** *Journal of pediatric nursing*  
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- **ENERGY-COST INDEX AS AN ESTIMATE OF ENERGY-EXPENDITURE OF CEREBRAL-PALSIED CHILDREN DURING ASSISTED AMBULATION** *DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY*  
Rose, J., Medeiros, J. M., Parker, R.  
1985; 27 (4): 485-490