Stanford



Malene Lindholm

Sr. Research Engineer, Medicine - Med/Cardiovascular Medicine

Bio

BIO

Dr. Malene Lindholm is a senior research engineer and Director of the human Molecular Athlete Moonshot for the Wu Tsai Human Performance Alliance at Stanford. After earning her PhD in Medicine at the Karolinska Institute in Sweden, she performed her postdoctoral studies at the Cardiovascular Institute at Stanford University. Her current research focuses on unraveling the multi-omic adaptation mechanisms to exercise across tissues and the genetic basis of extreme human performance. The ultimate objective is to transform the findings into tangible application in the field of precision exercise health and medicine.

ACADEMIC APPOINTMENTS

- Sr. Research Engineer, Medicine - Med/Cardiovascular Medicine
- Member, Wu Tsai Human Performance Alliance

HONORS AND AWARDS

- Early Career Investigator Award, American Heart Association Genomic and Precision Medicine Council (11/15/2020)
- Young Investigator Award, Swedish foundation for promoting exercise (Sveriges Centralförening för Idrottens Främjande) (10/2019)
- Young Investigator Award, Research Group on the Biochemistry of Exercise (10/2018)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Council on Genomic and Precision Medicine Early Career Committee (2022 - present)

PROFESSIONAL EDUCATION

- M.Sc., Karolinska Institute , Biomedicine (2007)
- PhD, Karolinska Institute , Medicine (2015)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Interested in the genetics of human performance and the multi-omic response to exercise and training for optimizing human health.

CLINICAL TRIALS

- HIIT vs. MICT Training Study, Recruiting
- GEnder Dysphoria Treatment in Sweden, Not Recruiting
- Molecular Transducers of Physical Activity Consortium, Not Recruiting

Publications

PUBLICATIONS

- **Acute Exercise Drives Transient Immune Dysregulation: Immune Score Analysis in the MoTrPAC Cohort**
  Brochet, P., Smith, G., Jin, C., Jimenez-Morales, D., Many, G., Lindholm, M. E., Smith, K., Khatri, P., Sealfon, S., Walsh, M., Montgomery, S. B., Snyder, M., Wheeler, et al
  LIPPINCOTT WILLIAMS & WILKINS.2026: A18787

- **Endurance Exercise Opposes Cardiac Disease Programs and Modulates Haploinsufficient Cardiomyopathy Genes**
  Brochet, P., Njoroge, J., Many, G., Lindholm, M. E., Montalvo Hernandez, S., Smith, G., Jimenez-Morales, D., Keshishian, H., Walsh, M., Montgomery, S. B., Kraus, W. E., Yan, Z.
  LIPPINCOTT WILLIAMS & WILKINS.2026: A19079

- **The effect of sex and endurance exercise training on the incretin signaling pathway in 17 rat tissues.** *Physiological genomics*
  Jin, C., Many, G., Reynoso Spurrier, C. S., Borsellino, P., Wheeler, M. T., Adkins, J. N., Snyder, M. P., Newgard, C. B., Radom-Aizik, S., Cooper, D. M., Bodine, S. C., Schenk, S., Lindholm, et al
  2026

- **Temporal multi-omic analysis uncovers sex-biased molecular programs underlying skeletal muscle adaptation to endurance training.** *Cell reports*
  Many, G. M., Jin, C., Day, N. J., Iyer, G., Smith, G., Voos, K., Sanford, J. A., Bareja, A., Jimenez-Morales, D., Leach, D. T., Sagendorf, T. J., Ahmed, A., Li, et al
  2026; 45 (8): 117823

- **Endurance exercise elicits temporal and sexual dimorphic multi-omics remodeling of liver metabolism revealed by MoTrPAC.** *Cell reports*
  Kelty, T. J., Franczak, E., Gay, N. R., Many, G. M., Sagendorf, T. J., Sanford, J. A., Hou, Z., Gaul, D. A., Fernández, F. M., Rekowski, M., Burant, C. F., Hevener, A. L., Adkins, et al
  2026; 45 (6): 117416

- **Publisher Correction: The impact of exercise on gene regulation in association with complex trait genetics.** *Nature communications*
  Vetr, N. G., Gay, N. R., Montgomery, S. B.
  2026; 17 (1)

- **The Long Non-coding RNA Landscape of Endurance Exercise Training.** *Molecular metabolism*
  Bonilauri, B., Smith, G. R., Raja, A. N., Jimenez-Morales, D., Ahmed, A., Jin, C., Sparks, L. M., Walsh, M. J., Montgomery, S. B., Bodine, S. C., Ashley, E. A., Lindholm, M. E.
  2026: 102358

- **Multi-omic identification of key transcriptional regulatory programs during endurance exercise training in rats.** *Nature communications*
  Smith, G. R., Zhao, B., Lindholm, M. E., Raja, A., Viggars, M., Pincas, H., Gay, N. R., Sun, Y., Vangeti, S., Ge, Y., Nair, V. D., Sanford, J. A., Amper, et al
  2026

- **Blood Biochemical Responses to Acute Exercise: Findings from the Molecular Transducers of Physical Activity Consortium (MoTrPAC).** *bioRxiv : the preprint server for biology*
  Robbins, J. M., Katz, D. H., Many, G. M., Rao, P., Smith, G. R., Tiwari, G., Jin, C., Spielmann, G., Montalvo, S., Iyer, G., Amar, D., Leach, D., Coyne, et al
  2026

- **Muscle Movement and Metabolism: Exercise and Skeletal Muscle as Mediators of Health. A Report from the 26th Annual Harvard Nutrition Obesity Symposium, 2025.** *The American journal of clinical nutrition*
  Carollo, L., Lawson, E. A., Stanley, T. L., Wang, J., Bhattacharya, R., Bishop, D. J., Carmichael, O., Esser, K. A., Febbraio, M. A., Fielding, R. A., Fourman, L. T., Goodpaster, B. H., Goodyear, et al
  2026: 101262

- **Integrative Multi-omics Analysis of the Human Skeletal Muscle Response to Endurance or Resistance Exercise: Findings from the Molecular Transducers of Physical Activity Consortium (MoTrPAC).** *bioRxiv : the preprint server for biology*
  Keshishian, H., Many, G. M., Smith, G., Clark, N. M., Iyer, G., Hart, P., Lindholm, M. E., Montalvo, S., Zhang, Z., Jin, C., Sanford, J. A., Carr, S. A., Adkins, et al
  2026

- **Integrative analysis of MoTrPAC and LINCS transcriptomes identifies cardiovascular-relevant exercise-mimetic drugs**
  Brochet, P., Jimenez-Morales, D., Lindholm, M., Wheeler, M., Katz, D.
  LIPPINCOTT WILLIAMS & WILKINS.2025

- **Brisk Usual Walking Pace Causally Remodels Brain, Heart and Metabolic Tissues**
  Gomes Botelho Quintas, B., Xia, R., Loong, S., Reddy, S., Cao, F., Steffner, K., Geraldo, A., Lindholm, M., Amar, D., Ashley, E.
  LIPPINCOTT WILLIAMS & WILKINS.2025

- **Multi-omics analysis of endurance exercise reveals cardioprotective remodeling in rat heart**
  Brochet, P., Njoroge, J., Montalvo Hernandez, S., Lindholm, M., Smith, G., Amar, D., Gay, N., Zhao, B., Hung, C., Jin, C., Chavez, C., Nachun, D., Zaslavsky, et al
  LIPPINCOTT WILLIAMS & WILKINS.2025

- **Sexually Distinct Multi-Omic Responses to Progressive Endurance Exercise Training in the Rat Lung - Findings from MoTrPAC.** *American journal of respiratory cell and molecular biology*
  Many, G. M., Sagendorf, T. J., Mitchell, H., Sanford, J. A., Cohen, S., Misra, R., Estevao, I., Díaz Ludovico, I., Gaul, D. A., Lindholm, M. E., Ushakumary, M. G., Pino, J., Musi, et al
  2025

- **The Long Non-coding RNA Landscape of Endurance Exercise Training.** *bioRxiv : the preprint server for biology*
  Bonilauri, B., Smith, G. R., Raja, A. N., Jimenez-Morales, D., Ahmed, A., Jin, C., Sparks, L. M., Walsh, M. J., Montgomery, S. B., Bodine, S. C., Ashley, E. A., Lindholm, M. E.
  2025

- **Endurance Training Enhances Sex-Specific Cardioprotective Metabolism.** *Circulation research*
  Brochet, P., Montalvo, S., Lindholm, M. E., Jimenez-Morales, D., Jin, C. A., Rasmussen, B. B., Kraus, W. E., Yan, Z., Wheeler, M. T., Katz, D. H.
  2025

- **Exercise pills for cardiometabolic health cannot mimic the exercise milieu.** *Trends in endocrinology and metabolism: TEM*
  Plaza-Florido, A., Lindholm, M. E., Carrera-Bastos, P., Santos-Lozano, A., Valenzuela, P. L., Fiuza-Luces, C., Radom-Aizik, S., Lucia, A.
  2025

- **Identification of candidate cardiomyopathy modifier genes through genome sequencing and RNA profiling.** *Frontiers in cardiovascular medicine*
  Lindholm, M. E., Abramowitz, S., Waggott, D. M., Grove, M. E., Dewey, F. E., Pan, C., Pavlovic, A., Shang, C., Huang, Y., Bensabath, L., Goldfeder, R. L., Cordero, P., Erbilgin, et al
  2025; 12: 1546493

- **Skeletal Muscle as a Mediator of Interorgan Crosstalk During Exercise: Implications for Aging and Obesity.** *Circulation research*
  Shero, J. A., Lindholm, M. E., Sandri, M., Stanford, K. I.
  2025; 136 (11): 1407-1432

- **Endurance exercise drives temporal and sexual dimorphic multi-omic adaptations in liver metabolism-Findings from MoTrPAC.** *bioRxiv : the preprint server for biology*
  Kelty, T. J., Franczak, E., Gay, N. R., Many, G. M., Sagendorf, T. J., Sanford, J. A., Hou, Z., Gaul, D. A., Fernández, F. M., Burant, C., Hevener, A. L., Adkins, J. N., Bodine, et al
  2025

- **Researcher views on returning results from multi-omics data to research participants: insights from The Molecular Transducers of Physical Activity Consortium (MoTrPAC) Study.** *BMC medical ethics*
  Ormond, K. E., Stanclift, C., Reuter, C. M., Carter, J. N., Murphy, K. E., Lindholm, M. E., Wheeler, M. T.
  2025; 26 (1): 22

- **Charting the Molecular Terrain of Exercise: The Power of Multi-Omic Mapping.** *Physiology (Bethesda, Md.)*
  Katz, D. H., Lindholm, M. E., Ashley, E. A.
  2024

- **Physiological Adaptations to Progressive Endurance Exercise Training in Adult and Aged Rats: Insights from the Molecular Transducers of Physical Activity Consortium (MoTrPAC).** *Function (Oxford, England)*
  Schenk, S., Sagendorf, T. J., Many, G. M., Lira, A. K., de Sousa, L. G., Bae, D., Cicha, M., Kramer, K. S., Muehlbauer, M., Hevener, A. L., Rector, R. S., Thyfault, J. P., Williams, et al

2024; 5 (4)

- **DNA methylation of exercise-responsive genes differs between trained and untrained men.** *BMC biology*
  Geiger, C., Needhamsen, M., Emanuelsson, E. B., Norrbom, J., Steindorf, K., Sundberg, C. J., Reitzner, S. M., Lindholm, M. E.
  2024; 22 (1): 147

- **The impact of exercise on gene regulation in association with complex trait genetics.** *Nature communications*
  Vetr, N. G., Gay, N. R., MoTrPAC Study Group, Montgomery, S. B., Adkins, J. N., Albertson, B. G., Amar, D., Amper, M. A., Armenteros, J. J., Ashley, E., Avila-Pacheco, J., Bae, D., Balci, A. T., et al
  2024; 15 (1): 3346

- **Temporal dynamics of the multi-omic response to endurance exercise training.** *Nature*
  2024; 629 (8010): 174-183

- **Sexual dimorphism and the multi-omic response to exercise training in rat subcutaneous white adipose tissue.** *Nature metabolism*
  Many, G. M., Sanford, J. A., Sagendorf, T. J., Hou, Z., Nigro, P., Whytock, K. L., Amar, D., Caputo, T., Gay, N. R., Gaul, D. A., Hirshman, M. F., Jimenez-Morales, D., Lindholm, et al
  2024

- **Molecular adaptations in response to exercise training are associated with tissue-specific transcriptomic and epigenomic signatures.** *Cell genomics*
  Nair, V. D., Pincas, H., Smith, G. R., Zaslavsky, E., Ge, Y., Amper, M. A., Vasoya, M., Chikina, M., Sun, Y., Raja, A. N., Mao, W., Gay, N. R., Esser, et al
  2024: 100421

- **Molecular Transducers of Physical Activity Consortium (MoTrPAC): Human Studies Design and Protocol.** *Journal of applied physiology (Bethesda, Md. : 1985)*
  Group, M. R., Jakicic, J. M., Kohrt, W. M., Houmard, J. A., Miller, M. E., Radom-Aizik, S., Rasmussen, B. B., Ravussin, E., Serra, M., Stowe, C. L., Trappe, S., AbouAssi, H., Adkins, et al
  2024

- **The mitochondrial multi-omic response to exercise training across rat tissues.** *Cell metabolism*
  Amar, D., Gay, N. R., Jimenez-Morales, D., Jean Beltran, P. M., Ramaker, M. E., Raja, A. N., Zhao, B., Sun, Y., Marwaha, S., Gaul, D. A., Hershman, S. G., Ferrasse, A., Xia, et al
  2024

- **Remodeling of the human skeletal muscle proteome found after long-term endurance training but not after strength training.** *iScience*
  Emanuelsson, E. B., Arif, M., Reitzner, S. M., Perez, S., Lindholm, M. E., Mardinoglu, A., Daub, C., Sundberg, C. J., Chapman, M. A.
  2024; 27 (1): 108638

- **Comparing the Blood Response to Hyperbaric Oxygen with High-Intensity Interval Training-A Crossover Study in Healthy Volunteers.** *Antioxidants (Basel, Switzerland)*
  Kjellberg, A., Lindholm, M. E., Zheng, X., Liwenborg, L., Rodriguez-Wallberg, K. A., Catrina, S. B., Lindholm, P.
  2023; 12 (12)

- **Exercise is associated with younger methylome and transcriptome profiles in human skeletal muscle.** *Aging cell*
  Voisin, S., Seale, K., Jacques, M., Landen, S., Harvey, N. R., Haupt, L. M., Griffiths, L. R., Ashton, K. J., Coffey, V. G., Thompson, J. M., Doering, T. M., Lindholm, M. E., Walsh, et al
  2023: e13859

- **The mitochondrial multi-omic response to exercise training across tissues.** *bioRxiv : the preprint server for biology*
  Amar, D., Gay, N. R., Jimenez-Morales, D., Beltran, P. M., Ramaker, M. E., Raja, A. N., Zhao, B., Sun, Y., Marwaha, S., Gaul, D., Hershman, S. G., Xia, A., Lanza, et al
  2023

- **Multiomic identification of key transcriptional regulatory programs during endurance exercise training.** *bioRxiv : the preprint server for biology*
  Smith, G. R., Zhao, B., Lindholm, M. E., Raja, A., Viggars, M., Pincas, H., Gay, N. R., Sun, Y., Ge, Y., Nair, V. D., Sanford, J. A., S Amper, M. A., Vasoya, et al
  2023

- **Mono- and Biallelic Protein-Truncating Variants in Alpha-Actinin 2 Cause Cardiomyopathy Through Distinct Mechanisms.** *Circulation. Genomic and precision medicine*
  Lindholm, M. E., Jimenez-Morales, D., Zhu, H., Seo, K., Amar, D., Zhao, C., Raja, A., Madhvani, R., Abramowitz, S., Espenel, C., Sutton, S., Caleshu, C., Berry, et al
  2021: CIRCGEN121003419

- **Time trajectories in the transcriptomic response to exercise - a meta-analysis.** *Nature communications*
  Amar, D., Lindholm, M. E., Norrbom, J., Wheeler, M. T., Rivas, M. A., Ashley, E. A.
  2021; 12 (1): 3471

- **Molecular Transducers of Physical Activity Consortium (MoTrPAC): Mapping the Dynamic Responses to Exercise.** *Cell*
  Sanford, J. A., Nogiec, C. D., Lindholm, M. E., Adkins, J. N., Amar, D., Dasari, S., Drugan, J. K., Fernandez, F. M., Radom-Aizik, S., Schenk, S., Snyder, M. P., Tracy, R. P., Vanderboom, et al
  2020; 181 (7): 1464–74

- **Exercise Induces Different Molecular Responses in Trained and Untrained Human Muscle.** *Medicine and science in sports and exercise*
  Moberg, M., Lindholm, M. E., Reitzner, S. M., Ekblom, B., Sundberg, C., Psilander, N.
  2020

- **An epigenetic clock for human skeletal muscle.** *Journal of cachexia, sarcopenia and muscle*
  Voisin, S., Harvey, N. R., Haupt, L. M., Griffiths, L. R., Ashton, K. J., Coffey, V. G., Doering, T. M., Thompson, J. M., Benedict, C., Cedernaes, J., Lindholm, M. E., Craig, J. M., Rowlands, et al
  2020

- **Skeletal Muscle Transcriptomic Comparison between Long-Term Trained and Untrained Men and Women.** *Cell reports*
  Chapman, M. A., Arif, M. n., Emanuelsson, E. B., Reitzner, S. M., Lindholm, M. E., Mardinoglu, A. n., Sundberg, C. J.
  2020; 31 (12): 107808

- **NOVEL ALPHA-ACTININ 2 MUTATIONS ARE ASSOCIATED WITH CARDIOMYOPATHY AND HYPERTROPHY IN HUMAN CARDIAC TISSUE AND IPSC-DERIVED CARDIOMYOCYTES**
  Lindholm, M., Zhu, H., Huang, Y., Ashley, E. A., Wheeler, M.
  ELSEVIER SCIENCE INC.2019: 1027

- **Metabolic and functional changes in transgender individuals following cross-sex hormone treatment: Design and methods of the GEnder Dysphoria Treatment in Sweden (GETS) study** *CONTEMPORARY CLINICAL TRIALS COMMUNICATIONS*
  Wiik, A., Andersson, D. P., Brismar, T. B., Chanpen, S., Dhejne, C., Ekstrom, T. J., Flanagan, J. N., Holmberg, M., Kere, J., Lilja, M., Lindholm, M. E., Lundberg, T. R., Maret, et al
  2018; 10: 148–53

- **Medical relevance of protein-truncating variants across 337,205 individuals in the UK Biobank study** *NATURE COMMUNICATIONS*
  DeBoever, C., Tanigawa, Y., Lindholm, M. E., McInnes, G., Lavertu, A., Ingelsson, E., Chang, C., Ashley, E. A., Bustamante, C. D., Daly, M. J., Rivas, M. A.
  2018; 9: 1612

- **The Impact of Endurance Training on Human Skeletal Muscle Memory, Global Isoform Expression and Novel Transcripts.** *PLoS genetics*
  Lindholm, M. E., Giacomello, S., Werne Solnestam, B., Fischer, H., Huss, M., Kjellqvist, S., Sundberg, C. J.
  2016; 12 (9)

- **Skeletal muscle hypoxia-inducible factor-1 and exercise** *EXPERIMENTAL PHYSIOLOGY*
  Lindholm, M. E., Rundqvist, H.
  2016; 101 (1): 28-32

- **The human cardiac and skeletal muscle proteomes defined by transcriptomics and antibody-based profiling** *BMC GENOMICS*
  Lindskog, C., Linne, J., Fagerberg, L., Hallstrom, B. M., Sundberg, C. J., Lindholm, M., Huss, M., Kampf, C., Choi, H., Liem, D. A., Ping, P., Varemo, L., Mardinoglu, et al
  2015; 16

- **An integrative analysis reveals coordinated reprogramming of the epigenome and the transcriptome in human skeletal muscle after training** *EPIGENETICS*
  Lindholm, M. E., Marabita, F., Gomez-Cabrero, D., Rundqvist, H., Ekstrom, T. J., Tegner, J., Sundberg, C. J.
  2014; 9 (12): 1557-1569

- **The human skeletal muscle transcriptome: sex differences, alternative splicing, and tissue homogeneity assessed with RNA sequencing** *FASEB JOURNAL*
  Lindholm, M. E., Huss, M., Solnestam, B. W., Kjellqvist, S., Lundeberg, J., Sundberg, C. J.
  2014; 28 (10): 4571-4581

- **Negative regulation of HIF in skeletal muscle of elite endurance athletes: a tentative mechanism promoting oxidative metabolism** *AMERICAN JOURNAL OF PHYSIOLOGY-REGULATORY INTEGRATIVE AND COMPARATIVE PHYSIOLOGY*
  Lindholm, M. E., Fischer, H., Poellinger, L., Johnson, R. S., Gustafsson, T., Sundberg, C. J., Rundqvist, H.
  2014; 307 (3): R248-R255

- **An evaluation of analysis pipelines for DNA methylation profiling using the Illumina HumanMethylation450 BeadChip platform** *EPIGENETICS*
  Marabita, F., Almgren, M., Lindholm, M. E., Ruhrmann, S., Fagerstrom-Billai, F., Jagodic, M., Sundberg, C. J., Ekstrom, T. J., Teschendorff, A. E., Tegner, J., Gomez-Cabrero, D.
  2013; 8 (3): 333-346