

Biomarkers with Potential Utility in Disability Adjudication of Physical Impairments

Stephanie M. George, PhD, MPH, MA
Epidemiologist and Program Director

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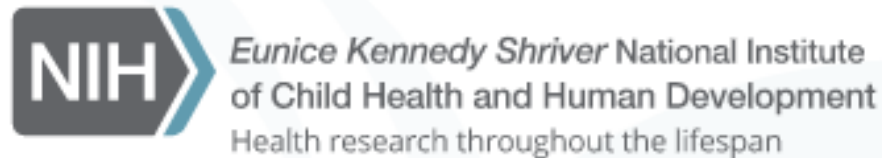


National Institute of
Arthritis and Musculoskeletal
and Skin Diseases

[NIAMS](#) Mission: To support research into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases, the training of basic and clinical scientists to carry out this research, and the dissemination of information on research progress in these diseases.

National Center for Medical Rehabilitation Research ([NCMRR](#))

- Through basic, translational, and clinical research, NCMRR aims to foster development of scientific knowledge needed to enhance the health, productivity, independence, and quality of life of people with physical disabilities.
- Promote rehabilitation research within the NIH, coordinate efforts of the ICs, and promote collaboration with other federal agencies.



https://www.nichd.nih.gov/publications/pubs/Documents/NIH_ResearchPlan_Rehabilitation.pdf

Outline

- Present overview of burden of musculoskeletal disorders
- Discuss some potential markers of interest for measuring musculoskeletal impairments and rehabilitation
 - Wearables
 - Imaging
 - Clinical measures
 - Functional assessment

Burden of musculoskeletal disorders in the US

United States, Both sexes, All ages, DALYs per 100,000

2017 rank



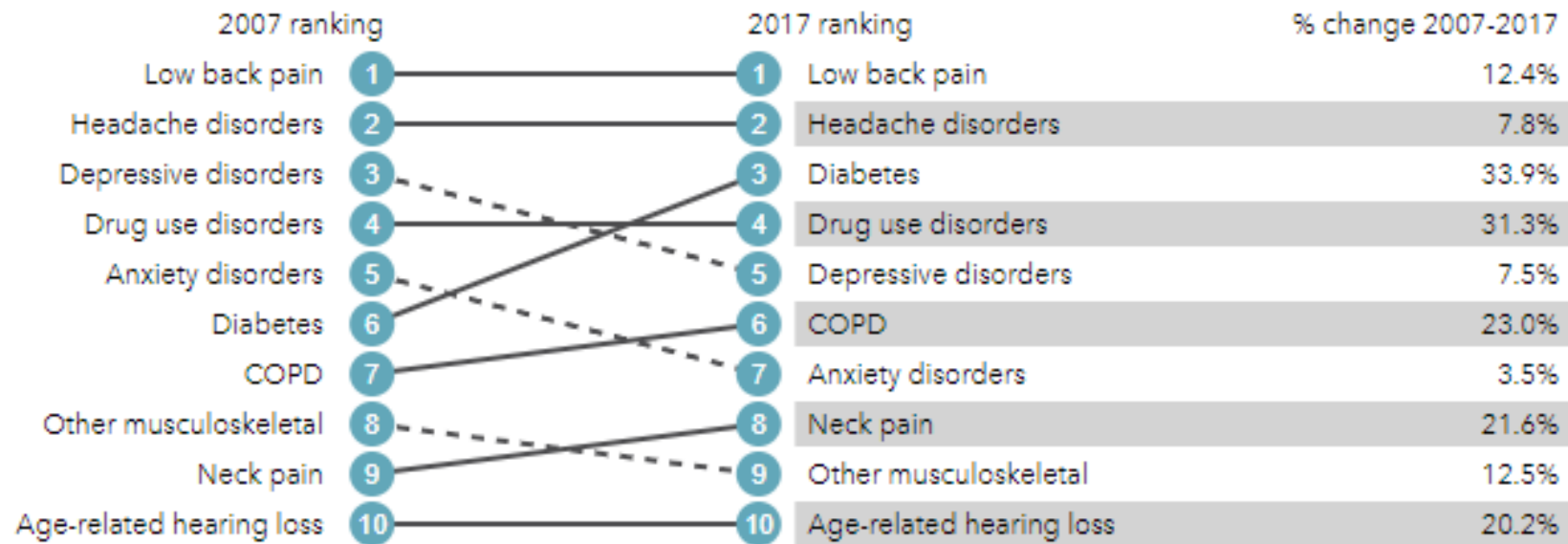
- Musculoskeletal disorders measured include:

- Rheumatoid arthritis
- Osteoarthritis
- Low back pain
- Neck pain
- Gout
- Other musculoskeletal

Low back pain is leading health problem

What health problems cause the most disability?

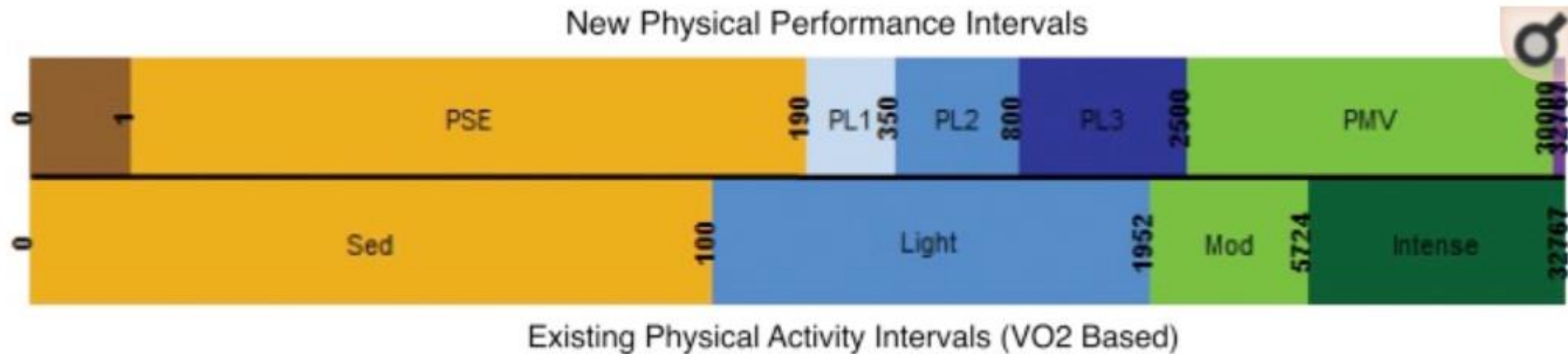
- Communicable, maternal, neonatal, and nutritional diseases
- Non-communicable diseases
- Injuries



Top 10 causes of years lived with disability (YLDs) in 2017 and percent change, 2007-2017, all ages, number

Wearables

- Accelerometry work in NHANES examined free-living physical activity in populations with musculoskeletal pain and mobility limitations
 - Resulted in accelerometry thresholds optimized for real-life physical performance in people with musculoskeletal regional body pain

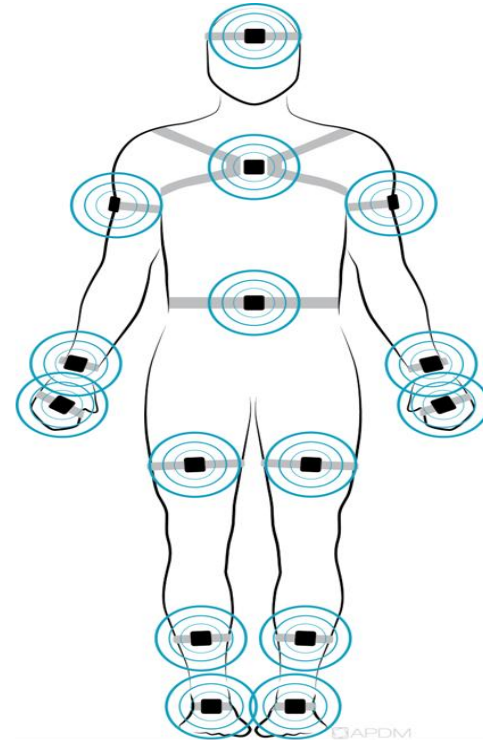


Performance Sedentary (PSE) = 1–100, Performance Light 1 (PL1) = 101–350, Performance Light 2 (PL2) = 351–800, Performance Light 3 (PL3) = 801–2500, and Performance Moderate and Vigorous (PMV) = 2501–30000.

[PMC5325560](https://pubmed.ncbi.nlm.nih.gov/35325560/)

Wearables

- Innovative and validated algorithms that use wirelessly-synchronized, wearable inertial sensors to detect mobility impairments and provide real-time visual feedback during patients' retraining (like gait training)
- Wireless, wearable system to estimate the tension in tendons of the legs during dynamic free movement
 - estimate of muscle force
- [1R41AR074897-01](https://www.apdm.com/wearable-sensors/)



<https://www.apdm.com/wearable-sensors/>;
R42HD071760, R44AG056012, R43NS090756,
R44AG055388, R43AG044863

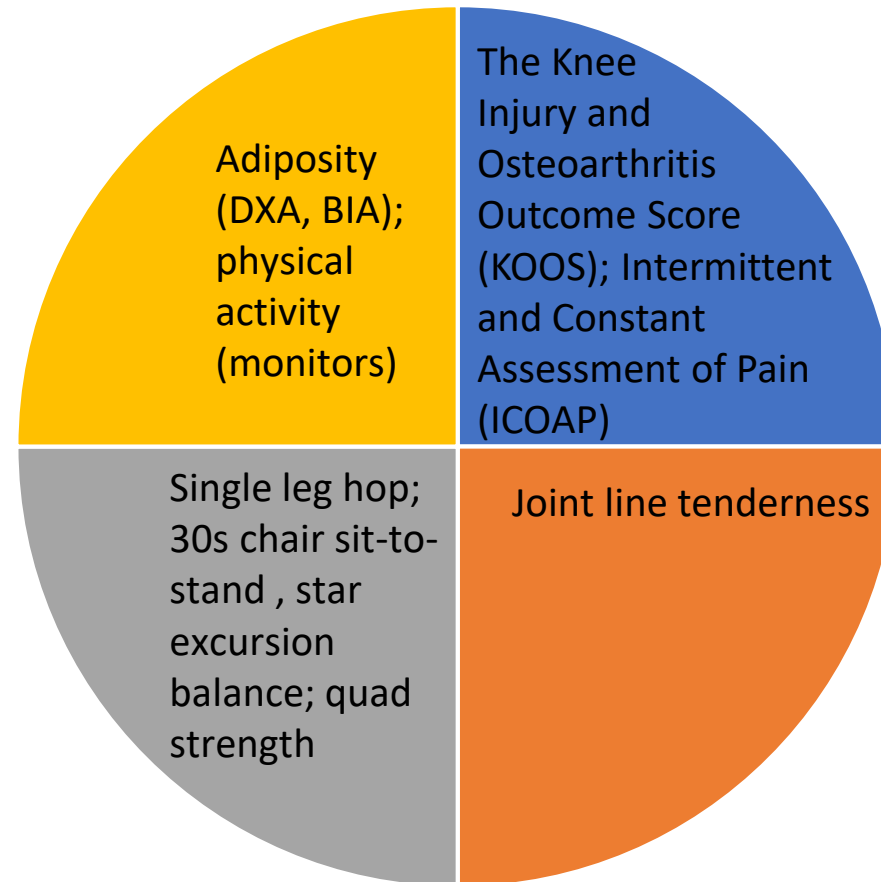
Imaging

- Fatty infiltration of posterior lumbar paraspinal muscles as predictor of treatment response for low back pain
 - [PMC5938809](#)
 - Axial MRIs; two methodologies for determining region of interest have been compared
- Advanced quantitative MRI technologies texture analysis of imaging and ultrasound common and of value in osteoarthritis
 - PMID: [30590194](#)

Imaging (+ clinical and functional) biomarkers

- Establishing outcome measures in early knee osteoarthritis
- Best practices for selection of multiple outcomes measures

Measures for clinical practice and research settings



- Patient reported outcomes
- Clinical features
- Physical function outcomes
- Modifiable lifestyle outcomes

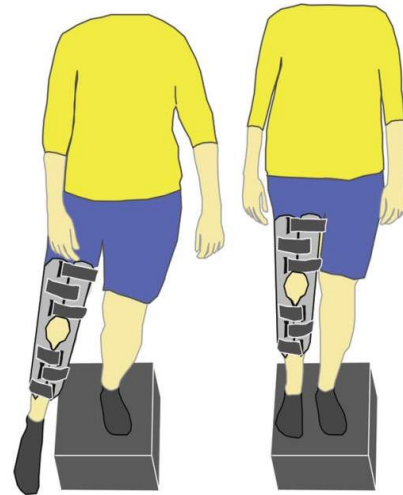
Current consortia exploring clinical, imaging, and functional assessments

- The FNIH Biomarkers Consortium's [Sarcopenia as a Valid Biomarker for Identifying Individuals at Risk for Disability](#)
 - Establish evidence-based cut-points for muscle mass and strength and determine their predictive validity for clinically meaningful outcomes (such as mobility, fractures, hospitalization and death).
 - Evaluate relative strength as a discriminator for mobility limitation and incident disability.
 - Explore the potential usefulness of sarcopenia as a clinical endpoint in randomized clinical trials.
- The NIH **Back Pain** Research Consortium ([BACPAC](#)) is a new patient-centric translational research initiative that will address the need for effective and personalized therapies for chronic low back pain
 - Part of the [NIH HEAL \(Helping to End Addiction Long-termSM\) Initiative](#).
 - One goal is to phenotype patients comprehensively, including symptoms, PROs, and psychosocial characteristics, combined with selected imaging and biomarkers, to produce algorithms for individualized multimodal interventions.



Functional assessments

- Single-step test of unilateral limb ability after total knee arthroplasty (n=207)
 - Test was valid and reliable measure of activity limitations when assessing lower limb impairments after surgery
 - [PMC4096695](#)



- Gait speed among women with hip fracture (n=217)
 - Limited support for 0.1-m/s cut point for substantial meaningful change for this population; consider other cutpoints
 - [PMC3230716](#)

Work Disability Functional Assessment Battery (WD-FAB)

- Functional assessment instrument developed collaboratively by SSA, NIH, and Boston University
- Self-reported assessment of whole person function as relates to work
- Framework: Activity level of WHO's International Classification of Functioning, Disability and Health (ICF)
- Content: 8 scales across 2 domains - Physical and Mental Function
 - Physical: Basic Mobility, Upper Body Function, Fine Motor Function, Community Mobility
- Methods: Item Response Theory and Computer Adaptive Testing
 - Choose from over 300 questions based on previous responses
 - Creates a tailored, individualized assessment that best measures a person's 'ability'
 - Can be administered in 25-30 minutes on average

WD-FAB Application

- Create functional profiles
- Measures change in function over time
- SSA and NIH currently designing pilot study to test application of WD-FAB in SSA's business process

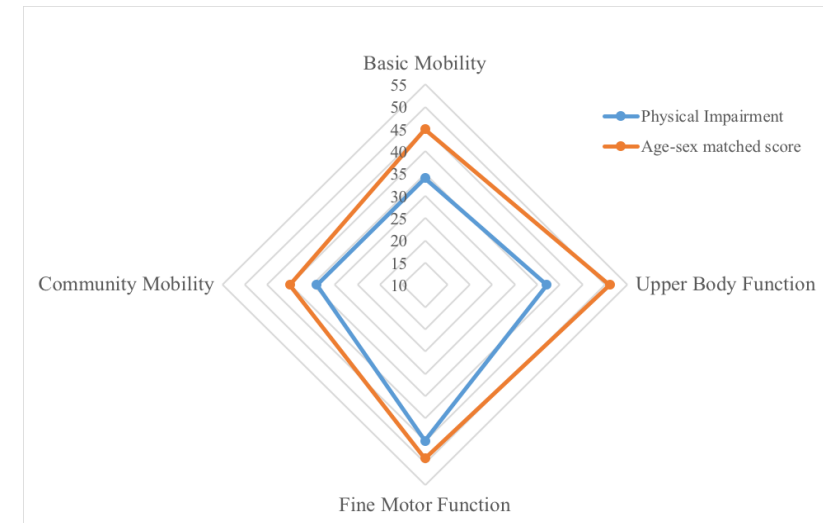


Figure 1. WD-FAB Physical Function profile for an individual with a history of TIAs

Basic Mobility involves getting into and out of positions, staying in positions for periods of time, and walking and moving around from one place to another.

Date	WD-FAB Basic Mobility	Score Estimate	Confidence Interval	Functional Level (?)
11/15/2017		30	28-32	Low (18-30)
2/15/2018		35	33-37	Average (31-40)
5/15/2018		50	48-52	High (41-53)

Figure 2. Comparison of WD-FAB Basic Mobility scores over time

Thank you