A little history

1990’s to early 2020’s: Exercise Physiology Core, Director Kerry Stewart
  • Supported initially by NCRR General Clinical Research Center grant award
  • Then a NCATS Clinical and Translational Science Award
  • Transition to Service Center

Survival of Service Centers is contingent on a broad user base
  • Economies of scale

Is there a demand for a Human Performance Laboratory Core?
Human Performance

Measuring an individual’s ability to efficiently respond to homeostatic stressors,
   Physical: exercise, physical activity, ADLs, injury, etc.
   Chemical: drugs, carcinogens, toxins, etc.
   Pathologic: infection, disease, etc.

At any biological level (subcellular, cellular, tissues, organ systems, organismal),

With three basic measurement categories
   Baseline phenotypic characterization
   Acute physiologic responses
   Chronic adaptations
Phenotypic Characterization

Static and Functional Phenotyping

Static: Body composition, resting metabolic rate, circulatory profiles
Functional: Walk tests, muscle strength, exercise capacity, vascular/pulmonary

Essential for cross-sectional, timecourse, and longitudinal study designs

Specific primary/secondary outcomes, exploratory aims
Providing appropriate physiologic and statistical controls
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Article
Maternal Aerobic Exercise, but Not Blood Docosahexaenoic Acid and Eicosapentaenoic Acid Concentrations, during Pregnancy Influence Infant Body Composition
Acute Responses

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Blood-based analyses
Endothelial function

Systemic metabolic responses
Integrative cardiopulmonary measures

Assess maximal and submaximal physiologic responses to acute stress of interest
Molecular Choreography of Acute Exercise

MoTrPAC
Molecular Transducers of Physical Activity Consortium

$170M NIH Common Fund
Low-dose aspirin and COX inhibition in human skeletal muscle

William A. Fountain, Masatoshi Naruse, Alex Claiborne, Andrew M. Stroh, Kevin J. Gries, Andrew M. Jones, Kiril Minchev, Bridget E. Lester, Ulrika Raue, Scott Trappe, and Todd A. Trappe

Human Performance Laboratory, Ball State University, Muncie, Indiana

Does aspirin influence skeletal muscle inflammation before and after exercise?
RESEARCH ARTICLE

Low-dose aspirin and COX inhibition in human skeletal muscle

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1. Basal characterization
2. Basal dose-response
3. Stimulated characterization
4. Stimulated dose-response
Exercise Metabolism and the Molecular Regulation of Skeletal Muscle Adaptation

Brendan Egan¹,² and Juleen R. Zierath²,³,⁴,*

How might this apply to your research?
Transcript → Protein → Phenotype → Outcomes

Consider the following interventions:
- Exercise
- Pharmaceuticals
- Surgery
- Medical Devices
- Therapeutics
- Inactivity
- Injury
- Lifestyle Modification
Big Picture: JH Potential?

Reference Standards for Cardiorespiratory Fitness Measured With Cardiopulmonary Exercise Testing Using Cycle Ergometry: Data From the Fitness Registry and the Importance of Exercise National Database (FRIEND) Registry

Leonard A. Kaminsky, PhD; Mary T. Imboden, MS; Ross Arena, PhD; and Jonathan Myers, PhD

Can we create a longitudinal database of functional outcome standards for various patient populations?
What Can We Do For You?

Anthropometrics
Body composition

Vascular Function
Pulse wave velocity
Augmentation index
Muscle Strength Testing

Metabolic Testing
Resting, Exercise, etc.

Exercise Stress Testing
Treadmill, Cycle
Vital Responses (HR, BP, etc.)
Blood Collection

More to come... we need your input!
Human Performance Core Lab

Currently planning to restructure

• Offer several portable services  
  Blood draw, handgrip, walk test, etc.

• Potential satellite locations (i.e. thinking beyond Bayview)

• Gauging interest to tailor the core to best suit your needs
Case Studies

Clinical applications of human performance measures
Energy Expenditure (VO2)

Maximal Energy (VO2max)

Fatigue (too close to the energy limit)

Adaptative Behavior (slowing down)

Physical/Cognitive Activities (Walking, Talking, Thinking, etc.)

Extra Energy for Unstable Homeostasis (Homeostatic Effort)

Energy Required for Homeostasis (RMR)

Dietary Thermogenesis
Energy Expenditure (VO2)

Maximal Energy (VO2max)

Physical/Cognitive Activities
(Walking, Talking, Thinking, etc.)

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(Homeostatic Effort)

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Fatigue (too close to the energy limit)

Adaptative Behavior
(slowing down)

Strong predictor of:
Physical function
Cardiovascular disease
All-cause mortality
Energy Expenditure (VO2)

Strong predictor of:
- Physical function
- Cardiovascular disease
- All-cause mortality

 Predictor of:
- Physical function
Aerobic capacity measurement

Maximal Graded Exercise Test
• Modified Balke Protocol
  • Constant speed
  • Incremental grade

Measure of Cardiorespiratory fitness
• $\text{VO}_2\text{peak} \ (\text{ml/kg/min})$
Energetic cost of walking measurement

Overground customary-paced walking test

- 2.5-minutes of walking at “usual comfortable pace”
- Oxygen consumption (VO₂) via a portable indirect calorimeter (ml/kg/min)

Measure of energy cost of walking

- VO₂ (ml/kg/m)
VO2 and brain health

Cardiorespiratory fitness tertiles

Cerebral blood flow (% global)

Cardiorespiratory fitness tertiles

Hippocampus (cm³)

Energetic cost of walking:
- 0.10 ml/kg/m
- 0.15 ml/kg/m
- 0.20 ml/kg/m
- 0.25 ml/kg/m

Time Since Baseline (Year)
Conclusion

Physiologic measures

• Can directly assess
  • Function
  • Functional capacity to respond to stressors

• Can be predictive of outcomes
  • Disease occurrence/progression
  • Response to treatment
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