



Relationship Between Accelerometer Data From Extremities and the Bouchard Physical Activity Scale

Marta S. Menciondo, PhD,
Margaret L. Healey, BA, Edward J. Kasarskis,
MD,
Richard J. Kryscio, PhD, Amy Xu

Supported by:
The National Institute of Neurological Disorders and Stroke
(1 RO1 NS045087-01)



Outline

- What is ALS?
- Patient Characteristics
- Bouchard Physical Activity Scale
- Actical Measurement of Physical Activity
- Mixed Model (fixed and random effects)
- Results
- Conclusions

What is ALS?



- Amyotrophic Lateral Sclerosis. Commonly known as Lou Gehrig's disease
- Belongs to a group of disorders known as motor neuron diseases
- Progressive neuromuscular disease that attacks the nerve cells (neurons) responsible for controlling voluntary muscle movement, leading to complete paralysis





What is ALS? (continued)

- Two major types of ALS
- Sporadic ALS strikes individuals that have no family history of the disease
 - accounts for 90% to 95% of cases
- Familial ALS (hereditary)
 - accounts for 5% to 10% of cases



What is ALS? (continued)

- Incidence:
2-5 people per 100,000 per year
- Approximately 5,000 new cases per year (13 per day) diagnosed in the U.S.
- Ethnicity and economic status are not risk factors for this disease



Progression of ALS

- Insidious onset of weakness
 - Limb or Bulbar onset
- Progression and regional spread of weakness
- Terminal phase
 - Limb paralysis
 - Inability to speak, swallow
 - Respiratory insufficiency
 - Preserved awareness



Early Treatment of ALS with Nutrition

Phase II study

- 5 sites
- 81 patients enrolled
 - 71 with complete data
- Visits at:
 - Baseline, 16, 32, and 48 weeks
- Each visit has 3 contact points over a 10-day period



Early Treatment of ALS with Nutrition

Main purpose of the study:

To develop an equation to evaluate nutritional imbalance in an ALS patient

Gold Standard:

DLW (Doubly Labeled Water)

Average cost: \$520 per patient per visit



Baseline Characteristics (n=71)

Age (yrs)	Mean=59.4 (range 24-79)
Male	45 (63%)
Female	26 (37%)
White	63 (89%)
African American	1 (1%)
Hispanic	5 (7%)
Other	2 (2%)
Weight (kg)	Mean=79.98 (range 47-118)



Patient Characteristics at Baseline

Resting Metabolic Rate (cal/day)	Mean=1,537 (range: 815-2,280)
ALS Health Status	
Mild	14 (20%)
Moderate	42 (59%)
Severe	15 (21%)



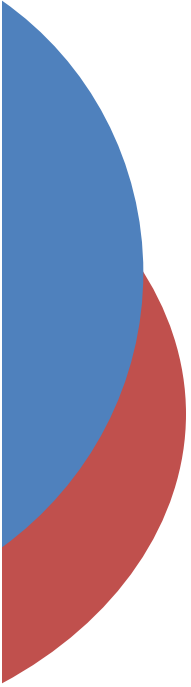
Bouchard Scale

- Measures physical activity on an ordinal scale of 1-9
- Self reported every 15 minutes



Bouchard Scale

Bouchard Level	Example	Median Calories Kcal/kg/15 min
1	sleeping, resting in bed	.26
2	sitting: eating, writing	.38
3	standing: washing, cooking	.57
4	slow walk, to dress	.69
5	house chores, painting	.84
6	baseball, golf, rowing	1.2
7	carpentry, shoveling snow	1.4
8	dancing, skiing	1.5
9	jogging, racquetball	2.0



Desirable Characteristics of an Outcome Measure in ALS Trials

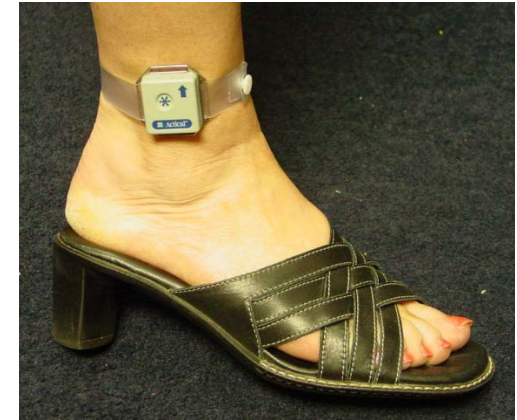
- Non-subjective
- Continuous variable
- Quantitative
- Portable device - Simple operation
- In home use



Accelerometers Measure . . .

- Number of individual movements (like a pedometer)
- The vigor (acceleration) of each movement
- Data collected over 1 minute epochs

Actical Accelerometer





In This Study

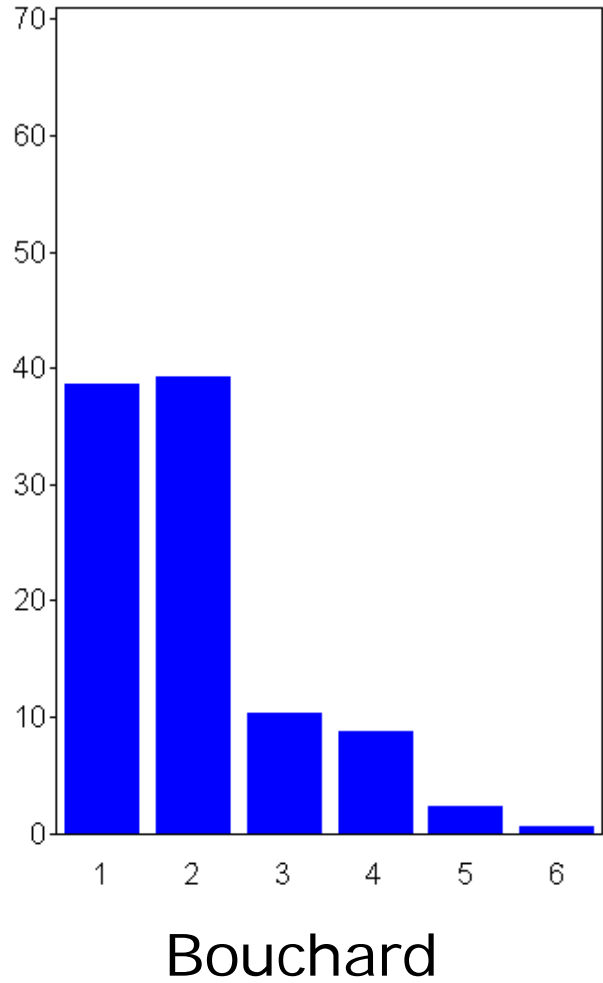
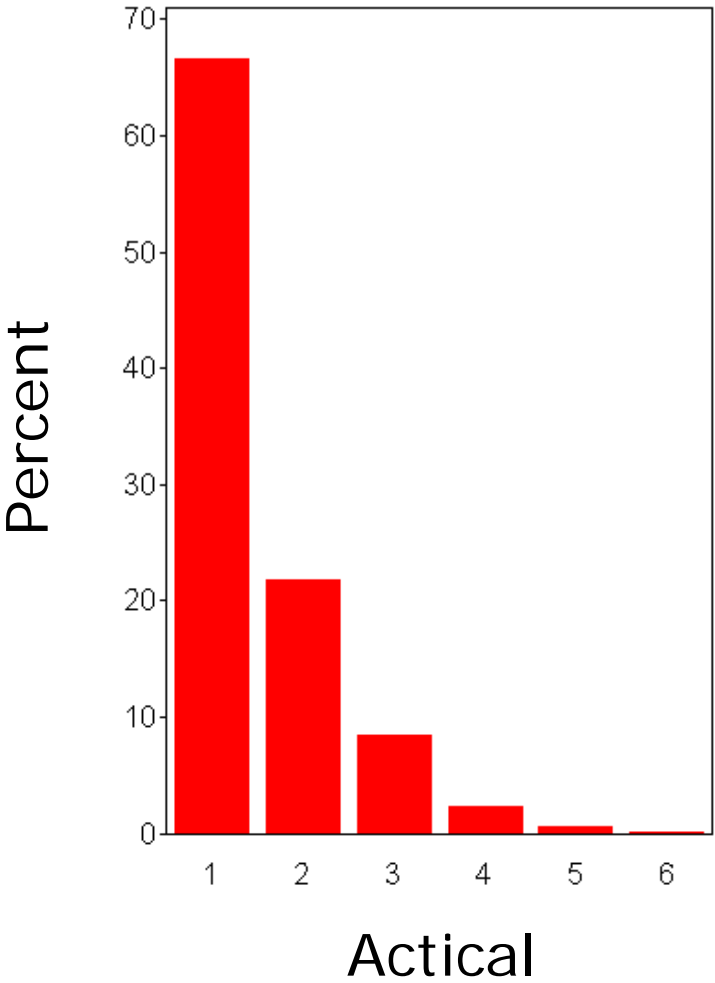
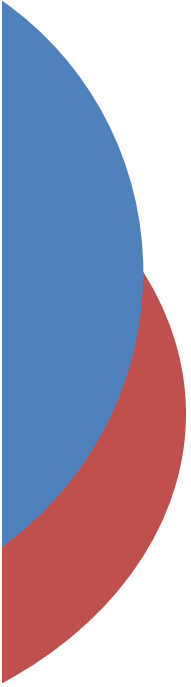
- Participants wear Actical devices on each wrist and ankle continuously for 2-3 days
- Actical predicts energy expenditure due to physical movement
- Actical movement data grouped into the nine Bouchard energy levels
- Predicted Total Energy Expenditure = Actical + Basic Metabolic Rate



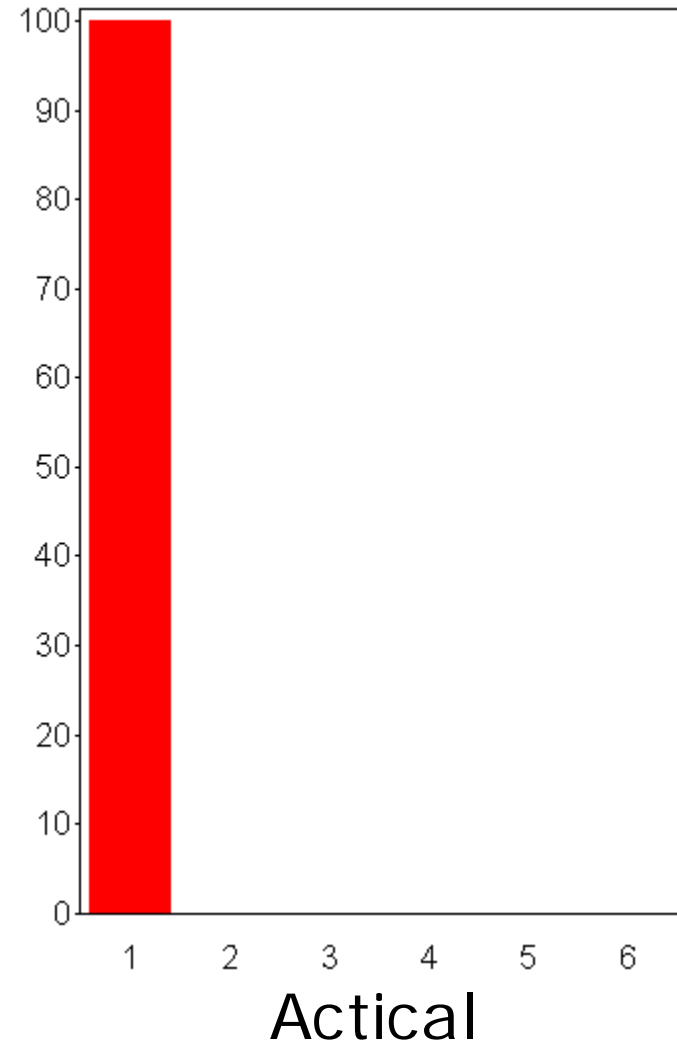
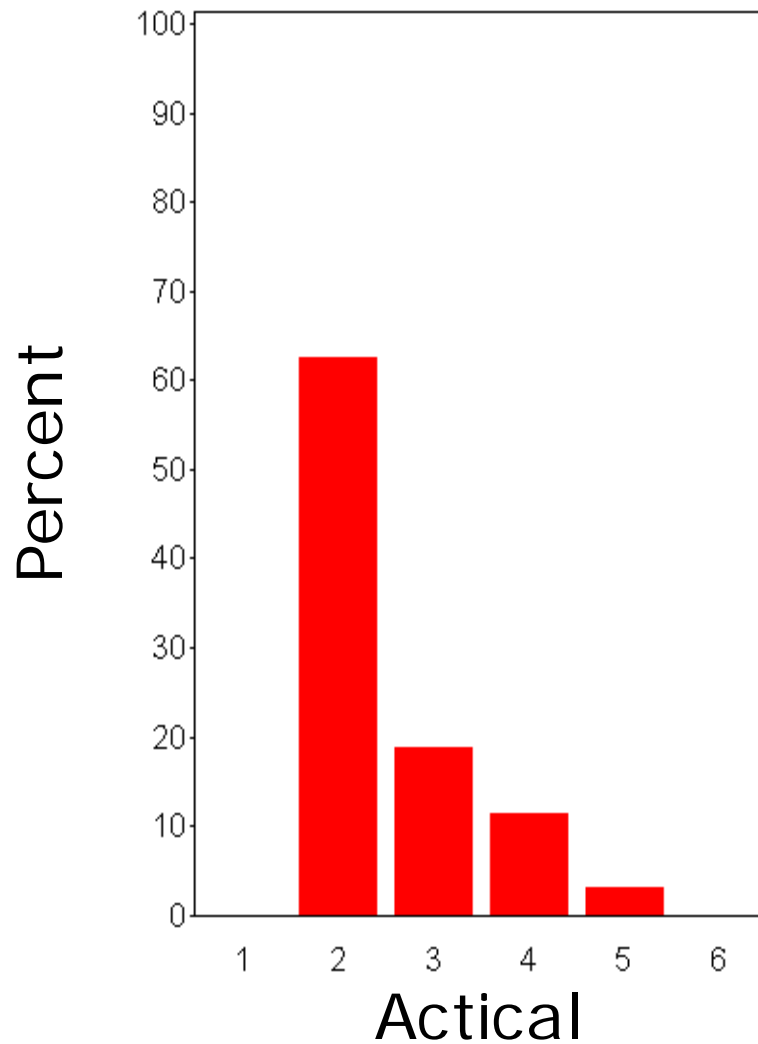
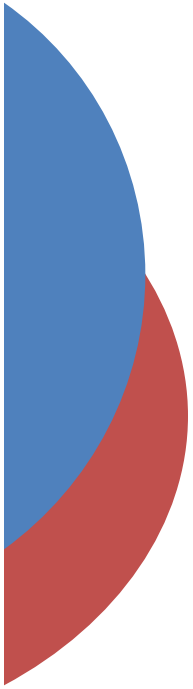
Data Used in This Presentation

- Baseline visit
- First 24hr day of wearing Actical devices
- Actical data aggregated in 15 minute epochs
- Basic Metabolic Rate measured upon waking

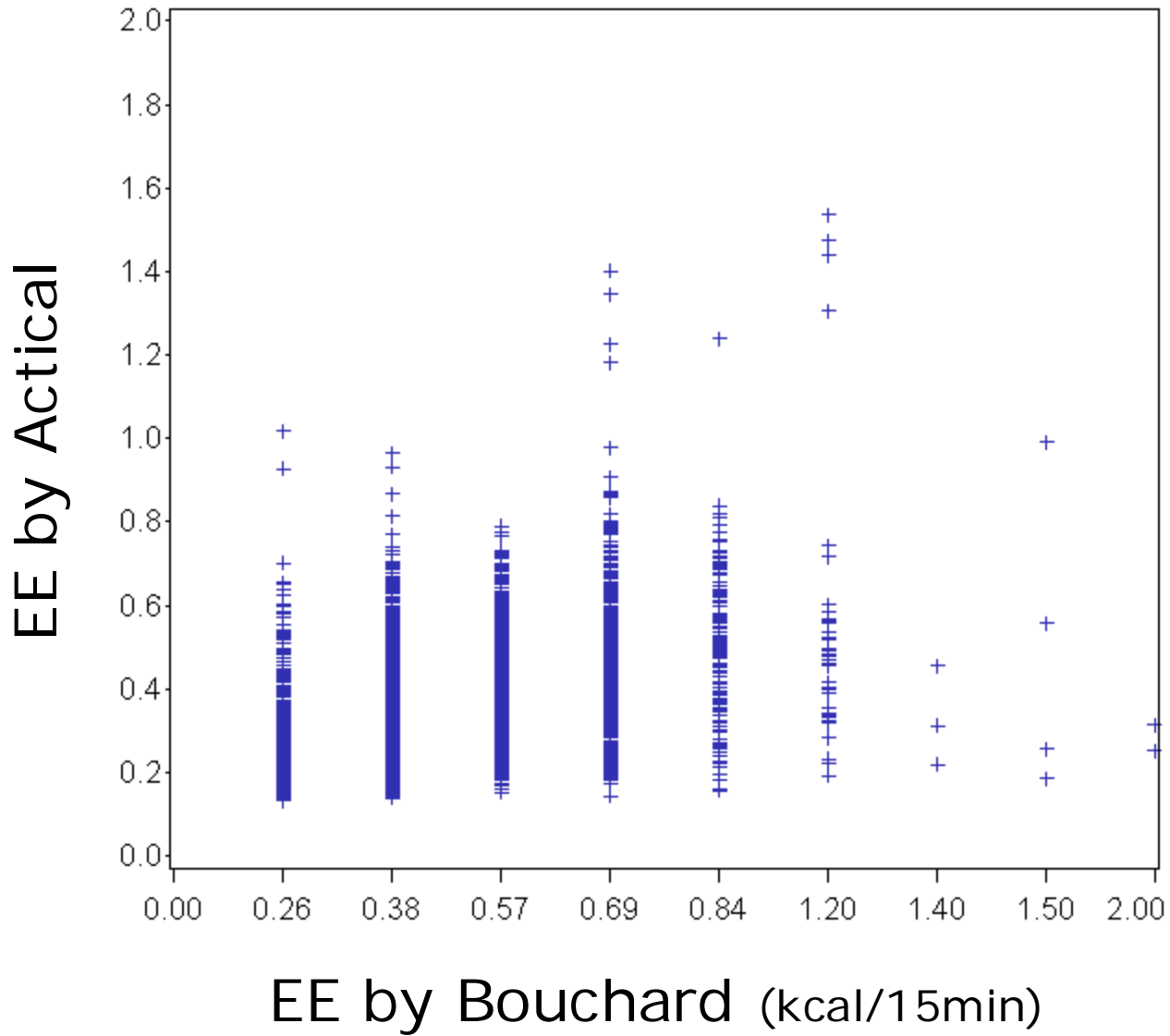
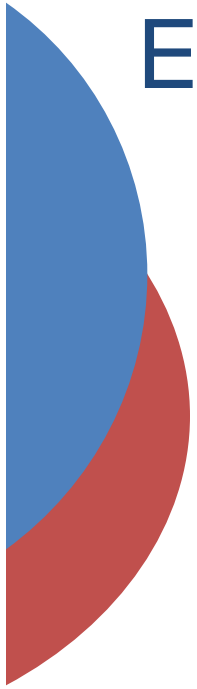
Physical Activity Levels



Actical for Two Sample Patients



Energy Expenditure: Actical vs Bouchard

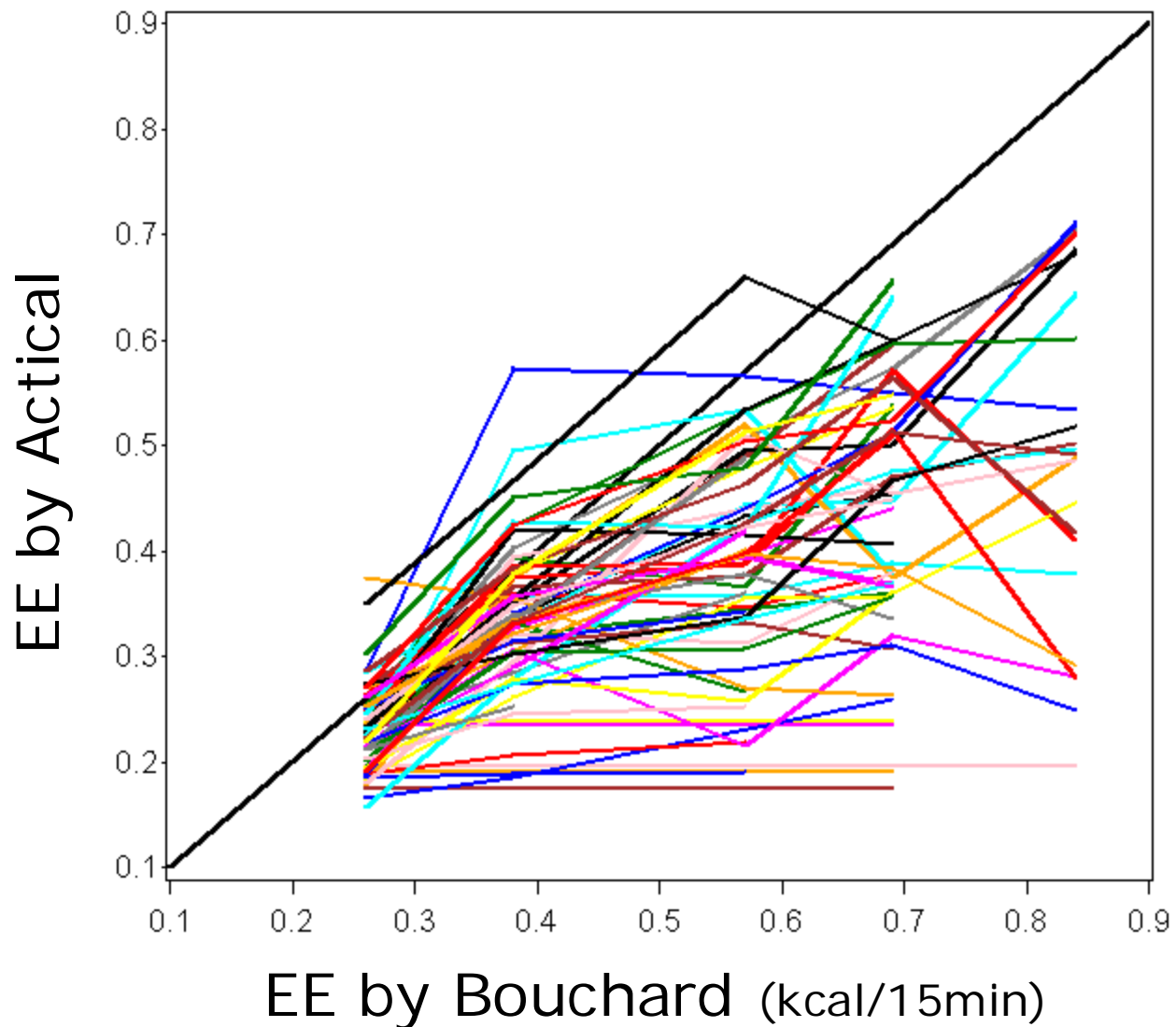




Data Reduction

- Problem:
Many repeated measurements on each subject
- Solution:
Average Actual Energy Expenditure at each Bouchard level for each patient

Average Energy Expenditure: Actical vs Bouchard





Data Analysis

Mixed Model with Fixed and Random Effects

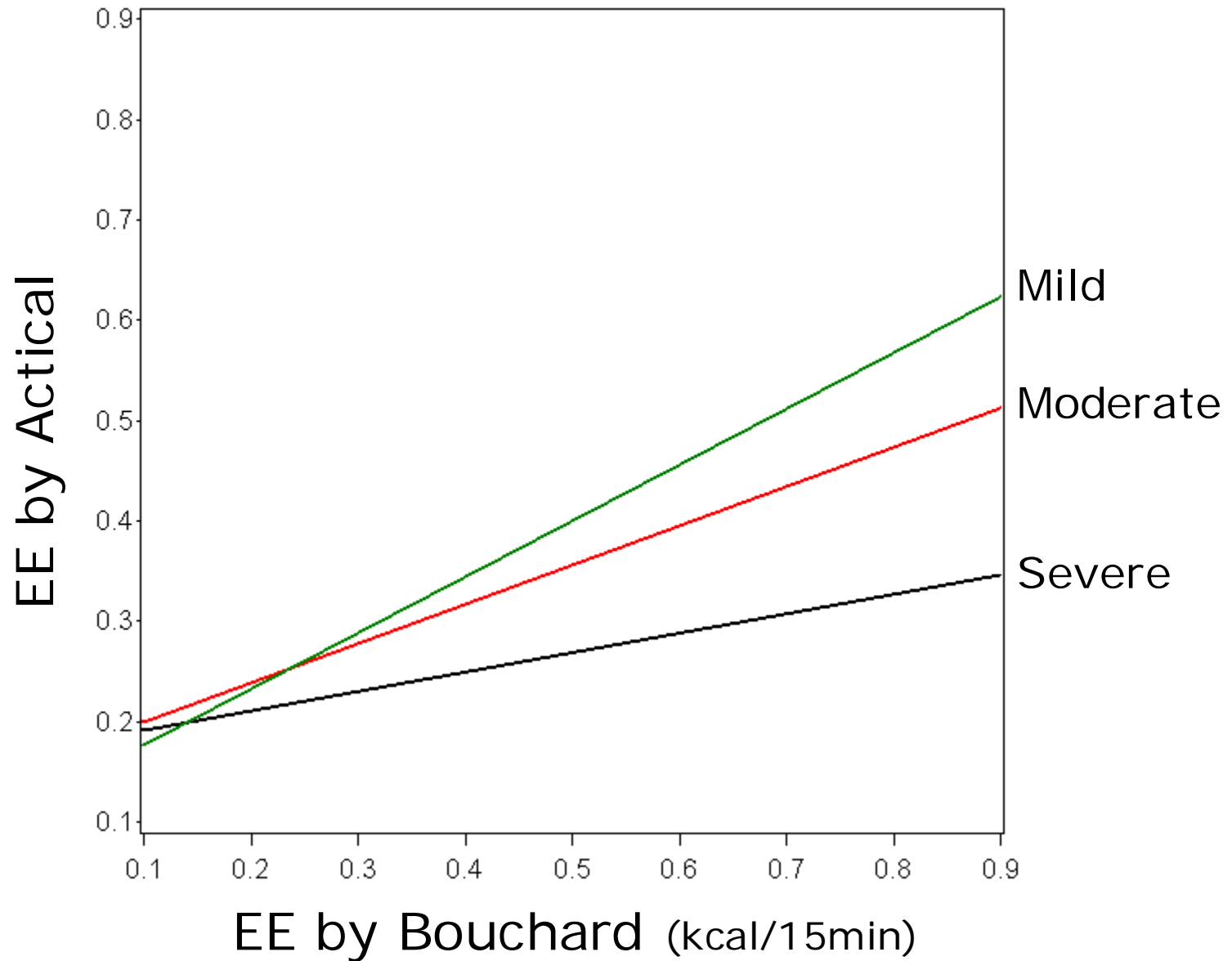
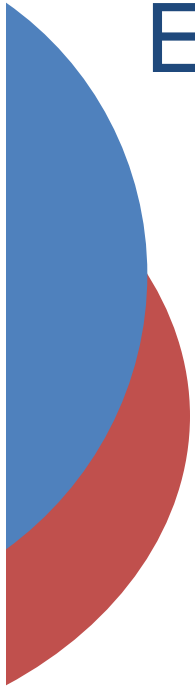
- Random Effects: Intercepts, Slopes, Measurement Error
- Fixed Effects: Health Status



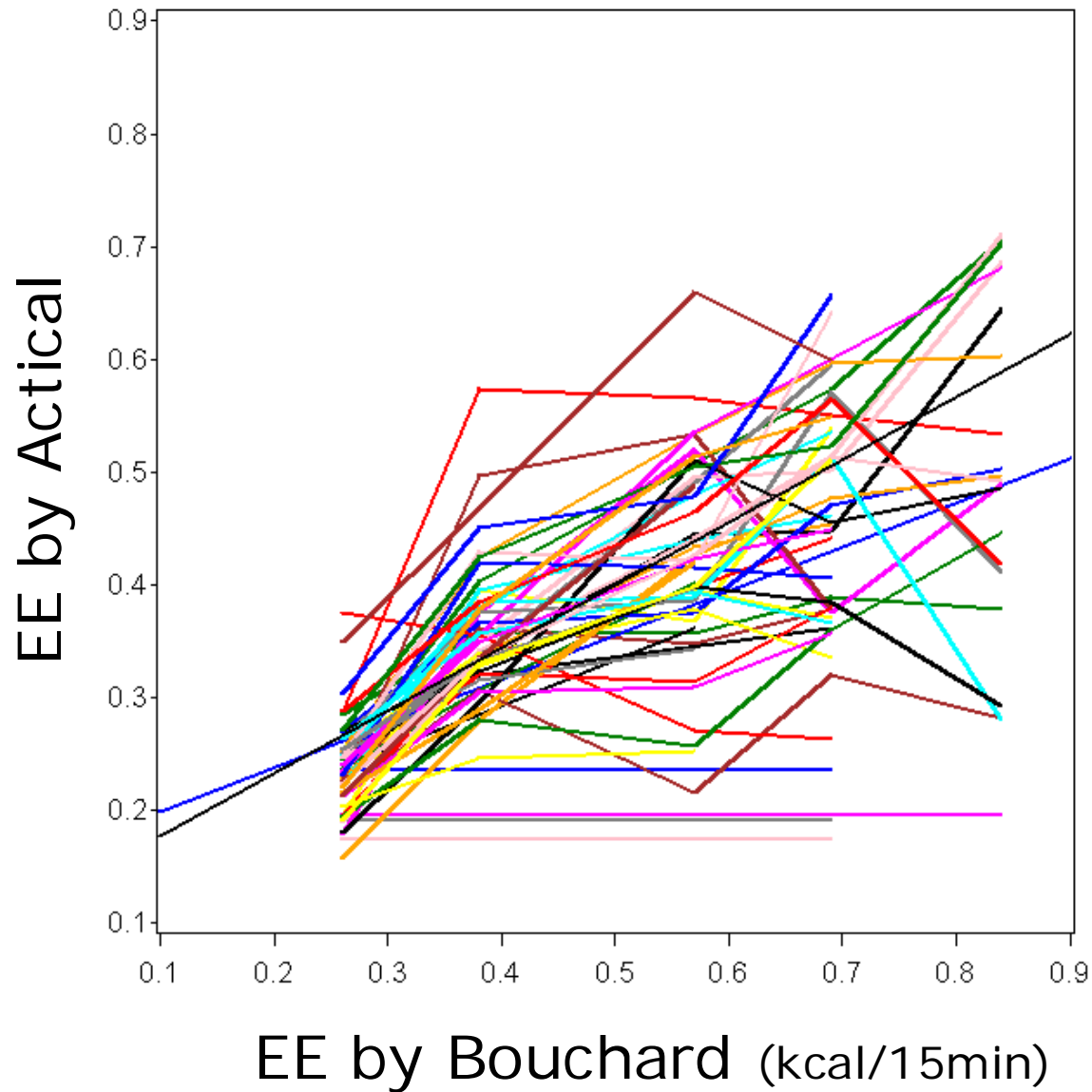
Results

- For Each Level of Health Status:
 - Relationship is linear
 - Each line lies below the 45° line (Bouchard overestimates Actual)
- Comparison among Health Status Levels:
 - The overestimation is significantly greater for the patients in the severe Health Status

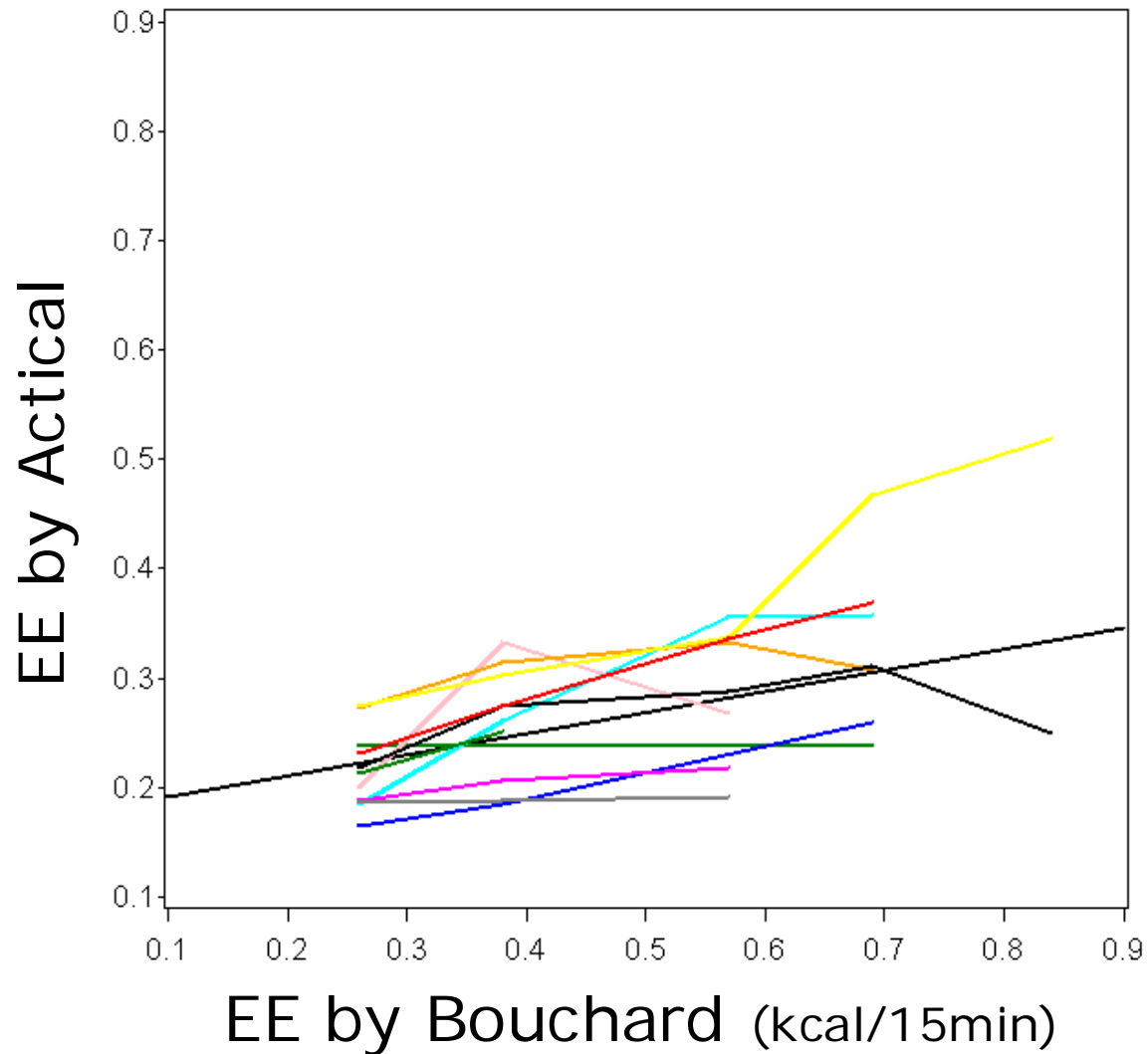
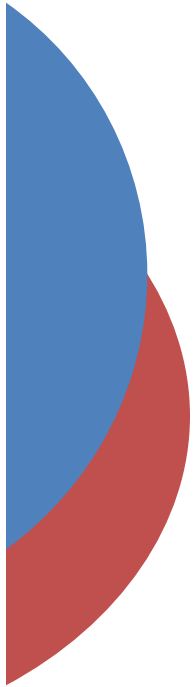
Energy Expenditure Predicted by Model



Mild and Moderate Health Status



Severe Health Status





Conclusions

- ALS patients have restricted activity levels (most Bouchard scores are 5 or less), which is verified by the Actical data
- Even at these restricted activity levels, ALS patients overestimate the intensity of their activities when Bouchard is compared to Actical



Conclusions

- The overestimation increases with the severity of the disease
- These findings illustrate the importance of accounting for different sources of variability



Acknowledgements

University of Kentucky

PI - Edward J. Kasarskis, MD, PhD
Richard Kryscio, PhD
Margaret Healey
Jodie Clasey
Lan Chi Lu
Christie Shrestha
Deborah Taylor
Megan Thompson
Kathryn Vanderpool
Susan Vincent-Rawn
Stephen Wells
Ken Westberry
UK GCRC

Columbia University

Hiroshi Mitsumoto, MD, FAAN
Jackie Montes
Daniel Bell

University of Vermont

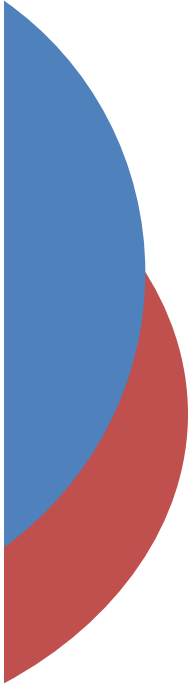
Rup Tandan, MD
Chris Potter
Jessy Gardner
Shannon Lennox
Dwight Matthews

University of Utah

Mark Bromberg
Summer Davis

Penn State University

Zachary Simmons, MD, FAAN
Ally Brothers
Susan Deiling
Michelle Heckenluber
Beth Stephens



THANK YOU

Questions?