Meeting 2

2018 Physical Activity Guidelines Advisory Committee

October 27th

ODPHP | Office of Disease Prevention and Health Promotion

Meeting 2

Welcome

Richard D. Olson, MD, MPH
Designated Federal Officer

PAGAC Public Meeting 2 Agenda

Day 1, Thursday October 27th

- Call to Order, Roll Call, and Welcome
- Public Oral Testimony
- Presentation and Discussion on Device-based vs. Reported Measurement of Physical Activity
- Committee Discussion
- Meeting Adjourn

Day 2, Friday October 28th

- Call to Order, Roll Call, and Welcome
- Introduction Subcommittee Presentations, Overarching Goals, and Committee Discussion
- Subcommittee Presentations
- Break
- Subcommittee Presentations
- Lunch
- Overall Question Prioritization
- Committee Discussion
- 3:15 pm Wrap Up and Next Steps
- Meeting Adjourn

2018 PAGAC

- **Ken Powell, MD, MPH, Co-chair**
  Retired, CDC and Georgia Department of Human Resources
- **Abby C. King, PhD, Co-chair**
  Stanford University School of Medicine
- **David Buchner, MD, MPH, FACSM**
  University of Illinois
- **Wayne Campbell, PhD**
  Purdue University
- **Loretta DiPietro, PhD, MPH, FACSM**
  George Washington University
- **Kirk I. Erickson, PhD**
  University of Pittsburgh
- **Charles H. Hillman, PhD**
  Northeastern University
- **John M. Jakicic, PhD**
  University of Pittsburgh
- **Kathleen F. Janz, EdD, FACSM**
  University of Iowa
- **Peter T. Katzmarzyk, PhD**
  Pennington Biomedical Research Center
- **William E. Kraus, MD, FACSM**
  Duke University
- **Richard F. Macko, MD**
  University of Maryland School of Medicine
- **David Marquez, PhD, FACSM**
  University of Illinois at Chicago
- **Anne McTiernan, MD, PhD, FACSM**
  Fred Hutchinson Cancer Research Center
- **Russell R. Pate, PhD, FACSM**
  University of South Carolina
- **Linda Pescatello, PhD, FACSM**
  University of Connecticut School of Medicine
- **Melicia C. Whitt-Glover, PhD, FACSM**
  Gramercy Research Group

Meeting 2

Public Oral Testimony

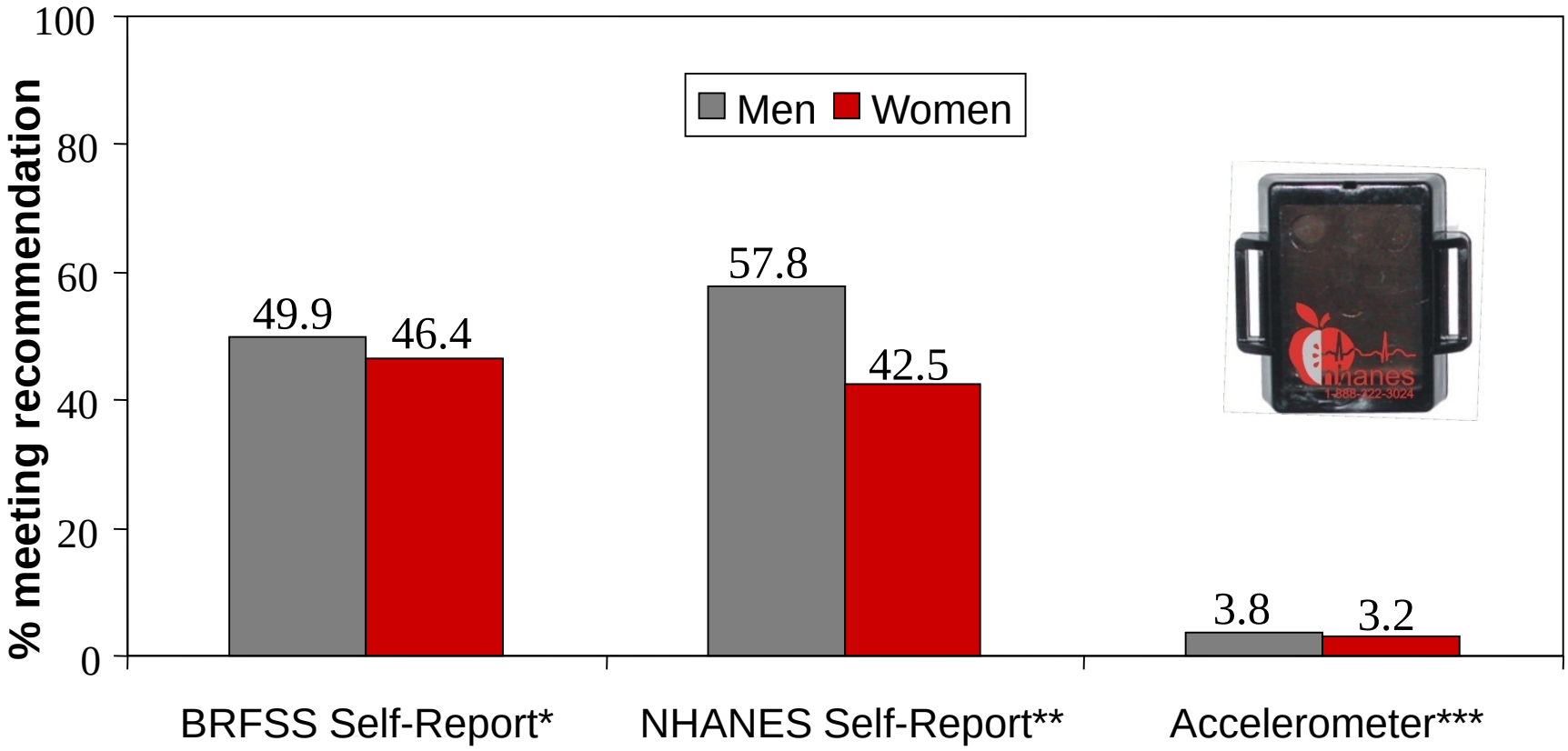
National Cancer Institute

PA Assessment Mode Issues for Consideration: A View from NHANES

Richard P. Troiano, Ph.D.

Captain, USPHS

U.S. Adults Meeting PA Recommendations



* BRFSS 2005 (30 min x 5d moderate or 20 min x 3 d vigorous)
** NHANES 2003-2004 (150 min/week moderate or greater intensity)
*** NHANES 2003-2004, 20-59 y (30 min x 5d moderate or greater, Troiano et al. 2008)

Presentation Overview

1. NHANES questionnaire and accelerometer protocol

2. Within-person activity time comparisons from 2003-2006 NHANES

3. Evolving thoughts about self-report and objective measures

4. Accelerometer relation with biomarkers and mortality

NHANES 2003-2006

- Nationally representative survey
  - Complex, multi-stage probability sample
  - Population racial-ethnic subgroups
    - Non-Hispanic White
    - Non-Hispanic Black
    - Mexican-American
- Interview in household
- Examination at mobile center

NHANES Physical Activity Questionnaire

- Administered in household interview
- Activities that last “at least 10 minutes”
- Past 30 days reference period
  - Report times per day, week as desired
- Contexts:
  - Transportation
  - Household tasks
  - Recreational exercise, sports, active hobbies
    - Vigorous and moderate intensity separately
    - Frequency & duration for specific activities engaged for 10+ min
  - Note: no occupational activity questions

Objective Measurement by Accelerometer

PA Monitors in NHANES 2003-2006

- Ages 6 y +
  - Wheelchair-bound/non-ambulatory excluded
- Ask for 7 d of wear while awake
  - Take off for water activities (swim, bathe)
- Mail back monitor
- Response rate ~90% (any data provided/eligible)

- Valid day
  - 10 h of wear
- Valid record for analysis
  - 4 or more valid days
- Waist-worn
  - Locomotor cutpoints

COMPARISON OF SELF-REPORT AND ACCELEROMETER

Category Agreement (%) (~ PAG Adherence)

Reported minutes	Bouted accelerometer minutes			
	0-149	**150-300**	**301 +**	**Total**
0-149	37.8	1.0	0.3	39.1
150-300	16.6	0.8	0.4	17.9
301 +	36.0	5.0	2.0	43.0
Total	90.4	6.9	2.7	100

40.6 % categorically agree

60.9% report meeting PAG

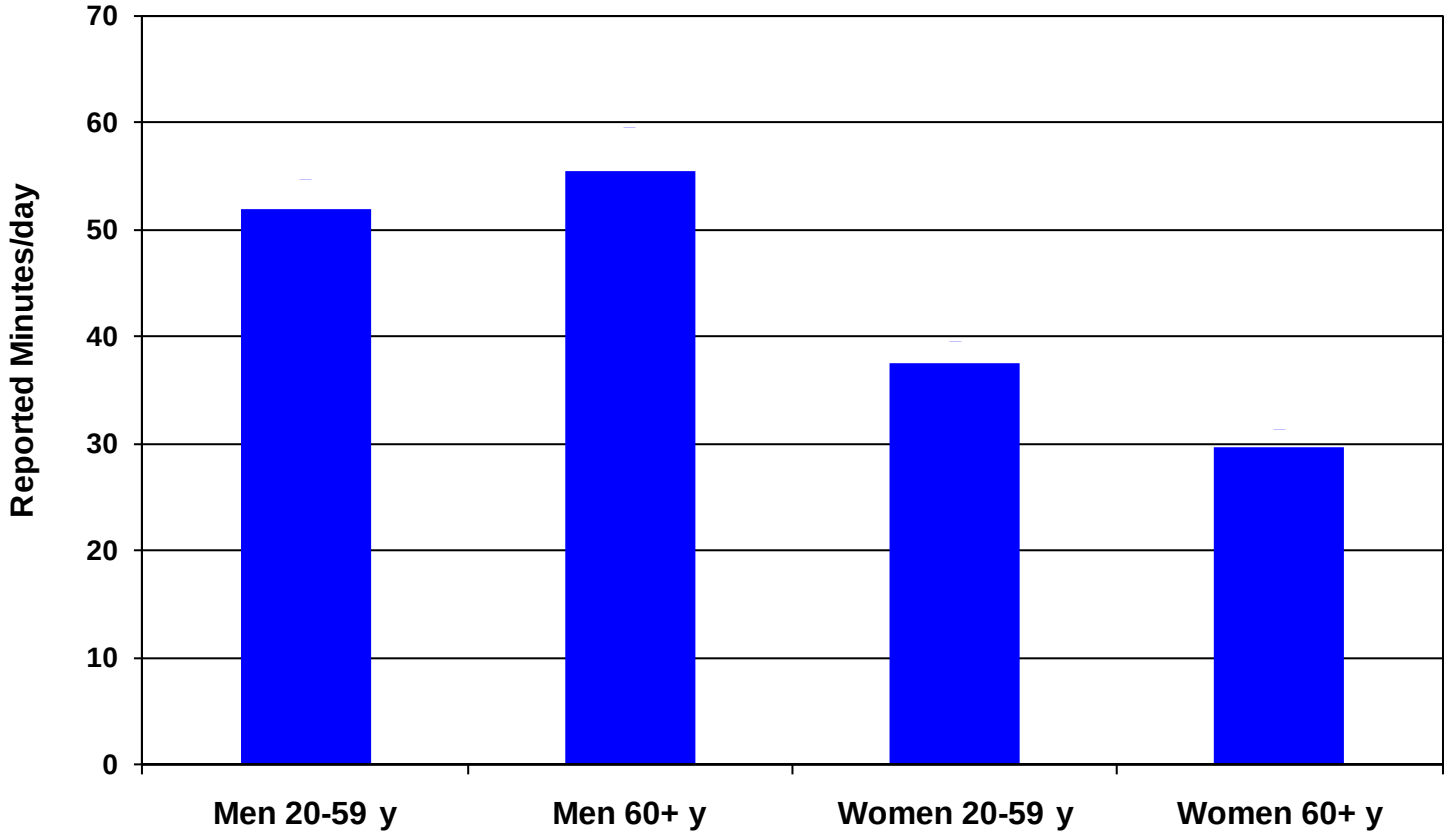
9.6% have 150 + bouted minutes by accelerometer

NHANES 2003-6 age 18+, weighted, n= 6576

A Deeper Dive

- 6092 adults (ages 20 y +) with questionnaire data and accelerometer wear for 4-7 days
- Questionnaire (Q)
  - Summed all minutes reported as moderate or greater intensity
- Accelerometer (A)
  - Summed moderate intensity or greater (AC $\geq$ 2020) minutes in “bouts”
- Categorized by zero, non-zero minutes from Q and A
  - Calculated minutes of moderate or greater intensity PA within each category and instrument
  - Divided non-zero groups into quintiles for classification agreement

Many Minutes Are Reported with Zero Measured Bouts



	Men 20-59 y	Men 60+ y	Women 20-59 y	Women 60+ y
Percent with no measured bouts	**39.2%**	**66.2%**	**52.8%**	**74.1%**

Category Agreement: Men Ages 20-59 y

Accel. Categ	*Category Based on Self-Report*						
	0	**1**	**2**	**3**	**4**	**5**	**Total**
0	***4.89***	9.61	7.52	5.36	6.39	5.42	39.20
1	1.71	***1.95***	2.61	2.23	2.06	1.78	12.34
2	1.33	2.06	***1.95***	2.73	1.56	2.42	12.04
3	0.94	2.12	2.22	***2.10***	2.65	2.21	12.24
4	0.58	1.44	2.14	2.83	***2.58***	2.49	12.07
5	0.76	0.89	1.46	2.68	2.72	***3.59***	12.11
Total	10.22	18.08	17.90	17.94	17.96	17.90	100.0

Values are weighted percent within each cell

Category Agreement: Men Ages 20-59 y

Accel. Categ	*Category Based on Self-Report*						
	0	**1**	**2**	**3**	**4**	**5**	**Total**
0	*4.89*	9.61	7.52	5.36	6.39	5.42	39.20
1	1.71	*1.95*	2.61	2.23	2.06	1.78	12.34
2	1.33	2.06	*1.95*	2.73	1.56	2.42	12.04
3	0.94	2.12	2.22	*2.10*	2.65	2.21	12.24
4	0.58	1.44	2.14	2.83	*2.58*	2.49	12.07
5	0.76	0.89	1.46	2.68	2.72	*3.59*	12.11
Total	10.22	18.08	17.90	17.94	17.96	17.90	100.0

17.1 % agree

Values are weighted percent within each cell

Category Agreement: Men Ages 20-59 y

Accel. Categ	*Category Based on Self-Report*						
	0	**1**	**2**	**3**	**4**	**5**	**Total**
0	*4.89*	9.61	7.52	5.36	6.39	5.42	39.20
1	1.71	*1.95*	2.61	2.23	2.06	1.78	12.34
2	1.33	2.06	*1.95*	2.73	1.56	2.42	12.04
3	0.94	2.12	2.22	*2.10*	2.65	2.21	12.24
4	0.58	1.44	2.14	2.83	*2.58*	2.49	12.07
5	0.76	0.89	1.46	2.68	2.72	*3.59*	12.11
Total	10.22	18.08	17.90	17.94	17.96	17.90	100.0

48.7 % agree
+/- 1 category

Values are weighted percent within each cell

Category Agreement: Men Ages 20-59 y

Accel. Categ	*Category Based on Self-Report*						
	0	**1**	**2**	**3**	**4**	**5**	**Total**
0	***4.89***	9.61	7.52	5.36	6.39	5.42	39.20
1	1.71	***1.95***	2.61	2.23	2.06	1.78	12.34
2	1.33	2.06	***1.95***	2.73	1.56	2.42	12.04
3	0.94	2.12	2.22	***2.10***	2.65	2.21	12.24
4	0.58	1.44	2.14	2.83	***2.58***	2.49	12.07
5	0.76	0.89	1.46	2.68	2.72	***3.59***	12.11
Total	10.22	18.08	17.90	17.94	17.96	17.90	100.0

Note distribution across accelerometer categories for low active individuals

Values are weighted percent within each cell

Effect of Relaxing Intensity and Bout Criteria

Men, 20-59 years

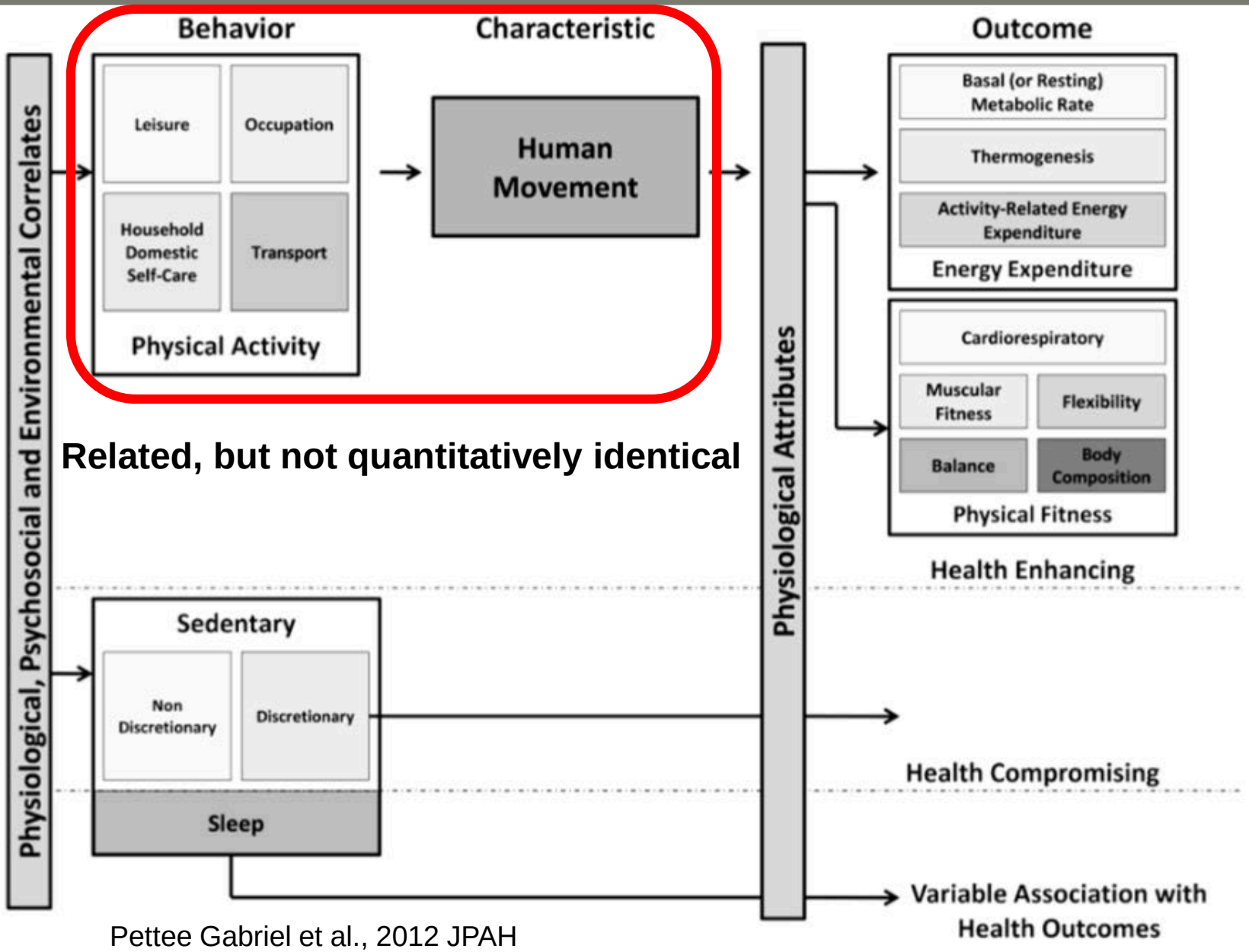
% Agree	2020 Cutpoint		760 Cutpoint	
	10 min	5 min	10 min	5 min
Exactly	17.1	20.2	21.7	20.2
+/- 1 category	48.7	52.3	55.3	53.4

Women, 20-59 years

% Agree	2020 Cutpoint		760 Cutpoint	
	10 min	5 min	10 min	5 min
Exactly	20.8	23.6	23.8	22.0
+/- 1 category	49.8	57.8	59.4	59.7

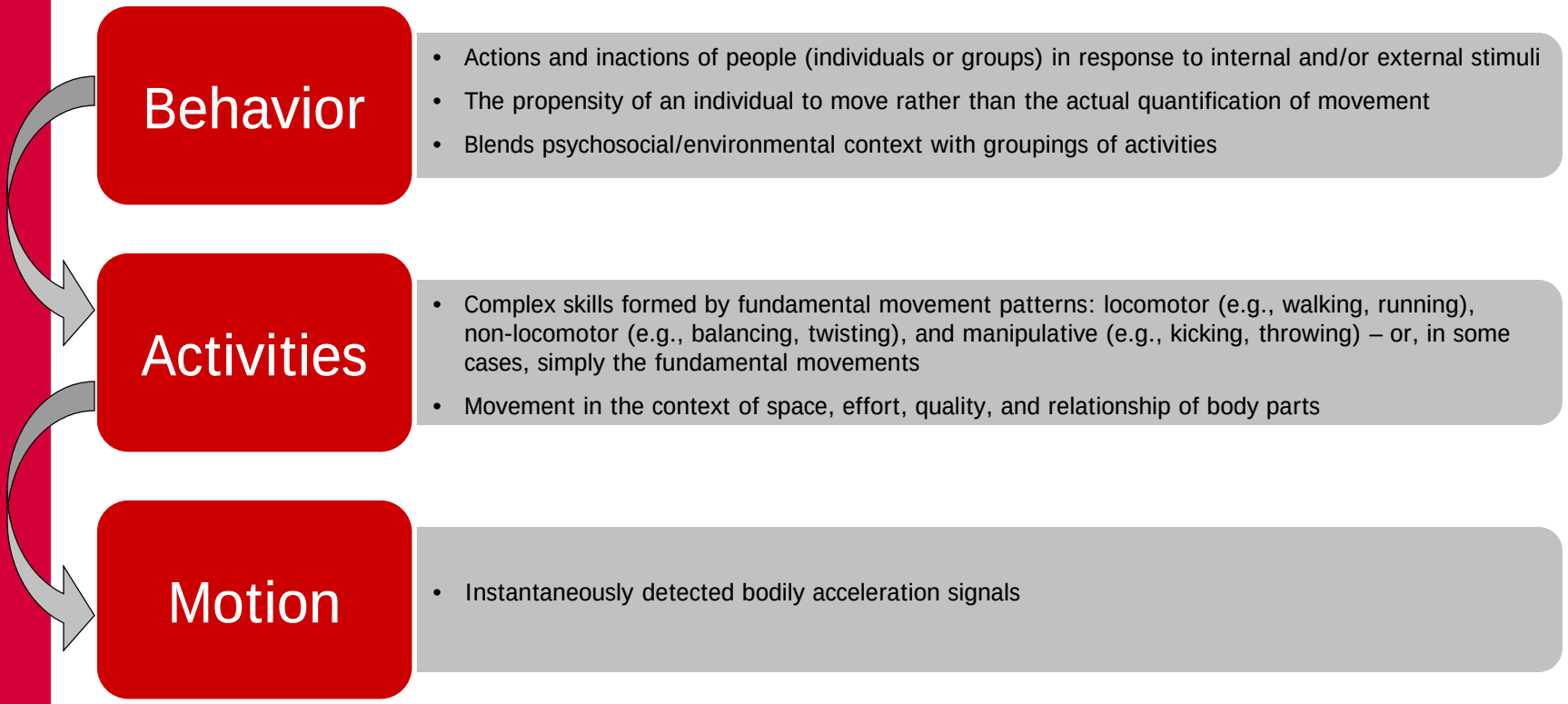
CONCEPTUALIZATION

Physical Activity Conceptual Framework



Pettee Gabriel et al., 2012 JPAH

A Conceptual Model for Measurement of Physical Activity



Heather Bowles & James McClain, National Cancer Institute

Sources of Poor Agreement

- Intensity assessment
  - Accelerometer – Absolute intensity ~3 MET
  - Questionnaire – Relative intensity
- Bout length assessment
  - Questionnaire asks for activities of at least 10 minutes
  - Activities with movement patterns of shorter duration may get included
- Behavior and motion are related, but not equivalent

ACCELEROMETER AND BIOMARKERS

Stronger Biomarker Associations

Biomarker	Self-report		Accelerometer	
	Beta (SE)	Adj. Wald F	Beta (SE)	Adj. Wald F
SBP	0.01 (0.03)	0.23	-0.43 (0.14)	8.89**
BMI	-0.04 (0.01)	14.95***	-0.77 (0.08)	86.71****
HDL (mg/dL)	0.10 (0.03)	8.54**	1.41 (0.27)	27.77****
Glycohemoglobin	-0.004 (0.001)	7.91**	-0.05 (0.01)	47.11****
Glucose	0.01 (0.07)	0.06	-1.67 (0.30)	30.77****
Insulin (μU/mL)	-0.08 (0.03)	10.15**	-1.11 (0.12)	81.53****

** $p < 0.01$
*** $p < 0.001$
**** $p < 0.0001$

Minutes in bouts, Beta per 10 min unit

Atienza et al., 2011 MSSE

DOSE AND MORTALITY

One (of several) Mortality Analyses

Accelerometer-measured dose-response for physical activity, sedentary time, and mortality in US adults[1–3]

Charles E Matthews,[4] Sarah Kozey Keadle,[4] Richard P Troiano,[5] Lisa Kahle,[7] Annemarie Koster,[9] Robert Brychta,[8] Dane Van Domelen,[10] Paolo Caserotti,[10] Kong Y Chen,[8] Tamara B Harris,[11] and David Berrigan[6]*

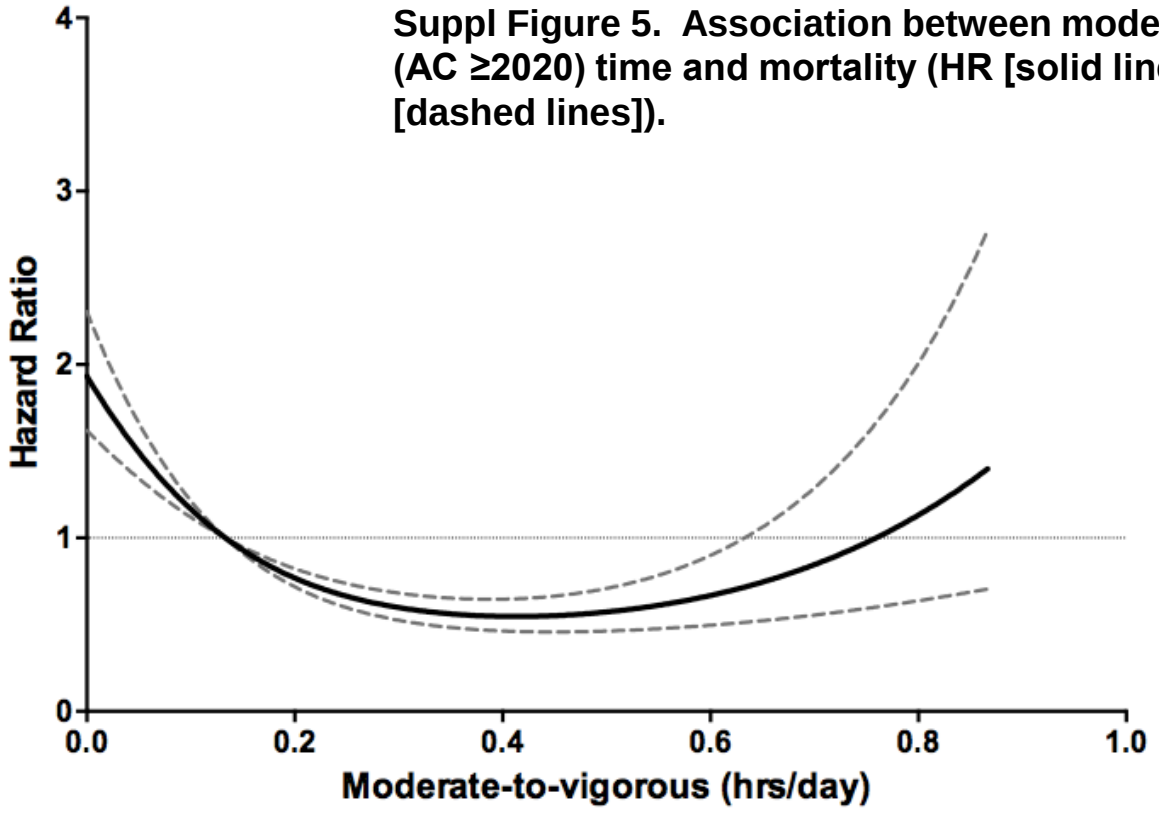
- NHANES 2003-2006 participants ages 40 y+ (n=4840 analyzed)
- Followed for mortality until 12/31/2011
- 700 deaths

- Isotemporal substitution model

AJCN in press

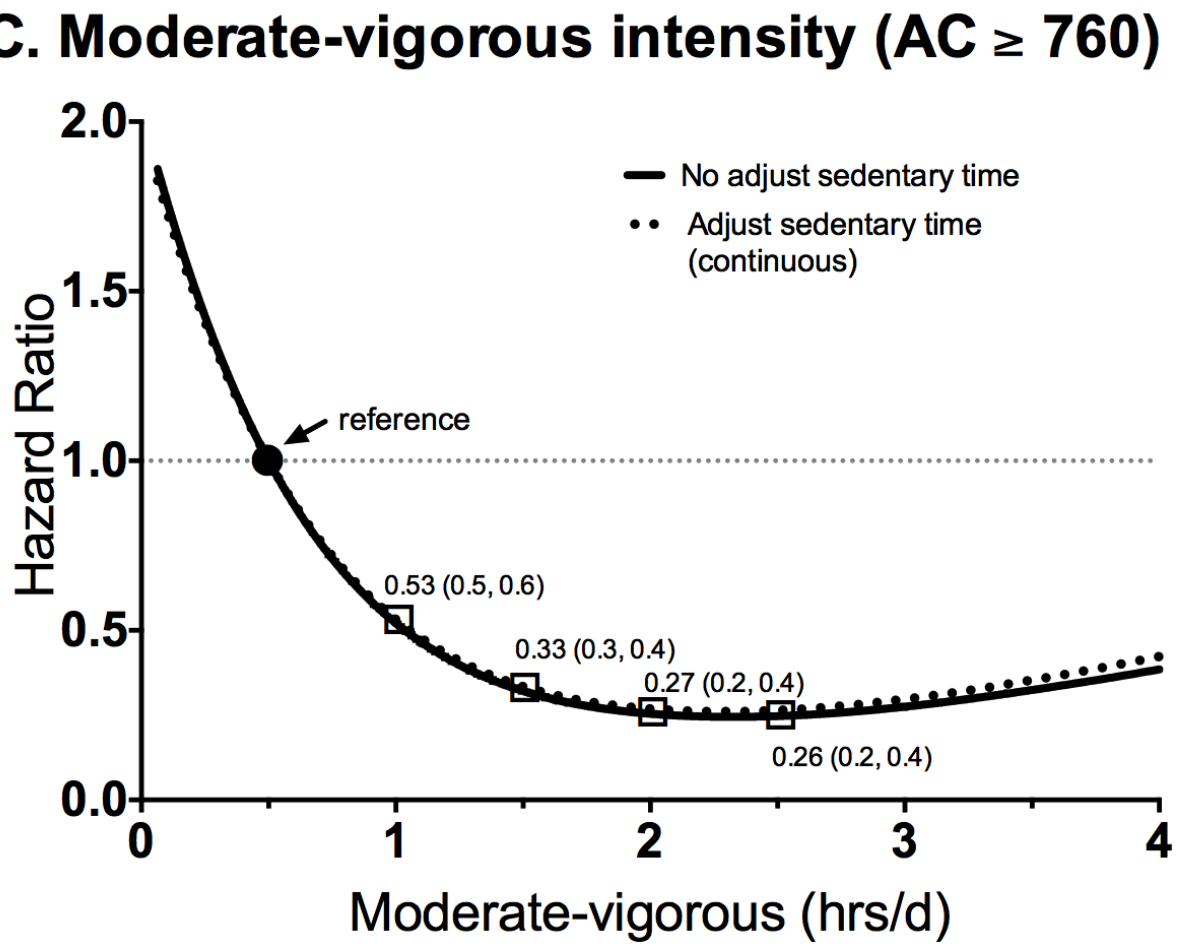
Accelerometer Dose and Mortality

Suppl Figure 5. Association between moderate-vigorous (AC ≥2020) time and mortality (HR [solid line], 95% CI [dashed lines]).



Adjusted for age, race, education, smoking, alcohol, diabetes, CHD, cancer, stroke, mobility limitations, BMI. Model fit is non-linear and non-wear time was trimmed at the 1st and 95th percentiles.

Accelerometer Dose and Mortality



Other Issues to Name-Check

- Absolute vs. relative intensity
- Device plus algorithm/cutpoint, not device alone
- Accuracy vs precision (or research vs consumer devices)
  - Especially in light of devices for self-monitoring
- Effect of wear location for devices
  - What is measured at wrist vs waist?
- Most important type of PA may not be aerobic

Thank you

Discussion

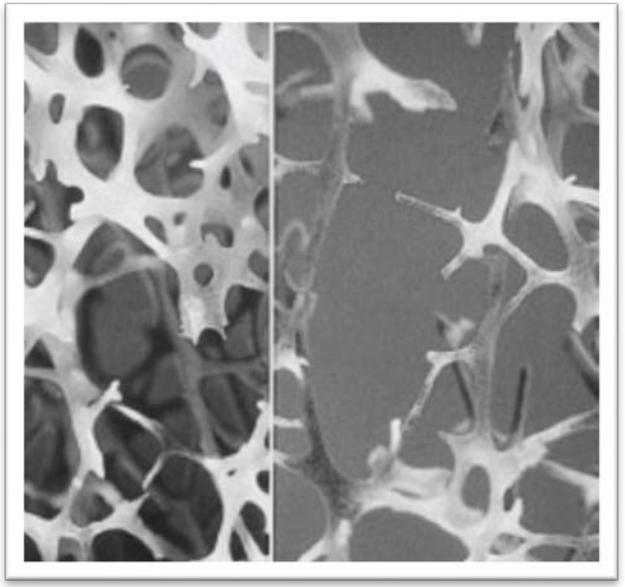
Meeting 2

Committee Discussion

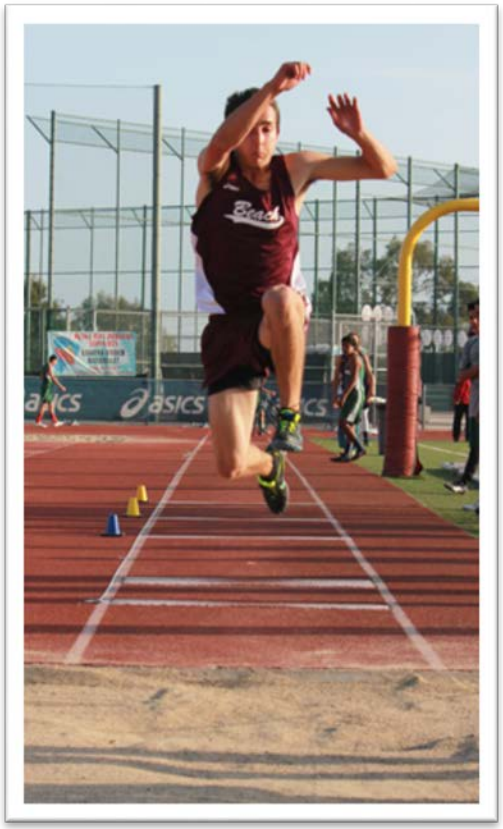
Physical Activity and Musculoskeletal Health

Kathy Janz,
Ken Powell,
Rick Troiano

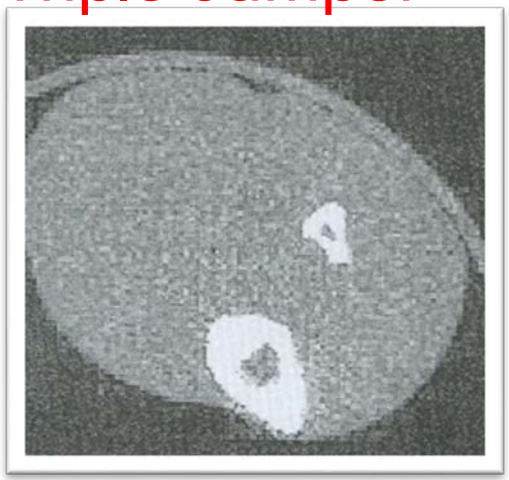
PAG 2018 Meeting 2,
Oct 27-28, 2016



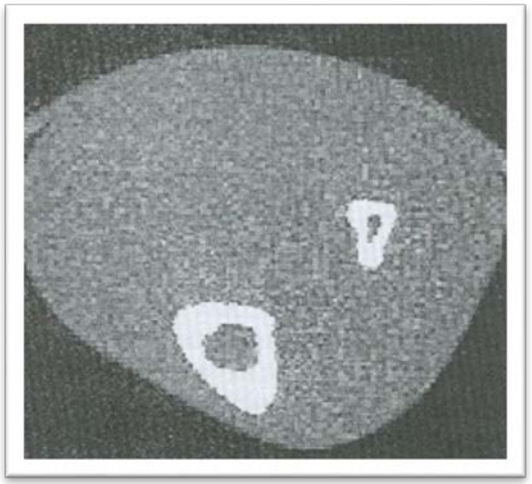
Lab, animal, & clinical studies indicate that ***osteogenic*** activities are high impact forces and/or high muscle forces applied rapidly, oddly, and with breaks.



Triple Jumper



Control Athlete

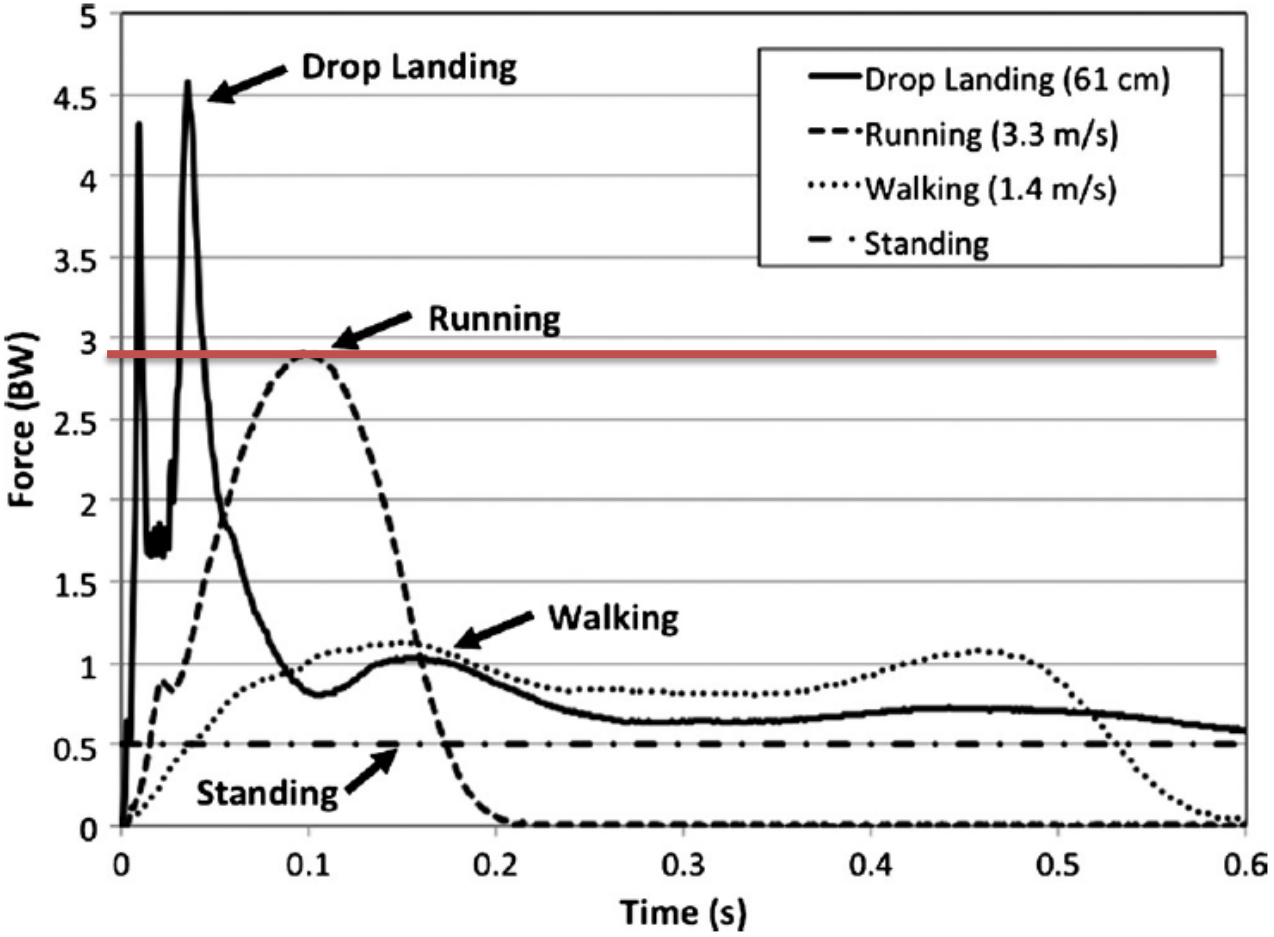


Cross Section Distal Tibia:pQCT

These activities effect the material, geometry, & micro architecture of whole bone.

Scans Khan et al. 2001 ; Nelson 1998

Animal, lab, & clinical studies indicate an impact* force threshold ~ 3 x BW needed to improve bone strength.



*Note High Muscle Forces (Power) Also Improve Bone Strength.

Gunter, Almstadt, Janz 2011

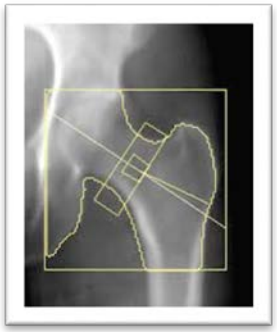
Multiple bone attributes define bone strength.

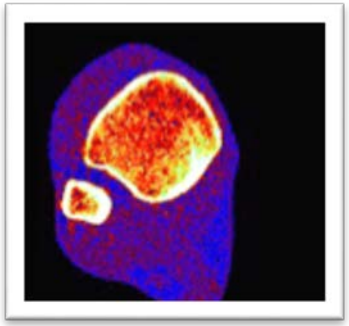
- Material: bone mineral mass and density
- Geometry: size, shape, distribution of whole bone
- Micro-architecture: porosity of trabecular & cortical bone

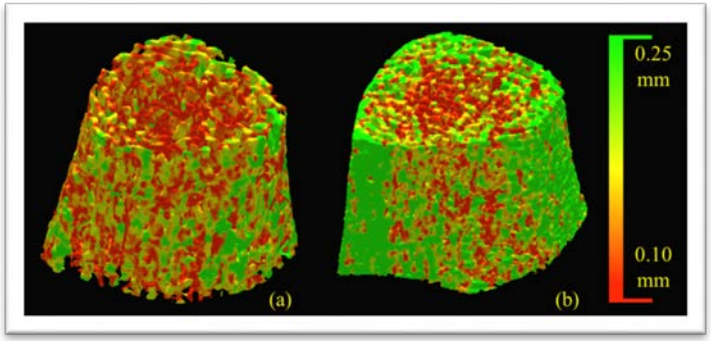
DXA, mid 1980s

pQCT, early 2000s

MDCT ~2010







What we hope to accomplish.

- Better quantification of physical activity dimensions that influence musculoskeletal health.
  - Improve understanding of dose-response
- Challenge to create dose measures of forces (impact & muscle) that can be understood outside of resistance training and accomplished safely during daily activity.

What we are asking (with a focus on adult literature):

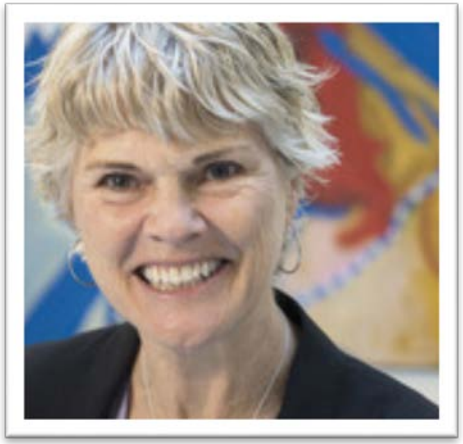
1. What are the most helpful physical activities for bone health and muscle strength?

2. Why those activities?

3. How much and how strong is the evidence to support dose for these activities?

Who we are asking:

- Wendy Khort, University of Colorado, physiology of aging, 2008 PAG, 2004 ACSM Position
- Jon Tobias, University of Bristol, everyday quantification bone loading
- Heather McKay, Director Hip Health & Mobility Centre, University of British Columbia
- Katherine Brooke-Wavell, Loughborough University, interventions athletes and adults



Meeting 2

Committee Discussion

Meeting 2

Meeting Adjourned

Richard D. Olson, MD, MPH
Designated Federal Officer