Staying Active: Mind and Body

Mark D. Peterson, Ph.D., M.S.
Research Assistant Professor
University of Michigan Health Systems
Department of Physical Medicine and Rehabilitation
Agenda

- Very Brief Perspective– Obesity Prevalence
  - Current Epidemiology and issues with obesity screening

- The Role of Obesity in Muscle Dysfunction
  - More than just excess baggage

- Mediators of Muscle Quality

- Implications for cardiometabolic health risk and muscle dysfunction in Post-Polio

- Which are the “Healthy Ideas” to Promote?
Obesity is a “Disease”
Simulation Modeling

- Predictions for 2030 suggest that 50% of the population will be obese...

- Thus accruing an additional
  - 6–8 million cases of diabetes
  - 5–7 million cases of heart disease and stroke
  - >500,000 additional cases of cancer*


*For every 5 kg/m² in BMI increases a man’s risk of oesophageal cancer by 52% and for colon cancer by 24%, and in women, endometrial cancer by 59%, gall bladder cancer by 59%, and postmenopausal breast cancer by 12%
Body Mass Index (BMI): A Good Proxy for Obesity

- Body Mass Index = $\text{wt}/\text{ht}^2 \ (\text{kg}/\text{m}^2)$

- Utility of BMI is particularly relevant to Cross-sectional research
  - RISK of disease increases when BMI increases

- But...
The Problem with BMI

- What we see on the surface or read from the scale is merely a glimpse of the truth

2 Trendy Terms

- “Normal Weight Obesity”  

- “Metabolically Healthy Obese”  
  Blüher, M, Curr Opin Lipid, 2010
Obesity Misclassification

![Graph showing the relationship between Body Mass Index (BMI) and Percent Body Fat (%BF) for females and males. The graph includes a scatter plot with data points for both genders, illustrating the misclassification between obesity and body fat percentage.](image-url)
To Add Confusion: Muscle Mass Changes with Aging

Lexell et al., 1988
What about Muscle Composition?

25 Years Old 65 Years Old

Goodpaster et al, 2006
“Muscle Attenuation”

- An altered skeletal muscle composition in aging and obese individuals is manifest by a reduced attenuation coefficient on CT (HU)
- Associated with muscle weakness, a reduced oxidative enzyme capacity, and IR in muscle.

Adiposity Attenuates MQ

- In 634 health non-obese individuals, adiposity was negatively associated with MQ.
- Diminished covariance between muscle mass & strength across each higher tertile of adiposity.
- Adiposity mediates the association between mass and function.

Intermuscular adipose tissue (IMAT) and Intramyocellular Lipid (IMCL)

Also develop as a feature of:
- Disease processes (e.g. DMD, T2DM)
- Spinal cord injury
- Sarcopenia (“sarcopenic obesity“)
- Obesity
- Prolonged sedentary behavior*

My Current Focus: Predictors, Confluence and Consequences of Frailty and Excess Adiposity in Cerebral Palsy

(a) a 53 year old, typically-developed male (65 kg body mass), and (b) a 54 year old male with CP (66 kg body mass).
What have we learned about CP that is “secondary” to the neurologic insult?

- Muscular Atrophy and Weakness
- Lower Cortical and Trabecular BMD
- Increased Subcutaneous Adiposity
- Increased Visceral Adiposity
- Increased Intermuscular Adiposity
- Lower Cardiorespiratory Fitness
- Less Habitual Physical Activity
- Greater Sedentary Behavior
- Very Low overall body mass (and BMI)
What are the Implications for Post-Polio?

First steps:
- How much activity is occurring?
- How much inactivity is occurring?

Second Steps:
- Which “Healthy Ideas” should we Promote?
Objectively Measured SB and PA

- **N=20 Post-Polio**
- **Age 61 years ± 4**
- **Steps per day: 3000-3400**
  - Recommendation: 10,000/day
- **MVPA: <10 minutes**
  - Recommendation: 30-60 min/day
Objectively Measured SB and PA

- Sedentary
- Sleep
- Baseline PA
- Low PA
- Moderate PA
- Vigorous PA

[Graph showing the comparison of sedentary, sleep, baseline physical activity (PA), low PA, moderate PA, and vigorous PA over hours and minutes.]
What is the Difference between Sedentary Vs. Inactive?

- SB: ≤ 1.5 METs (and not sleeping)
- Baseline Activity: >1.5 METs and ≤ 3 METs
- Low-Intensity PA: >3 METs ≤ 4.8 METs
- Moderate-Intensity PA: >4.8 METs and ≤ 7.2 METs
- Vigorous PA: >7.2 METs
So, what are the points of Interventions?

- Despite the contention that “Recognizing obesity as a disease will help change the way the medical community tackles this complex issue…”
  - AMA, 2013

- Physical inactivity and excess adiposity are interdependent factors, and thus clinical and public health advocacy to encourage replacing SB with PA should work!
A “Packaging” problem...
Since *Sedentary Behavior* is associated with:

- Muscle weakness and atrophy, bone deterioration, diminished ROM, gross motor dysfunction, cardiometabolic decline, decreased QoL, and depression

Many experts believe simply reducing time spent in SB would have the greatest health benefit.
Dangers of Sedentary Behavior
Dangers of Sedentary Behavior

- Time spent sitting correlates with an elevated risk of mortality for all causes and for cardiovascular disease
  - Dose-response pattern
- Sitting seems to have be associated with mortality independent of leisure time physical activity levels

A brisk walk in the park keeps Marry B in shape between dog shows. His owner, Columbus resident Cathy Stumbo, got up early to give her 3-year-old Doberman his regular workout. They typically log 15 miles in Berliner Park.
Nearly half of participants reached 60% of HR maximum (highlighted with grey box).
Option 2: Resistance Exercise?

John Turner: Age 67
Hypertrophy in Aging Adults

- The role of RE for **preservation of lean mass and BMR** during calorie restriction
  - Particularly important for elderly with diabetes

- Moreover, data reveal that hypertrophic adaptation is possible in very old (mean ~90 years) subjects.

RE in the “Oldest Old”

- Short-term (8 weeks, 3x/week), light- to moderate-intensity (30-70% 1RM) exercise training improves leg muscle strength in the oldest old (90-97 years)

**Strength and Mortality: A Final Thought**

- Muscular strength capacity is independently associated with all cause mortality
- Even after adjusting for cardiorespiratory fitness and other potential health-risk parameters

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Mark D. Peterson

- mdpeterz@med.umich.edu
- mdpeterz@gmail.com

Nobody really lives long enough to die of old age. We die from accidents, and most of all, disuse.

-Walter Bortz M.D.