

Measures of Mobility and Functional Impairment: Handgrip Strength

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Hello!

Background

- Assistant Professor
 - Department of Health, Nutrition, and Exercise Sciences
- Affiliate Faculty
 - Center for Large Data Research & Data Sharing in Rehabilitation
 - University of Texas Medical Branch

Research Interests

- Epidemiology of aging
- Topics related to physical activity and health across the lifespan
- Methodological improvements

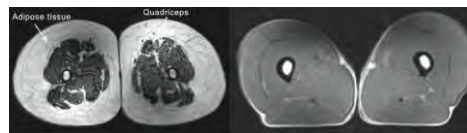
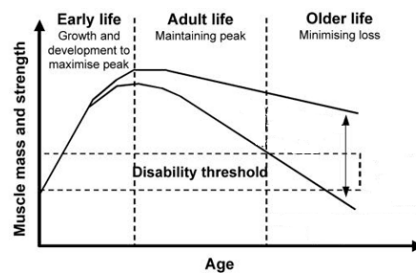


Presentation Objectives

- Examine how muscle strength is assessed in clinical settings
- Evaluate why low handgrip strength is bad for health
- Determine possible limitations for handgrip strength, and how such limitations could be overcome



Handgrip Strength



74 year-old sedentary

70 year-old triathlete



Handgrip Strength



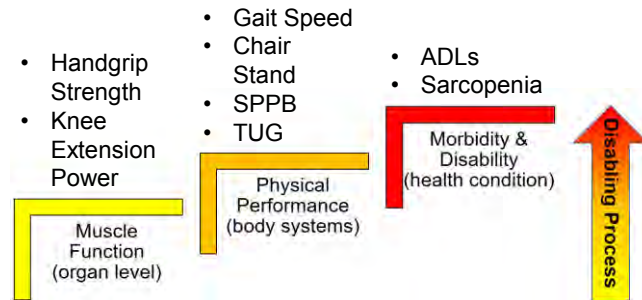
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Handgrip Strength



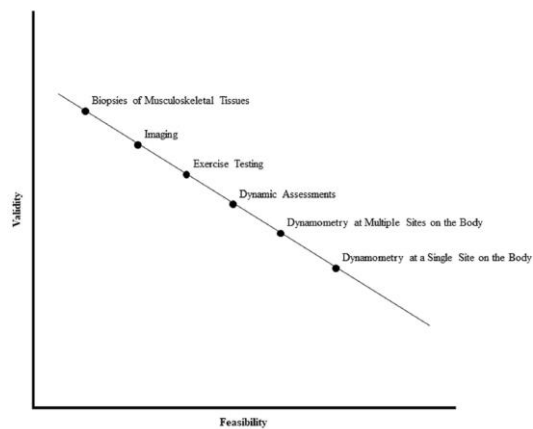
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Handgrip Strength



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Handgrip Strength



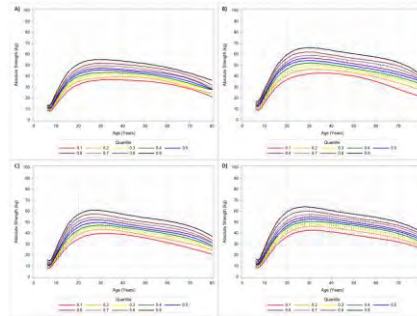
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Handgrip Strength

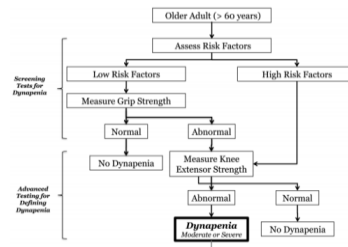
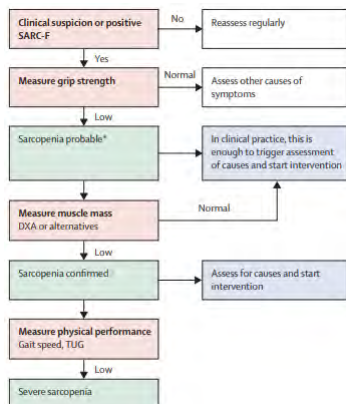
Categorical Weakness

- Men: <26-kilograms
- Women: <16-kilograms
- Normalized Handgrip Strength: (handgrip strength (kg) / body weight (kg) or body mass index (kg/m²))

Percentiles



Handgrip Strength



Handgrip Strength

- Weakness is part of frailty evaluations (representing different physiological systems; ability to cope with acute or chronic stressors)
 - Unintentional weight loss (10 lbs. in past year)
 - Self-reported exhaustion
 - Weakness (grip strength)
 - Slow walking speed
 - Low physical activity

Handgrip Strength

- Low handgrip strength has been shown to be associated with:
 - **Diabetes**
 - Heart disease
 - Dementia and Alzheimer's disease
 - Functional disability
 - Osteoporosis
 - Premature death

Table 3
Cox Proportional Hazard Regression for Baseline Variables and Diabetes in A, Male and B, Female Participants

	HR*	95% CI
A. Male Participants		
Muscle weakness (reference: strong male participants)	1.22	1.18–1.26
Education	1.06	1.05–1.06
Employed (reference: not employed)	1.25	1.20–1.31
IADL disability (reference: no IADL disability)	0.81	0.78–0.84
Interview language (reference: Spanish)	0.88	0.85–0.91
Married (reference: not married)	0.88	0.85–0.91
Obese (reference: not obese)	1.16	1.12–1.20
B. Female Participants		
Muscle weakness (reference: strong female participants)	1.24	1.21–1.27
Education	0.99	0.98–0.99
Employed (reference: not employed)	1.51	1.49–1.58
IADL disability (reference: no IADL disability)	0.74	0.73–0.76
Interview language (reference: Spanish)	0.91	0.89–0.94
Married (reference: not married)	0.76	0.74–0.78
Obese (reference: not obese)	1.77	1.73–1.81

Handgrip Strength

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Table 2. Association Between Handgrip Weakness and Time to Incident Chronic Heart Failure.

	Hazard Ratio	95% Confidence Interval
Handgrip Weakness (Reference: Not-Weak)	1.35	1.05, 1.74
Male (Reference: Female)	1.04	0.82, 1.31
White (Reference: Black)	0.77	0.58, 1.01
Age	0.81	0.77, 0.85
Body Mass Index	1.05	1.03, 1.07
Current Smoker (Reference: Non-Smoker)	1.48	1.05, 2.07
Previous Smoker (Reference: Non-Smoker)	1.22	0.95, 1.57
Previous Heart Condition (Reference: No Previous Heart Condition)	7.02	5.53, 8.92
Diabetes (Reference: No Diabetes)	1.36	1.06, 1.74
Self-Rated Health (Reference: Excellent)		
Very Good	2.29	1.04, 5.02
Good	2.68	1.23, 5.82
Fair	4.48	2.05, 9.77
Poor	6.81	3.02, 15.37

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Handgrip Strength

- Low handgrip strength has been shown to be associated with:
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 - Heart disease
 - **Dementia and Alzheimer's disease**
 - Functional disability
 - Osteoporosis
 - Premature death

Table 2. Association Between Decreased Handgrip Strength and Mild Cognitive Impairment.

	Odds Ratio	95% Confidence Interval
Handgrip Strength (5-Kilogram Decrease)	1.16	1.10, 1.23

Table 3. Association Between Decreased Handgrip Strength and Severe Cognitive Impairment.

	Odds Ratio	95% Confidence Interval
Handgrip Strength (5-Kilogram Decrease)	1.06	1.03, 1.09

Table 4. Association Between Decreased Handgrip Strength and Cognitive Impairment Progression.

	Odds Ratio	95% Confidence Interval
Handgrip Strength (5-Kilogram Decrease)	1.14	1.09, 1.19

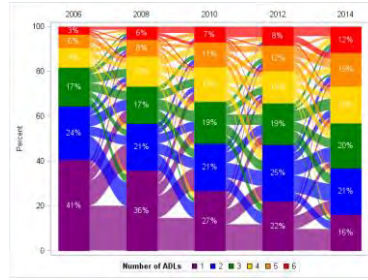
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Handgrip Strength

- Low handgrip strength has been shown to be associated with:
 - Diabetes
 - Heart disease
 - Dementia and Alzheimer’s disease
 - **Functional disability**
 - Osteoporosis
 - Premature death

TABLE 2 The time-varying associations between handgrip strength and individual ADL limitations

Handgrip strength (5-kg decrease)	Dressing		Eating		Transferring		Toileting		Bathing		Walking	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
1.09	1.07-1.11	1.20	1.14-1.28	1.08	1.06-1.12	1.06	1.04-1.08	1.14	1.12-1.19	1.14	1.12-1.19	1.12-1.19



Handgrip Strength

- Low handgrip strength has been shown to be associated with:
 - Diabetes
 - Heart disease
 - Dementia and Alzheimer’s disease
 - Functional disability
 - **Osteoporosis**
 - Premature death

TABLE 2. Results from the logistic regression models for the association between muscle strength and osteoporosis.*

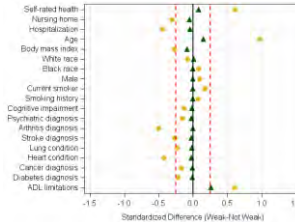
	Males		Females	
	Odds ratio†	95% CI	Odds ratio†	95% CI
Handgrip strength	0.94	0.94-0.94	0.90	0.90-0.90
Age	1.05	1.05-1.05	1.06	1.06-1.06
Body mass index	0.93	0.93-0.94	0.89	0.89-0.89
Ethnicity (reference: non-Hispanic black)				
Non-Hispanic Asian	6.62	6.51-6.72	6.42	6.37-6.48
Hispanic	2.56	2.52-2.60	2.19	2.17-2.21
Non-Hispanic white	3.26	3.22-3.31	3.97	3.94-4.00
Supplementation (reference: no supplement)	1.77	1.76-1.78	0.50	0.50-0.50
Mean dietary calcium	1.00	1.00-1.00	1.00	1.00-1.00
Mean dietary vitamin D	0.98	0.98-0.98	0.98	0.98-0.98

*95% CI = 95% confidence intervals; Supplement, takes calcium and vitamin D supplement. †All odds ratios were $p < 0.0001$.



Handgrip Strength

- Low handgrip strength has been shown to be associated with:
 - Diabetes
 - Heart disease
 - Dementia and Alzheimer's disease
 - Functional disability
 - Osteoporosis
 - **Premature death**
 - Being weak was associated with a 40% greater risk for premature death



Handgrip Strength

- While low handgrip strength (weakness) is linked with many health complications...
 - How do we communicate low handgrip strength (weakness) as a risk factor to patients?
 - Poor use in clinical settings?

Table 1
Tools used to assess muscle mass, muscle strength and physical performance in clinical practice.

Outcomes	Tools	Proportion of users (%)
Muscle mass (n=136)	Call circumference	57.9
	Dual-energy X-ray absorptiometry (DXA)	45.9
	Skinfold thickness	30.8
	Bioelectrical impedance analysis (BIA)	22.6
	Ultrasound	18.5
	Magnetic resonance imaging (MRI)	16.4
Muscle strength (n=139)	Handheld dynamometer	66.4
	Leg press	24.2
	Chest press	9.39
	Isometric dynamometer	7.38
	Vigometer	2.91
	Other	11.4
Physical performance (n=182)	Call speed	63.3
	Timed up and go	58.8
	Self-reported physical function	58.1
	Sit to stand 5 times	53.9
	Standing balance	52.9
	Short physical performance battery test (SPPB)	28.8
	Stair climb	25.1
	3-D accelerometers	3.66
Other	5.76	

Handgrip Strength

- Current and future research trends:
 - Handgrip strength asymmetry (non-dominant handgrip strength (kg) / dominant handgrip strength (kg))
 - Clinically meaningful differences within measures
 - Technologies
 - Additional aspects of muscle function

Handgrip Strength

- What about physical activity?
- What about nutrition?
- What about health events and trajectories (e.g., hospitalizations, falls)

Handgrip Strength

- Convenient measure of muscle strength
- Powerful biomarker of aging
- Incomplete, but promise exists for change
- Routine (geriatric) health assessments

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Thank You!



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Any Questions?

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Case Examples

- Some research shown in the presentation suggested that many healthcare providers do not utilize clinical assessments of physical performance (e.g., handgrip strength, gait speed, etc.).

Do you utilize assessments of physical performance? Why or why not?



Case Examples

- An older patient without an age-related disability (e.g., ADLs) or morbidity (e.g., sarcopenia) was identified as having low handgrip strength, but not poor physical functioning (e.g., gait speed).

What would you recommend for this patient?

