



PRACTICAL APPLICATION: USING WALKING SPEED IN CLINICAL PRACTICE

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Course Outline

- What makes WS such a **vital screening tool** & outcome measure?
- How fast do community living older adults really walk?
- How does WS change during rehabilitation for persons with **hip fracture**?
- Using WS to document outcomes in persons with **total joint arthroplasty**.
- WS: an indicator of health/functional status in **cardiopulmonary disease**.
- WS in **stroke survivors**
- Reporting **G-codes** for walking speed



What makes WS such a vital screening tool & outcome measure?

Walking Speed as a **Vital Sign**

General indicator that can predict **future events** & reflect various underlying **physiological processes**

(Studenski 2003, 2009)

- **A vital sign:**
 - A summary indicator of multiple physiologic system inputs, that reflects the overall health of the organism
 - In general, there are normal & abnormal ranges
 - Differential diagnosis of an abnormal vital sign is based on contributing systems e.g. causes of hypertension



6th VITAL SIGN: Walking Speed

APTA

Walking Speed is....

- "...almost the perfect measure" (Wade 1992)
 - **Reliable** (Richards 1996)
 - **Valid** (Steffen 2002)
 - **Sensitive** (van Iersel 2008)
 - **Specific** (Harada 1995)
 - **Correlates with**
 - **Functional ability** (Perry 1995)
 - **Balance confidence** (Mangione 2007)



Contributors to Self-Selected Walking Speed- "How people pick their own speed"

1. Individual's health status (Lord 2005)
2. Motor control (Gerin-Lajoie 2006)
3. Muscle performance & Musculoskeletal condition (Buchner 1996; Ostchega 2004)
4. Sensory & perceptual function (teVelde 2003)
5. Endurance & habitual activity level (Langlois 1997)
6. Cognitive status (Persad 2008)
7. Motivation & mental health (Lemke 2000; Fredman 2006)
8. Characteristics of the environment in which one walks (Robinet 1988)

Walking Speed as a **Vital Sign**

- WS can not stand alone as the only predictor or evaluative tool for **function...**
- ...just as **blood pressure** is not the only sign of **heart disease** or measure in change of cardiovascular status

Walking Speed is Outstanding Indicator

Could be a common metric to describe walking

- Predictive:
 - Walking speed is a powerful indicator of health & disease
- Evaluative:
 - Clinical evaluation of abnormal gait speed
- Simple, Feasible, & Understandable:
 - Normative data, understand abnormal data, understand meaningful change

Normal Walking Speed

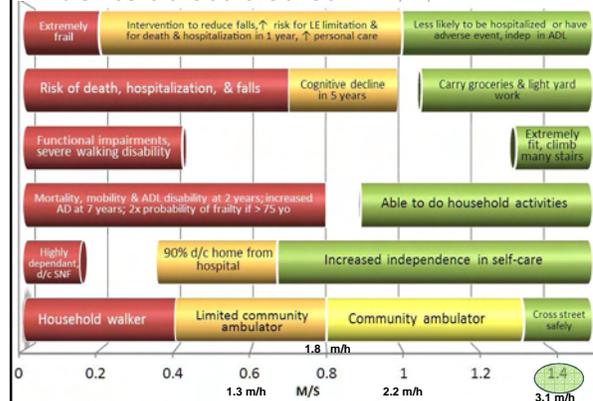
Studenski et al., 2011, JAMA

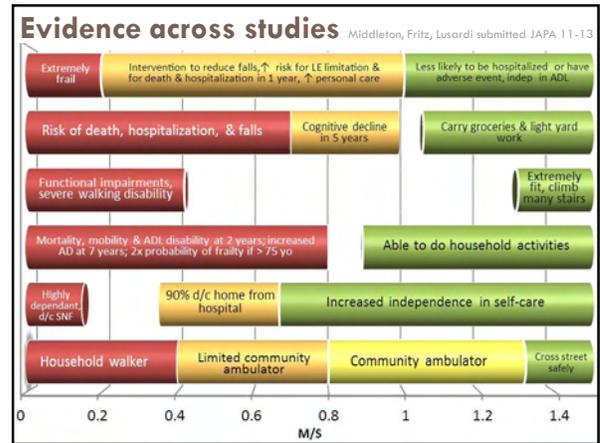
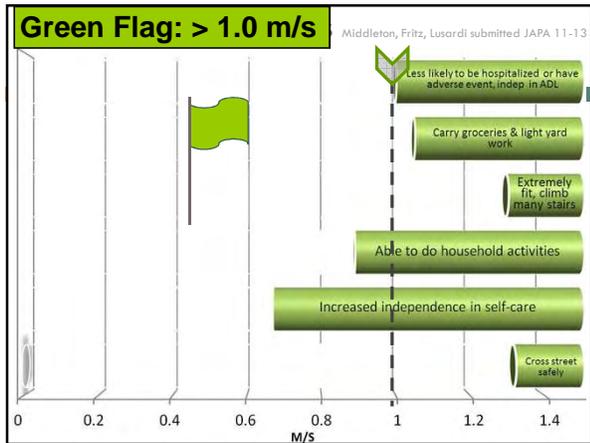
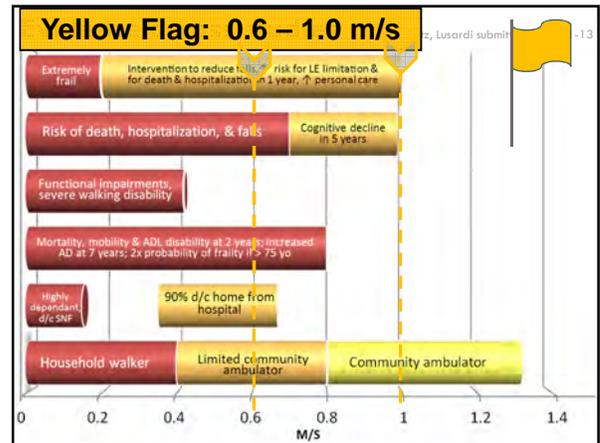
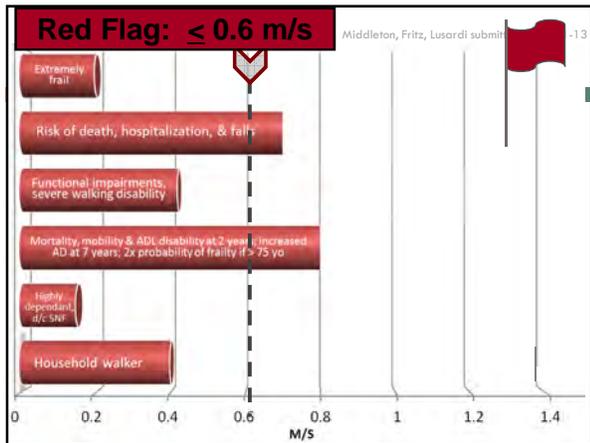
Walking Speed Varies By Age, Gender, & anthropometrics



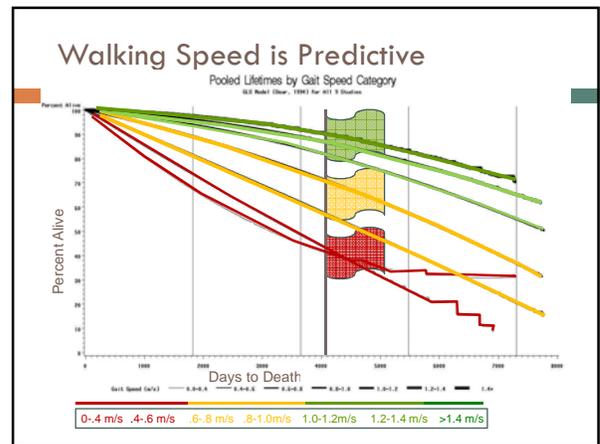
Evidence across studies

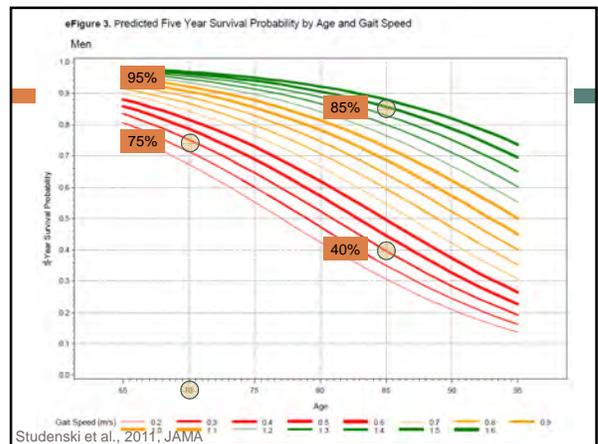
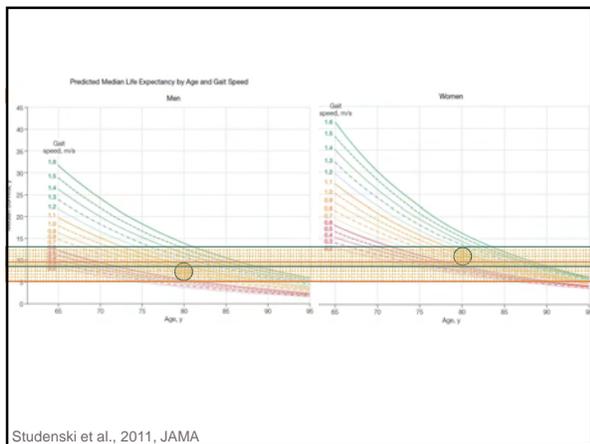
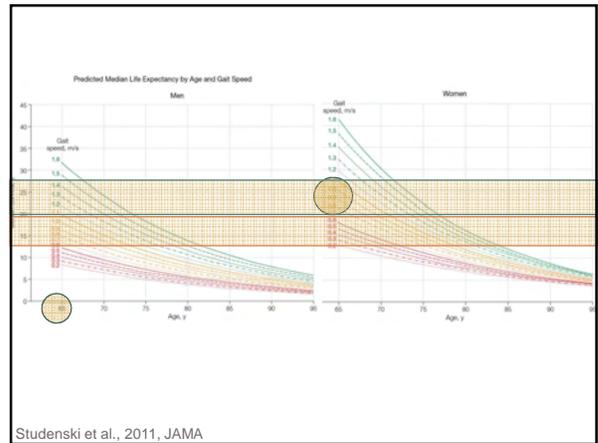
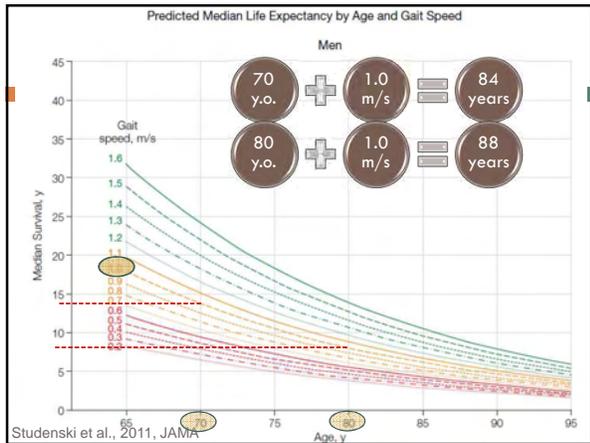
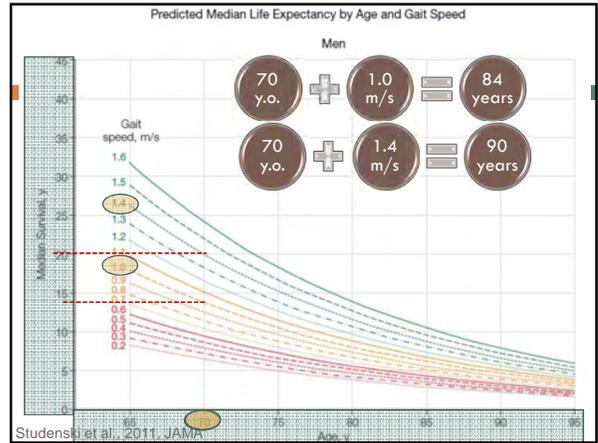
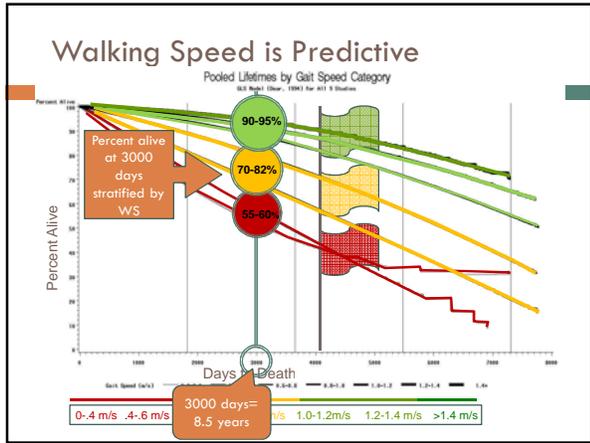
Middleton, Fritz, Lusardi submitted JAPA 11-13

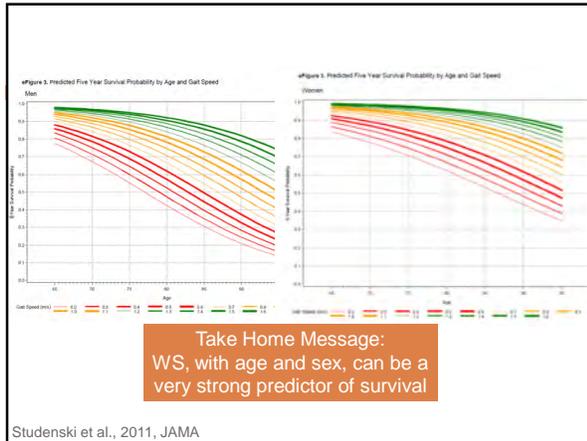




Walking Speed Predicts...







Gait Speed and Survival in Older Adults

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Context Survival estimates help individualize goals of care for geriatric patients, but life tables fail to account for the great variability in survival. Physical performance measures, such as gait speed, might help account for variability, allowing clinicians to make more individualized estimates.

Objective To evaluate the relationship between gait speed and survival.

Design, Setting, and Participants Pooled analysis of 9 cohort studies (collected between 1986 and 2000), using individual data from 34 485 community-dwelling older adults aged 65 years or older with baseline gait speed data, followed up for 6 to 21 years. Participants were a mean (SD) age of 73.5 (5.9) years; 59.6%, women; and 79.8%, white; and had a mean (SD) gait speed of 0.92 (0.27) m/s.

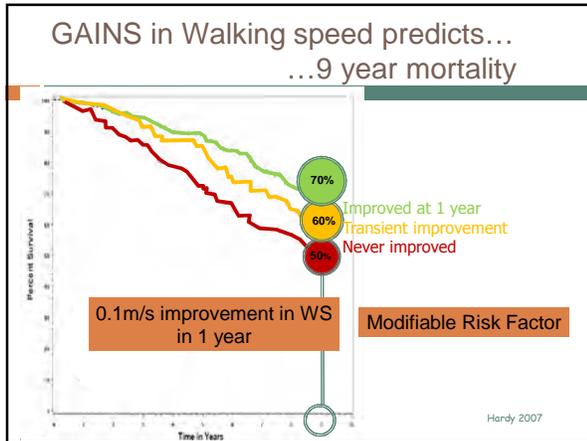
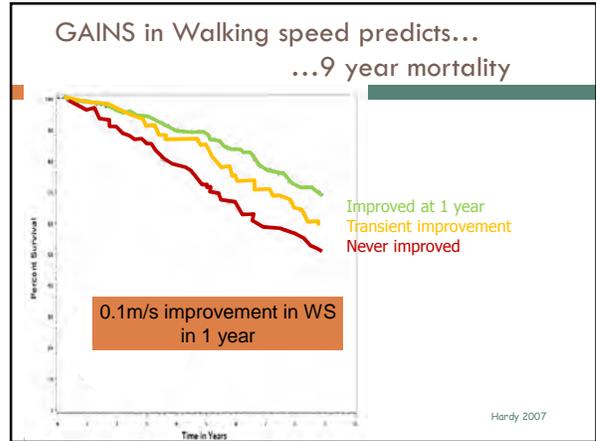
Main Outcome Measures Survival rates and life expectancy.

Results There were 17 528 deaths; the overall 5-year survival rate was 84.8% (confidence interval [CI], 79.6%–88.8%) and 10-year survival rate was 59.7% (95% CI, 46.5%–70.6%). Gait speed was associated with survival in all studies (pooled hazard ratio per 0.1 m/s, 0.88; 95% CI, 0.87–0.90; $P < .001$). Survival increased across the full range of gait speeds, with significant increments per 0.1 m/s. At age 75, predicted 10-year survival across the range of gait speeds ranged from 19% to 87% in men and from 35% to 91% in women. Predicted survival based on age, sex, and gait speed was as accurate as predicted based on age, sex, use of mobility aids, and self-reported function or as age, sex, chronic conditions, smoking history, blood pressure, body mass index, and hospitalization.

Conclusion In this pooled analysis of individual data from 9 selected cohorts, gait speed was associated with survival in older adults.

JAMA. 2011;305(1):50-58 www.jama.com

Gains in WS Predicts...



How to Measure Walking Speed

Feasibility of Use

Several standardized assessments reliably predict function & health related events:

- Yet, consistent use in PT & other clinical settings is not widely practiced (Duncan 2000)

Factors contributing to non-use of standardized assessments include:

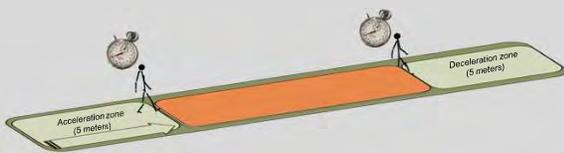
- Insufficient time
- Inadequate equipment or space
- Lack of knowledge in interpreting the assessment (Cesari 2005)

Assessment

- Most normative values are based on measuring the middle 2/3rds of a walkway (Bohannon 2008)
 - Timing 3 times provides a more accurate estimate than a single trial (Steffen 2002; Lusardi 2003; Bohannon 2009)
- However, measurements of WS are **highly reliable** regardless of:
 - the method for measurement
 - different patient populations (Bohannon 1997; Steffen 2002)

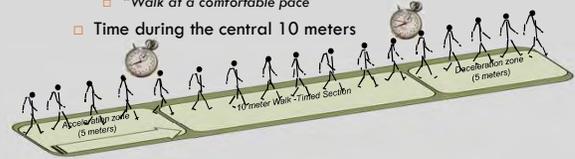
10 Meter Walk Test

- Reliable, inexpensive method (Perera 2006)
- 20 meter path
 - Central 10 meters being the timing area



10 Meter Walk Test

- Reliable, inexpensive method (Perera 2006)
- 20 meter path
 - Central 10 meters being the timing area
- Start your patient at the beginning of the 20 meter line
 - Ask pt to walk "at a comfortable pace" to the end line
 - "Walk at a comfortable pace"
 - Time during the central 10 meters



5 Meter Walk Test

- Reliable
 - Recommended as most feasible
- 7 meter path
 - Central 5 meters being the timing area



5 Meter Walk Test

Quick Gait Speed Test

seconds	= 5 m/time to walk
4 seconds	1.25 m/s
5 seconds	1.0 m/s
6 seconds	0.83 m/s
7 seconds	0.71 m/s
8 seconds	0.63 m/s
9 seconds	0.55 m/s
10 seconds	0.5 m/s

Conversion

Meters/second	Miles / hour
0.4	0.9
0.6	1.3
0.8	1.8
1.0	2.2
1.2	2.7
1.4	3.1



Test-retest reliability

Test-retest reliability coefficients reported in the literature range from:

0.929 (Evan 1997) to 0.97 (Stephens 1999)

Variability related to:

- ▣ Method used to measure
- ▣ Distance measure
- ▣ Diagnosis
- ▣ Use of assistive device
- ▣ Age
- ▣ Anthropometrics (primary leg length)
- ▣ Self-selected or fast WS

Change In WS

True change vs. measurement error

- ▣ Different populations have different MDC's (minimal detectable change scores)
- ▣ Most common is 0.1 m/s

Change of 0.1 m/s is predictor

- ▣ Gain of 0.1 m/s is predictor for well-being in those without normal WS (Purser 2005; Hardy, Perera 2007)
- ▣ Decrease in 0.1 m/s is linked with:
 - ▣ poorer health status
 - ▣ more disability
 - ▣ longer hospital stays
 - ▣ increased medical costs (Purser 2005)

Use a change of 0.1 m/s for patient goals

Given an individual's resources:

Self-selected walking speed (SSWS)

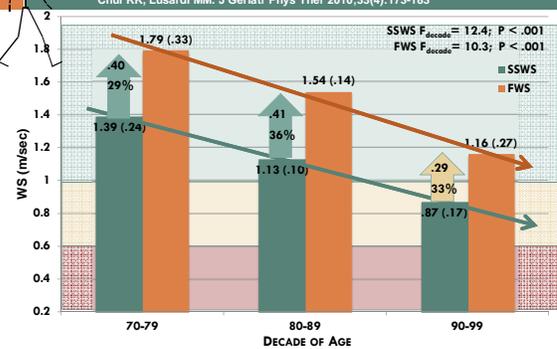
- ▣ most energy efficient Talkowski, Phys Ther 2008
- ▣ minimizes metabolic cost per unit distance walked Molino-Lova, Gait Posture 2012

Ability to increase walking speed (Fast Walking Speed (FWS))

- ▣ index of "functional reserve" Sallinen, Aging Clin Exp Res 2011; Ko Age Aging 2010
- ▣ Ability to meet demands of activity and environment Asher, Age Ageing 2012

Self Selected and Fast Walking Speeds in Healthy Community Living Older Adults

Chui KK, Lusardi MM. J Geriatr Phys Ther 2010;33(4):173-183



Mrs. P. SSWS vs FWS

Video clip: center 4m of an 8m walkway
 Mrs. P: 85 yrs. self reported health "very good"

Mrs. E. SSWS vs FWS

Video clip: center 4m of an 8m walkway
 Mrs. E: 83 yrs. self reported health "good"

Mrs. R. SSWS vs FWS

Video clip: center 4 m of a 7 m walkway
 Mrs. R: 89 yrs. self reported health "fair"

WALKING ABILITY

SO MANY CHOICES: What provides "biggest bang" ?

Decision Making: Easy to do across settings
 Minimum time and equipment
 Valid (meaningful)
 Reliable
 Interpretable (norms, MDC, MCID)
 Discriminates / Predicts

BOTTOM LINE: SSWS and FWS are the place to start ! They tell you something

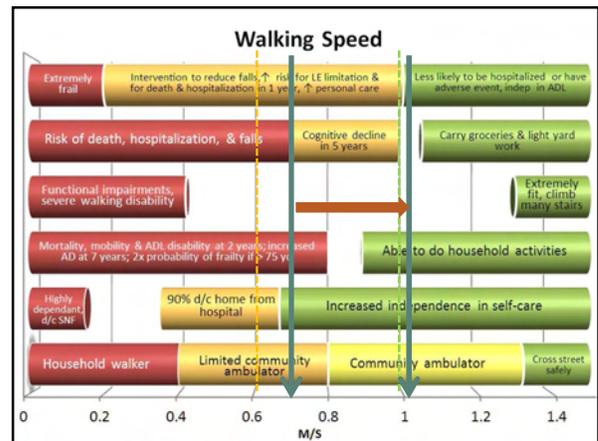
Interpretation: Walking Speed
 An 83 year old woman; fell at home, hospitalized, now recovering from pneumonia.

Discharged from Acute Care (4 days) to Subacute Rehab

Initial Examination	Reassessment
SSWS = 0.69 m/s	SSWS = 1.05 m/s

IS THIS A MEANINGFUL CHANGE?
 (i.e., was PT efficacious ?)

Mean difference:
 $SSWS_{DC} - SSWS_{IE} = .36 \text{ m/s}$



Using WS in Documentation (1.0 or greater)

Pt's walking speed improved from .69 m/s to 1.05 m/s, moving her from a limited community walking speed to a community walking speed, making the patient safe for walking in the community, less likely to be hospitalized, more independent in self care, and less likely to have other adverse events

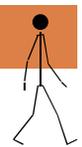
Using WS in Documentation (.6 m/s to .9 m/s)

Pt's walking speed of (0.6 m/s to .9 m/s) indicates that the patient may have decreased ability to walk in the community and has increased risk of falls

Using WS in Documentation (.59 m/s & below)



Pt's walking speed of (0.59 m/s or less) indicates walking is severely impaired, the patient is only able to walk at home or very limited in community walking, the patient has increased dependence in ADL's and is at risk for hospitalization and falls.



How does WS change during rehabilitation for persons with **hip fracture**?

Incidence and Mortality of Hip Fractures in the United States

Carmen A. Brauer, MD, MSc, FRCSC
 Marcelo Coca-Perraillon, MA
 David M. Cutler, PhD
 Allison B. Rosen, MD, MPH, ScD

- Examined Medicare claims from 1986-2005.
- For both genders incidence:
 - 1986-1995 increased
 - 1995-2005 decreased

A systematic review of hip fracture incidence and probability of fracture worldwide

J. A. Kanis · A. Odén · E. V. McCloskey · H. Johansson · D. A. Wahl · C. Cooper ·

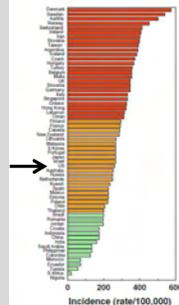


Fig. 1. Age-standardized annual incidence of hip fractures in women (1980-2000) according to country together with the colour code.

Hip Fractures

- Risk Factors
 - Age (Brauer et al., 2009)
 - Gender - women sustained 72% of hip fractures (NHDS, 2010)
 - 2.6 female to 1 male ratio
 - Being Caucasian increases risk (Kanis et al., 2012)
 - Osteoporosis increases risk (NOF, 2008)

Summary

- The incidence of hip fx is decreasing, but the number of hip fx is increasing as the % of older adults in the population increases.
- There are many long-term predictors of hip fracture, including **WALKING SPEED** (SSWS < .69 m/s).
- There is excellent (ICC = .82 - .97) **TEST-RETEST RELIABILITY** of walking speed post hip fracture.
- LOWER EXTREMITY STRENGTH** best predicts (R² = 53.3%) walking speed post hip fracture.
- EXERCISE** can significantly increase walking speed post hip fracture

Walking Speed After Total Joint Replacement TKA & THA



Walking Speed with Knee OA

- Symptomatic knee OA (radiographic knee OA + knee pain) results in almost a 9-fold increased risk of fast decline trajectory in walking speed compared with healthy (White et al 2013)
- Knee pain alone or radiographic knee OA alone also had a higher risk of fast decline; but magnitude of risk was less than for symptomatic knee OA. (White et al 2013)

Assessment of Walking Speed

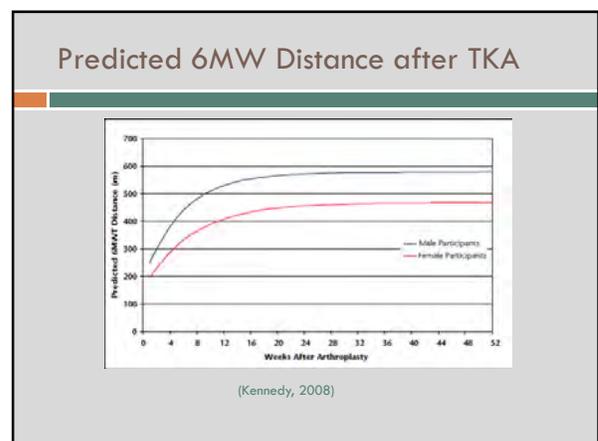
- Usual walking speed is not commonly assessed in the TJA population, so comparison to other populations is limited.
- Often, studies will report six minute walk (6MW) distance as a surrogate for walking speed, although it is designed to measure endurance. (Harada 1999; Parent 2003; Steffen 2002)

Time course of Recovery

- The majority of functional recovery for THA and TKA occurs during the first 6 to 9 weeks post-operatively. (Kennedy 2006)
- Generally, patients after THA recover walking speed and 6MW distance more favorably than TKA. (Kennedy 2006)

Recovery after TKA

- Patients reach preoperative levels of performance between 3 and 6 months after surgery. (Bade, 2010)
- Maximal gait speed for patients following TKA is achieved between 6-7 months post-operatively. (Kennedy 2008)
- Most patients are able to achieve or surpass their pre-operative walking speed 1 year after TKA, but still lag behind healthy, age-matched controls by 13-18%. (Moffet 2004; Walsh 1998)



Recovery after THA

- 9-11 weeks after THA, patients begin to exceed 6MW outcomes of patients with TKA. (Kennedy 2006)
- Through the first 26 weeks after THA, usual gait speed improved from an average of 0.93 m/s before surgery to 1.12 m/s. (van den Akker-Scheek, 2008)
- Years after THA, patients were still 17% slower at their fastest walking speed (1.5m/s) than healthy controls (1.8m/s). (Sicard-Rosenbaum, 2002)

Variability in gait speed

- There is a wide range of disability in the TJA population, with some patients seeking to maintain household ambulation and others seeking to return to sport. (Weiss 2002)
- Variability in gait speed surrounding TJA is high, with an interquartile range of 0.68 -1.36 m/s in people awaiting surgery. (Kennedy 2002)



Clinical Implications

- 6MW data and other performance-based measures provide a general idea of the trajectory of recovery for gait speed and physical performance after TKA and THA.
- Self-report measures of function likely fail to adequately capture patient performance surrounding TJA.
- Variability in gait speed further reinforces the need for clinical assessment at the individual level.



Walking speed: an indicator of health/functional status in individuals with cardiopulmonary dysfunction

Issues in CV & P Population

As compared to other populations:

- Higher incidence of morbidity and mortality
- Higher incidence of chronicity of disease
- Higher incidence of functional impairments
- Higher incidence of re-hospitalization
- Huge impact on health care dollars

Issues with Cardiovascular and Pulmonary Patients

In 2010, cardiovascular, lung, and blood diseases accounted for 1,017,000 deaths and 41 percent of all deaths in the United States. The estimated economic cost in 2009 for these diseases was \$424 billion—23 percent of the total economic costs of illness, injuries, and death.

What does the evidence tell us about Walk Speed in the cardiopulmonary population?

Gait speed and Cardiac Surgery

- Slow gait speed ($<.83\text{m/sec}$) was associated with higher risk of in-hospital complications from cardiac surgery in population of elderly patients.

Afilalo et al Am Col Card
2010

Risk Factors for Hospital Readmission in Heart Failure

- Risk factors for hospital admission after a new diagnosis of heart failure included diabetes, chronic kidney disease, and depression as well as functional class III or IV.
- Other risk factors included slow gait ($<0.8\text{m/sec}$) and muscle weakness defined as weak grip strength

Chaudry et al J Am
Coll Cardiol 2013

Gait Speed Meaningful Threshold in Acute Care

- Mean walk speed in study: 0.43m/sec
- 0.35 m/sec meaningful threshold
- $<0.35\text{m/sec}$ should not be allowed to walk independently

Graham JE Physical
Therapy 2010; 90:1592

Guess Mrs. W's SSWS (COPD)



Guess Mrs. W's FWS



Mrs. W.

- SSWS: .685 m/sec
- FWS .89 m/sec



Walking speed in stroke survivors: an indicator of functional status but not necessarily an indicator of quality of walking

The good news

The MDC for stroke survivors is the same as the norm for all diagnoses =.1 m/s

Bohannon, 2013

Patient Video Clips

Reporting G-codes for walking speed

What are the G-Codes A Review

- Functional limitation reporting - nicknamed G-Codes
- For the Middle Class Tax Relief Act of 2012 - CMS collects data on beneficiaries' functional outcomes from out-patient therapy
- 5 year project
- Must be supported in the medical record and on the claim

When are G-codes reported

- At the outset of a therapy episode of care
- At least once every 10 treatment days
- When an evaluative procedure, including a reevaluation is furnished and billed
- At the time of discharge from the therapy episode of care
- When 1 code is ended & there is still need for further therapy
- When a new or different functional limitation within the same episode of care is started

How to use walking speed for functional limitation reporting

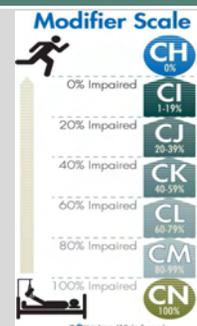
Mobility: Walking & Moving Around

G8978	Mobility: walking & moving around functional limitation, current status, at therapy episode outset and at reporting intervals
G8979	Mobility: walking & moving around functional limitation, projected goal status, at reporting intervals
G8980	Mobility: walking & moving around functional limitation, discharge status, at discharge from therapy

Severity/Complexity Modifiers C-codes

Modifier	Impairment Limitation Restriction
CH	0 percent impaired, limited or restricted
CI	At least 1 percent but less than 20 percent impaired, limited or restricted
CJ	At least 20 percent but less than 40 percent impaired, limited or restricted
CK	At least 40 percent but less than 60 percent impaired, limited or restricted
CL	At least 60 percent but less than 80 percent impaired, limited or restricted
CM	At least 80 percent but less than 100 percent impaired, limited or restricted
CN	100 percent impaired, limited or restricted

A Simplified Way to Look at it . .



Stroke specific C-codes

10 Meter Walk Test (m/s)	
0	CN
.01 - .02	CM
.21 - .4	CL
.41 - .6	CK
.61 - .8	CJ
.81 - .99	CI
1.0	CH

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