Gait Speed and Survival in Older Adults [redacted]

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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.

ble 1. Characteristics of Participants in the 9 Cohort Studies

Study	CHS	EPESE	Health, ABC	Hispanic EPESE	Invecchiare in Chianti	Osteoporotic Fractures in Men	NHANES III	PEP	Study of Osteoporotic Fractures
	No. (%) of Participants by Study								
ple size, No	5801	2128	3048	1905	972	5833	3958	481	10349
men	3336 (57.51)	1404 (65.98)	1575 (51.67)	1098 (57.64)	541 (55.66)	0	2044 (51.64)	216 (43.96)	10349 (100)
ce/ethnicity									
White	4854 (83.68)	2126 (99.91)	1783 (58.50)	0	972 (100)	5223 (89.54)	2535 (64.05)	384 (80.24)	9662 (93.36)
Black	909 (15.67)	2 (0.09)	1265 (41.50)	0	0	235 (4.03)	699 (17.66)	89 (18.13)	654 (6.32)
Hispanic	0	0	0	1905 (100)	0	122 (2.09)	623 (15.74)	0	0
Other	38 (0.66)	0	0	0	0	253 (4.34)	101 (2.55)	8 (1.63)	33 (0.32)
mean (SD), y	72.81 (5.58)	78.85 (5.52)	73.62 (2.87)	74.74 (5.96)	74.58 (7.06)	73.61 (5.84)	75.17 (6.93)	74.08 (5.74)	71.81 (5.21)
group, y									
65-74	3852 (66.40)	559 (26.27)	1912 (62.73)	1083 (56.85)	555 (57.10)	3401 (58.31)	2033 (51.36)	279 (56.82)	7486 (72.34)
75-84	1732 (29.86)	1204 (56.58)	1136 (37.27)	668 (35.07)	302 (31.07)	2183 (37.42)	1484 (37.49)	188 (38.29)	2596 (25.08)
≥85	217 (3.74)	365 (17.15)	0	154 (8.08)	115 (11.83)	249 (4.27)	441 (11.14)	24 (4.89)	200 (1.93)
Missing	0	0	0	0	0	0	0	0	67 (0.65)
speed, mean (SD), m/s	0.88 (0.22)	0.83 (0.13)	1.12 (0.23)	0.56 (0.23)	1.00 (0.26)	1.19 (0.23)	0.58 (0.23)	0.88 (0.24)	0.96 (0.22)
speed class, m/s									
<0.4	149 (2.57)	0	4 (0.13)	515 (27.03)	35 (3.60)	11 (0.19)	480 (12.13)	20 (4.07)	33 (1.19)
≥0.4 to <0.6	526 (9.07)	78 (3.67)	20 (0.66)	621 (32.60)	39 (6.07)	54 (0.93)	897 (22.66)	40 (8.15)	466 (4.50)
≥0.6 to <0.8	1887 (32.53)	791 (37.17)	189 (6.20)	467 (24.51)	110 (11.32)	206 (3.53)	1368 (34.56)	110 (22.40)	1752 (16.93)
≥0.8 to <1.0	2076 (35.79)	1105 (51.90)	705 (23.13)	220 (11.55)	246 (25.31)	875 (15.00)	887 (22.41)	166 (33.81)	3768 (36.41)
≥1.0 to <1.2	1077 (18.57)	135 (6.34)	1093 (35.86)	77 (4.04)	305 (31.38)	1774 (30.41)	294 (7.43)	116 (22.63)	3054 (29.51)
≥1.2 to <1.4	0	17 (0.80)	684 (22.44)	4 (0.21)	170 (17.49)	1911 (32.76)	32 (0.81)	36 (7.33)	970 (9.37)
≥1.4	86 (1.48)	2 (0.09)	353 (11.58)	1 (0.05)	47 (4.84)	1002 (17.18)	0	3 (0.61)	217 (2.10)
ility aid use									
None	NA	1962 (92.30)	3048 (100)	1817 (95.38)	881 (90.64)	5792 (99.30)	3664 (92.57)	453 (94.11)	10165 (98.22)
Cane	NA	87 (4.09)	0	49 (2.57)	8 (0.82)	38 (0.65)	201 (5.08)	21 (4.27)	All aids
Walker	NA	67 (3.15)	0	23 (1.21)	3 (0.31)	0	74 (1.87)	5 (1.01)	Combined
Other/missing	NA	12 (0.56)	0	16 (0.84)	80 (8.23)	3 (0.05)	19 (0.48)	3 (0.61)	184 (1.78)
mean (SD)	26.96 (4.71)	25.63 (4.54)	27.40 (4.82)	27.91 (5.13)	27.51 (4.11)	27.39 (3.83)	26.66 (5.11)	27.53 (5.12)	26.61 (4.57)
category									
<25	2237 (38.65)	803 (38.24)	983 (32.25)	555 (29.13)	276 (28.40)	1593 (27.31)	1344 (39.01)	156 (31.77)	4352 (42.05)
25-30	2407 (41.49)	886 (42.64)	1286 (42.26)	758 (39.79)	437 (46.96)	2991 (51.28)	1559 (39.39)	211 (42.97)	3842 (37.12)
>30	1144 (19.72)	411 (19.31)	777 (25.49)	577 (30.29)	243 (25.00)	1247 (21.38)	852 (21.53)	123 (25.05)	2155 (20.82)
Missing	13 (0.22)	28 (1.32)	0	15 (0.79)	16 (1.65)	2 (0.03)	3 (0.08)	1 (0.20)	0
pitalized past year	NA	395 (18.57)	456 (14.96)	304 (15.96)	129 (13.27)	NA	775 (19.58)	97 (19.76)	1116 (11.51)
ases									
Cancer	830 (14.33)	486 (22.84)	575 (18.91)	115 (6.04)	95 (9.77)	1697 (29.09)	387 (9.78)	113 (23.01)	NA
Arthritis	2977 (51.94)	2055 (96.57)	1706 (56.72)	812 (42.62)	304 (31.31)	2764 (47.39)	1827 (46.16)	286 (58.25)	6003 (63.10)
Diabetes	690 (11.90)	335 (15.74)	453 (14.88)	456 (23.86)	106 (10.91)	624 (10.70)	607 (15.34)	84 (17.11)	681 (7.04)
Heart disease	1230 (21.20)	312 (14.66)	652 (22.03)	155 (8.14)	49 (5.05)	1379 (23.64)	484 (12.23)	89 (18.13)	NA
reported health excellent/very good	2177 (37.61)	542 (74.48)	1343 (44.12)	870 (45.67)	591 (62.61)	5012 (85.95)	1204 (30.47)	229 (46.64)	8537 (82.49)
deaths during follow-up	3851 (66.39)	1955 (91.87)	848 (27.82)	972 (51.02)	187 (19.24)	1073 (18.40)	2837 (71.68)	293 (59.55)	5512 (53.26)
ian survival years (95% CI)	13.25 (13.00-13.56)	9.57 (9.17-9.92)	NE	11.70 (11.11-NE)	NE	NE	9.86 (9.53-10.19)	11.15 (9.82-11.92)	17.23 (16.97-17.47)
w-up period, median (range), y	13.25 (0.01-19.06)	9.57 (0.10-20.65)	9.00 (0.02-9.00)	11.54 (0.07-12.29)	8.00 (0.16-8.00)	6.84 (0.04-8.26)	9.86 (0.06-17.75)	11.15 (0.12-13.76)	15.03 (0.02-21.00)
th of walk	15 feet	8 feet	6 m	8 feet	4 m	6 m	4 m	4 m	6 m
of baseline data collection	1989-90, 1992-93	1987-1989	1997-1998	1995-1996	1998-2000	2000-2002	1988-1994	1998	1986-1988, 1997
of most recent mortality follow-up	2007	2008	2007	2007	2008	2008	2006	2010	2008

viations: ABC, Aging and Body Composition; BMI, body mass index, calculated as weight in kilograms divided by height in meters squared; CHS, Cardiovascular Health Study; CI, confidence interval; EPESE, Established Populations for the Epidemiological Study of the Elderly; NA, not applicable; NE, not estimable due to insufficiently long follow-up and resulting low mortality rate less than or close to 50%; NHANES III, Third National Health and Nutrition Examination Survey; PEP, Predicting Elderly Performance.

Table 3. Predictive Accuracy for 5- and 10-Year Survival by Individual Study and Pooled Data Presented as Area Under the Receiver Operating Characteristic Curves

Outcome and Predictors	CHS	EPESE	Health, ABC	Hispanic EPESE	Invecchiare in Chianti	Osteoporotic Fractures in Men	NHANES III	PEP	Study of Osteoporotic Fractures	Pooled
	C Statistic (95% Confidence Interval)									
5-Year Mortality										
Age, sex	0.705 (0.685-0.725)	0.685 (0.658-0.712)	0.606 (0.575-0.637)	0.694 (0.662-0.725)	0.797 (0.754-0.841)	0.700 (0.677-0.723)	0.710 (0.691-0.729)	0.674 (0.616-0.732)	0.646 (0.625-0.667)	0.690 (0.662-0.717)
Age, sex, diseases	0.711 (0.692-0.731)	0.692 (0.665-0.719)	0.616 (0.586-0.647)	0.703 (0.671-0.725)	0.793 (0.747-0.838)	0.704 (0.681-0.727)	0.719 (0.700-0.737)	0.694 (0.737-0.750)	0.662 (0.639-0.684)	0.698 (0.673-0.723)
Age, sex, diseases, BMI, systolic BP, prior hospitalization	0.736 (0.717-0.756)[b,c]	0.702 (0.676-0.728)	0.650 (0.620-0.680)[b,c]	0.726 (0.698-0.755)[b,c]	0.808 (0.765-0.850)	0.728 (0.706-0.749)[b]	0.744 (0.727-0.762)[b,c]	0.728 (0.674-0.781)[b,c]	0.665 (0.643-0.686)	0.719 (0.693-0.745)[b]
Age, sex, use of mobility aid, functional status[a]	NA	NA	NA	0.735 (0.705-0.765)	0.803 (0.756-0.851)	NA	0.738 (0.720-0.757)	0.720 (0.663-0.776)	NA	0.747 (0.720-0.774)
Age, sex, gait speed	0.734 (0.716-0.753)[c]	0.711 (0.685-0.737)[c]	0.642 (0.612-0.673)[b,c]	0.710 (0.679-0.741)	0.803 (0.760-0.846)	0.729 (0.707-0.751)[b,c]	0.737 (0.719-0.755)[b]	0.718 (0.664-0.771)[c]	0.682 (0.662-0.703)[b,c]	0.717 (0.694-0.740) 0.741 (0.706-0.775)[d]
10-Year Mortality										
Age, sex	0.721 (0.707-0.734)	0.725 (0.704-0.746)	NA	0.700 (0.677-0.724)	NA	NA	0.741 (0.726-0.757)	0.674 (0.627-0.721)	0.689 (0.676-0.703)	0.712 (0.692-0.731)
Age, sex, diseases	0.728 (0.715-0.742)	0.738 (0.716-0.759)	NA	0.709 (0.685-0.733)	NA	NA	0.749 (0.734-0.764)	0.698 (0.652-0.744)	0.706 (0.692-0.719)	0.724 (0.707-0.740)
Age, sex, diseases, BMI, systolic BP, prior hospitalization	0.745 (0.732-0.759)	0.749 (0.729-0.770)	NA	0.733 (0.710-0.756)[b]	NA	NA	0.768 (0.754-0.783)[b]	0.723 (0.678-0.727)[b,c]	0.709 (0.696-0.722)	0.739 (0.719-0.759)[b]
Age, sex, functional status, walking aid use[a]	NA	NA	NA	0.722 (0.699-0.746)	NA	NA	0.761 (0.746-0.776)	0.702 (0.655-0.748)	NA	0.732 (0.698-0.767)
Age, sex, gait speed	0.740 (0.727-0.754)	0.753 (0.733-0.774)[b]	NA	0.709 (0.685-0.732)	NA	NA	0.766 (0.751-0.780)[b]	0.723 (0.679-0.768)[b,c]	0.719 (0.705-0.731)[b]	0.737 (0.718-0.755)[b] 0.734 (0.692-0.777)[d]

Abbreviations: ABC, Aging and Body Composition; BMI, body mass index, calculated as weight in kilograms divided by height in meters squared; BP, blood pressure; CHS, Cardiovascular Health Study; CI, confidence interval; EPESE, Established Populations for the Epidemiological Study of the Elderly; NA, not applicable; NHANES III, Third National Health and Nutrition Examination Survey; PEP, Predicting Elderly Performance.

[a] Functional status was operationally defined for 3 levels: (1) activities of daily living (ADLs) dependence is defined as report of needing help from another person or being unable to perform any of 6 basic ADLs, 2) instrumental ADL difficulty is defined as report of no ADL dependence but difficulty performing shopping, meal preparation, or heavy housework, and (3) independent is defined as no report of ADL dependence or instrumental ADL difficulty.

[b] Value is the pooled estimate of the area under the receiver operator characteristic curve for age, sex, and gait speed for the studies that were used in the comparisons of gait speed with use of mobility aids and functional status. Four studies were included in the estimates of 5 y mortality and three in the estimates of 10 y mortality. Values are reported as the C statistic representing area under the receiver operator characteristic curve, values that differ by 0.025 or more are considered substantially different.

[c] C statistic is greater than for age and sex alone.

[d] C statistic is greater than for age, sex, and diseases.

Table 2. Five- and 10-Year Survival in Men and Women by Age and Gait Speed Group

Gait Speed, m/s	5-Year Survival (95% CI), %[a]						10-Year Survival (95% CI), %					
	Men			Women			Men			Women		
	Age 65-74	Age 75-84	Age ≥85	Age 65-74	Age 75-84	Age ≥85	Age 65-74	Age 75-84	Age ≥85	Age 65-74	Age 75-84	Age ≥85
Speed <0.4	68 (47-82)	60 (38-76)	25 (15-36)	80 (71-86)	69 (58-78)	47 (40-54)	56 (23-80)	15 (4-33)	8 (3-18)	58 (46-69)	35 (24-47)	11 (5-19)
≥0.4 to <0.6	77 (72-81)	57 (49-64)	31 (24-39)	88 (85-90)	75 (68-80)	61 (50-70)	53 (41-64)	23 (15-31)	6 (3-11)	67 (61-72)	42 (36-48)	18 (9-30)
≥0.6 to <0.8	79 (74-83)	65 (57-71)	49 (35-61)	91 (89-93)	82 (78-86)	74 (59-78)	57 (52-62)	31 (24-38)	11 (3-28)	74 (71-77)	52 (46-57)	23 (18-28)
≥0.8 to <1.0	85 (82-88)	75 (69-79)	54 (43-64)	93 (91-95)	89 (86-91)	73 (59-83)	67 (62-71)	43 (36-50)	14 (7-25)	80 (75-83)	62 (56-68)	39 (22-56)
≥1.0 to <1.2	90 (85-93)	83 (76-87)	68 (57-77)	96 (94-98)	91 (87-94)	61 (35-79)	69 (63-74)	53 (46-59)	50 (6-84)	86 (82-89)	73 (70-77)	33 (13-54)
≥1.2 to <1.4	93 (86-96)	85 (79-89)	62 (46-74)	96 (94-97)	93 (87-96)	67 (5-95)	75 (40-91)	51 (16-78)	NE	83 (38-96)	80 (72-86)	NE
Speed ≥1.4	95 (89-97)	93 (86-96)	91 (51-99)	97 (94-99)	95 (72-99)	NE	93 (81-98)	50 (6-84)	NE	87 (71-95)	92 (71-98)	NE
All gait speeds	87 (82-91)	74 (65-81)	46 (39-53)	93 (91-94)	84 (80-87)	64 (58-70)	62 (58-66)	36 (30-42)	10 (8-13)	77 (71-82)	54 (46-60)	22 (15-29)

Abbreviations: CI, confidence interval; NE, not estimable due to small number of participants in categories.

[a] Survival estimates are derived from individual study Kaplan-Meier survival estimates that are pooled across studies using random-effects models with inverse variance weighting.