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Physical and cognitive function in older men: Is longitudinal study participation related to better functioning?

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To the Editor

Longitudinal studies, the gold standard for measuring intra-individual trajectories of change over time, provide crucial information about human aging through the repeated observation of developmental trends. Knowing the extent to which cross-sectional data from a longitudinal sample relates to data from a one-time measurement sample is essential to data interpretation and application in clinical trials, treatment decisions, and health policy for older adults. However, when participants are rigorously screened at enrollment and attrition is high, longitudinal participants may become increasingly select over time, limiting the generalizability of findings [1, 2, 3]. Individuals enrolled with exceptional health or who received repeated health evaluations while continuing in a study may have better physical and cognitive function than individuals who lack these characteristics and experiences.

METHODS

We compared cross-sectional physical and cognitive performance data, collected concurrently as part of a two-site study using identical assessment protocols, from longitudinal participants in the Veterans Affairs (VA) Normative Aging Study (NAS) at VA Boston Healthcare System with that of cross-sectional participants from the Atlanta VA

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Madeleine Hackney: data analysis, drafting and revision, final approval
Andrea Burridge: data analysis, drafting and revision, final approval
Karri Hawley: conception, data acquisition
Avron Spiro: data acquisition, revision, final approval
Katharina Echt: conception, data acquisition, data analysis, drafting and revision, final approval.

Medical Center (VAMC). The study was approved by IRBs at both sites and participants provided written informed consent. Ninety-six men from the Atlanta VAMC (Cross-Sectional Sample A: mean age: 68±7, range: 60–90; years education: 14.2±3; Mini-Mental State Examination (MMSE): 26.8±2.2) and 63 men from the Normative Aging Study (Longitudinal Sample B: mean age: 77±5, range: 65–88; years education: 15.0±3 years; MMSE: 27.7±1.4) were recruited and evaluated for physical function, including gait speed, Timed Up and Go (TUG), 30-s chair stand and grip strength. Cognitive measures included listening comprehension, vocabulary, abstract reasoning and recall memory. Self-reported physical (PCS) and mental (MCS) component scores of health-related quality of life were derived from the Veterans RAND-36 Health Survey. We compared samples using t-tests for continuous variables and Chi-Square tests for categorical variables. Differences between the samples in performance were evaluated using regression analysis. Successive models adjusted for age, age and education, and finally age, education, and multiple potential confounders (vision, hearing, number of prescribed medications, income, PCS, MCS, race).

RESULTS

Sample B was significantly older and had higher MMSE scores than Sample A. More black individuals and more individuals with low income (<$20,000) were in Sample A (race: 38% African American, 60% White, 2% other; income 30% < 20K, 41% 20K-60K, 22% >60K, 7% other) than in Sample B (race: 2% African American, 97% White, 2% other; income: 3% <20K, 54% 20K-60K, 29% >60K, 14% other). Before the visit for this study, individuals from Sample B had participated in the NAS for a mean of 40.3±2 years (range: 37–46) and had made a mean of 11.5±2 study visits (range: 7–14).

Sample B performed better than Sample A for grip strength, 30-s chair stand, and TUG, after adjusting for age, (ΔR^2's > 0.045; p's < 0.01); however neither age nor sample were significantly related to gait speed (R^2=0.004; p=0.76). Controlling for multiple potential confounders, the sample relationship remained significant for chair stand, TUG, and grip strength (Table 1). Adjusting for age and education, Sample B performed better than Sample A on all cognitive performance variables, (ΔR^2's > 0.042; p's < 0.01). Controlling for potential confounders, the sample relationship remained significant for vocabulary only (p < 0.05, Table 1).

DISCUSSION

Although longitudinal participants from Sample B were older than those in cross-sectional Sample A, they demonstrated superior physical and cognitive performance. Sample differences persisted for TUG, 30-s chair stand, grip strength, and vocabulary even with adjustment for age, income, education, race, and 5 other potential confounders.

Information gained from longitudinal studies may not fully generalize to older adult populations. Sample selectivity among longitudinal cohorts may persist over time, given differences in cross-sectional performance apparent here 32 to 44 years after Sample B met stringent NAS enrollment criteria. Selective attrition of weaker participants may explain Sample B's superior performance; however, evidence suggests that individuals lost to follow up demonstrate similar or better health than those remaining in studies.[4] Moreover, no systematic relationship between health outcomes and attrition were found in two major health and aging studies.[5] Potentially, frequent monitoring and overt quantification of health status may have reinforced healthier lifestyle choices[6] in Sample B.

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Elements of Financial/Personal Conflicts	Hackney ME		Burridge A		Hawley K	
	Yes	No	Yes	No	Yes	No
Employment or Affiliation		x		x		x
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Honoraria		x		x		x
Speaker Forum		x		x		x
Consultant		x		x		x
Stocks		x		x		x
Royalties		x		x		x
Expert Testimony		x		x		x
Board Member		x		x		x
Patents		x		x		x
Personal Relationship		x		x		x

Elements of Financial/Personal Conflicts	Spiro A		Echt KV	
	Yes	No	Yes	No
Employment or Affiliation		x		x
Grants/Funds		x		x
Honoraria		x		x
Speaker Forum		x		x
Consultant		x		x
Stocks		x		x
Royalties		x		x
Expert Testimony		x		x

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	Yes	No	Yes	No
Board Member		x		x
Patents		x		x
Personal Relationship		x		x

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TABLE 1

Performance and Adjusted Comparison between Samples' Physical and Cognitive Performance Variables

Physical Performance	SAMPLE A Valid N	SAMPLE A Mean (SD)	SAMPLE B Valid N	SAMPLE B Mean (SD)		Age	Sample	Income	Vision	PCS	Race§
Grip Strength (kg)	93	37.7(9)	49	38.3(8)	β	**−.236**	**.304**	**.187**	**−.387**	.020	
(R^2= .270)					p	.025	.006	.036	.000	.822	
30 Second Chair Stand*	78	9.8(4)	60	12.2(3)	β	−.217	**.351**	.180	.023	**.206**	
(R^2= .231)					p	.071	.004	.051	.861	.022	
Timed Up and Go (s)	83	8.4(3)	62	7.9(3)	β	**.332**	**−.301**	**−.305**	**.102**	−.181	
(R^2= .296)					p	.039	.003	.008	.001	.399	
Gait Speed (m/s)	82	1.1(.2)	62	1.1(.2)	β	.010	.013		**−.245**	**.268**	**.338**
(R^2= .229)					p	.930	.911		.039	.002	.000
Cognitive Performance	**Valid N**	***Mean (SD)***	**Valid N**	***Mean (SD)***		**Age**	**Education**	**Sample**	**Race**	**PCS**	
Delayed Recall Memory (range: 0–10)	96	5.3(2)	61	5.8(2)	β	**−.286**	.084	.183	.132	.059	
(R^2= .085)					p	.004	.301	.086	.148	.487	
Listening Comprehension (range: 0–10)	96	8.5(1)	63	8.8(1)	β	**−.354**	.134	.128	**.335**	.082	
(R^2= .195)					p	.000	.083	.201	.000	.302	
Vocabulary (range: 0–40)	96	30.1(6)	54	34.4(3)	β	−.018	**.249**	**.218**	**.394**	.036	
(R^2= .381)					p	.830	.000	.014	.000	.613	
Abstract Reasoning (range: 0–40)	96	18.6(9)	54	22.5(9)	β	**−.227**	.128	.086	**.418**	**.183**	
(R^2= .253)					p	.012	.120	.371	.000	.020	

Values for the physical and cognitive performances are presented as means and standard deviations. Final models are tabled. Age- and Age/Education-adjusted models were evaluated for the physical and cognitive performance variables, respectively, to test for significant relation between performance and sample. Models were further screened for potential confounders, including vision, hearing, number of prescribed medications, MCS, PCS, race, income and also education for the physical performance measures. Confounders included in the final, tabled models were chosen on the basis of significant relations to outcome variables. R^2 values refer to tabled models.

*Sample A vs. Sample B different at $p< 0.01$ two-sided test of equality for column means.

§Race was significant for gait speed only; Sample is coded as Sample A=0, Sample B=1; Race is coded as Black=1, White=2.