Atrial Fibrillation and Declining Physical Performance in Older Adults: The Health, Aging and Body Composition Study (Health ABC)

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Abstract

Background—Age is the foremost risk factor for atrial fibrillation (AF) and AF has a rising prevalence in older adults. How AF may contribute to decline in physical performance in older

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adults has had limited investigation. We examined the associations of incident AF and 4-year interval declines in physical performance at ages 70, 74, 78, and 82 years in the Health, Aging, and Body Composition (Health ABC) Study.

Methods and Results—Health ABC is a prospective cohort of community-dwelling older adults (n=3075). The study conducted serial assessments of physical performance with the Health ABC physical performance battery (PPB, scored 0-4), grip strength, 2-minute walk distance, and 400-meter walking time. Incident AF was identified from the Center for Medicare and Medicaid Services, and related to 4-year interval decline in physical performance. Following exclusions, the analysis included 2753 Health ABC participants (52% women, 41% black race). Participants with AF had a significantly greater 4-year PPB decline than those without AF at age 70, 74, 78, and 82, with mean estimated decline ranging from −.08 to −0.10 units (95% confidence interval, −0.18 to −0.01; *P*<0.05 for all estimates) following multivariable adjustment. Grip strength, walk distance, and walk time similarly showed significantly greater declines at each 4-year age interval in participants with AF.

Conclusions—In community-based cohort older adults, incident AF was associated with increased risk of decline in physical performance. Further research is essential to identify mechanisms and preventive strategies for how AF may contribute towards declining physical performance in older adults.

Keywords

atrial fibrillation; aging; epidemiology; physical exercise

Atrial fibrillation (AF) has a significant public health burden and conveys profound morbidity and mortality. AF is largely a disease of advancing age, as risk doubles with each progressive decade of gaining and exceeds 20% by age 80 years.[1,2] The aging of the population and accompanying rise in prevalence have magnified its morbidity and health care costs.

Older adults are at increased risk for both AF and decline in physical performance. AF has been related to decline in physical function, yet most studies have consisted primarily in individuals of younger age (i.e. <70 years) and limited quantification of physical performance to exercise testing.[3-5] Further assessment of the relation between AF and physical function is needed to identify the relations between AF and age-related mobility. Understanding how AF is interrelated with non-cardiac pathophysiology in aging may guide AF management and likewise prompt interventions to prevent physical performance decline. In addition, the contributions of AF towards the frailty syndrome[6] – a complex and dynamic clinical syndrome marking progressive functional decline[7,8] – have not been well established.

We sought to identify the associations of AF and prospective decline in physical performance in the Health, Aging, and Body Composition Study (Health ABC). The associations of AF and insults in aging – silent cerebral infarcts, diastolic and systolic heart failure, decreased exertional stamina, and others – may contribute to decline in physical

performance. We hypothesized that AF would exacerbate progressive decline in physical performance measured in this community-based cohort of older adults.

Methods

Study cohort

Health ABC is a longitudinal study of community-dwelling, older adults designed to examine aging-related health outcomes.[9,10] Cohort participants were recruited by randomly sampling white and all black Medicare beneficiaries around Memphis, Tennessee, and Pittsburgh, Pennsylvania. Eligibility criteria included age 70-79 years, white or black race, and well-functioning, defined as not having difficulty walking a quarter mile, climbing a flight of stairs, and performing activities of daily living without assistance. Study participants underwent the initial, baseline examination in 1997-98 (n=3,075; 52% women, 42% black race), followed by 6-month interim telephone contacts with annual examinations through year 6 and then at years 8 and 10. Examinations included standardized assessments (interview, interim history and medications, physical examination and anthropometry, motor and cognitive testing, and blood tests). The present study used data from the baseline exam and years 4, 6, 8, and 10.

The present analysis excluded participants lacking Center for Medicare and Medicaid Services (CMS) data (n=36) pertinent to AF status, those with prevalent AF at the Health ABC baseline visit identified by CMS coding (n=128), missing follow-up assessments of physical function (n=3), or lacking covariates (n=155). Health ABC study protocols were approved by Institutional Review Boards at the University of Tennessee and the University of Pittsburgh, and participants provided informed consent at all study visits.

Determination of incident atrial fibrillation in Health ABC

Incident AF was obtained by linkage of unique participant identifiers with the CMS database.[11] CMS data were obtained from the baseline exam through 10 years. Individuals with International Classification of Diseases, Ninth Revision, codes 427.31 or 427.32 from either a single inpatient or 2 outpatient claims within 365 days were identified as having AF. The use of 2 outpatient claims has been reported as improving diagnostic specificity.[11,12] The earliest date of ICD-9 coding assignment was deemed the date of incident AF. Participant electrocardiograms or hospital records pertinent to identifying AF were not available for review; AF is not an adjudicated study end-point in Health ABC. Ascertainment of AF using ICD-9 coding has been reported to have 84% sensitivity and 98% specificity for AF identification.[13] Duration of AF was determined from the date of incident AF to the date of subsequent exams.

Physical performance assessment in Health ABC

A primary objective of Health ABC is to examine changes in physical performance in older adults concomitant with aging. The Health ABC Physical Performance Battery (PPB) combines measures modified from the lower extremity performance tests employed in the Established Populations for the Epidemiologic Studies of the Elderly battery[14] and is well-validated for the repeated measure of physical performance in older adults.[15,16] The Health

ABC PPB is determined from: (1) standing balance, assessed by 30-seconds in the semi-tandem, tandem, and one-leg stands; (2) chair stands, measured as the time to rise 5 times unassisted from a seated position; (3) gait speed, time to walk 6 meters at usual pace; and (4) a narrow walk balance test using a 6-meter long, 20- centimeter wide path for balance assessment. The methods for conducting the PPB assessments and their baseline distributions in Health ABC have been previously detailed.[9,15] Scoring of the Health ABC PPB ranges continuously from 0 to 4, where a higher score indicates superior performance.

Measures in addition to the PPB comprised hand grip strength, 2-minute walking distance, and time to complete a 400-meter walk. Grip strength was performed using a Jamar Hydraulic Hand Dynamometer (Sammons-Preston, Jackson, MI) in two trials of both hands. Participants were excluded for wrist or hand pain an upper-extremity procedure in the 3 months prior to testing. Walking assessments were conducted by completion of the 2-minute walk, 30-second pause, and then the timed 400-meter walk. Participants were instructed to walk as far as possible during the 2-minute walk and to complete the 400-meter walk as quickly as possible at a pace they could maintain. Participants were excluded from the walking test for having systolic blood pressure >199 mm Hg, diastolic blood pressure >109 mm Hg, resting heart rate <40 or >110 beats/minute, or specified electrocardiographic abnormalities (pre-excitation, idioventricular rhythm, ventricular tachycardia, third degree or complete heart block, or evidence of acute injury, ischemia, or marked T-wave abnormality). The Health ABC PPB was performed at baseline and exam years 4, 6, and 10. The remaining physical performance assessments were performed at these years and exam year 8.

Baseline study measurements and interim events

Race (black or white) and smoking status (current/former or never) were determined by self-report. Moderate-to-heavy alcohol consumption was defined as men consuming 14 drinks weekly and women 7 drinks weekly. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). Systolic and diastolic blood pressures were determined from the average of two measurements obtained in a seated position. Hypertension was determined by self-report and initiation of new antihypertensive medication. Diabetes was ascertained from self-reported history, fasting glucose 126 mg/dL, or use of oral hypoglycemic or insulin medications. Blood samples were assayed for serum creatinine and after an 8-hour fast for total and high-density lipoprotein cholesterol measures (Ortho-Clinical Diagnostics, Rochester, NY). Abnormal cholesterol was defined as total cholesterol 200 or high-density lipoprotein <40 mg/dL. Medications were classified using the Iowa Drug Information System. Prevalent cardiovascular disease was defined in Health ABC as including coronary artery disease (determined by angioplasty, bypass graft, myocardial infarction, or electrocardiogram showing a major Q-wave abnormality) and stroke by self-report and review of medications. Prevalent heart failure was established by self-report or medications.

Interim covariates were incident hypertension, diabetes, cardiovascular disease, and cancer. Incident cardiovascular disease was defined as hospitalization for myocardial infarction or angina; stroke; or congestive heart failure with overnight hospitalization, as determined by

report or documentation and adjudicated as previously detailed.[17-19] Incident cancer was determined by malignancy history (excluding melanoma) and following adjudication of a cancer diagnosis.[20] Interim incident covariates were ascertained at annual examinations or 6-month telephone contacts with Health ABC participants or their proxies. Deaths were identified using obituaries, the Social Security Death Index, or telephone contact with participant representative; death certificates, interviews with next of kin, and hospital records were reviewed by the study's Diagnosis and Disease Ascertainment Committee to adjudicate cause of death. Follow-up duration was determined from the baseline visit through 10 years with censoring at the date of death or last known study contact.

Statistical analyses

We examined categorical variables for their distributions and continuous variables for their mean and standard deviations. We examined Health ABC PPB and additional measures of physical performance (grip strength, walking distance, and time to complete a 400-meter walk) and their 4-year decline in HABC participants with and without incident AF. We employed a mixed-effects model using a random intercept and slope of age. Age was considered a time-varying variable. We developed models to estimate the 4-year decline at ages 70, 74, 78, and 82 years for each of the physical performance assessments. We determined interactions by examining the statistical significance of interaction terms. Specifically, we examined the fixed effect of age and then examined statistical interaction terms to determine effect modification by sex, race, study site, body mass index, systolic and diastolic blood pressure, smoking, alcohol use, cholesterol, and creatinine. We used fixed effects on age, the product of age*AF duration, age*incident AF, and age^2 (centered at 74 years). The initial model (Model 1) adjusted for baseline age, sex, race, study site, and the interaction of age*sex. Model 2 included all Model 1 covariates and additionally adjusted for body mass index, systolic and diastolic blood pressure, smoking, moderate/heavy alcohol use, cholesterol, creatinine, and interactions of age*body mass index and age*creatinine, and the following covariates as time-varying exposures: hypertension, diabetes, cardiovascular disease, and cancer. Models examining grip strength, walking distance, and 400-meter walk time were constructed using the same random effects as the 4-year decline in Health ABC PPB. All statistical analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC). A 2-sided $P<0.01$ was deemed statistically significant.

Results

Following exclusions, the analysis consisted in 2753 Health ABC participants (52% women, 41% black race; Table 1). Many study participants had risk factors for AF (mean body mass index in the overweight range; prevalence of current/former smoking, 56%; hypertension, 39%; and diabetes, 39%). Over the 10-year follow-up, 262 participants both developed AF and had subsequent physical performance assessments. Table 2 summarizes participation, AF status, and the number of participants completing physical performance assessments across exam years. Supplemental Table 1 presents the distributions of assessments across Health ABC participants at ages 70, 74, 78, and 82 years.

The estimates of 4-year declines in Health ABC PPB scores at ages 70, 74, 78, and 82 years, are shown in Table 3. The table presents the mean estimated 4-year decline in Health ABC PPB scores in participants without AF, those with AF, and the difference in PPB decline between those with and without AF at the specified age. Participants with AF at each of the 4-year age categories had significantly greater decline in Health ABC PPB compared to those without AF. For instance, at age 70 in the multivariable and interim-adjusted model 3, those without AF had a PPB decline of 0.20, whereas those with AF had a decline of 0.28, for an absolute difference in decline of 0.08. The decline in PPB in participants with AF was accelerated by approximately 4 years compared to those without AF. This significantly accelerated decline in PPB in participants with AF compared to those without remained present following adjustment for baseline and time-varying covariates. Figure 1 presents the differences in the estimates of PPB decline across progressive 4-year age categories graphically. The figure demonstrates distinct trajectories of Health ABC PPB decline between participants with and without AF from age 70 years onwards.

Table 4 describes the estimates for 4-year decline in grip strength with and without incident AF at ages 70, 74, 78, and 82 years. Similar to the PPB estimates, participants with AF had a significantly greater grip strength decline relative to those without. The decline remained significant across age group and progressive multivariable adjustment. Likewise, Table 5 presents the differences in 2-minute walking distance and 400-meter walking time. Like the other measures, there are progressive declines in 2-minute walking distance and 400-meter walk time with aging, but those with AF have a significantly greater 4-year decrease compared to those without.

Discussion

In a community-based, biracial cohort of older adults, we observed that participants with AF had a significantly higher 4-year decline in physical performance compared to those without AF The results reported here were consistent for each measure employed in Health ABC to evaluate physical performance (including PPB, grip strength, 2-minute walking distance, and 400-meter walk time). The accelerated decline in physical performance with AF was not substantively attenuated by comorbidities such as stroke, congestive heart failure, cancer and non-cardiac diseases associated with morbidity in older adults. Figure 1 summarizes the accelerated, progressive decline of physical performance in cohort participants with AF.

Health ABC enrolled community-dwelling older adults with a primary objective of studying determinants of the onset of mobility impairment, and hence is an important opportunity to examine the relations of AF with physical performance in healthy older adults.

Small changes in physical function in older adults have been shown to be clinically meaningful,[21] particularly because of the relation of decline in physical function to clinical events. Our work describes the modest but important associations between AF and progressive decline in physical performance in Health ABC participants. For example, PPB is measured continuously from 0 to 4, and a 4-year decline of 0.12 has been determined as a meaningful change in physical function.[22] We identified that cohort participants with AF

experience an additional decline of 0.10 (95% CI 0.18 to 0.01) at age 82 after accounting for relevant covariates.

In the context of the literature

The literature has documented the relations of physical performance measures and adverse outcomes in older adults. Subtle changes may contribute towards adverse outcomes in older adults. Gait speed – a highly reproducible measure, central to the Health ABC PPB, and integral to 2-minute distance and 400-meter walk time – has been associated with prospective disability, loss of capacity for activities of daily living, cognitive decline, dementia, institutionalization, and mortality.[23-26] Chair stands, also part of the Health ABC PPB, have similarly been associated with disability and mortality in Health ABC participants.[27] Hand grip strength has been associated with prospective disability[28] and functional decline,[29] and is a core measure for assessing frailty, in turn related to cardiovascular outcomes.[30-32] In our analysis AF was related to two of the proposed criteria for frailty[33] – reduced grip strength and slower walking speed. A robust literature has confirmed the clinical importance of the assessments of physical performance performed here. Our findings support the hypothesis that AF contributes towards degenerative processes of physical performance in aging.

The relation of AF and physical function has had repeated assessments in community-based studies and clinical trials.[34] In general the literature has been challenged by limited inclusion of adults beyond the eighth decade. Prior investigations examining AF and frailty in older adults remain limited. A cross-sectional study of community-dwelling older adults, younger than Health ABC, identified an association between AF and reduced gait speed,[35] but did not assess the prospective relation of AF to gait speed decline. Studies of hospitalized patients have reported increased disability and frailty in older adults with AF, but relied on self-reported disability and did not use a validated definition of frailty.[36,37] Perception of frailty has been reported as a fall risk in anticoagulation for stroke prevention in AF,[38] but again not using validated criteria for frailty. Our analyses extend these prior findings that AF is associated with a decline in physical performance in aging, and underscore the importance of more formal evaluations of the contributions of AF towards frailty and longitudinal adversity in aging.

Interrelated mechanisms of AF and declining physical performance

We posit that the associations between AF and decline in physical performance are interrelated. AF is a clinical syndrome with both cardiovascular and non-cardiovascular manifestations. Our analysis adjusted for standard AF risk factors that may relate to diminished physical performance. It is further possible that incident AF is an intermediate outcome resulting from exposures related to physiologic decline in aging. Cardiovascular disease, a chief risk factor for AF, is associated with the development of frailty.[39] Obesity and diabetes merit particular attention for their separate associations with AF and the development of sarcopenia and progression to frailty.[40,41] Novel risk factors for AF in older adults (e.g., hypogonadism[42]) have also been related to sarcopenia.[43] Subclinical cardiovascular disease and inflammation may also be associated with AF and declining physical performance.[44-47] Silent cerebral infarcts secondary to AF[48] were not accounted for

in our analysis and may also affect physical performance in older adults. Essential questions entail investigating the reciprocal associations of sarcopenia and AF; the relation of inflammation to AF in aging; the burden of silent cerebral infarcts; and the association of AF patterns (i.e. paroxysmal, persistent, chronic) with physical performance.

AF may also have a more direct contribution towards the decline in physical performance. AF alters atrial structure and performance, modifies atrial refractoriness, reduces atrial transport (systole), and promotes atrial fibrosis.[49] Irregular heart rates diminish left ventricular filling and cardiac output.[50] Structural and electrical cardiac remodeling may impair peripheral perfusion and ultimately diminished capacity for activities of daily living.[51,52] We present a summary of selected clinical pathways for the association between AF and physical function in Figure 2.

Our analysis has multiple strengths. First, the measures of physical performance were administered in a standardized format. Second, we conducted our study in a cohort of older adults with preserved functional capacity at baseline, enhancing the relevance of our findings for community-dwelling older adults. Third, our baseline age range was 70-79 years. As age is the foremost risk factor for both AF and for decline in physical performance, conducting our study in this demographic enhanced the generalizability and relevance of our findings for older adults.

Our study has some limitations. Health ABC had selected geographic enrollment, and generalizability to other races, ethnicities, or geographic regions may be limited. Second, our analysis may have limited generalizability to the growing number of older adults with marginally limited physical performance who reside in transitional settings with supportive care. Such individuals may have unrecognized AF and likely experience more accelerated decline in physical performance than the cohort examined here. We expect that our findings likely underestimate the relation of AF to functional decline by selecting a healthier cohort of older adults. Third, comorbidity is highly common in late adulthood and our analyses accounted only for major comorbid conditions and risk factors. AF and physical performance, both complex phenotypes, have multiple potential physiologic pathways. We cannot exclude residual confounding, and recognize that unaccounted for comorbidities may affect both risk of AF and decline in physical performance. Silent cerebral infarcts in particular may have an unrecognized role in mediating the relation of AF and decline in physical function. Fourth, AF status was obtained solely from CMS coding with potential for misclassification of AF status. Even more importantly, Health ABC participants may have had incident AF, developed frailty or other comorbidities, and either not attended subsequent exams or been unable to participate in physical performance assessments. Hence, our results are biased by including only those with AF who were able to perform the physical performance assessments. Fifth, our study is observational; no inference can be made about whether AF causes decline in physical performance. Further, our work cannot establish how treatment of AF may limit age-related changes in physical performance or functional decline. Sixth, there may be non-random missing data. Health ABC participants who were ill or who died would not have attended examinations, yet may have had an interim change in physical performance that we did not measure or identify.

Conclusions

We demonstrated that incident AF in independent older adults was associated with significantly greater 4-year decline in physical performance, as determined by validated, clinically relevant measures. We hypothesize that AF is a marker of the frailty syndrome and exacerbates the multisystem decline in physical performance in aging-related pathophysiology. It is possible that AF and physical decline share underlying neuroendocrine or neuromuscular causes. Further research is essential to delineate specific mechanisms relating the onset of AF to decline in physical performance. As well, investigating how training may impact declining physical performance in individuals with AF merits investigation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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WHAT IS KNOWN

- Studies have related atrial fibrillation (AF) and reduced physical function, but most investigations have not included adults beyond the eighth decade, the age group at highest risk for both AF and decline in physical performance.

- Decline in physical performance in older adults is an important marker of increased risk of cardiovascular and non-cardiovascular morbidity and mortality.

WHAT THE STUDY ADDS

- In this study of community-dwelling older adults, participants with AF experienced a greater 4-year decline in physical performance across multiple measures than those without AF.

- The study demonstrates that AF contributes towards the multisystem decline in physical performance as part of aging-related pathophysiology.

- The study expands our understanding of the insults associated with AF, and raises the hypothesis that interventions may attenuate the contribution of AF towards the decline in physical strength and performance in vulnerable older adults.
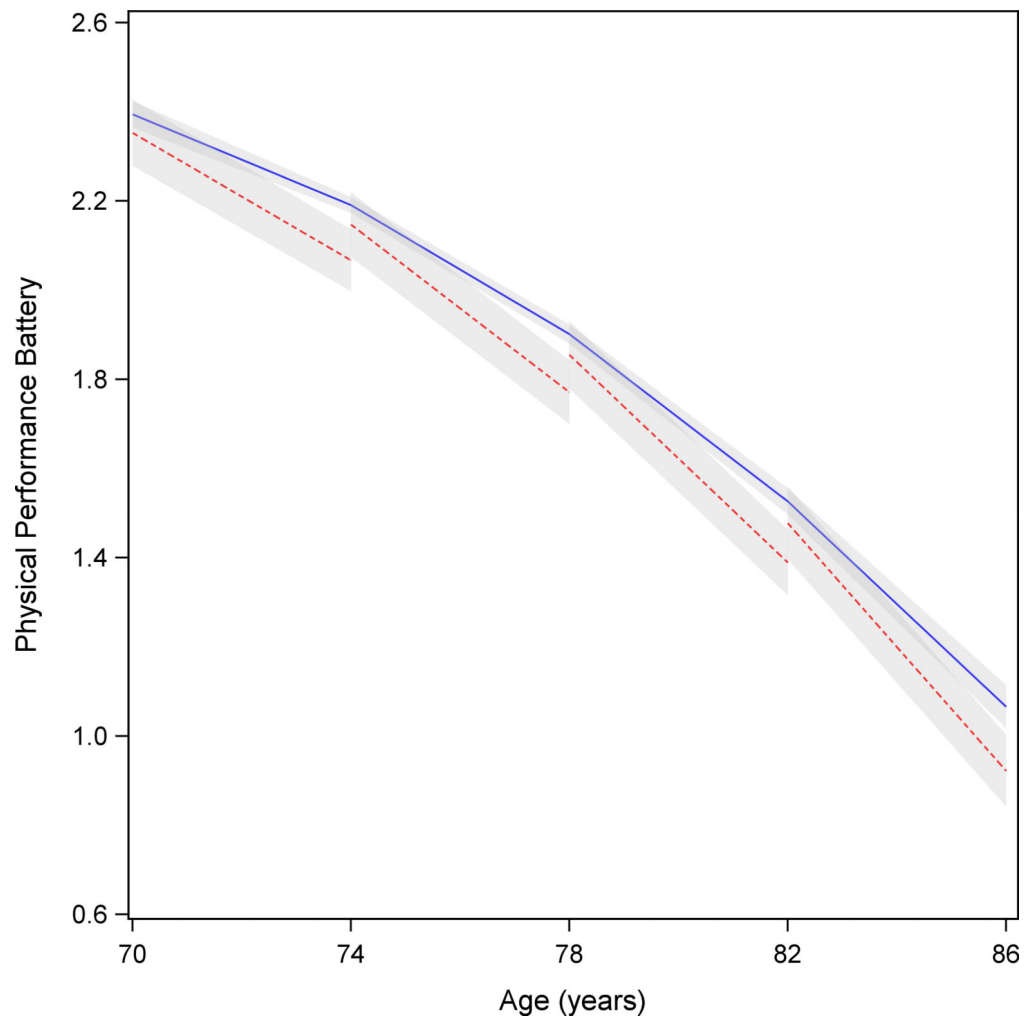
Figure 1.
Model predicted trajectory of mean Health ABC physical performance battery scores. The 4-year decline in Health ABC participants' physical performance battery at ages 70, 74, 78, and 82 years, comparing participants with incident atrial fibrillation (red-dashed line) and those without (blue solid line; shaded, 95% confidence intervals).
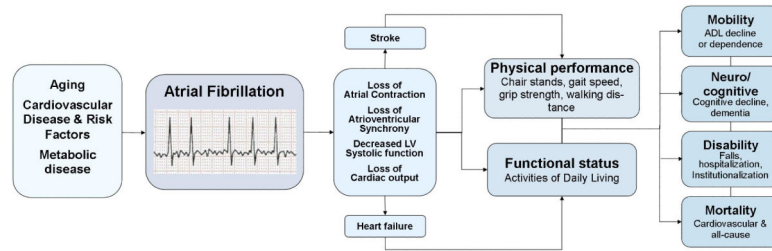
Figure 2.
Proposed relation between atrial fibrillation, loss of physical performance capacity and functional status, and morbidity in older adults. The figure shows proposed pathways relating atrial fibrillation – with augmented risk in older adults with cardiovascular disease and its risk factors – to loss of atrial mechanics and decreased ventricular function. Heart failure, stroke, and decreased atrial function may contribute towards the decline in physical performance as observed in our analysis. Poor physical performance and functional status in older adults have been related to declining mobility, loss of independence, cognitive decline, disability, institutionalization, and increased mortality.

Table 1

Baseline characteristics for the Health, Aging, and Body Composition Study cohort from the initial, 1997-98 exam (n=2753).

Clinical characteristics	
Age, years	73.6 ± 2.9
Women	1427 (52)
Black race	1140 (41)
Memphis, TN site	1390 (51)
Smoking, current/former	1540 (56)
Moderate or heavy drinking	451 (16)
Body mass index, kg/m2	27.4 ± 4.8
Systolic blood pressure, mm Hg	136 ± 21
Diastolic blood pressure, mm Hg	71 ± 12
Creatinine, mg/dL	1.10 ± 0.40
Abnormal cholesterol	183 (7)
Hypertension	1067 (39)
Diabetes	1067 (39)
Prevalent cardiovascular disease	702 (26)
Prevalent cancer	473 (17)
Measures of physical performance	
Health ABC PPB, scored 0-4	2.20 ± 0.54
Grip strength, kg	32.7 ± 10.9
Mean walking distance, meters	153.4 ± 27.2
400-meter walk time, seconds	331 ± 61

Continuous variables expressed as mean ± sd, categorical variables as n (%). PPB indicates Physical Performance Battery.

Table 2

Health ABC exam participation in across exam years, AF status, and physical function assessment in the present analysis.

Health ABC Exam	Calendar Year	Total Attendees	Age	No. with AF at exam	Health ABC PPB	Grip strength	Two-minute walk distance	400-meter walk time
Year 1 (baseline)	1997-98	2753	73.6±2.9	0	2649	2711	2375	2100
Year 4	2000-01	2504	76.6±2.9	109	2131	2167	1845	1522
Year 6	2002-03	2381	78.5±2.9	152	1910	1926	1630	1316
Year 8	2004-05	2098	80.5 ±2.8	164	N/A	1629	1271	1003
Year 10	2006-07	1870	82.3±2.9	184	1318	1462	1001	772

Continuous values expressed as mean±standard deviation. AF indicates atrial fibrillation; PPB, physical performance battery.

Table 3

Estimates of 4-year decline in Health ABC physical performance battery [*] by AF status at ages 70, 74, 78, and 82.

	AF status	Age 70 Est (95% CI)	P	Age 74 Est (95% CI)	P	Age 78 Est (95% CI)	P	Age 82 Est (95% CI)	P
	No prior AF	−0.21 (−0.23, −0.18)		−0.29 (−0.30, −0.28)		−0.38 (−0.39, −0.36)		−0.46 (−0.49, −0.43)	
Model 1	Incident AF	−0.29 (−0.37, −0.21)		−0.38 (−0.46, −0.30)		−0.47 (−0.55, −0.39)		−0.555 (−0.64, −0.47)	
	Difference[†]	**−0.08 (−0.16, −0.01)**	**0.026**	**−0.09 (−0.164, −0.010)**	**0.027**	**−0.09 (−0.17, −0.01)**	**0.027**	**−0.10 (−0.18, −0.01)**	**0.027**
	No prior AF	−0.20 (−0.22, −0.17)		−0.28 (−0.30, −0.27)		−0.37 (−0.39, −0.35)		−0.46 (−0.48, −0.43)	
Model 2	Incident AF	−0.28 (−0.36, −0.21)		−0.37 (−0.45, −0.30)		−0.46 (−0.54, −0.38)		−0.55 (−0.64, −0.47)	
	Difference	**−0.08 (−0.16, −0.01)**	**0.023**	**−0.09 (−0.16, −0.01)**	**0.023**	**−0.09 (−0.17, −0.01)**	**0.023**	**−0.10 (−0.18, −0.01)**	**0.024**

Model 1, adjusted baseline age, sex, race, site, and interaction of age-by-female. Model 2, additionally adjusted on baseline BMI, SBP, DBP, smoking, moderate/heavy drinking, abnormal cholesterol, creatinine, and interactions of age with BMI and creatinine, and for hypertension, diabetes, cardiovascular disease, and cancer as time-varying covariates. Est indicates estimate.

[*]
Health ABC physical performance battery, scored 0-4, employed as a continuous measure.

[†]
Difference is the difference in 4-year physical function decline between Health ABC participants with and without incident AF at the specified age.

Table 4

Estimates of 4-year decline in grip strength[*] in Health ABC participants by AF status at ages 70, 74, 78, and 82.

	AF status	Age 70 Est (95% CI)	Age 74 Est (95% CI)	Age 78 Est (95% CI)	Age 82 Est (95% CI)
Model 1	No prior AF	−1.67 (−1.89, −1.44)	−1.97 (−2.09, −1.84)	−2.27 (−2.42, −2.12)	−2.57 (−2.83, −2.31)
	With AF	−1.73 (−1.96, −1.50)	−2.03 (−2.16, −1.91)	−2.33 (−2.48, −2.19)	−2.63 (−2.89, −2.38)
	Difference[†]	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]
Model 2	No prior AF	−1.59 (−1.84, −1.35)	−1.91 (−2.05, −1.76)	−2.22 (−2.38, −2.06)	−2.53 (−2.80, −2.27)
	With AF	−1.65 (−1.90, −1.41)	−1.97 (−2.11, −1.82)	−2.28 (−2.44, −2.12)	−2.59 (−2.85, −2.33)
	Difference	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]	**−0.06 (−0.09, −0.03)**[‡]

Est indicates estimate. Model 1 adjusted for baseline age, sex, race, site, and interaction of age*sex. Model 2, additionally adjusted for smoking, moderate/heavy drinking, baseline BMI, SBP, DBP, abnormal cholesterol, creatinine, and interactions of age with BMI and creatinine, and for hypertension, diabetes, cardiovascular disease, and cancer as time-varying covariates.

[*] Grip strength, scored 0-4, employed as a continuous measure.

[†] Difference is the difference in 4-year grip strength decline between Health ABC participants with and without AF by the specified age.

[‡] P<.001.

Table 5

Estimates of 4-year decline in mean, 2-minute walking distance (meters) and 400-meter walk time (seconds) [*] in Health ABC participants by AF status at ages 70, 74, 78, and 82 years.

Model	AF status	Age 70 Est (95% CI)		Age 74 Est (95% CI)		Age 78 Est (95% CI)		Age 82 Est (95% CI)	
		Walking distance (meters)	400-meter walk time (seconds)	Walking distance (meters)	400-meter walk time (seconds)	Walking distance (meters)	400-meter walk time (seconds)	Walking distance (meters)	400-meter walk time (seconds)
Model 1	No prior AF	−1.20 (−2.32, −0.13)	9.9 (7.24, 12.53)	−6.20 (−6.81, −5.58)	22.1 (20.5, 23.7)	−11.16 (−11.9, −10.4)	34.4 (32.3, 36.4)	−16.13 (−17.5, −14.8)	46.6 (43.2, 50.0)
	With AF	−1.46 (−2.55, −0.36)	10.5 (7.87, 13.19)	−6.42 (−7.04, −5.81)	22.8 (21.2, 24.3)	−11.39 (−12.2, −10.6)	35.0 (33.0, 37.0)	−16.36 (−17.7, −15.0)	47.2 (43.8, 50.6)
	Difference [†]	**−0.23 (−0.39, −0.08)** [‡]	**0.7 (0.3, 1.0)** [§]	**−0.23 (−0.39, −0.08)** [‡]	**0.7 (0.3, 1.0)** [§]	**−0.23 (−0.39, −0.08)** [‡]	**0.7 (0.3, 1.0)** [§]	**−0.23 (−0.39, −0.08)** [‡]	**0.7 (0.3, 1.0)** [§]
Model 2	No prior AF	−1.15 (−2.31, 0.02)	9.7 (6.8, 12.5)	−6.18 (−6.88, −5.47)	22.1 (20.3, 23.9)	−11.23 (−12.0, −10.4)	34.5 (32.4, 36.6)	−16.25 (−17.6, −14.9)	46.9 (43.5, 50.4)
	With AF	−1.36 (−2.53, −0.18)	10.3 (7.4, 13.1)	−6.39 (−7.09, −5.69)	22.7 (20.9, 24.5)	−11.44 (−12.2, −10.6)	35.2 (33.0, 37.3)	−16.46 (−17.8, −15.1)	47.6 (44.1, 51.0)
	Difference	**−0.21 (−0.37, −0.06)** [‡]	**0.6 (0.3, 1.0)** [§]	**−0.21 (−0.37, −0.06)** [‡]	**0.6 (0.3, 1.0)** [§]	**−0.21 (−0.37, −0.06)** [‡]	**0.6 (0.3, 1.0)** [§]	**−0.21 (−0.37, −0.06)** [‡]	**0.6 (0.3, 1.0)** [§]

Est indicates estimate. Model 1 adjusted for baseline age, sex, race, site, and interaction of age*sex. Model 2, additionally adjusted for smoking, moderate/heavy drinking, baseline BMI, SBP, DBP, abnormal cholesterol, creatinine, and interactions of age with BMI and creatinine, and for hypertension, diabetes, cardiovascular disease, and cancer as time-varying covariates.

[*] Walking distance in meters employed as a continuous measure.

[†] Difference is the difference in 4-year walking distance decline between Health ABC participants with and without incident AF at the specified age.

[‡] P<0.01.

[§] P<0.001.