Published in final edited form as:

Am J Cardiol. 2015 September 15; 116(6): 883–888. doi:10.1016/j.amjcard.2015.06.013.

Relation of Physical Activity and Incident Atrial Fibrillation (From the Multi-Ethnic Study of Atherosclerosis [MESA])

Aneesh Bapat, MD^a, Yiyi Zhang, PhD^b, Wendy S. Post, MD^{b,c}, Eliseo Guallar, MD, DrPH^b,
Elsayed Z. Soliman, MD, MSc, MS^d, Susan R. Heckbert, MD, PhD^e, Joao Lima, MD^a, Alain
G. Bertoni, MD, MPH^f, Alvaro Alonso, MD, PhD^g, and Saman Nazarian, MD, PhD^{a,b}

^aDepartment of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

^bDepartment of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

^cDivision of Cardiology, Johns Hopkins University School of Medicine, Baltimore, MD

^dEpidemiological Cardiology Research Center (EPICARE), Department of Epidemiology and
Prevention, and Department of Internal Medicine, Cardiology Section, Wake Forest School of
Medicine, Winston-Salem, NC

^eDepartment of Epidemiology, University of Washington, Seattle, WA

^fMaya Angelou Center for Health Equity, Wake Forest University, Winston-Salem, NC

^gDivision of Epidemiology and Community Health, University of Minnesota School of Public
Health, Minneapolis, MN

Abstract

Prior studies have raised the question of whether an association exists between physical activity and atrial fibrillation (AF). We used the Multi-Ethnic Study of Atherosclerosis (MESA) database to examine the association between physical activity and AF in a diverse population without clinically recognized cardiovascular disease (CVD). MESA participants (N=5793) with complete baseline physical activity and covariate data were included. Cox proportional hazards models were used to calculate hazard ratios (HR) for incident AF by levels of total intentional exercise and vigorous physical activity, independently and in combination. Multivariable models adjusted for demographics and CVD risk factors. During a mean follow-up of 7.7±1.9 years, 199 AF cases occurred. In the overall MESA population, neither vigorous physical activity nor total intentional exercise were independently associated with incident AF after adjusting for covariates. However, within the group that reported any vigorous physical activity, there was a statistically significant inverse association between total intentional exercise (modeled as a continuous variable) and incident AF. Among those who reported any vigorous physical activity, the top tertile of total

Address for Correspondence: Saman Nazarian, MD, PhD, Johns Hopkins University, Carnegie 592, 600 N. Wolfe Street, Baltimore, MD 21287, Phone: 410-614-2751; Fax: 410-502-4854, snazarian@jhmi.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Disclosures: Dr. Nazarian is a scientific advisor to Biosense Webster Inc and principal investigator for research funding to Johns Hopkins from Biosense Webster, Inc (Diamond Bar, CA, USA). All other authors: none.

intentional exercise was associated with a significantly lower risk of incident AF compared with the group with no total intentional exercise in the fully adjusted model (HR 0.46, 95%CI 0.22-0.98). In conclusion, neither total intentional exercise nor vigorous physical activity alone were associated with incident AF, but greater total intentional exercise was associated with a lower risk of incident AF among those that participated in any vigorous physical activity. As importantly, no subgroup of participants demonstrated an increased risk of incident AF with greater physical activity. The results re-emphasize the beneficial role of physical activity for cardiovascular health.

Keywords

activity; exercise; atrial fibrillation; MESA

INTRODUCTION

A number of studies have examined and present data both for and against an association between physical activity and AF. There seems to be an increased propensity for AF amongst elite athletes such as marathon runners¹⁻⁴. There is also a suggestion that the intensity of exercise may play a role in risk of incident AF⁵, and a number of studies have specifically implicated vigorous exercise as a risk factor for incident AF^{6,7}. The physiologic basis for an association exists, and physical activity is potentially implicated in providing the trigger, modulators, and substrate for AF onset⁴. On the other hand, other studies have suggested a decreased risk of AF among walkers and runners⁸, and those that participate in low to moderate intensity activity⁹. A recent meta-analysis of four prospective cohort studies demonstrated no association between regular physical activity and AF¹⁰ amongst non-athletes. The conflicting data suggest that there is still much to be uncovered regarding the association of physical activity and AF, especially among the general population. In this study we sought to examine the association between physical activity and AF in the Multi-Ethnic Study of Atherosclerosis (MESA) cohort.

METHODS

Inclusion criteria and methods of the MESA study have been described previously¹¹. In brief, between July 2000 and August 2002, a total of 6814 men and women aged 45–84 years old and free of clinically apparent cardiovascular disease were recruited from six US communities: Baltimore City and Baltimore County, MD; Chicago, IL; Forsyth County, NC; Los Angeles County, CA; Northern Manhattan and the Bronx, NY; and St. Paul, MN. Participants filled out a survey documenting their baseline level of physical activity, and the specific type and duration of physical activity. Patients with self-reported AF were excluded from enrollment in MESA. All participants were contacted every nine months to inquire about interval hospitalizations, obtain medical records, and abstract ICD-9 codes from the records. Incident AF events were ascertained based on hospital discharge ICD-9 codes (427.3×) and Medicare claims data for those who were enrolled in fee-for-service Medicare at any time during follow-up. The institutional review boards at all participating centers approved the study and all participants gave informed consent. In this study, we included all

participants with completed physical activity questionnaires and complete covariate data (N = 5793).

During the baseline examination (2000–2002), standardized questionnaires and calibrated devices were utilized to obtain demographic data, tobacco use data, co-morbidities, current prescription medication usage, weight, and height. Resting, seated blood pressure was measured 3 times using a Dinamap automated oscillometric sphygmomanometer (model Pro 100; Critikon, Tampa, Florida); the last 2 measurements were averaged for analysis. Hypertension was defined on the basis of use of an antihypertensive medication, systolic blood pressure ≥ 140 or diastolic blood pressure ≥ 90 mm Hg. Fasting blood samples were drawn and were sent to a central laboratory for measurement of glucose and lipids¹². Participants were considered to have diabetes if they used hypoglycemic drugs or if their fasting blood glucose was greater than 7.0 mmol/L (126 mg/dL). Participants were considered to have impaired fasting glucose if they did not have diabetes according to the preceding criteria but their fasting blood glucose level was 5.6–7.0 mmol/L (100–126 mg/dL) in accordance with the 2004 American Diabetes Association definition¹³. Incident coronary heart disease (CHD) during follow-up was defined as myocardial infarction, angina, resuscitated cardiac arrest, or death attributed to coronary heart disease.

The MESA Typical Week Physical Activity Survey (TWPAS), completed during the baseline examination, identifies the amount of time spent in and the frequency of various physical activities during a typical week in the previous month. The survey has 28 items in 9 categories of activities (1-household chores, 2-lawn/yard/garden/farm, 3-care of children/adults, 4-transportation, 5-non-occupational walking, 6-dancing and sport activities, 7-conditioning activities, 8-leisure activities, 9-work). Respondents were asked whether they participated in these activities, and if applicable they answered questions regarding the average number of days per week and time per day engaged in each activity. Where appropriate, the physical activity survey accounted for exercise intensity at three levels (heavy, moderate, or light), which was determined by the type of activity in any given category (i.e. sitting or standing versus pushing or lifting). Minutes of activity were summed for each discrete activity type and multiplied by metabolic equivalent (MET) level¹⁴.

In our study we used two summary variables derived from the MESA TWPAS data: total intentional exercise and vigorous physical activity. Total intentional exercise focused on the areas of physical activity recommended by USDHHS guidelines and was a sum of walking for exercise, sports, dancing, and conditioning. We were interested in the role of exercise intensity, since the conflicting results of previous studies suggest that it may mediate the association between physical activity and AF. Vigorous physical activity was a sum of MET-min/wk spent as “heavy effort” in only the following modes of activity: household chores, lawn/yard/garden/farm work, conditioning activities, and occupational/volunteering work. Conditioning was the only form of physical activity included in both the total intentional exercise and vigorous physical activity summary measures.

All participants who completed the TWPAS and had completed covariate data were included in this study, with the vigorous physical activity and total intentional exercise summary measures used as independent variables. Baseline characteristics for the entire

group as well as each subgroup were summarized as mean (standard deviation) and numbers (percentages), and compared using the Student's t-test or Chi-squared tests as appropriate. Cox proportional hazards models were used to examine the association of total intentional exercise or vigorous physical activity, modeled as continuous variables, with incident AF for the entire cohort. Because of the wide range of total intentional exercise, the variable was scaled down by dividing by its standard deviation. Model 1 included covariates for demographics including age, sex, race/ethnicity, insurance status and education level. Model 2 included all variables in model 1 in addition to risk factors including cigarette smoking, resting heart rate, systolic blood pressure, use of anti-hypertensives, low density lipoprotein, high density lipoprotein, body mass index, diabetes, and left ventricular hypertrophy (by ECG criteria). Model 3 included all model 2 variables, with the addition of incident coronary heart disease (CHD). We subsequently modeled total intentional exercise and vigorous physical activity as categorical variables by stratifying them into tertiles and performed similar analyses.

In order to further elucidate the effect of vigorous physical activity, the participants were then stratified into two subgroups: those that performed any vigorous physical activity and those that did not perform any. For each subgroup, Cox proportional hazards models, as above, were used to examine the association of total intentional exercise with incident AF. We additionally stratified total intentional exercise into tertiles, and applied the same Cox models for each subgroup. To provide detailed analyses of the dose-response relationship of total intentional exercise with incident AF in those that participated in vigorous physical activity, we modeled total intentional exercise with restricted quadratic splines with knots at the 25th, 50th and 75th percentiles of the total intentional exercise distribution. In spline analyses, we used the 25th percentile of the total intentional exercise distribution as the reference value. We tested for potential interactions with age, gender, and race/ethnicity, by using multiplicative models as a part of model 2.

RESULTS

Of the total 6814 MESA participants 5793 had complete TWPAS and covariate data and were included in our study. Overall, 199 (3.4%) developed AF over a mean follow up of 7.7 ± 1.9 years. There were 1300 (22.4%) participants who reported no total intentional exercise. The average $\pm$ standard deviation of weekly total intentional exercise was 1567 ± 2345 MET-min/wk overall and was 2007 ± 2471 MET-min/wk among those who reported some total intentional exercise. Among the entire population, the average age was 62 ± 10 years, and 47% were men. Of the entire study population, 1866 (32.2%) reported participation in vigorous physical activity, and of those that reported some total intentional exercise, 1612 (35.9%) participated in any vigorous physical activity.

A comparison of baseline characteristics for the entire population, as well as the subgroups stratified by participation in vigorous physical activity is presented in Table 1. The distribution of total intentional exercise by tertile for the two subgroups is shown in Figure 1, and demonstrates generally higher total intentional exercise ranges for the subgroup with any vigorous physical activity. Besides exercising more, the participants that took part in vigorous physical activity were younger, were more likely to be male, and were ethnically

different as compared to those that did not. Participants with any vigorous physical activity also had a lower heart rate, SBP, higher low density lipoprotein and lower high density lipoprotein, lower body mass index, were less likely to be on anti-hypertensive agents, tended to be better educated, and had a lower prevalence of diabetes.

There was no association between vigorous physical activity (continuous variable) and incident AF, and this finding persisted after adjustment for confounders and inclusion of incident CHD. Additionally, when vigorous physical activity was classified into tertiles and compared with the group with no reported vigorous physical activity, it was not associated with incident AF (Table 2). There were no interactions between vigorous physical activity and age, gender, or race on AF risk.

In the overall cohort, we observed no association between total intentional exercise and incident AF after adjusting for covariates and including incident CHD. Similarly, no significant association was observed between total intentional exercise and incident AF after categorization of the total intentional exercise variable into four levels: no reported total intentional exercise and tertiles of those with any total intentional exercise (Table 2). Additionally, we found no interactions between total intentional exercise and age, gender, or race on AF risk.

Among the participants without vigorous physical activity, total intentional exercise as a continuous variable was not associated with incident AF in model 2 (HR 0.984, $p=0.89$), or after inclusion of incident CHD in model 3 (HR 1.00, $p=0.99$). Similarly, categorization of total intentional exercise into four levels did not produce any significant findings in terms of association with incident AF (Table 3). Although there were no interactions with gender or ethnicity, we did find a significant interaction with age (P for interaction 0.04). Specifically, among the second age quartile (ages 53-60) compared with the remainder of the population, greater total intentional exercise (modeled as a continuous variable) was negatively associated with incident AF (HR=0.84, $p=0.03$).

Among participants that did report vigorous physical activity, a significant inverse association was observed between total intentional exercise modeled as a continuous variable and incident AF (Model 2: HR 0.654, $p=0.013$) and was preserved after adding incident CHD to the model (HR 0.679, $p=0.020$). The spline regression model for this subgroup (Figure 2) revealed that the HR for incident AF declined with increasing total intentional exercise. After categorization of total intentional exercise into four categories, the middle and upper tertiles of total intentional exercise compared with the group with zero total intentional exercise demonstrated a trend toward reduced AF risk (Table 3), which met significance for the upper tertile in models 1 and 2, and for the middle tertile in model 1. Upon addition of incident CHD in model 3, the trend was maintained, but did not meet statistical significance for the upper and middle tertiles. No interactions between total intentional exercise and age, gender, or race/ethnicity were noted in this subgroup.

DISCUSSION

Overall, in the study population, neither vigorous physical activity nor total intentional exercise are independently associated with incidence of AF. However, among participants who performed any vigorous physical activity, total intentional exercise is inversely associated with incident AF. Importantly, the results demonstrate that the association is not mediated by protection from incident CHD. In this cohort, greater physical activity, an essential component of cardiovascular health maintenance, was not associated with an increased risk of AF in any of the subgroups studied.

It is surprising that physical activity is not associated with incident AF given the favorable impact of the former upon several AF risk factors. However, a thorough review of the literature suggests that effect modification by age and exercise intensity may null the overall association in the general population. A number of studies, including those of the MESA population, have demonstrated physical activity induced cardiac remodeling, including increased left and right ventricular mass and volume^{15,16}. The resultant “athlete’s heart” is thought to implicate a physiological, rather than pathological, role for physical activity^{17,18}, which is concordant with our findings. Our findings are in line with a 2013 study which demonstrated a protective role for walking and running in the development of incident AF⁸, and an analysis of the Cardiovascular Health Study which demonstrated a protective role of leisure time physical activity and low-moderate intensity exercise in development of AF⁹. A recent analysis of the Henry Ford Exercise Testing Project demonstrated an inverse association between cardiorespiratory fitness status and risk of incident AF¹⁹. Our study supports those findings, and it is certainly possible that, by stratifying by participation in vigorous physical activity, we may have isolated a subset of participants with higher cardiorespiratory fitness.

Our findings are in contrast with those of several other studies that demonstrated an increased risk of AF among athletes and among those who participate in more vigorous physical activity^{6,7}. The aforementioned studies focused on competitive athletes, and one presented a population with average energy expenditure of more than 4000 MET-min/wk³, which is far greater than even the MESA population with any vigorous physical activity. Another consideration is that the average age of our study population, 62 years, is generally older than that of the studies that demonstrated an increased AF risk with exercise. Vagal tone is postulated to mediate exercise induced AF, but since it decreases with age, it may not be as significant a contributor in our population. One study that reported an increased risk of lone AF with vigorous exercise also demonstrated that the increased risk disappeared among participants >50 years of age⁶. Similarly, the above noted Cardiovascular Health Study was performed in a population comprised of participants 65 years of age or older.

There are several limitations to the findings of this study. The perceived benefit of physical activity may have been attenuated by “silent”, asymptomatic AF, which would most likely have been missed in our study. A recent study²⁰ demonstrated that in patients >75 years in age, AF is more likely to be asymptomatic. Since this is a significant subset of our population (31%), the AF incidence is likely underestimated. Another finding from the aforementioned study was that asymptomatic AF was associated with limited physical

activity. Thus, it is possible that the participants in our study with minimal exercise may be more likely to have asymptomatic AF, which would be missed. The study shows an association between physical activity and incident AF among those who reported vigorous physical activity, and does not prove cause and effect. Although we accounted for an extensive list of confounders, it is possible that other variables, such as better health status, may confound or mediate the association under study. Survey data were used to quantify the amount of physical activity performed and may introduce recall or misclassification bias. Additionally, due to the study survey design, the vigorous physical activity summary measure includes activities that may not be considered “vigorous” in a general sense, such as heavy housework or garden work. This definition may have biased our results. Survey response bias may also exist since patients with incomplete data were excluded.

ACKNOWLEDGEMENTS

Dr. Nazarian is funded by National Institutes of Health (NIH) grants K23HL089333 and R01HL116280. The MESA study was funded by grants N01-HC-95159 through N01-HC95169 from the National Heart, Lung and Blood Institute. The authors thank the other investigators, staff, and participants of the MESA study for their contributions. A full list of participating MESA investigators and institutions can be found at <http://www.mesa-nhlbi.org>. The content is the responsibility of the authors and does not necessarily represent the official views of the NIH.

REFERENCES

1. Abdulla J, Nielsen JR. Is the risk of atrial fibrillation higher in athletes than in the general population? A systematic review and meta-analysis. *Europace*. 2009; 11:1156–1159. [PubMed: 19633305]
2. Elosua R, Arquer A, Mont L, Sambola A, Molina L, García-Morán E, Brugada J, Marrugat J. Sport practice and the risk of lone atrial fibrillation: a case-control study. *Int J Cardiol*. 2006; 108:332–337. [PubMed: 15963583]
3. Molina L, Mont L, Marrugat J, Berruezo A, Brugada J, Bruguera J, Rebato C, Elosua R. Long-term endurance sport practice increases the incidence of lone atrial fibrillation in men: a follow-up study. *Europace*. 2008; 10:618–623. [PubMed: 18390875]
4. Mont L, Sambola a, Brugada J, Vacca M, Marrugat J, Elosua R, Paré C, Azqueta M, Sanz G. Long-lasting sport practice and lone atrial fibrillation. *Eur Heart J*. 2002; 23:477–482. [PubMed: 11863350]
5. Calvo N, Brugada J, Sitges M, Mont L. Atrial fibrillation and atrial flutter in athletes. *Br J Sports Med*. 2012; 46(Suppl 1):i37–i43. [PubMed: 23097477]
6. Anthony Aizer MD, Michael Gaziano MD, Cook Nancy R. Manson JoAnn E. Buring Julie E. Christine M, Albert M. Relation of Vigorous Exercise to Risk of Atrial Fibrillation. *Am J Cardiol*. 2009; 103:1572–1577. MScA, b, h, J. MPHb, c, d, e. ScDb G. MD, DrPHb, g. ScDb, d, f, g. MPH a, b, c G. [PubMed: 19463518]
7. Karjalainen J, Kujala U, Kaprio J. Lone atrial fibrillation in vigorously exercising middle aged men: case-control study. *BMJ*. 1998; 316:1784–1785. [PubMed: 9624065]
8. Williams PT, Franklin Ba. Reduced incidence of cardiac arrhythmias in walkers and runners. *PLoS One*. 2013; 8:e65302. [PubMed: 23762337]
9. Mozaffarian D, Furberg CD, Psaty BM, Siscovick D. Physical activity and incidence of atrial fibrillation in older adults: the cardiovascular health study. *Circulation*. 2008; 118:800–807. [PubMed: 18678768]
10. Ofman P, Khawaja O, Rahilly-Tierney CR, Peralta A, Hoffmeister P, Reynolds MR, Gaziano JM, Djousse L. Regular Physical Activity and Risk of Atrial Fibrillation: A Systematic Review and Meta-analysis. *Circ Arrhythm Electrophysiol*. 2013; 6:252–256. [PubMed: 23515264]
11. Bild DE. Multi-Ethnic Study of Atherosclerosis: Objectives and Design. *Am J Epidemiol*. 2002; 156:871–881. [PubMed: 12397006]

12. Cushman M, Cornell ES, Howard PR, Bovill EG, Tracy RP. Laboratory methods and quality assurance in the Cardiovascular Health Study. *Clin Chem*. 1995; 41:264–270. [PubMed: 7874780]
13. Association AD. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*. 2013;27. [PubMed: 22961571]
14. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz aM, Strath SJ, O'Brien WL, Bassett DR, Schmitz KH, Emplainscourt PO, Jacobs DR, Leon aS. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*. 2000; 32:S498–S504. [PubMed: 10993420]
15. Turkbey E, Jorgensen N, Johnson W. Physical activity and physiological cardiac remodelling in a community setting: the Multi-Ethnic Study of Atherosclerosis (MESA). *Heart*. 2010; 96:42–48. [PubMed: 19858139]
16. Aaron CP, Tandri H, Barr RG, Johnson WC, Bagiella E, Chahal H, Jain A, Kizer JR, Bertoni AG, Lima JaC, Bluemke Da, Kawut SM. Physical activity and right ventricular structure and function. The MESA-Right Ventricle Study. *Am J Respir Crit Care Med*. 2011; 183:396–404. [PubMed: 20813888]
17. Pluim BM, Zwinderman a. H, van der Laarse a. vander Wall EE. The Athlete s Heart : A Meta-Analysis of Cardiac Structure and Function. *Circulation*. 2000; 101:336–344. [PubMed: 10645932]
18. Maron BJ. Structural features of the athlete heart as defined by echocardiography. *J Am Coll Cardiol*. 1986; 7:190–203. [PubMed: 2934463]
19. Qureshi WT, Alirhayim Z, Blaha MJ, Juraschek SP, Keteyian SJ, Brawner Ca, Al-Mallah MH. Cardiorespiratory Fitness and Risk of Incident Atrial Fibrillation: Results from the Henry Ford Exercise Testing (FIT) Project. *Circulation*. 2015 Available at: <http://circ.ahajournals.org/cgi/doi/10.1161/CIRCULATIONAHA.114.014833>.
20. Boriani G, Laroche C, Diemberger I, Fantecchi E, Popescu MI, Rasmussen LH, Sinagra G, Petrescu L, Tavazzi L, Maggioni AP, Lip GY. Asymptomatic atrial fibrillation: clinical correlates, management and outcomes in the EORP-AF Pilot General Registry. *Am J Med*. 2014; 128:509–518. [PubMed: 25534423]

Figure 1.

The violin plots (light blue) show the probability density of total intentional exercise within each total intentional exercise tertile in participants (A) with and (B) without vigorous physical activity. The white dot shows the median value and the dark blue box represents the interquartile range, with the dark blue vertical line extending to the lower and upper adjacent values.

Figure 2.

The solid black line indicates multivariable-adjusted hazard ratios for incident AF as a function of total intentional exercise (normalized by standard deviation) using restricted quadratic splines in the subgroup of participants that reported vigorous exercise. The two dashed lines delineate the upper and lower 95% confidence intervals. The horizontal gray dotted line indicates a hazard ratio of 1. The model was adjusted for age, gender, ethnicity, education level, insurance status, cigarette smoking, resting heart rate, systolic blood pressure, use of anti-hypertensives, low density lipoprotein, high density lipoprotein, body mass index, left ventricular hypertrophy, and diabetes. The reference group for this analysis was the remainder of the study population, i.e. those that did not participate in vigorous physical activity.

TABLE 1
Baseline characteristics of entire population and subgroups

Variable	Overall (N=5793)	Vigorous Physical Activity		P value
		= 0 (N=3927)	> 0 (N=1866)	
Total Intentional Exercise (MET-min/wk)	1566 ± 2345	1168 ± 1674	2406 ± 3184	< 0.010
Age (years)	62 ± 10	63 ± 10	59 ± 10	< 0.010
Resting Heart Rate (bpm)	63 ± 9	64 ± 10	61 ± 9	< 0.010
Systolic Blood Pressure (mm Hg)	126 ± 21	128 ± 22	123 ± 20	< 0.010
Low density lipoprotein (mg/dl)	117 ± 31	117 ± 32	119 ± 31	= 0.012
High density lipoprotein (mg/dl)	51 ± 15	52 ± 15	50 ± 14	< 0.010
Body mass index (kg/m²)	28 ± 5	29 ± 6	28 ± 5	< 0.010
Female	53%	62%	36%	< 0.010
White	38%	33%	48%	<0.010
Chinese-American	12%	13%	9%	
Black	27%	29%	25%	
Hispanic	22%	24%	17%	
Education				< 0.010
<i>Less than HS grad</i>	19%	22%	11%	
<i>HS Grad</i>	18%	20%	14%	
<i>Post-HS degree</i>	29%	27%	34%	
<i>Grad degree</i>	18%	15%	23%	
Smoker				< 0.010
<i>Never</i>	51%	52%	47%	
<i>Former</i>	36%	35%	40%	
<i>Current</i>	13%	13%	13%	
HTN Meds	36%	39%	29%	< 0.010
Diabetes mellitus	12%	14%	9%	< 0.010

TABLE 2
Association of total intentional exercise and vigorous physical activity with incident AF

Total Intentional Exercise					Vigorous Physical Activity				
	N	HR	CI	p		N	HR	CI	p
No total intentional exercise	1300	1.00	--	--	No vigorous physical activity	3927	1.00	--	--
Lower tertile	1497	1.16	0.78-1.72	0.467	Lower tertile	534	0.93	0.54-1.60	0.804
Middle tertile	1497	0.86	0.56-1.31	0.482	Middle tertile	690	1.14	0.73-1.77	0.559
Upper tertile	1499	0.85	0.56-1.30	0.465	Upper tertile	642	1.29	0.81-2.04	0.296

Model 2 (adjusted for age, sex, race/ethnicity, education level, insurance status, cigarette smoking, resting heart rate, systolic blood pressure, use of anti-hypertensives, low density lipoprotein, high density lipoprotein, body mass index, diabetes mellitus, and left ventricular hypertrophy) was used to produce the data shown above.

Tertiles shown above represent the following ranges of vigorous physical activity [MET-min/wk]: Lower: 32.5-779, Middle: 780-2339, Upper: 2340+ and the following ranges of total intentional exercise [100 MET-min/wk]: Lower: 0.175-7.574, Middle: 7.575-19.574, Upper: 19.575+.

TABLE 3
Hazard ratio for association between total intentional exercise tertiles and incident atrial fibrillation for groups stratified by participation in vigorous physical activity

Subgroup	Tertile	Model 1				Model 2				Model 3			
		AF	HR	CI	p	HR	CI	p	HR	CI	p	HR	CI
No vigorous physical activity (N = 3927)	No total intentional exercise		1.00	--	--	1.00	--	--	1.00	--	--	1.00	--
	Lower tertile	136	1.16	0.73-1.83	0.539	1.20	0.75-1.90	0.447	1.09	0.68-1.75	0.705	1.00	--
	Middle tertile		0.95	0.58-1.56	0.845	0.99	0.60-1.63	0.972	1.02	0.62-1.68	0.948	1.00	--
	Upper tertile		0.97	0.58-1.62	0.901	1.04	0.62-1.76	0.869	1.06	0.63-1.79	0.817	1.00	--
Any vigorous physical activity (N = 1866)	No total intentional exercise		1.00	--	--	1.00	--	--	1.00	--	--	1.00	--
	Lower tertile	63	0.91	0.42-1.96	0.812	1.06	0.48-2.32	0.886	1.01	0.46-2.24	0.974	1.00	--
	Middle tertile		0.49	0.18-0.87	0.021	0.46	0.21-1.01	0.054	0.48	0.22-1.06	0.070	1.00	--
	Upper tertile		0.44	0.21-0.91	0.026	0.46	0.22-0.98	0.045	0.50	0.24-1.05	0.067	1.00	--

Tertiles shown above represent following ranges of total intentional exercise [100 MET-min/wk]: Lower: 0.175-7.574, Middle: 7.575-19.574, Upper: 19.575+.

Model 1: Adjusted for demographics, i.e. age, sex, race/ethnicity, education level, and insurance status

Model 2: Adjusted for demographics and risk factors, i.e. cigarette smoking, resting heart rate, systolic blood pressure, use of anti-hypertensives, low density lipoprotein, high density lipoprotein, body mass index, diabetes mellitus, and left ventricular hypertrophy

Model 3: Adjusted for demographics, risk factors, and incident CHD