Published in final edited form as:

J Phys Act Health. 2018 December 01; 15(12): 895–899. doi:10.1123/jpah.2018-0064.

Television Watching as Sedentary Behavior and Atrial Fibrillation: The Atherosclerosis Risk in Communities Study

Yasuhiko Kubota,

Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, MN, USA.

Alvaro Alonso,

Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA, USA.

Amil M. Shah,

Division of Cardiovascular Medicine, Brigham and Women's Hospital, Boston, MA, USA.

Lin Y. Chen, and

Cardiovascular Division, University of Minnesota Medical School, Minneapolis, MN, USA.

Aaron R. Folsom

Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, MN, USA.

Abstract

Background: There is no research on the association of television (TV) watching with atrial fibrillation (AF).

Methods: From 1987 to 1989, the authors obtained information on the frequency of TV watching in 14,458 participants, aged 45–64 years, without a history of AF. The authors used the Cox proportional hazards model to estimate hazard ratios and their 95% confidence intervals of AF according to the frequency of TV watching (“never or seldom,” “sometimes,” “often,” or “very often”).

Results: During the 294,553 person-years of follow-up, the authors identified 2,476 AF events. Adjustment for other potential confounding factors, including physical activity, did not change the associations, in which “very often” watching TV carried 1.28 (95% confidence interval, 1.09–1.50) times AF risk compared with “never or seldom” watching TV (P for trend = .002). Even among individuals who met a recommended level of physical activity, watching TV “very often” carried 1.36 (1.02–1.82) times AF risk, compared with watching TV “never or seldom.”

Conclusion: Greater frequency of TV watching was independently associated with increased risk of AF even after adjusting for physical activity. Moreover, a recommended level of physical activity did not eliminate the increased risk of frequent TV watching for AF. Avoiding frequent TV watching might be beneficial for AF prevention.

Keywords

physical activity; epidemiology; community-based research; obesity

Several investigations have suggested that sedentary behavior is associated with increased risk of incident or fatal atherosclerotic cardiovascular disease (CVD) and all-cause mortality, independent of physical activity.^{1–4} A recent study reported that high levels of physical activity did not prevent the increased mortality risk associated with high television (TV) watching time.⁵ Thus, of several sedentary behaviors, TV watching might be a risk factor or marker for atherosclerotic CVD independent of physical activity.

Atrial fibrillation (AF) is the most frequent sustained cardiac arrhythmia in Western countries.⁶ Thus, it is important to identify risk factors for AF. Many modifiable risk factors for atherosclerotic CVD are associated with increased AF occurrence,⁷ although physical activity seems more weakly associated with AF than with atherosclerotic CVD.^{7–8} TV watching may also be positively associated with AF risk through several mediators such as obesity and hypertension. However, to date no study has investigated the association between TV watching and AF occurrence. TV watching is the most commonly reported daily activity around the world apart from working and sleeping,⁹ and thus a study of TV watching and AF may be informative for future public health recommendations.

Therefore, we tested, in a prospective study, the hypothesis that the frequency of TV watching is positively associated with incident AF, independent of other AF risk factors, including physical activity.

Methods

Study Design, Setting, and Population

The Atherosclerosis Risk in Communities (ARIC) Study is an ongoing population-based prospective study designed to examine the etiology of CVDs.¹⁰ From 1987 to 1989 (visit 1), the ARIC Study recruited and examined 15,792 men and women (aged 45–64 y) from 4 US communities: Washington County, MD; Forsyth County, NC; Jackson, MS (African Americans only); and suburbs of Minneapolis, MN. The participants were followed up with from 1990 to 1992 (visit 2, 93% return), 1993 to 1995 (visit 3, 86% return), 1996 to 1998 (visit 4, 80% return), and 2009 to 2011 (visit 5, 41% return). The home interview and clinic examination surveyed health behaviors, cardiovascular conditions, and various demographic characteristics.

The institutional review boards of the collaborating universities (University of North Carolina at Chapel Hill, Wake Forest Baptist Medical Center, University of Mississippi Medical Center, University of Minnesota, and Johns Hopkins University) approved the study protocol, and each participant provided written informed consent.

Risk Factor Measurements

The main exposure of interest for this analysis was the frequency of TV watching. Participants were asked to select their frequency of TV watching during leisure time as part

of the Baecke physical activity questionnaire¹¹: “never or seldom,” “sometimes,” “often,” or “very often.” ARIC also assessed the frequency of TV watching at ARIC visit 3 (1993–1995) and visit 5 (2011–2013). The percent exact agreement on the 4 categories of TV watching for visit 1 versus visit 3 was 54% ($\kappa = 0.40$). The kappa was 0.26 for visit 1 versus visit 5, and kappa was 0.30 for visit 3 versus visit 5. The percentages of participants who reported watching TV “very often” were 6.6%, 7.4%, and 14.8% across the respective visits. Thus, the frequency of TV watching was used as a time-varying variable.

We assessed potential confounding factors, including age, sex, race (white or African American), smoking status (current, former, or never), educational attainment (grade school, high school without graduation, high school with graduation, vocational school, college with or without graduation, or graduate or professional school), alcohol drinking status (current, former, or never), height (in centimeters), estimated glomerular filtration rate (in milliliters per minute), electrocardiogram (ECG)-based left ventricular hypertrophy,¹² physical activity levels (metabolic equivalents of task [METs] per week), and a healthy diet score. The Baecke physical activity questionnaire also queried participants about the usual frequency and number of hours they walked and participated in up to 4 sports during the previous year.

¹¹ As in prior ARIC studies,^{13,14} each sport activity was converted into METs via the compendium of physical activities. The reliability and validity of the Baecke questionnaire have been evaluated in several populations and summarized elsewhere.^{15,16} Moderate activities were defined as those involving a workload of 3 to 6 METs, and vigorous activities were those involving a workload of >6 METs. Physical activity levels were categorized into 3 levels based on American Heart Association (AHA) recommendation: “recommended” (≥ 75 min/wk of vigorous intensity or ≥ 150 min/wk of any combination of moderate + vigorous intensity), “intermediate” (1–74 min/wk of vigorous intensity or 1–149 min/wk of any combination of moderate + vigorous intensity), or “poor” (0 min/wk of moderate or vigorous intensity).¹⁷ Diet was assessed by a slightly modified, 66-item Harvard food frequency questionnaire,¹⁸ and a healthy diet score was calculated by adding each point (0 or 1) of the following 5 healthy dietary metrics¹⁹: ≥ 4.5 cups/day of fruits and vegetables (approximated as ≥ 4.5 servings/d in the ARIC study); ≥ 2 or more 3.5-oz servings/week of fish (approximated as ≥ 3- to 5-oz servings/wk); ≥ 3 or more 1-oz servings/day of whole grains (approximated as ≥ 3 servings/d); sodium (<1500 mg/d); and ≤ 36 oz/week of sugar-sweetened beverages (approximated as ≤ 4 glasses/wk).

In this study, we considered body mass index (in kilogram per meter square), systolic and diastolic blood pressure (in mm Hg), anti-hypertension medication use, diabetes mellitus (a fasting blood glucose ≥ 126 mg/dL, nonfasting blood glucose ≥ 200 mg/dL, a self-reported physician diagnosis of diabetes, or use of antidiabetic medication in the past 2 wk),²⁰ and prevalent coronary heart disease and heart failure as potential mediating factors between TV watching and AF, rather than confounding factors.^{21,22}

Ascertainment of AF

Atrial fibrillation was ascertained by ECG conducted at study examinations, hospitalization discharge summaries, and death certificates.²³ A 12-lead ECG was performed with the participant in a supine position at each study visit and was transmitted electronically to the

ARIC Central ECG Reading Center. A cardiologist visually checked and confirmed ECGs automatically coded as AF or atrial flutter.²⁴ Information from all participants' hospitalizations was ascertained through surveillance of local hospitals and annual phone calls. AF was defined as the presence of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 427.31 or 427.32. AF events related to open cardiac surgery were not included. Previous studies have demonstrated the adequate validity of those hospital discharge codes for ascertainment of AF.²³

Statistical Analysis

SAS software (version 9.4; SAS Institute Inc, Cary, NC) was used for statistical analyses. All statistical tests were 2-tailed, and *P* values < .05 were regarded as significant.

We excluded participants who had ECG evidence of prebaseline AF (*n* = 37). We also excluded participants missing data on the frequency of TV watching (*n* = 32); nonwhite participants in Washington County or Minneapolis or nonwhite/nonblack participants in Forsyth County (*n* = 103) to allow multivariable adjustment for race and study site²⁵; and participants missing covariates (*n* = 1,194). After exclusions, 14,458 participants were included in the present analyses.

Because very few participants reported "Never" watching TV (*n* = 277), we analyzed 4 groups: "never or seldom," "sometimes," "often," or "very often." We computed mean levels or percentages of AF risk factors at baseline according to the frequency of TV watching. Person-years of follow-up were calculated from the baseline to the following first endpoint: AF, death, loss to follow-up, or administrative censoring at December 31, 2013. Hazard ratios (HRs) of AF occurrence and their 95% confidence intervals (CIs) were calculated after adjusting for AF risk factors using the Cox proportional hazards model. The proportional hazards assumption in Cox regression was tested using risk factor-by-time interactions and was not violated. As we found no statistical interactions between sex or race and TV watching in relation to AF risk, we pooled the analysis across sex and race. Model 1 adjusted for age, sex, and race/ARIC field center; and model 2 (main model) additionally for height, smoking status, drinking status, educational attainment, estimated glomerular filtration rate, left ventricular hypertrophy, physical activity levels, and a healthy diet score. We also evaluated potential mediation by the factors mentioned above (model 3–5).

For sensitivity analysis, we reran models by excluding those with early AF events (5 y from baseline) to assess the possibility of reverse causation and also updated information on physical activity (visit 3 and 5) and body mass index (visit 2–5).

Results

Baseline Characteristics According to the Frequency of TV Watching

As shown in Table 1, the prevalences of participants who watched TV "never or seldom," "sometimes," "often, and "very often" were 18.6%, 46.8%, 26.6%, and 7.9%, respectively. Participants who more often watched TV were more likely to be African American, be current smokers, and have ECG-based left ventricular hypertrophy. They were less likely to

meet the AHA recommended level of physical activity and graduate from high school. Moreover, they had higher levels of all potential mediators.

Association of Frequency of TV Watching With Incidence of AF

During the 294,553 person-years of follow-up for the 14,458 ARIC participants, we identified 2,476 incident AF events (Table 2). The age-, sex-, and race-adjusted model (model 1) showed a positive dose-response relation between the frequency of TV watching and AF incidence (P for trend $< .001$). Further adjustment for other potential confounding factors (model 2) attenuated but did not substantially change the association, in which “very often” watching TV carried 1.28 (95% CI, 1.09–1.50) times the risk of AF compared with “never or seldom” watching TV (P for trend = .002).

We evaluated the extent to which the observed association between the frequency of TV watching and AF risk might be mediated by health impairments such as hypertension and obesity at baseline and prevalent and incident coronary heart disease and heart failure by adjusting for potential mediators and assessing how much the TV association was attenuated (models 3–6). Models 3 to 5 showed slight to moderate attenuations of the association between the frequency of TV watching and AF: HRs for individuals who “very often” watched TV decreased from 1.28 for model 2 to 1.23 for model 3 (adjusted for systolic and diastolic blood pressure, hypertension medication, and diabetes mellitus), 1.17 for model 4 (body mass index), and 1.23 for model 5 (prevalent coronary heart disease and heart failure), respectively. Of those potential mediators, body mass index (model 4) appeared to be strong, as it greatly attenuated the association between TV watching and AF.

Joint Associations of Frequency of TV Watching and Physical Activity with Risk of AF

As shown in Figure 1, compared with individuals who “never or seldom” watched TV and met the recommended physical activity level, those who “very often” watched TV had a statistically significant increased risk of AF, regardless of physical activity levels. For example, even individuals who met the recommended physical activity level but watched TV “very often” had an AF HR of 1.36 (95% CI, 1.02–1.82), and those who watched TV “very often” and whose physical activity level was poor had an HR of 1.43 (1.13–1.81). There was no significant interaction between TV watching and physical activity in relation to AF risk ($P = .84$).

Sensitivity Analyses

Sensitivity analyses mentioned in the “Methods” section produced similar results (data not shown).

Discussion

In the prospective population-based ARIC cohort, watching TV more frequently, especially watching “very often,” was associated with increased risk of AF. This association appeared to be mediated by several health conditions, particularly obesity at baseline. Even individuals meeting the AHA-recommended level of physical activity had increased risk of AF when they “very often” watched TV compared with when they “never or seldom”

watched TV. Those associations appeared not to be explained by reverse causation. Although studies have reported associations of TV watching with atherosclerotic CVD, venous thromboembolism, and mortality,^{5,9,26–28} to the best of our knowledge this is the first prospective study investigating the association between TV watching and incident AF.

Of several sedentary behaviors, TV watching has particularly been associated with impaired health.^{5,9,26–28} TV watching might capture unique aspects of sedentary behaviors. Frequent TV watchers may have unhealthy diets from snacks and soft drinks consumed during watching TV.²⁹ We also showed the inverse association between the frequency of TV watching and healthy diet score. Moreover, people usually watch TV after dinner, and then maybe sedentary for a long time, whereas at work they may routinely break up their sitting time.³⁰ Prolonged postprandial sedentary time may impair glucose and lipid metabolism even in the setting of a healthy diet,³⁰ which could lead to risk factors for AF such as obesity and diabetes mellitus.

Individuals who met the AHA-recommended level of physical activity but also “very often” watched TV had a significantly increased risk of AF compared with those who met the recommended level of physical activity and seldom watched TV. The association between TV watching and AF appeared to be mediated by obesity. These suggest that recommended physical activity might not be able to eliminate the health disadvantages of TV watching, that is, obesity and AF. A previous study found that even more than twice the recommended level of physical activity did not eliminate the increased risk of all-cause mortality from TV watching.⁵ Few ARIC participants reached twice the recommended level of physical activity, so we could not attempt to replicate this finding, but our results in addition to the previous report⁵ may suggest that even individuals achieving the recommended physical activity should not excessively watch TV to lower AF risk.

A few limitations of our study should be considered. First, our exposure was the qualitative frequency of TV watching, not the precise time spent watching TV. The frequency and time spent watching TV should be correlated, but our results might need a careful interpretation. Secondly, we cannot negate the possibility of residual confounding of the observed associations by unmeasured AF risk factors. In addition, we used self-reported physical activity level. Thus, there is also the possibility of residual confounding by physical activity. Next, we have not validated the frequency of TV watching. Thus, there is the possibility of social desirability bias, and the individual interpretation of this frequency could be biased based on a participant’s unique demographics (age, gender, socioeconomic status, etc). Finally, AF cases were mainly ascertained by hospital discharge codes. Although a previous study has demonstrated the adequate validity of those hospital discharge codes for ascertainment of AF,²³ some asymptomatic AF events, as well as those managed exclusively in the outpatient setting, might not have been identified. Lastly, we could not capture paroxysmal AF events. Thus, we might have underestimated the number of AF events.

In conclusion, in the prospective population-based ARIC cohort, watching TV more frequently was associated with an increased risk of AF, even after adjusting for physical activity. Furthermore, achieving the AHA recommendation for physical activity appeared

not to eliminate increased risk of frequent TV watching for AF. Avoiding frequent TV watching might be beneficial for AF prevention.

Acknowledgments

The authors thank the staff and participants of the ARIC study for their important contributions. The National Heart, Lung, and Blood Institute (NHLBI) supported ARIC via contracts HHSN268201100005C, HHSN268201100006C, HHSN268201100007C, HHSN268201100008C, HHSN268201100009C, HHSN268201100010C, HHSN268201100011C, and HHSN268201100012C. Additional support was provided by American Heart Association grant 16EIA26410001.

References

1. Wilmot EG, Edwardson CL, Achana FA, et al. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*. 2012;55: 2895–2905. PubMed ID: doi:10.1007/s00125-012-2677-z [PubMed: 22890825]
2. Biswas A, Oh PI, Faulkner GE, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med*. 2015;162: 123–132. PubMed ID: doi:10.7326/M14-1651 [PubMed: 25599350]
3. Chomistek AK, Manson JE, Stefanick ML, et al. Relationship of sedentary behavior and physical activity to incident cardiovascular disease: results from the Women's Health Initiative. *J Am Coll Cardiol*. 2013;61:2346–2354. PubMed ID: doi:10.1016/j.jacc.2013.03.031 [PubMed: 23583242]
4. Young DR, Reynolds K, Sidell M, et al. Effects of physical activity and sedentary time on the risk of heart failure. *Circ Heart Fail*. 2014; 7:21–27. PubMedID: doi:10.1161/CIRCHEARTFAILURE.113.000529 [PubMed: 24449810]
5. Ekelund U, Steene-Johannessen J, Brown WJ, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet*. 2016;388:1302–1310. PubMed ID: doi: 10.1016/S0140-6736(16)30370-1 [PubMed: 27475271]
6. Violi F, Soliman EZ, Pignatelli P, Pastori D. Atrial fibrillation and myocardial infarction: a systematic review and appraisal of pathophysiologic mechanisms. *J Am Heart Assoc*. 2016;5:pii: e003347 PubMed ID: doi:10.1161/JAHA.116.003347 [PubMed: 27208001]
7. Miller JD, Aronis KN, Chrispin J, et al. Obesity, exercise, obstructive sleep apnea, and modifiable atherosclerotic cardiovascular disease risk factors in atrial fibrillation. *J Am Coll Cardiol*. 2015;66:2899–2906. PubMed ID: doi:10.1016/j.jacc.2015.10.047 [PubMed: 26718677]
8. Huxley RR, Misialek JR, Agarwal SK, et al. Physical activity, obesity, weight change, and risk of atrial fibrillation: the atherosclerosis risk in communities study. *Circ Arrhythm Electrophysiol*. 2014;7:620–625. PubMed ID: doi:10.1161/CIRCEP.113.001244 [PubMed: 24907285]
9. Grøntved A, Hu FB. Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: a meta-analysis. *JAMA*. 2011;305:2448–2455. PubMed ID: doi:10.1001/jama.2011.812 [PubMed: 21673296]
10. The Atherosclerosis Risk in Communities (ARIC). Study: design and objectives. The ARIC investigators. *Am J Epidemiol*. 1989;129: 687–702. doi:10.1093/oxfordjournals.aje.a115184 [PubMed: 2646917]
11. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr*. 1982;36:936–942. PubMed ID: doi:10.1093/ajcn/36.5.936 [PubMed: 7137077]
12. Casale PN, Devereux RB, Alonso DR, Campo E, Kligfield P. Improved sex-specific criteria of left ventricular hypertrophy for clinical and computer interpretation of electrocardiograms: validation with autopsy findings. *Circulation*. 1987;75:565–572. PubMed ID: doi:10.1161/01.CIR.75.3.565 [PubMed: 2949887]
13. Kubota Y, Heiss G, MacLehose RF, Roetker NS, Folsom AR. Educational attainment and lifetime risk of cardiovascular disease: the atherosclerosis risk in communities study. *JAMA Intern Med*. 2017;177:1165–1172. PubMed ID: doi:10.1001/jamainternmed.2017.1877 [PubMed: 28604921]

14. Kubota Y, Evenson KR, MacLehose RF, Roetker NS, Joshi CE, Folsom AR. Physical activity and lifetime risk of cardiovascular disease and cancer. *Med Sci Sports Exerc.* 2017;49:1599–1605. PubMed ID: doi:10.1249/MSS.0000000000001274 [PubMed: 28350711]
15. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc.* 2000;32:S498–S504. PubMed ID: doi:10.1097/00005768-200009001-00009 [PubMed: 10993420]
16. Jacobs DR, Jr, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc.* 1993;25:81–91. PubMed ID: doi:10.1249/00005768-199301000-00012 [PubMed: 8423759]
17. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation.* 2007;116:1081–1093. PubMed ID: doi:10.1161/CIRCULATIONAHA.107.185649 [PubMed: 17671237]
18. Rimm EB, Giovannucci EL, Stampfer MJ, Colditz GA, Litin LB, Willett WC. Reproducibility and validity of an expanded self-administered semiquantitative food frequency questionnaire among male health professionals. *Am J Epidemiol.* 1992;135:1114–1126. PubMed ID: doi:10.1093/oxfordjournals.aje.a116211 [PubMed: 1632423]
19. Folsom AR, Yatsuya H, Nettleton JA, et al. Community prevalence of ideal cardiovascular health, by the American Heart Association definition, and relationship with cardiovascular disease incidence. *J Am Coll Cardiol.* 2011;57:1690–1696. PubMed ID: doi:10.1016/j.jacc.2010.11.041 [PubMed: 21492767]
20. Kubota Y, London SJ, Cushman M, et al. Lung function, respiratory symptoms and venous thromboembolism risk: the Atherosclerosis Risk in Communities study. *J Thromb Haemost.* 2016;14:2394–2401. PubMed ID: doi:10.1111/jth.13525 [PubMed: 27696765]
21. Mora S, Cook N, Buring JE, et al. Physical activity and reduced risk of cardiovascular events: potential mediating mechanisms. *Circulation.* 2007;116:2110–2118. PubMed ID: doi:10.1161/CIRCULATIONAHA.107.729939 [PubMed: 17967770]
22. 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 ID: doi:10.1161/CIRCULATIONAHA.108.785626 [PubMed: 18678768]
23. Alonso A, Agarwal SK, Soliman EZ, et al. Incidence of atrial fibrillation in whites and African-Americans: the Atherosclerosis Risk in Communities (ARIC) study. *Am Heart J.* 2009;158:111–117. PubMed ID: doi:10.1016/j.ahj.2009.05.010 [PubMed: 19540400]
24. Soliman EZ, Prineas RJ, Case LD, Zhang ZM, Goff DC, Jr. Ethnic distribution of ECG predictors of atrial fibrillation and its impact on understanding the ethnic distribution of ischemic stroke in the Atherosclerosis Risk in Communities (ARIC) study. *Stroke.* 2009;40: 1204–1211. PubMed ID: doi:10.1161/STROKEAHA.108.534735 [PubMed: 19213946]
25. Kubota Y, McAdams-DeMarco M, Folsom AR. Serum uric acid, gout, and venous thromboembolism: the atherosclerosis risk in communities study. *Thromb Res.* 2016;144:144–148. PubMed ID: doi:10.1016/j.thromres.2016.06.020 [PubMed: 27337701]
26. Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *JAMA.* 2003;289:1785–1791. PubMed ID: doi:10.1001/jama.289.14.1785 [PubMed: 12684356]
27. de Zwaan C, Janssen JH, Cheriex EC, Janevski BK, Wellens HJ. Watching television and pulmonary embolism. *Am J Cardiol.* 1984;54:1391–1392. PubMed ID: doi:10.1016/S0002-9149(84)80116-2 [PubMed: 6507326]
28. Kim Y, Wilkens LR, Park SY, Goodman MT, Monroe KR, Kolonel LN. Association between various sedentary behaviours and all-cause, cardiovascular disease and cancer mortality: the Multiethnic Cohort Study. *Int J Epidemiol.* 2013;42:1040–1056. PubMed ID: doi:10.1093/ije/dyt108 [PubMed: 24062293]
29. Frydenlund G, Jørgensen T, Toft U, Pisinger C, Aadahl M. Sedentary leisure time behavior, snacking habits and cardiovascular biomarkers: the Inter99 Study. *Eur J Prev Cardiol.* 2012;19:1111–1119. PubMed ID: doi:10.1177/1741826711419999 [PubMed: 21859779]

30. Benatti FB, Ried-Larsen M. The effects of breaking up prolonged sitting time: a review of experimental studies. *Med Sci Sports Exerc.* 2015;47:2053–2061. PubMed ID: doi:10.1249/MSS.0000000000000654 [PubMed: 26378942]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1 —.
Joint association of TV watching and physical activity with risk of atrial fibrillation. N indicates never or seldom; S, sometimes; O, often; V, very often; PA, physical activity.

Table 1

Baseline Characteristics According to the Frequency of TV Watching (n = 14,458), ARIC, 1987–1989

	Never or seldom	Sometimes	Often	Very often
Participants, n	2,695	6,771	3,852	1,140
Age, y	53.6 (5.7)	54.1 (5.7)	54.7 (5.8)	54.5 (5.9)
Female, %	59.1	57.6	48.4	54.3
African American, %	15.3	24.8	27.0	54.1
Current smoker, %	20.3	24.4	29.1	38.7
Current drinker, %	58.2	55.9	58.9	46.4
High school graduation, %	83.1	77.6	76.9	54.2
Height, cm	168.2 (9.1)	168.1 (9.2)	169.3 (9.4)	168.3 (9.2)
eGFR, ml/min/1.73 m ²	102.0 (13.9)	102.6 (15.2)	101.9 (16.5)	104.3 (20.0)
ECG-left ventricular hypertrophy, %	1.6	1.8	2.3	5.1
Healthy diet score	2.1	2.0	1.8	1.7
Physical activity level, METs/wk	12.6	10.4	9.0	6.8
Potential mediators				
Body mass index, kg/m ²	26.8 (4.9)	27.7 (5.3)	28.1 (5.3)	28.7 (6.1)
Systolic blood pressure, mm Hg	139.1 (17.2)	141.2 (17.9)	142.2 (18.4)	146.1 (21.0)
Diastolic blood pressure, mm Hg	92.3 (11.4)	93.4 (11.8)	94.0 (12.0)	95.5 (13.2)
Anti-hypertension medication use, %	19.8	24.4	27.5	35.5
Diabetes, %	8.1	11.3	13.0	17.3
History of coronary heart disease, %	3.3	4.1	6.6	5.5
History of heart failure, %	3.3	4.0	5.2	8.5

Abbreviations: ARIC, Atherosclerosis Risk in Communities; ECG, electrocardiogram; eGFR, estimated glomerular filtration rate; MET, metabolic equivalents of task. Note: Values are mean (SD) for continuous variables and percentage for categorical variables.

Table 2

Hazard Ratios and 95% Confidence Intervals for Incident Atrial Fibrillation According to the Frequency of TV Watching (n = 14,458), ARIC, 1987–2013

	Never or seldom	Sometimes	Often	Very often	P for trend
Participants, n	2,695	6,771	3,852	1,140	
Person-years	57,397	140,152	76,045	20,958	
Cases	407	1,153	708	208	
Model 1	1	1.00 (0.89–1.12)	1.10 (0.97–1.25)	1.45 (1.24–1.70)	<.001
Model 2	1	0.98 (0.87–1.10)	1.06 (0.93–1.20)	1.28 (1.09–1.50)	.002
Mediator analyses					
Model 3	1	0.96 (0.85–1.08)	1.01 (0.89–1.15)	1.23 (1.04–1.44)	.02
Model 4	1	0.96 (0.85–1.08)	1.01 (0.89–1.14)	1.17 (0.99–1.38)	.05
Model 5	1	0.98 (0.87–1.10)	1.03 (0.91–1.17)	1.23 (1.04–1.44)	.02

Abbreviation: ARIC, Atherosclerosis Risk in Communities. Note: Model 1: Adjusted for age, sex, and race/ARIC field center. Model 2: Adjusted for model 1 + height, smoking status, pack-years of smoking, drinking status, educational attainment, eGFR, left ventricular hypertrophy, and physical activity. Model 3: Adjusted for model 2 + systolic and diastolic blood pressure, hypertension medication use, and diabetes mellitus. Model 4: Adjusted for model 2 + body mass index. Model 5: Adjusted for model 2 + history of coronary heart disease and heart failure.