

ONLINE APPENDIX

Thacker EL, McKnight B, Psaty BM, et al. Association of body mass index, diabetes, hypertension, and blood pressure levels with risk of permanent atrial fibrillation

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eTable 1. Baseline characteristics of Group Health enrollees followed for recurrent AF

Characteristic*	N = 1,517
<i>Demographic characteristics</i>	
Age, y, mean (SD)	69.4 (11.1)
Male, N (%)	788 (51.9)
White race, N (%)	1,399 (92.5)
Group Health enrollment, y, mean (SD)	21.7 (13.5)
<i>Location of initial AF diagnosis</i>	
Outpatient, N (%)	483 (32.2)
Urgent care, N (%)	165 (11.0)
Emergency department, N (%)	610 (40.7)
Inpatient, N (%)	217 (14.5)
Other, N (%)	23 (1.5)
<i>Most severe symptom present at initial AF diagnosis†</i>	
Loss of consciousness, N (%)	33 (2.3)
Heart failure, N (%)	124 (8.8)
Chest pain, N (%)	304 (21.5)
Shortness of breath, N (%)	240 (17.0)
Mental status change, N (%)	19 (1.3)
Dizziness, N (%)	126 (8.9)
Palpitations, N (%)	289 (20.5)
Other, N (%)	74 (5.2)
No symptoms, N (%)	204 (14.4)
<i>Clinical characteristics</i>	
Body weight, kg, mean (SD)	87.5 (22.5)
Height, cm, mean (SD)	171.4 (10.2)
Body mass index, kg/m ² , mean (SD)	29.7 (7.1)
18.5 – 24.9 (normal), N (%)	387 (25.5)
25.0 – 29.9 (overweight), N (%)	547 (36.1)
30.0 – 34.9 (obese 1), N (%)	319 (21.0)
35.0 – 39.9 (obese 2), N (%)	135 (8.9)
≥ 40.0 (obese 3), N (%)	129 (8.5)
Diabetes, N (%)	237 (15.6)
Hypertension, N (%)	811 (53.5)
Systolic blood pressure, mm Hg, mean (SD)	136.0 (20.7)
Diastolic blood pressure, mm Hg, mean (SD)	76.4 (11.6)
Coronary heart disease, N (%)	319 (21.0)
Valvular heart disease, N (%)	85 (5.6)
Heart failure, N (%)	111 (7.3)
Prior stroke, N (%)	105 (6.9)

* Five participants had missing values for race, six for years of Group Health enrollment, 19 for location of initial AF diagnosis, and 104 for symptoms present at initial AF diagnosis.

† Symptoms are listed in order of severity, with loss of consciousness as most severe.

eTable 2. Distributions of survival times by BMI categories and outcome status*

Body mass index (kg/m ²)	Participants with permanent AF				Censored participants†			
	n	Survival time percentile			n	Survival time percentile		
		25 th	50 th	75 th		25 th	50 th	75 th
18.5 – 24.9 (normal)	65	0.5	1.5	2.6	276	1.9	4.7	5.9
25.0 – 29.9 (overweight)	114	0.3	1.5	2.6	383	2.8	5.0	6.4
30.0 – 34.9 (obese 1)	43	0.4	1.9	3.4	224	3.0	5.1	6.4
35.0 – 39.9 (obese 2)	33	0.3	1.4	2.5	95	4.0	5.2	6.4
≥ 40.0 (obese 3)	31	0.3	1.3	3.3	90	2.3	4.8	6.2
Overall	317	0.4	1.5	2.7	1068	2.6	5.0	6.2

Body mass index (kg/m ²)	Participants with recurrent AF				Censored participants‡			
	n	Survival time percentile			n	Survival time percentile		
		25 th	50 th	75 th		25 th	50 th	75 th
18.5 – 24.9 (normal)	245	0.04	0.2	0.9	142	0.6	3.2	6.1
25.0 – 29.9 (overweight)	376	0.06	0.3	1.1	171	1.3	5.0	6.6
30.0 – 34.9 (obese 1)	215	0.05	0.3	1.3	104	1.9	5.2	6.7
35.0 – 39.9 (obese 2)	97	0.04	0.2	1.0	38	2.7	5.2	6.3
≥ 40.0 (obese 3)	91	0.09	0.3	1.0	38	3.6	5.7	6.9
Overall	1,024	0.05	0.3	1.1	493	1.3	5.0	6.5

* Survival times are given in years.

† For permanent AF, censored participants reached the end of follow-up, disenrolled from Group Health, had an AF ablation or maze procedure, or died.

‡ For recurrent AF, censored participants reached the end of follow-up, disenrolled from Group Health, or died.

eTable 3. Hazard ratios of permanent AF for different definitions of permanent AF*

Risk factor	Events	Person-years	Model 3† HR (95% CI)
<i>Permanent AF definition: AF present on four separate occasions with the first and fourth occasions 6-36 months apart and no documented sinus rhythm</i>			
Overall	188	5,694	—
Age, per 10 y	—	—	1.34 (1.14, 1.57)
Female	90	2,791	1.00 (reference)
Male	98	2,903	1.19 (0.88, 1.61)
Body mass index, (kg/m ²)‡			
18.5 – 24.9 (normal)	33	1,329	1.00 (reference)
25.0 – 29.9 (overweight)	70	2,054	1.54 (1.01, 2.35)
30.0 – 34.9 (obese 1)	41	1,292	1.50 (0.94, 2.41)
35.0 – 39.9 (obese 2)	20	562	1.89 (1.06, 3.40)
≥ 40.0 (obese 3)	24	457	3.12 (1.76, 5.53)
Diabetes:			
No	160	4,863	1.00 (reference)
Yes	28	831	1.00 (0.65, 1.53)
Hypertension:			
No	87	2,768	1.00 (reference)
Yes	101	2,926	0.96 (0.71, 1.32)
Systolic blood pressure, per 10 mm Hg	—	—	0.92 (0.84, 1.01)
Diastolic blood pressure, per 10 mm Hg	—	—	1.10 (0.93, 1.29)
<i>Permanent AF definition: AF present on two separate occasions 12-36 months apart without any documented sinus rhythm</i>			
Overall	249	4,853	—
Age, per 10 y	—	—	1.34 (1.16, 1.54)
Female	128	2,361	1.00 (reference)
Male	121	2,492	1.02 (0.79, 1.33)
Body mass index, (kg/m ²)§			
18.5 – 24.9 (normal)	47	1,132	1.00 (reference)
25.0 – 29.9 (overweight)	92	1,750	1.41 (0.98, 2.02)
30.0 – 34.9 (obese 1)	55	1,094	1.38 (0.93, 2.07)
35.0 – 39.9 (obese 2)	28	483	1.73 (1.06, 2.83)
≥ 40.0 (obese 3)	27	394	2.24 (1.35, 3.74)
Diabetes:			
No	213	4,140	1.00 (reference)
Yes	36	713	1.00 (0.68, 1.45)
Hypertension:			
No	113	2,379	1.00 (reference)
Yes	136	2,474	0.96 (0.73, 1.25)
Systolic blood pressure, per 10 mm Hg	—	—	0.98 (0.91, 1.05)
Diastolic blood pressure, per 10 mm Hg	—	—	1.08 (0.95, 1.24)

Risk factor	Events	Person-years	Model 3† HR (95% CI)
Hg			
<i>Permanent AF definition: AF present on two separate occasions 6-18 months apart without any documented sinus rhythm</i>			
Overall	266	5,492	—
Age, per 10 y	—	—	1.27 (1.11, 1.46)
Female	140	2,660	1.00 (reference)
Male	126	2,832	0.95 (0.73, 1.22)
Body mass index, (kg/m ²)‡			
18.5 – 24.9 (normal)	58	1,270	1.00 (reference)
25.0 – 29.9 (overweight)	94	1,986	1.16 (0.83, 1.62)
30.0 – 34.9 (obese 1)	60	1,241	1.19 (0.82, 1.73)
35.0 – 39.9 (obese 2)	26	544	1.24 (0.76, 2.01)
≥ 40.0 (obese 3)	28	450	1.71 (1.05, 2.80)
Diabetes: No	224	4,686	1.00 (reference)
Yes	42	806	1.10 (0.77, 1.56)
Hypertension: No	117	2,682	1.00 (reference)
Yes	149	2,810	1.04 (0.80, 1.36)
Systolic blood pressure, per 10 mm Hg	—	—	0.97 (0.90, 1.04)
Diastolic blood pressure, per 10 mm Hg	—	—	1.07 (0.94, 1.22)

* The definition of permanent AF used in primary analyses (see Table 2) was AF present on two separate occasions 6-36 months apart without any documented sinus rhythm.

† Models 1 & 2 not shown. Model 3: Adjusted for age, sex, all risk factors shown in the table, and baseline coronary heart disease, valvular heart disease, heart failure, and prior stroke.

‡ The HR per 5-kg/m² increment of continuous BMI was 1.21 (95% CI: 1.09, 1.34).

§ The HR per 5-kg/m² increment of continuous BMI was 1.16 (95% CI: 1.05, 1.27).

|| The HR per 5-kg/m² increment of continuous BMI was 1.09 (95% CI: 0.99, 1.20).

eTable 4. Hazard ratios of recurrent AF

Risk factor	Events	Person-years	Model 1* HR (95% CI)	Model 2† HR (95% CI)	Model 3‡ HR (95% CI)
Overall	1,204	2,827	—	—	—
Age, per 10 y	—	—	1.07 (1.01, 1.13)	1.09 (1.02, 1.16)	1.09 (1.03, 1.16)
Female	484	1,412	1.00 (reference)	1.00 (reference)	1.00 (reference)
Male	540	1,415	1.12 (0.99, 1.27)	1.14 (1.00, 1.29)	1.16 (1.02, 1.32)
Body mass index (kg/m ²)§					
18.5 – 24.9 (normal)	245	666	1.00 (reference)	1.00 (reference)	1.00 (reference)
25.0 – 29.9 (overweight)	376	998	1.10 (0.94, 1.30)	1.13 (0.96, 1.33)	1.14 (0.97, 1.35)
30.0 – 34.9 (obese 1)	215	657	1.01 (0.84, 1.22)	1.07 (0.88, 1.29)	1.08 (0.89, 1.30)
35.0 – 39.9 (obese 2)	97	251	1.23 (0.97, 1.56)	1.29 (1.01, 1.64)	1.32 (1.03, 1.69)
≥ 40.0 (obese 3)	91	254	1.25 (0.98, 1.61)	1.34 (1.04, 1.74)	1.34 (1.04, 1.74)
Diabetes:					
No	872	2,358	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	152	469	0.92 (0.78, 1.10)	0.88 (0.74, 1.06)	0.88 (0.73, 1.06)
Hypertension:					
No	475	1,333	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	549	1,494	1.00 (0.88, 1.14)	1.01 (0.89, 1.15)	1.02 (0.89, 1.16)
Systolic blood pressure, per 10 mm Hg	—	—	0.97 (0.94, 1.00)	0.97 (0.93, 1.01)	0.97 (0.93, 1.01)
Diastolic blood pressure, per 10 mm Hg	—	—	0.96 (0.90, 1.01)	0.97 (0.91, 1.04)	0.98 (0.91, 1.05)

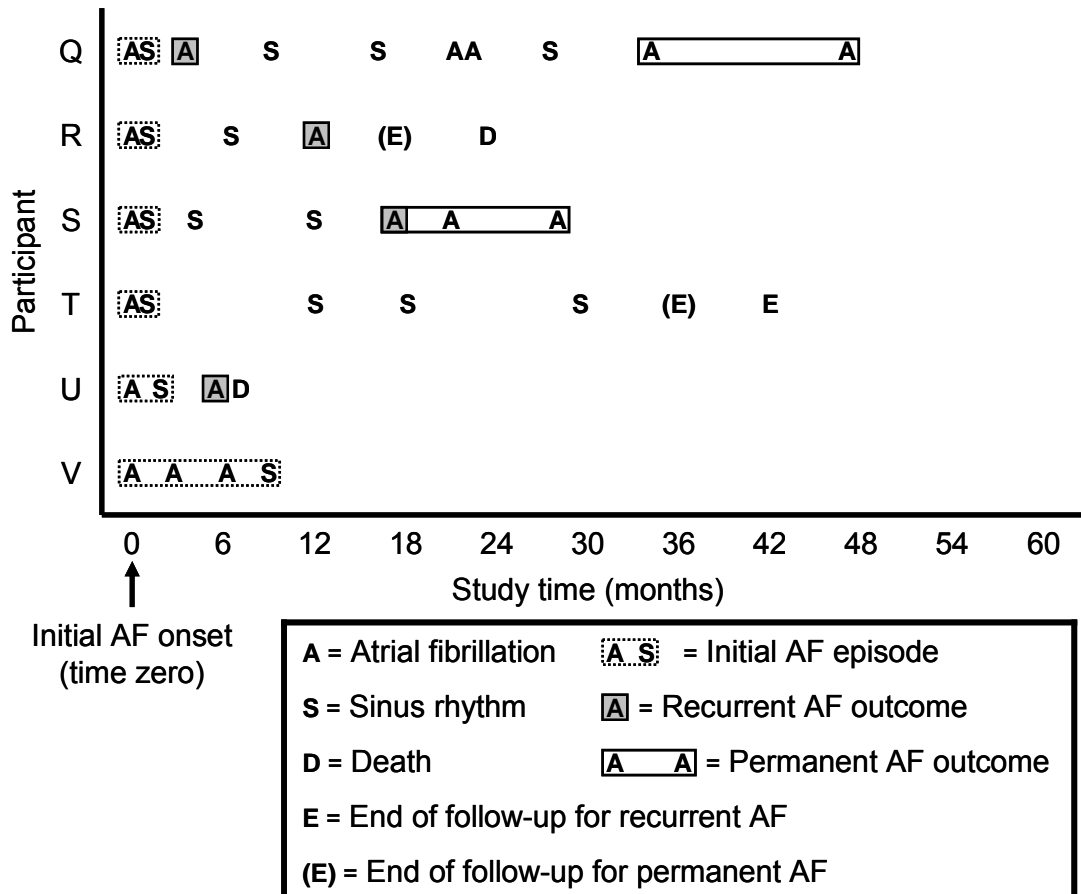
* Model 1: Adjusted for age and sex.

† Model 2: Adjusted for age, sex, and all risk factors shown in the table.

‡ Model 3: Adjusted for age, sex, all risk factors shown in the table, and baseline coronary heart disease, valvular heart disease, heart failure, and prior stroke.

§ The HRs per 5-kg/m² increment of continuous BMI were 1.04 (95% CI: 1.00, 1.09) in model 1; 1.06 (95% CI: 1.01, 1.11) in model 2; and 1.06 (95% CI: 1.01, 1.11) in model 3.

eFigure 1.



Examples of participant timelines showing recurrent and permanent AF outcomes:

Participant Q: Sinus rhythm was observed one day after initial AF onset, indicating the initial AF episode had terminated, and the participant entered follow-up for outcomes. Recurrent AF was observed in month 4. Permanent AF was observed in months 34-47, where AF was present on two separate occasions at least six months apart without any documented sinus rhythm.

Participant R: Sinus rhythm was observed one day after initial AF onset. Recurrent AF was observed in month 12. Permanent AF was not observed. Follow-up for permanent AF ended in month 17, six months prior to the participant's death in month 23.

Participant S: Sinus rhythm was observed one day after initial AF onset. Recurrent AF was observed in month 18. Permanent AF was observed in months 18-28.

Participant T: Sinus rhythm was observed one week after initial AF onset. Recurrent AF was not observed. Follow-up for recurrent AF ended in month 42, when the study ended. Permanent AF was not observed. Follow-up for permanent AF ended in month 36, six months prior to the study end in month 42.

Participant U: Sinus rhythm was observed two months after initial AF onset. Recurrent AF was observed in month 6. The participant died in month 7 and was therefore excluded from the analysis of permanent AF because less than six months of follow-up time were available after termination of the initial AF episode.

Participant V: Sinus rhythm was observed nine months after initial AF onset. Because the initial AF episode did not terminate within six months the participant was excluded from the study and did not enter follow-up for outcomes.