

Accelerometer-derived physical activity and the risk of mortality, heart failure, and stroke in patients with atrial fibrillation: A prospective study from UK Biobank

Supplementary materials

Supplementary Table 1. Definitions of covariates and outcomes.

Supplementary Table 2. Comparison of the baseline characteristics between excluded and included patients of our study.

Supplementary Table 3. Baseline characteristics of the study population according to the adherence to physical activity extended guidelines based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer.

Supplementary Table 4. The risk of primary and secondary outcomes according to the adherence to the physical activity guidelines.

Supplementary Table 5. The risk of primary and secondary outcomes according to the adherence to the physical activity standard guideline determined by the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer, by excluding clinical outcomes during the first 90 days of follow-up.

Supplementary Table 6. Adherence to the physical activity standard guideline and the risk of all-cause mortality, cardiovascular mortality, heart failure, and ischemic stroke according to several subgroups.

Supplementary Figure 1. Cumulative risks of A) all-cause mortality, B) cardiovascular mortality, C) heart failure, and D) stroke, stratified by adherence to physical activity extended guideline based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer.

Supplementary Figure 2. The risk of all-cause mortality and heart failure according to the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer applying the cutoff of 125mg and 150mg; A) all-cause mortality (MVPA cutoff, 125 mg); B) all-cause mortality (MVPA cutoff, 150 mg); C) heart failure (MVPA cutoff, 125 mg), and; D) heart failure (MVPA cutoff, 150 mg).

Supplementary Figure 3. Cumulative risks of all-cause mortality and heart failure stratified by adherence to physical activity standard guidelines based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer applying the cutoff of 125mg and 150mg; A) all-cause mortality (MVPA cutoff, 125 mg); B) all-cause mortality (MVPA cutoff, 150 mg); C) heart failure (MVPA cutoff, 125 mg), and; D) heart failure (MVPA cutoff, 150 mg).

Supplementary Table 1. Definitions of covariates and outcomes.

Diagnosis	UK Biobank Field ID	Diagnostic code (ICD-9 or ICD-10)
Inclusion		
Atrial fibrillation	41270, 41280, 131350	I48
Primary outcome		
All-cause mortality	40000	
Secondary outcome		
Cardiovascular mortality	40001	I code
Heart failure	41270, 41280, 131354	I50, I11.0, I13.0, I13.2
Stroke	20002, 20008, 20004, 20010, 41270, 41280, 131360, 131362, 131364, 131366, 131368, 41271, 41281, 41272, 41282, 42006	I60-I64
Covariates		
Age	21022	
Sex	31	
Body mass index	21001	
Current smoking	20116	
Alcohol intake	1558	
Diabetes mellitus	2443, 6153, 6177, 20002, 130708, 130710, 130712, 130714	
	41270, 41280	E11-E14
Hypertension	6153, 6177, 20002, 2966, 131286, 131288, 131290, 131292, 131294	
	41270, 41280	I10-I13, I15
Dyslipidemia	6153, 6177, 20002, 130814	
	41270, 41280	E78
Myocardial infarction	41270, 41280	I21-I22, I25
Townsend Deprivation Index	189	
Charlson Comorbidity Index		
Myocardial infarction	41270, 41280	I21-I22, I25
Congestive heart failure	41270, 41281	I50
Peripheral vascular disease	41270, 41282	I70-I79
Cerebrovascular accident or transient ischemic attack	41270, 41283	I60-I69
Dementia	41270, 41284	F03, G30
Chronic obstructive pulmonary disease	41270, 41285	J41-J45, J47, J64
Connective tissue disease	41270, 41286	M30-M36, M06
Peptic ulcer disease	41270, 41287	K25, K26
Liver disease	41270, 41288	B18, B19, K70-K77

Hemiplegia	41270, 41289	G80-G82
Moderate to severe chronic kidney disease	41270, 41290	N17-N19
Malignancy (localized solid tumor, leukemia, lymphoma)	41270, 41291	C00-C99 (except C44, C73)
Metastatic malignancy	41270, 41292	C76-C80
AIDS	41270, 41293	B20-B24

Abbreviations: ICD, International Classification of Diseases.

Supplementary Table 2. Comparison of the baseline characteristics between excluded and included patients of our study.

	Patients with AF		p-value
	Excluded ^a N=34,988	Included ^b N=3,002	
Age	67.2 ± 6.1	67.1 ± 6.1	0.74
Sex			<0.001
Female	12,985 (37.1%)	978 (32.6%)	
Male	22,003 (62.9%)	2,024 (67.4%)	
Body mass index (kg/m²)	29.1 ± 5.4	28.1 ± 5.0	<0.001
Comorbidities			
Hypertension	18,885 (54.0%)	1,953 (65.1%)	<0.001
Diabetes mellitus	4,040 (11.5%)	317 (10.6%)	0.10
Dyslipidemia	13,727 (39.2%)	1,521 (50.7%)	<0.001
Myocardial infarction	3,098 (8.9%)	245 (8.2%)	0.20
CHA₂DS₂-VASc	2.2 ± 1.2	2.4 ± 1.3	<0.001
Medications			
Hypertensive medication	15,147 (43.3%)	1,220 (40.6%)	0.005
Dyslipidemia medication	12,684 (36.3%)	1,065 (35.5%)	0.40
Warfarin	3,140 (9.0%)	502 (16.7%)	<0.001
Antiplatelet	11,301 (32.3%)	1,122 (37.4%)	<0.001
Charlson Comorbidity Index	3.0 ± 1.5	3.5 ± 1.9	<0.001
Townsend deprivation index	-1.1 ± 3.2	-1.8 ± 2.8	<0.001
Lifestyle behaviors			
Current smoking	3,751 (10.7%)	173 (5.8%)	<0.001
Daily drinking	8,293 (23.7%)	862 (28.7%)	<0.001
Laboratory values			
Systolic blood pressure (mmHg)	144.9 ± 20.5	141.9 ± 19.8	<0.001
Diastolic blood pressure (mmHg)	82.8 ± 11.2	82.6 ± 11.3	0.45
Cholesterol (mmol/L)	5.4 ± 1.2	5.3 ± 1.2	0.099
HDL(mmol/L)	1.4 ± 0.4	1.4 ± 0.4	0.26
LDL (mmol/L)	3.3 ± 0.9	3.3 ± 0.9	0.23
TG (mmol/L)	1.8 ± 1.0	1.7 ± 1.0	<0.001
Glucose (mmol/L)	5.4 ± 1.6	5.2 ± 1.2	<0.001
HbA1c (mmol/mol)	38.1 ± 8.5	36.8 ± 6.7	<0.001

Abbreviation: HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglyceride.

^a: Patients with AF who do not have accelerometer data or have accelerometer data before their AF diagnosis.

^b: Patients with AF who have accelerometer data (after their AF diagnosis).

Supplementary Table 3. Baseline characteristics of the study population according to the adherence to physical activity extended guidelines based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer.

	Total N=2,324	Not meeting PA extended* guideline N=1,909 (82.1%)	Meeting PA extended* guideline N=415 (17.9%)	p- value
Age	66.9 ± 6.2	67.4 ± 6.0	65.0 ± 6.5	<0.001
Sex				<0.001
Female	816 (35.1%)	712 (37.3%)	104 (25.1%)	
Male	1,508 (64.9%)	1,197 (62.7%)	311 (74.9%)	
Race				
White	2287 (98.5%)	1878 (98.4%)	409 (98.6%)	0.861
Body mass index	27.9 ± 4.9	28.3 ± 5.1	26.0 ± 3.7	<0.001
Comorbidities				
Hypertension	1,438 (61.9%)	1,224 (64.1%)	214 (51.6%)	<0.001
Diabetes mellitus	203 (8.7%)	184 (9.6%)	19 (4.6%)	<0.001
Dyslipidemia	1,101 (47.4%)	945 (49.5%)	156 (37.6%)	<0.001
Myocardial infarction	144 (6.2%)	128 (6.7%)	16 (3.9%)	0.029
Medications				
Hypertensive medication	877 (37.7%)	761 (39.9%)	116 (28.0%)	<0.001
Dyslipidemia medication	743 (32.0%)	647 (33.9%)	96 (23.1%)	<0.001
Warfarin	308 (13.3%)	263 (13.8%)	45 (10.8%)	0.11
Antiplatelet	833 (35.8%)	702 (36.8%)	131 (31.6%)	0.045
CHA₂DS₂-VASc	2.2 ± 1.1	2.2 ± 1.1	2.0 ± 1.1	<0.001
Charlson Comorbidity Index	3.2 ± 1.7	3.3 ± 1.7	2.8 ± 1.6	<0.001
Townsend Deprivation Index	-1.9 ± 2.7	-1.9 ± 2.7	-1.7 ± 2.8	0.084
Lifestyle behaviors				
Current smoking	130 (5.6%)	107 (5.6%)	23 (5.5%)	0.96
Daily drinking	669 (28.8%)	538 (28.2%)	131 (31.6%)	0.17
Laboratory data				
Systolic blood pressure (mmHg)	142.1 ± 19.4	142.6 ± 19.3	140.2 ± 19.9	0.026
Diastolic blood pressure (mmHg)	82.6 ± 11.0	82.6 ± 11.0	82.1 ± 11.4	0.41
Cholesterol (mmol/L)	5.4 ± 1.1	5.4 ± 1.2	5.5 ± 1.0	0.10
HDL(mmol/L)	1.4 ± 0.4	1.4 ± 0.4	1.4 ± 0.3	0.003
LDL (mmol/L)	3.3 ± 0.9	3.3 ± 0.9	3.4 ± 0.8	0.15
TG (mmol/L)	1.7 ± 0.9	1.7 ± 0.9	1.6 ± 0.9	0.003
Glucose (mmol/L)	5.1 ± 1.0	5.1 ± 1.1	5.0 ± 0.8	0.050
HbA1c (mmol/mol)	36.4 ± 6.2	36.7 ± 6.5	35.5 ± 4.6	<0.001
Overall acceleration (miligravity, mg)	24.9 ± 7.4	23.2 ± 5.7	33.0 ± 8.6	<0.001

MVPA duration (min/week)	105.8 (37.4-229.4)	80.0 (26.7-151.3)	420.1 (352.5-550.1)	<0.001
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Abbreviation: PA, physical activity; HDL-C, high-density lipoprotein cholesterol; LDL-C, Low-density lipoprotein cholesterol; TG, triglyceride; MVPA, moderate to vigorous physical activity.

*: ESC/AHA/WHO extended recommendation, MVPA \geq 300 min/week

Supplementary Table 4. The risk of primary and secondary outcomes according to the adherence to the physical activity guidelines.

Outcomes and MVPA duration	Event / N	Cumulative incidence	HR (95% CI)					
			Model 1		Model 2		Model 3	
All-cause mortality								
MVPA < 150 min/wk	134/1430	13.4%	1 (Reference)		1 (Reference)		1 (Reference)	
150 min/wk ≤ MVPA < 300 min/wk	29/481	6.4%	0.639 (0.428-0.955)	p=0.029	0.673 (0.449-1.009)	p=0.055	0.759 (0.504-1.142)	p=0.186
300 min/wk ≤ MVPA	18/413	6.8%	0.459 (0.280-0.750)	p=0.002	0.503 (0.306-0.828)	p=0.007	0.539 (0.325-0.895)	p=0.017
			p-for-trend <0.001		p-for-trend <0.001		p-for-trend <0.001	
Cardiovascular mortality								
MVPA < 150 min/wk	43/1430	5.13%	1 (Reference)		1 (Reference)		1 (Reference)	
150 min/wk ≤ MVPA < 300 min/wk	11/481	2.3%	0.755 (0.389-1.464)	p=0.405	0.805 (0.413-1.572)	p=0.526	0.918 (0.467-1.805)	p=0.805
300 min/wk ≤ MVPA	8/413	3.8%	0.636 (0.299-1.353)	p=0.240	0.708 (0.329-1.524)	p=0.377	0.755 (0.345-1.651)	p=0.481
			p-for-trend =0.390		p-for-trend =0.056		p-for-trend <0.001	
Heart failure								
MVPA < 150 min/wk	171/1430	15.9%	1 (Reference)		1 (Reference)		1 (Reference)	
150 min/wk ≤ MVPA < 300 min/wk	27/481	7.7%	0.451 (0.300-0.677)	p<0.001	0.495 (0.329-0.745)	p=0.001	0.601 (0.398-0.907)	p=0.015
300 min/wk ≤ MVPA	27/413	7.3%	0.521(0.347-0.782)	p=0.002	0.609 (0.403-0.920)	p=0.018	0.782 (0.513-1.192)	p=0.252
			p-for-trend <0.001		p-for-trend <0.001		p-for-trend <0.001	
Stroke								
MVPA < 150 min/wk	61/1430	4.9%	1 (Reference)		1 (Reference)		1 (Reference)	
150 min/wk ≤ MVPA < 300 min/wk	15/481	4.1%	0.721 (0.410-1.268)	p=0.256	0.787 (0.445-1.393)	p=0.411	0.812 (0.456-1.447)	p=0.481
300 min/wk ≤ MVPA	15/413	3.7%	0.835 (0.475-1.469)	p=0.532	0.958 (0.538-1.706)	p=0.884	0.905 (0.501-1.634)	p=0.740
			p-for-trend =0.467		p-for-trend =0.039		p-for-trend =0.002	

Abbreviation: PA, physical activity; HR, hazard ratio; CI, confidence interval.

Model 1: unadjusted

Model 2: adjusted by age and sex

Model 3: adjusted by age, sex, body mass index, current smoking, daily drinking, Charlson Comorbidity Index, and Townsend Deprivation Index.

Supplementary Table 5. The risk of primary and secondary outcomes according to the adherence to the physical activity standard guideline determined by the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer, by excluding clinical outcomes during the first 90 days of follow-up.

Outcomes and adherence to PA standard guideline	Event / N	Cumulative incidence	HR (95% CI)		
			Model 1	Model 2	Model 3
All-cause mortality					
Not meeting	132/1430	13.0%	1 (Reference)	1 (Reference)	1 (Reference)
Meeting	49/481	6.8%	0.583 (0.419-0.812) p=0.001	0.630 (0.449-0.882) p=0.007	0.698 (0.495-0.986) p=0.041
Cardiovascular mortality					
Not meeting	42/1430	4.9%	1 (Reference)	1 (Reference)	1 (Reference)
Meeting	20/481	3.1%	0.732 (0.425-1.261) p=0.261	0.820 (0.470-1.430) p=0.484	0.918 (0.520-1.621) p=0.768
Heart failure					
Not meeting	171/1430	15.8%	1 (Reference)	1 (Reference)	1 (Reference)
Meeting	54/481	7.2%	0.460 (0.337-0.630) p<0.001	0.527 (0.383-0.725) p<0.001	0.656 (0.473-0.908) p=0.011
Stroke					
Not meeting	59/1430	4.5%	1 (Reference)	1 (Reference)	1 (Reference)
Meeting	32/481	4.3%	0.896 (0.580-1.384) p=0.621	1.017 (0.652-1.589) p=0.939	1.013 (0.641-1.602) p=0.955

Abbreviation: PA, physical activity; HR, hazard ratio; CI, confidence interval

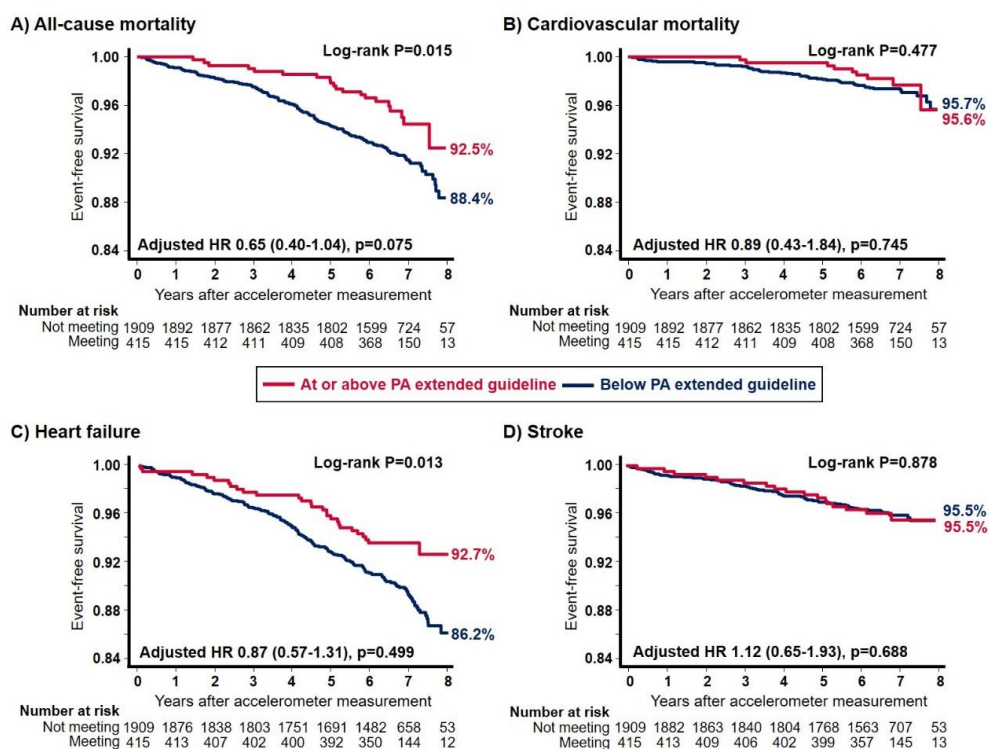
Supplementary Table 6. Adherence to the physical activity standard guideline and the risk of all-cause mortality, cardiovascular mortality, heart failure, and ischemic stroke according to several subgroups.

Subgroup	All-cause mortality			Cardiovascular mortality			Heart failure			Stroke		
	HR (95% CI) ^a	P value	P-for-interaction	HR (95% CI) ^a	P value	P-for-interaction	HR (95% CI) ^a	P value	P-for-interaction	HR (95% CI) ^a	P value	P-for-interaction
Age												
<65	0.271 (0.121-0.610)	0.002	0.018	0.430 (0.125-1.475)	0.180	0.275	0.528 (0.257-1.088)	0.083	0.911	0.699 (0.282-1.733)	0.440	0.616
≥65	0.847 (0.584-1.228)	0.487		1.021 (0.552-1.887)	0.948		0.673 (0.473-0.956)	0.027		1.001 (0.597-1.678)	0.997	
Sex												
Male	0.785 (0.539-1.143)	0.206	0.465	1.307 (0.698-2.449)	0.403	0.214	0.615 (0.428-0.883)	0.008	0.587	0.591 (0.211-1.654)	0.316	0.224
Female	0.568 (0.230-1.403)	0.220		0.349 (0.075-1.617)	0.178		0.854 (0.434-1.679)	0.647		1.164 (0.688-1.967)	0.572	
CCI												
<3	0.568 (0.268-1.205)	0.140	0.327	1.047 (0.366-2.995)	0.932	0.559	0.879 (0.415-1.862)	0.736	0.221	1.411 (0.558-3.567)	0.466	0.400
≥3	0.748 (0.511-1.094)	0.134		0.841 (0.428-1.656)	0.617		0.653 (0.456-0.934)	0.020		0.830 (0.485-1.419)	0.496	
CVAS												
<2	0.529 (0.193-1.444)	0.214	0.386	0.634 (0.169-2.385)	0.500	0.659	0.844 (0.335-2.128)	0.719	0.190	0.616 (0.197-1.928)	0.406	0.185
≥2	0.741 (0.516-1.065)	0.106		1.006 (0.543-1.864)	0.984		0.644 (0.457-0.908)	0.012		1.087 (0.661-1.786)	0.742	

Abbreviation: PA, physical activity; HR, hazard ratio; CI, confidence interval.

a) adjusted by age, sex, body mass index, current smoking, daily drinking, Charlson Comorbidity Index, and Townsend Deprivation Index.

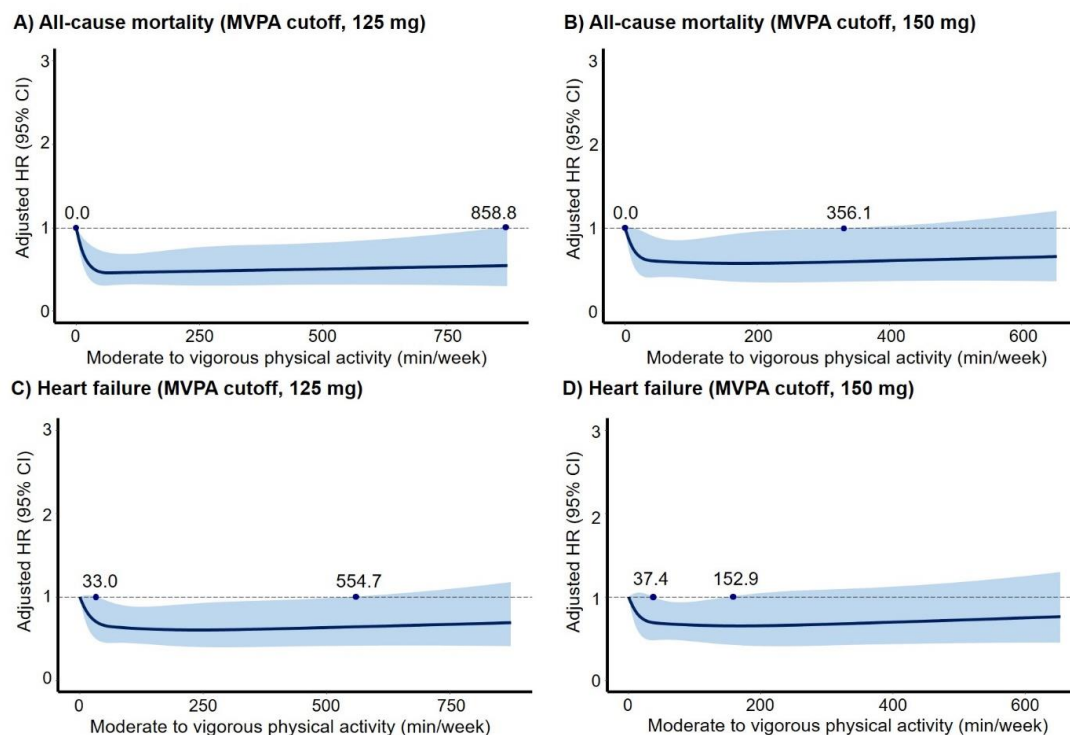
Supplementary Figure 1. Cumulative risks of A) all-cause mortality, B) cardiovascular mortality, C) heart failure, and D) stroke, stratified by adherence to physical activity extended guidelines based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer.



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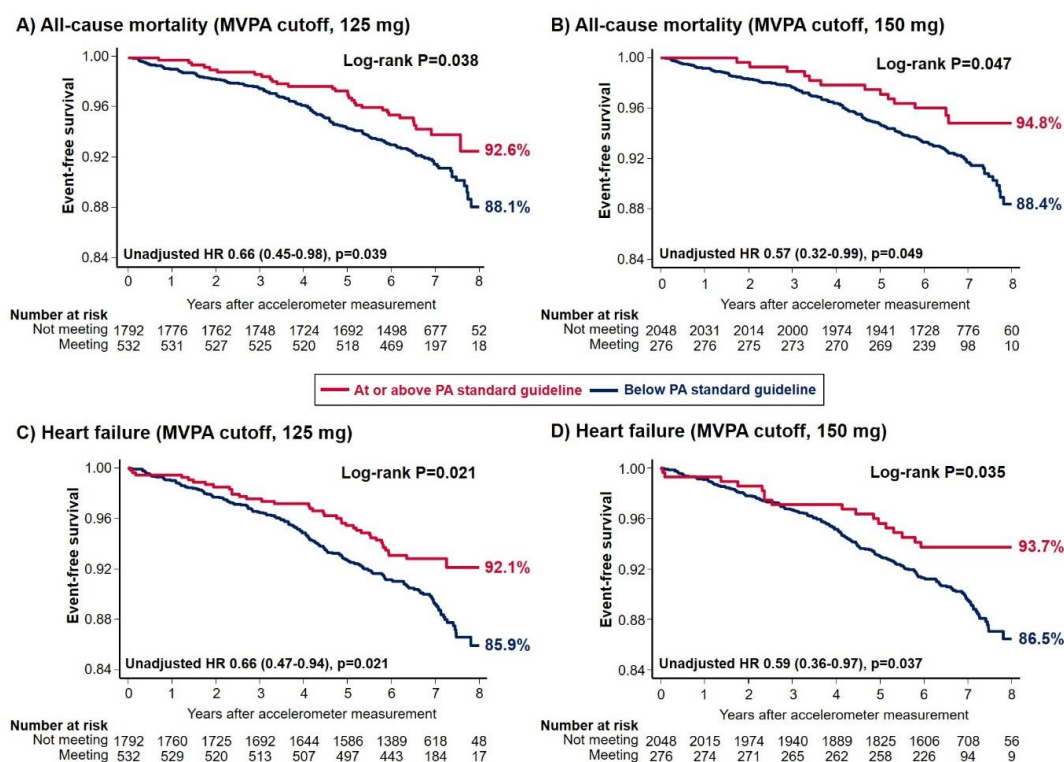
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Abbreviation: HR, hazard ratio; CI, confidence interval

Hazard ratios were adjusted by age, sex, body mass index, current smoking, daily drinking, Charlson Comorbidity Index, and Townsend Deprivation Index.

Supplementary Figure 3. Cumulative risks of all-cause mortality and heart failure stratified by adherence to physical activity standard guidelines based on the objectively measured moderate to vigorous physical activity using a wrist-worn accelerometer applying the cutoff of 125mg and 150mg: A) all-cause mortality (MVPA cutoff, 125 mg); B) all-cause mortality (MVPA cutoff, 150 mg); C) heart failure (MVPA cutoff, 125 mg), and; D) heart failure (MVPA cutoff, 150 mg).



Abbreviation: HR, hazard ratio; MVPA, moderate to vigorous physical activity; PA, physical activity.