

Supplementary Materials

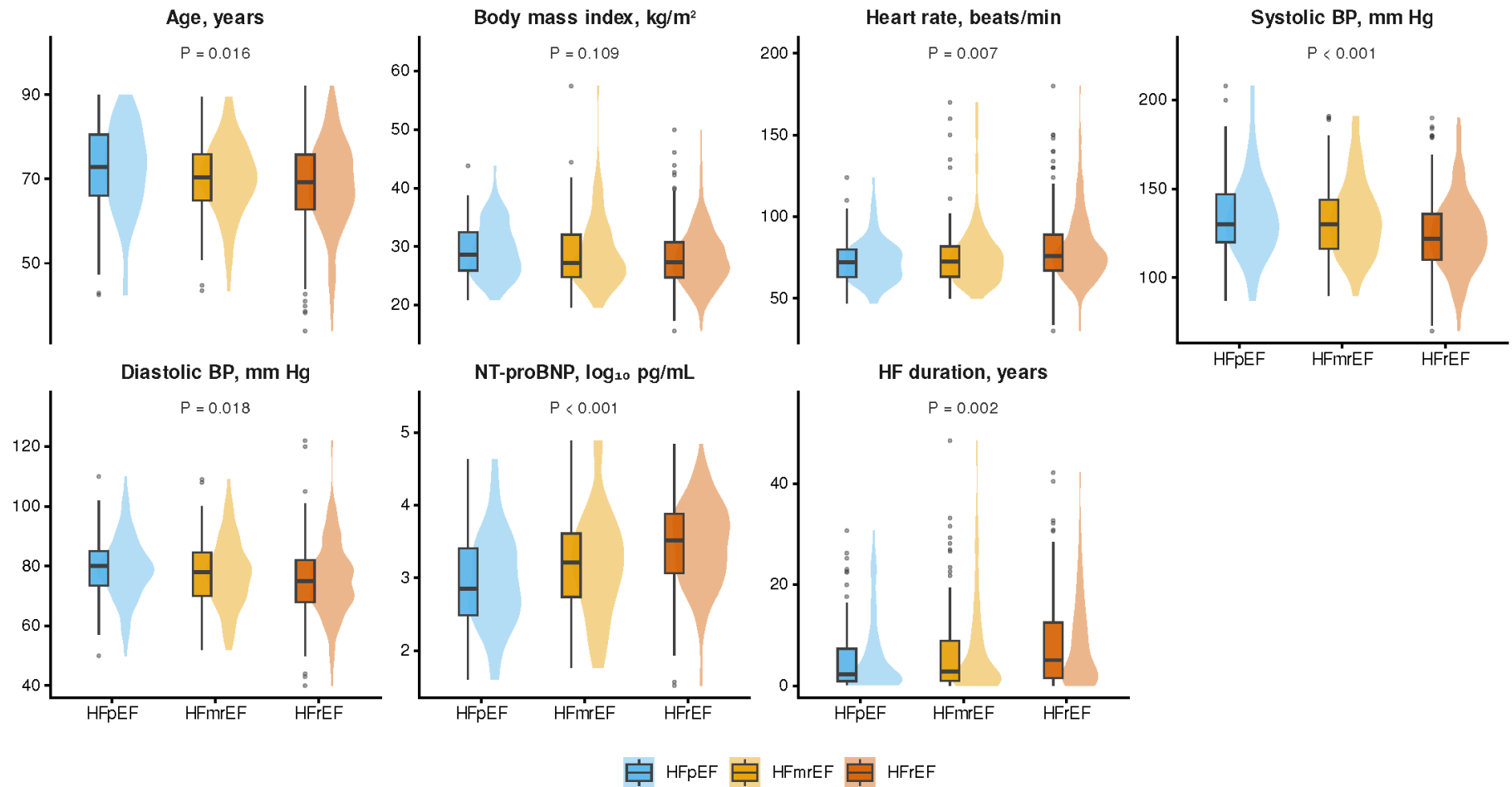
The STROBE (cohort) and RECORD reporting checklist, mapping each item to its location in the manuscript, is provided as a separate file.

Supplementary Table SI. *Sensitivity analyses for the adjusted association between non-ischemic etiology (versus ischemic) and all-cause mortality, by phenotype.*

Analytic approach	HFrEF (n = 625)	HFmrEF (n = 260)	HFpEF (n = 319)
Crude (unadjusted)	0.74 (0.50–1.08) P = 0.122	4.25 (1.77–10.21) P = 0.001	1.16 (0.56–2.41) P = 0.696
Entropy balancing (primary)	1.03 (0.68–1.58) P = 0.875	3.99 (1.51–10.51) P = 0.005	0.84 (0.37–1.90) P = 0.670
Doubly robust	1.00 (0.66–1.54) P = 0.982	4.09 (1.39–12.05) P = 0.011	0.75 (0.30–1.85) P = 0.527
Stabilized IPTW (trimmed)	0.98 (0.64–1.49) P = 0.924	4.05 (1.55–10.58) P = 0.004	0.74 (0.33–1.65) P = 0.461
Multiple imputation (m = 20)	1.06 (0.70–1.62) P = 0.775	3.60 (1.43–9.02) P = 0.006	0.83 (0.36–1.89) P = 0.656

Note. Adjusted hazard ratios (95% CI) for non-ischemic versus ischemic etiology. Effective sample sizes after weighting (ischemic / non-ischemic): 218.5 / 263.6 (HFrEF), 91.3 / 125.1 (HFmrEF), 47.9 / 231.1 (HFpEF); maximum weights 10.05, 6.95, 19.32. In HFmrEF, leave-one-out hazard ratios ranged 3.71–5.84, none crossing unity. IPTW = inverse probability of treatment weighting.

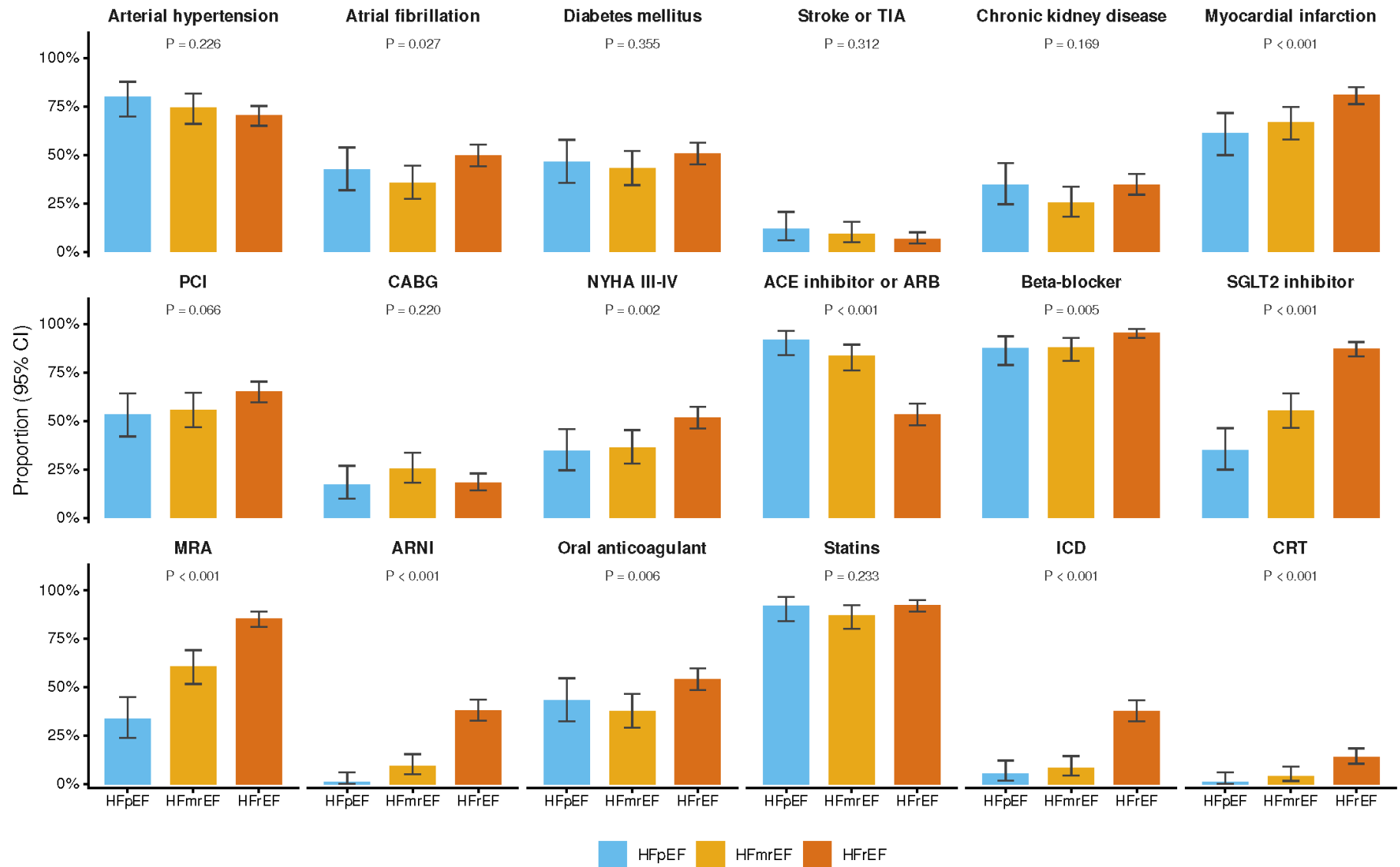
Distribution of continuous variables across ischemic heart failure phenotypes



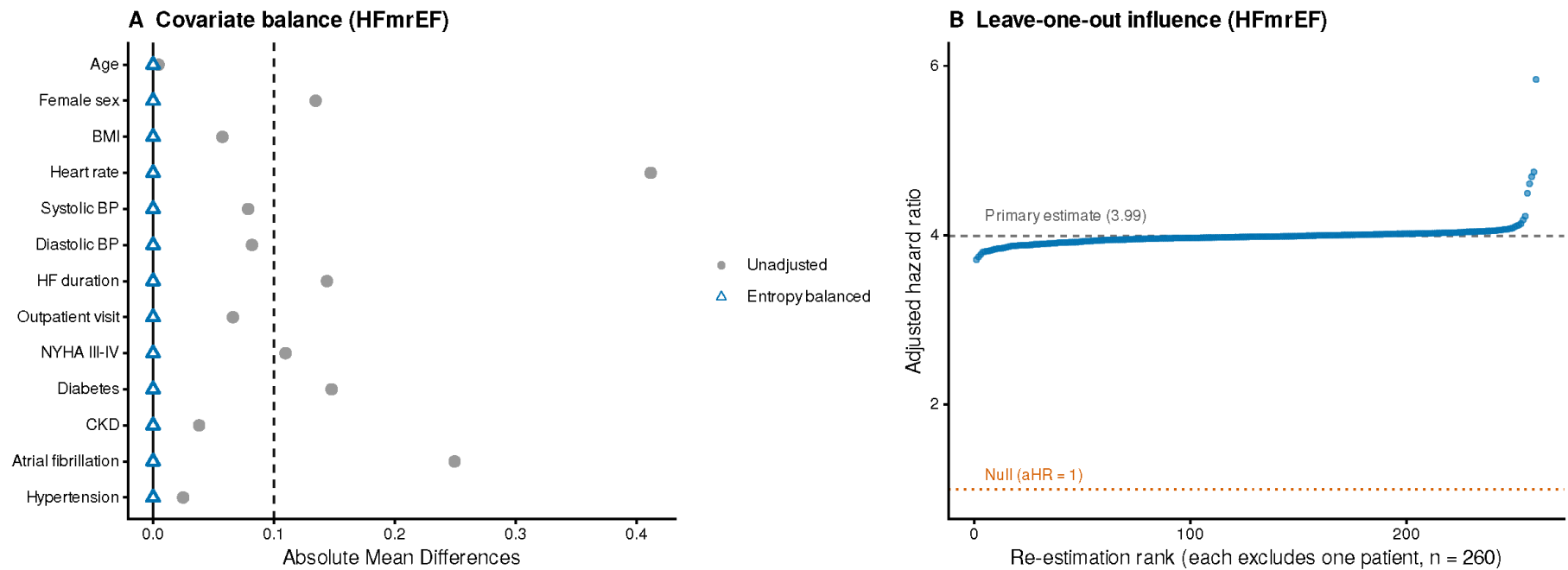
Supplementary Figure S1. Distribution of continuous variables across ischemic phenotypes (half-violin and half-boxplot; NT-proBNP on a log₁₀ scale).

Categorical variable proportions across ischemic heart failure phenotypes

Bars: proportion; error bars: 95% Jeffreys confidence interval



Supplementary Figure S2. Categorical variable proportions across ischemic phenotypes; bars with 95% Jeffreys confidence intervals.



Supplementary Figure S3. Covariate balance (Love plot) and leave-one-out influence diagnostics for the HFmrEF estimate.

Supplementary Table SII. Effective sample size and maximum weight after entropy balancing, by phenotype.

Phenotype	n	Events	aHR (95% CI)	ESS isch.	ESS non-isch.	Max weight (isch / non)
HFrEF	625	105	1.03 (0.68–1.58)	218.5	263.6	10.05 / 6.26
HFmrEF	260	34	3.99 (1.51–10.51)	91.3	125.1	6.95 / 4.04
HFpEF	319	42	0.84 (0.37–1.90)	47.9	231.1	19.32 / 2.67

Note. Effective sample size = $(\Sigma w)^2 / \Sigma w^2$ within each exposure group; aHR for non-ischemic vs ischemic.

Supplementary Table SIII. Mortality, etiology distribution and heart-failure duration by phenotype and etiology.

Phenotype	Etiology	N	Deaths (%)	Median follow-up (mo)
HFrEF	Ischemic	305	58 (19%)	14.8
HFrEF	Non-ischemic	322	48 (14.9%)	14.5
HFmrEF	Ischemic	118	7 (5.9%)	15.7
HFmrEF	Non-ischemic	144	28 (19.4%)	14.3
HFpEF	Ischemic	75	9 (12%)	14.4
HFpEF	Non-ischemic	246	33 (13.4%)	14.5

Note. Within-phenotype ischemic share: HFrEF 48.6%, HFmrEF 45%, HFpEF 23.4%. HF duration (median [IQR], y) non-ischemic: HFrEF 2.4 [0.7–7.8], HFmrEF 1.9 [0.9–6.6], HFpEF 1.8 [0.7–6.2].

Supplementary Table SIV. Comparison of patients with versus without documented LVEF.

Variable	LVEF known (n=1210)	LVEF missing (n=200)	P
age	68.9 (60.3–76.2)	70.5 (60.1–76.7)	0.455
bmi	28.0 (25.0–32.0)	27.8 (24.2–32.7)	0.741
hr	77.0 (67.0–90.0)	75.0 (69.0–85.2)	0.285
sbp	127.5 (113.0–140.0)	127.0 (116.0–140.0)	0.704
dbp	78.0 (70.0–85.0)	78.0 (70.0–84.0)	0.809
hf_duration	2.7 (0.9–8.7)	4.5 (1.2–9.2)	0.007
dm	455 (37.6%)	77 (41.0%)	0.423
ckd	329 (27.2%)	49 (26.1%)	0.814
af	627 (51.8%)	96 (51.1%)	0.909
htn	823 (68.0%)	130 (69.1%)	0.821
mi	423 (35.0%)	59 (31.4%)	0.38
Mortality	183/1210 (15.1%)	36/200 (18%)	–

Note. Continuous: median (IQR), Wilcoxon rank-sum; binary: n (%), chi-squared.

Supplementary Table SV. Small-sample-robust analyses and statistical power, HFmrEF stratum.

Analysis	aHR (95% CI)	P
Weighted Cox, Wald CI (primary)	3.99 (1.51–10.51)	0.005
Weighted Cox, profile-likelihood CI	3.99 (1.51–10.51)	–
Firth penalized, crude	3.42 (1.61–8.25)	0.001
Firth penalized, adjusted (age, sex, NYHA)	2.94 (1.36–7.18)	0.005

Note. Power (34 events): ~98% for the observed HR; minimum detectable HR at 80% power = 2.63. Etiology-by-phenotype interaction: robust Wald $\chi^2(2) = 6.89$, $P = 0.032$.

Supplementary Table SVI. HFmrEF estimate additionally balancing on registry-bridged covariates (available-case).

Balancing set	aHR (95% CI)	n	Events
Primary (13 covariates)	3.99 (1.51–10.51)	260	34
+ egfr	5.04 (1.70–14.89)	227	33
+ hb	4.25 (1.35–13.43)	233	33
+ lvedd	4.39 (1.56–12.37)	209	31
+ egfr+hb+lvedd	5.23 (1.55–17.70)	177	30

Note. eGFR by Cockcroft–Gault; Hb = hemoglobin; LVEDD = LV end-diastolic diameter. Myocardial fibrosis and systematic chamber geometry were not collected.

Supplementary Table SVII. Characteristics of the NT-proBNP subsample, HFmrEF.

Subsample	n	Deaths (%)	Median age	Ischemic
NT-proBNP available	159	25 (15.7%)	72.8	42.1%
NT-proBNP missing	103	10 (9.7%)	68.2	49.5%

Note. The subsample with available NT-proBNP differed from the remainder, confirming the augmented analysis is available-case.

Supplementary Table SVIII. Bounding sensitivity analysis for inclusion of the 12 in-hospital deaths (HFmrEF).

Scenario	HFmrEF ischemic	HFmrEF non-ischemic	RR (non/isch)	P
Primary (12 excluded)	7/118 (5.9%)	28/144 (19.4%)	3.28	0.002
Proportional allocation of 12	8/119 (6.7%)	29/145 (20.0%)	2.98	0.002
Worst case (all 12 → ischemic)	19/130 (14.6%)	28/144 (19.4%)	1.33	0.337

Note. The 12 patients who died during the index hospitalization were excluded at cohort definition and lack individual phenotype/covariate data; their impact is therefore bounded rather than modelled directly. Overall crude mortality: 219/1410 (15.5%) (primary) versus 231/1422 (16.2%) including the 12. At least 6 of the 12 would have to be ischemic HFmrEF deaths to abolish crude significance, whereas ischemic HFmrEF comprises only ~8% of the cohort. RR, risk ratio (non-ischemic vs ischemic); P, Fisher exact test.