The impact of physical function on healthcare resource use and clinical outcomes in patients with heart failure: A UK Biobank study

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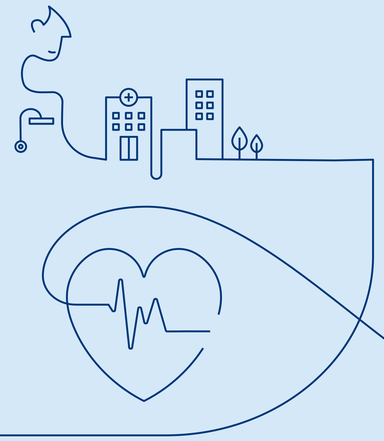
Individuals living with HF who engage in **low or moderate levels of physical activity have a higher hazard of HHF and ACM and use more healthcare resources** than those with high levels of physical activity.



Conclusion

The benefits of physical activity in patients with HF can be observed at both the patient-level and the healthcare system-level. It is important to support patients with HF in undertaking regular physical activity through interventions such as cardiac rehabilitation programmes and effective treatments that may help better manage symptoms and remove barriers to increasing physical activity levels.

Background

- Heart failure (HF) is associated with frequent hospitalisations and an increased risk of mortality,[1] severely impacting patients' quality of life.
- World Health Organisation (WHO) guidelines recommend adults undertake at least 150 minutes of moderate-intensity physical activity throughout the week.[2] Similarly, organisations such as the European Society of Cardiology and the American College of Cardiology/American Heart Association recommend that patients with HF undertake regular physical activity to improve functional capacity and quality of life.[3,4]
- Exercise-based cardiac rehabilitation programmes have been shown to reduce hospitalisations in patients with HF,[5] however there is little research on the wider impact of physical activity on healthcare resource use (HCRU) in this population.

Objective

- To investigate the impact of physical activity on clinical outcomes and HCRU in patients with HF.

Methods

- Participants from the UK Biobank database with a prior diagnosis of HF and linked primary and secondary care data, without a record of cancer (excluding melanoma) in the five years prior to the index date, were included in this study.
- Biobank participants were recruited between 2006 and 2010; data were sourced from release v19 (March 2025).
- The study index date (day 0) was defined as the day of the first record of physical activity data in eligible participants. Participant characteristics were gathered over an unlimited lookback period (prior to the index date).
- Clinical outcomes (hospitalisation for HF [HHF] and all-cause mortality [ACM]) were collected between index and end of follow-up or death. HCRU outcomes (hospital episodes and length of stay [LOS]) were collected over a 5-year period from index.
- The exposure variable was excess metabolic equivalent of task (MET)-score (i.e., activity beyond basal metabolic rate), measured as excess MET-hours per week, estimated via self-reported physical activity.
- Patients were categorised by excess MET-score into 'low' (< 3 excess MET-hours per week), 'moderate' (≥ 3 and <7.5 excess MET-hours per week), 'recommended' (≥ 7.5 and < 15 excess MET-hours per week, to align with WHO recommendations[2]) and 'high' (≥ 15 excess MET-hours per week).
- Clinical time-to-event outcomes were summarised using Kaplan-Meier curves with 95% confidence intervals (CIs), stratified by excess MET-score, and modelled using a Cox proportional hazard (PH) model (for ACM) and a cause-specific Cox PH model (for HHF).
- HCRU outcomes were summarised using smoothed plots against excess MET-score at 5-year time-points with 95% CIs, and modelled using negative binomial hurdle models.
- Variable selection for the modelling was performed via least absolute shrinkage and selection operator (LASSO) in a series of 100 bootstrap iterations; variables that persisted in 90% of bootstrap iterations were retained in the final model, with excess MET-score specified to be always retained.

Results

- Of the 501,931 UK Biobank participants, 1,661 (mean age 62 years, 75% male, 95% white ethnicity) had a diagnosis of HF prior to index and were eligible for inclusion in the study.
- 11.8%, 9.9%, 12.1%, and 38.8% of participants were categorised as low, moderate, recommended, and high excess MET-scores, respectively. Excess MET-scores were unknown in 27.5% of participants (Table 1).
- Compared with high excess MET-scores, low excess MET-scores were associated with increased hazard (HR [95% CI]) of HHF (1.35 [1.08-1.68]) and ACM (1.26 [1.00, 1.59]); moderate excess MET-scores also had increased hazard of HHF (1.29 [1.04-1.58]) and ACM (1.26 [1.00-1.58]; Figure 1).
- Similarly, low and moderate excess MET-scores were associated with increased odds (OR [95% CI]) of hospitalisation (1.84 [1.26-2.68] and 1.47 [1.01-2.12] respectively) and LOS >0 days (1.85 [1.27-2.69] and 1.45 [1.01-2.09], respectively) compared with high excess MET-scores (Figure 2).
- Recommended excess MET-scores were associated with similar hazard and odds of all outcomes compared with high excess MET-scores (Figure 1, Figure 2).

TABLE 1: CLINICAL AND HCRU OUTCOMES BY EXCESS MET-SCORE

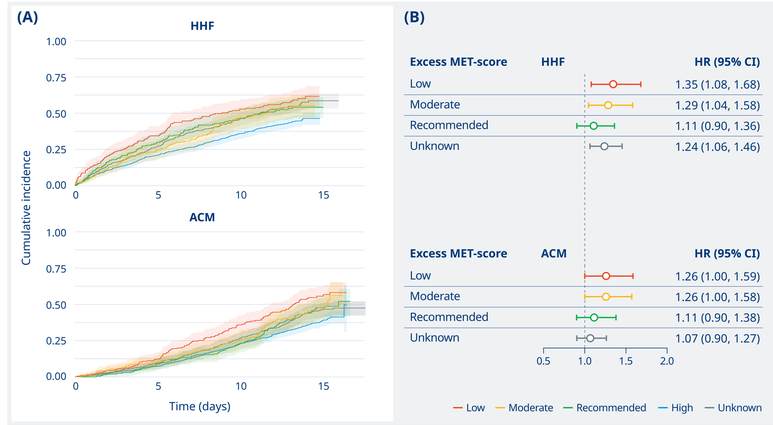
	Excess MET-score (MET-hours per week)				
	Low (N=195)	**Moderate** (N=164)	Recommended (N=201)	High (N=644)	Unknown (N=457)
Clinical outcomes, n (%)					
HHF	115 (59.0)	88 (53.7)	107 (53.2)	284 (44.1)	254 (55.6)
ACM	109 (55.9)	80 (48.8)	95 (47.3)	248 (38.5)	208 (45.5)
HCRU outcomes, mean (SD)					
Hospital episodes	12.7 (53.1)	5.8 (19.8)	4.1 (5.6)	3.8 (6.4)	5.3 (7.7)
5-year LOS (days)	35.4 (81.7)	14.6 (29.4)	15.0 (32.5)	11.8 (27.1)	17.3 (31.6)

Abbreviations: ACM: all-cause mortality; HCRU: healthcare resource utilisation; HHF: hospitalisation for heart failure; LOS: length of stay; MET: metabolic equivalent of task; SD: standard deviation

Limitations

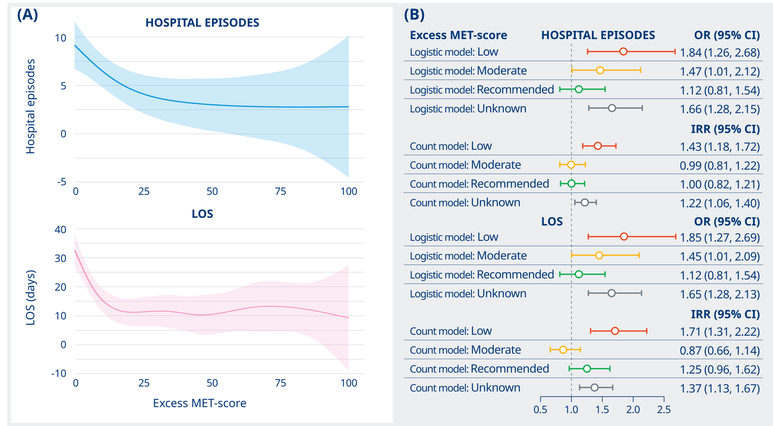
- The UK Biobank population are more reflective of a 'healthy volunteer' cohort and therefore may not be completely generalisable to the wider UK population.
- The physical activity data used in this study were patient-reported rather than objectively measured; however, self-reported and objectively measured physical activity have been shown to correlate in this cohort.[6]
- Retrospective studies using electronic health records are reliant on the accuracy of coding practices and the availability of clinical codes.
- Patients with very poor functional status may have died before physical activity was recorded, potentially underestimating the true effect of low activity.

FIGURE 1: CUMULATIVE INCIDENCE BY EXCESS MET-SCORE (A) AND EXCESS MET-SCORE COEFFICIENTS (B) FOR CLINICAL OUTCOMES



Abbreviations: ACM: all-cause mortality; CI: confidence interval; HHF: hospitalisation for heart failure; HR: hazard ratio; MET: metabolic equivalent of task

FIGURE 2: SMOOTHED HCRU BY EXCESS MET-SCORE (A) AND EXCESS MET-SCORE COEFFICIENTS (B) FOR HCRU OUTCOMES



Negative HCRU values are artefacts of the smoothing confidence bands

Abbreviations: CI: confidence interval; HCRU: healthcare resource utilisation; IRR: incidence rate ratio; LOS: length of stay; MET: metabolic equivalent of task; OR: odds ratio

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