

538044 : Higher postoperative physical activity is associated with lower ctDNA-MRD positivity and longer recurrence-free survival across solid tumors : The SCRUM-MONSTAR LIFELOG study



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Background

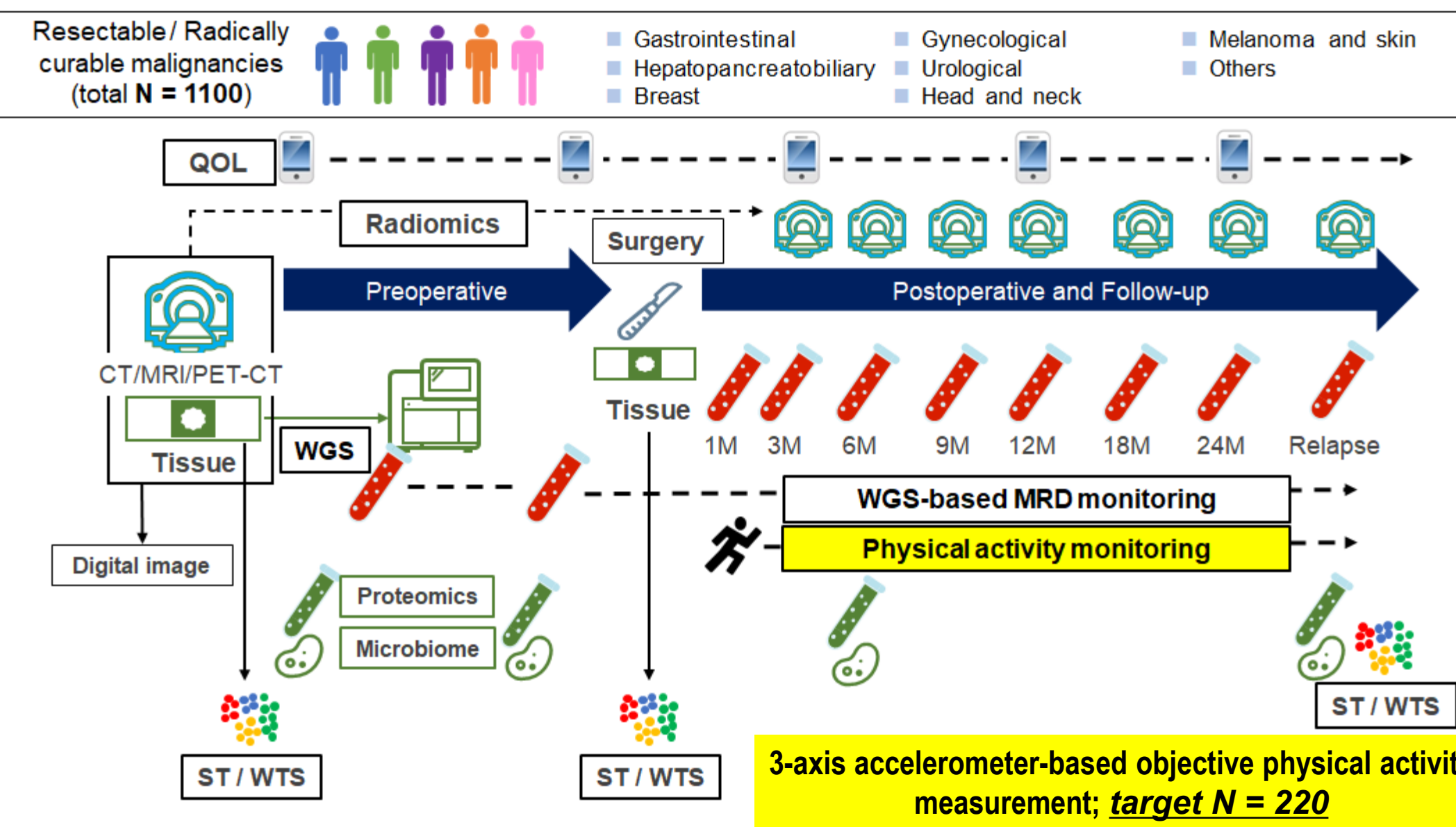
Physical activity is associated with improved survival across multiple cancer types, yet its relationship with **molecular residual disease (MRD)** detected by **circulating tumor DNA (ctDNA)** remains unclear.

We tested whether objectively measured postoperative activity correlates with ctDNA-MRD status and recurrence-free survival across solid tumors in the **SCRUM-MONSTAR LIFELOG** study, an ancillary protocol of MONSTAR-SCREEN-3.

Methods

STUDY OVERVIEW

ANCILLARY TO SCRUM-MONSTAR-SCREEN-3 resection cohort · UMIN00053975



METHODOLOGY HIGHLIGHTS

WEARABLE
mSafety™ (Sony) wrist device

- Triaxial accel + gyro · 32 Hz
- PPG · heart rate / HRV
- Encrypted LTE-M streaming
- GGIR pipeline → ENMO (mg)
- Continuous · no recall bias

91.9% adequate wear (≥10 h/d × ≥3 d/wk)

PHENOTYPING
Activity metrics → 3 clusters

- Mean PA (mg)
- MVPA Time (%)
- Longest MVPA (min)
- High-Intensity HR (%)
- Non-Sedentary (%)

Data-driven, unsupervised stratification

ctDNA-MRD ASSAY
Myriad tumor-informed WGS

- Tumor-informed WGS
- ≥250 patient-specific clonal SNVs
- Tumor fraction LOD ≈ 0.0001%
- Serial sampling: preop/1/3mo
- Overlap weighting

→ confounder-adjusted

Industry-leading sensitivity, longitudinal

Patients with **LOW** postoperative activity had **MORE ctDNA-MRD** AND a **4-FOLD HIGHER** risk of recurrence.

Wearable-derived activity reflects **ctDNA dynamics** and identifies patients at higher relapse risk, supporting **exercise as a modifiable target** for future risk-adapted intervention trials.

STUDY STRENGTHS

- 01 First-in-kind ancillary**
Wearable × WGS-MRD coupling in a prospective pan-tumor cohort
- 02 High-fidelity sensor stack**
32 Hz triaxial accel + PPG · raw data · no recall bias
- 03 Ultra-sensitive ctDNA-MRD**
Tumor-informed WGS · ≥500 patient-specific clonal mutations
- 04 MONSTAR-SCREEN platform**
Nationwide multi-omics platform · parent N = 3,200

Results

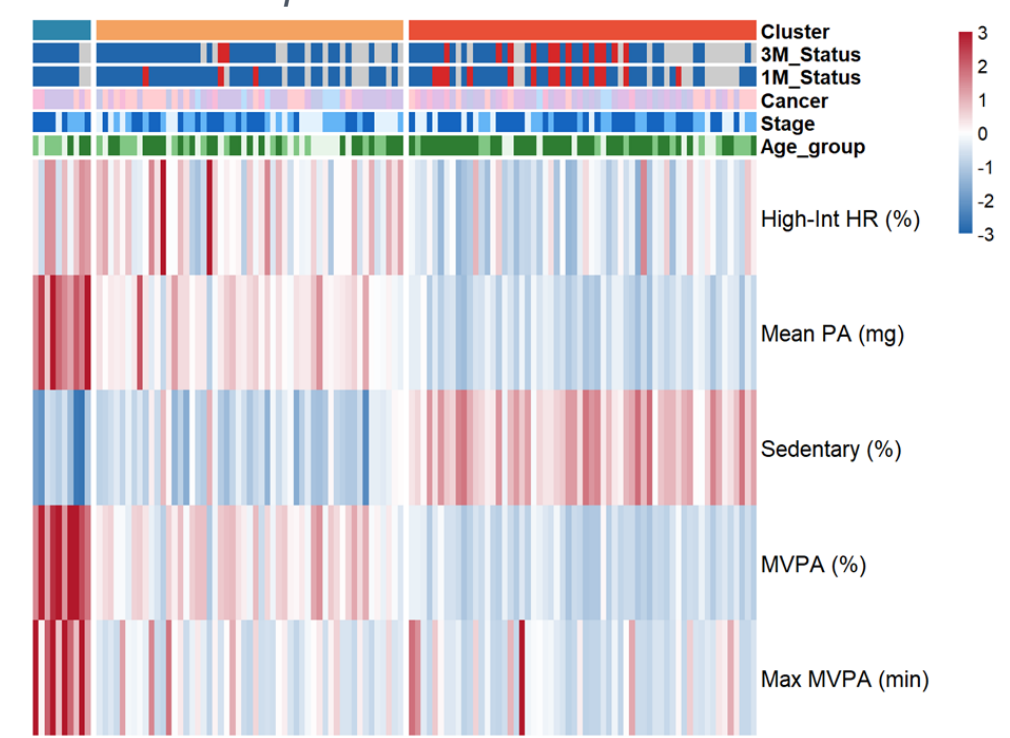
KEY FINDINGS

Pan-tumor surgical cohort (n = 123, 6 cancer types): low postoperative activity → higher ctDNA-MRD positivity, shorter recurrence-free survival.

CLUSTERING SETUP

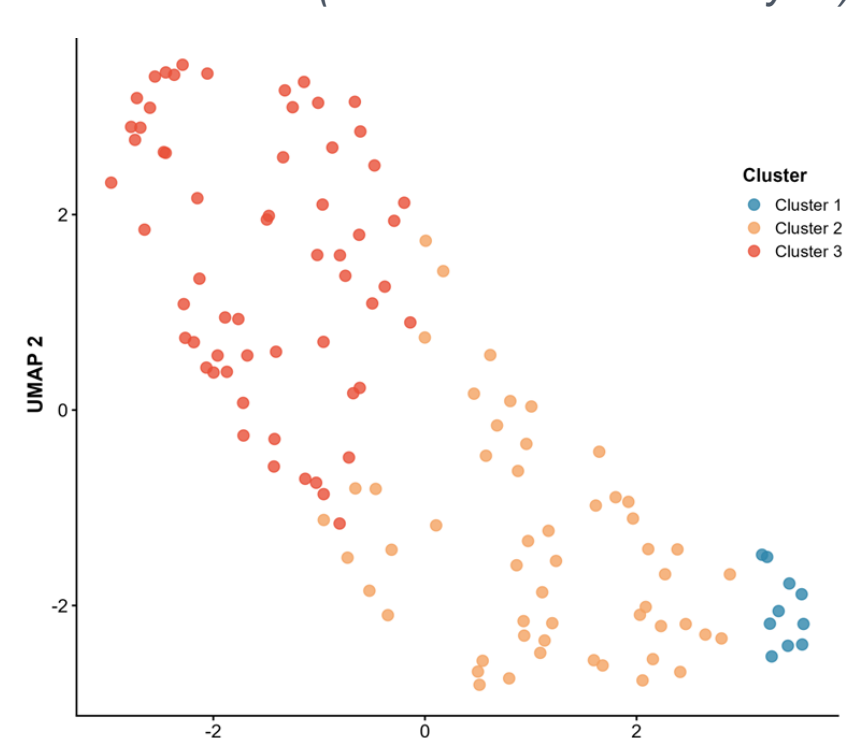
Activity phenotypes & ctDNA

5 metrics × patients · cluster + clinical annotations



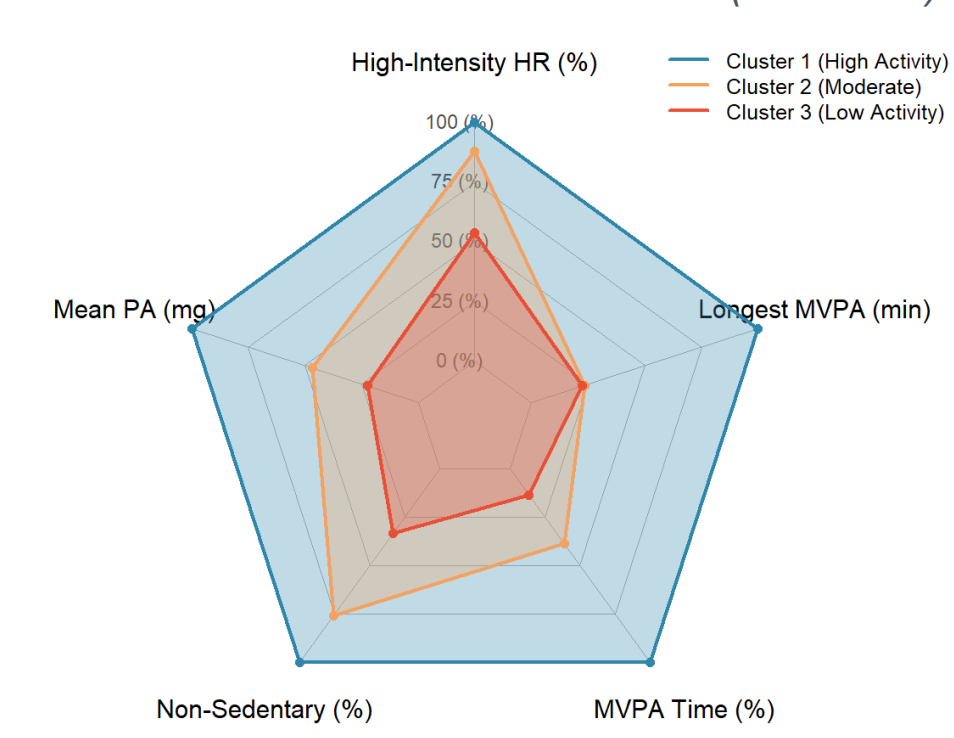
Cluster separation

UMAP · k = 3 (elbow + silhouette analysis)



Activity profile by cluster

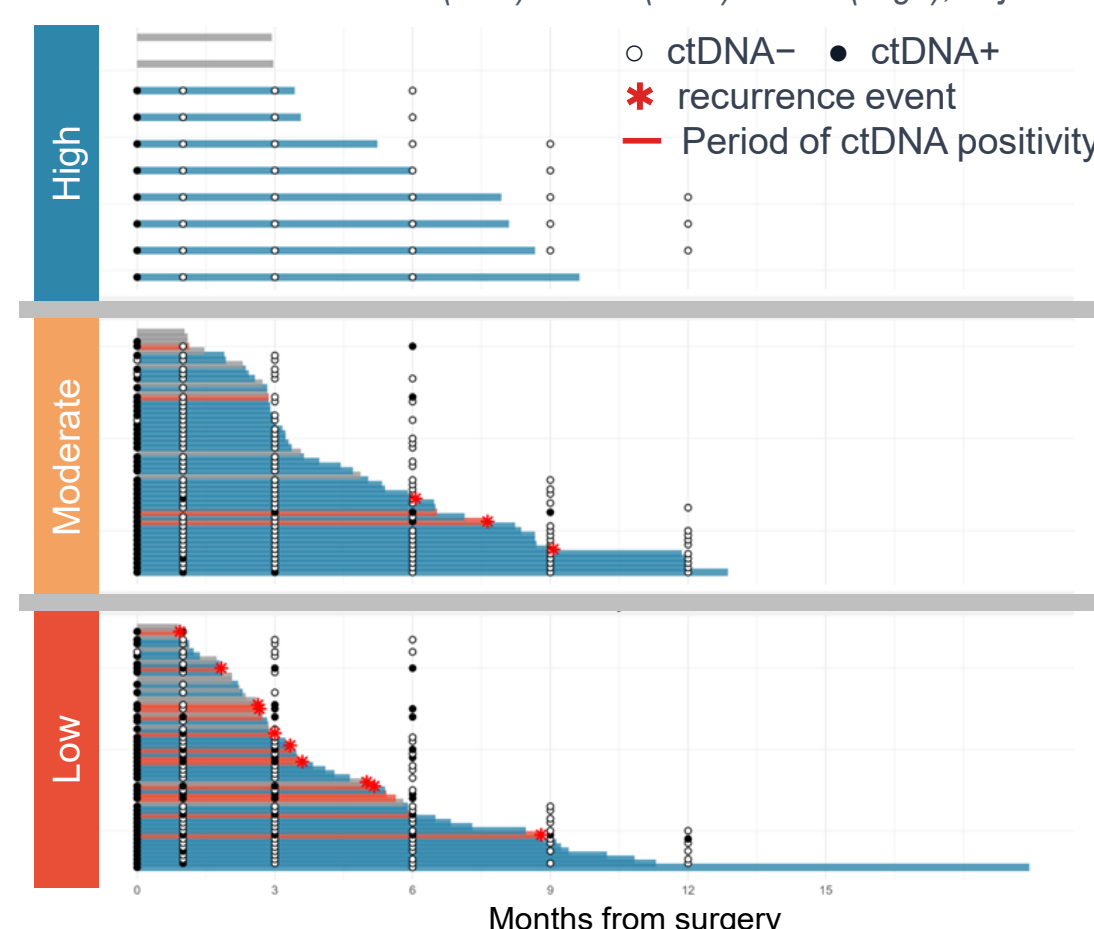
5 metrics differ across clusters (P < 0.001)



MAIN OUTCOMES

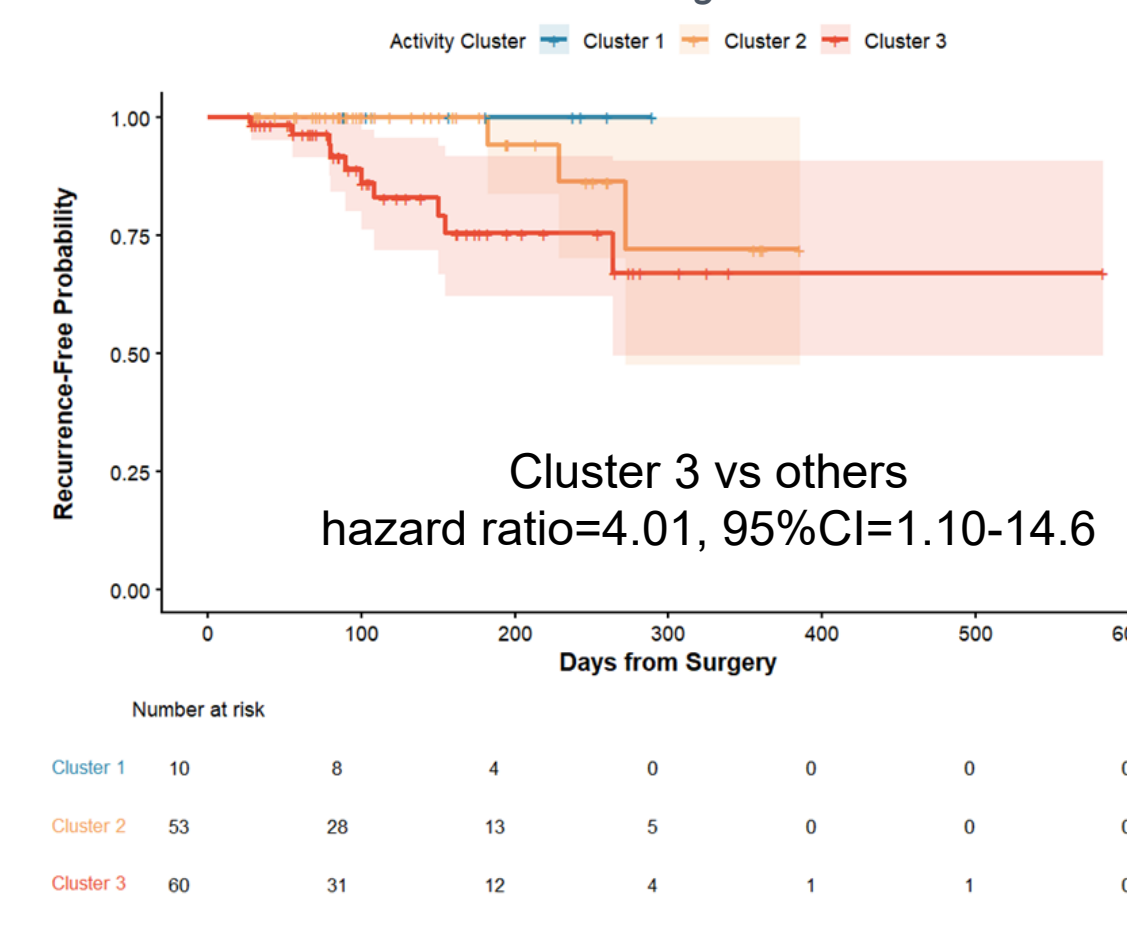
Swimmer plot · ctDNA-MRD trajectory

3-mo ctDNA-MRD+: 29% (Low) vs 5% (Mod) vs 0% (High); adj. P = 0.003



Recurrence-free survival

Cluster 3 vs Clusters 1+2 · log-rank P = 0.035



Characteristic	Cluster			P (unadj. / adj.)
	High n=10	Mod n=53	Low n=60	
Median age, y	69	66	73	.11
Male, %	90	55	55	.10
Stage III-IV, %	60	36	53	.32
Cancer type, %				.42
· Colorectal	20	28	20	
· Genitourinary	30	19	37	
· Other GI	50	34	30	
· Other	0	19	13	
Adjuvant chemo, %	60	53	57	.88
3-mo ctDNA-MRD+, %	0	5	29	P = .007 adj. P = .003

FUTURE DIRECTIONS

Toward translation and intervention

External validation

Expansion-phase enrollment toward target N = 220, with cross-validation in independent multicenter cohorts.

Mechanistic studies

Integrate activity phenotypes with MONSTAR-3 multi-omics (plasma proteomics · spatial transcriptome · microbiome).

Therapeutic translation

Exercise-based intervention RCT in the postoperative period; activity-guided risk stratification.

Preclinical complement

Mouse model of exercise intensity × tumor immunity; mechanistic proof-of-concept (parallel).

Acknowledgements

STUDY PROTOCOL
Yajima S, et al. *Int J Clin Oncol*. 2025;30(8):1439–1447. doi:10.1007/s10147-025-02798-y

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