

Pectoralis muscle area, density and intramuscular fat percentage independently predicts mortality in pulmonary hypertension associated with chronic lung disease

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Background:

- Sarcopenia is an important prognostic predictor in chronic diseases, particularly in the context of an ageing population.
- CT-derived pectoralis muscle measures are known markers of sarcopenia and have shown to be prognostic in COPD and lung cancer cohorts, but their effect in Pulmonary Hypertension (PH), a complex cardiopulmonary condition is unknown.
- Existing studies predominantly rely on manual measurements of the pectoralis at a single slice level.
- Deep learning can enable automated volumetric assessment of the pectoralis muscle. The significance of volumetric and intra-muscular biomarkers are poorly understood.
- All patients with Pulmonary Hypertension associated with chronic lung disease (PH-CLD) undergo Chest Computed Tomography (CT) imaging as part of their diagnosis

Aim: To assess prognostic value of deep learning automated pectoralis muscle quantity and quality biomarkers in PH-CLD.

Methods:

- Patients were identified from the ASPIRE registry (2007-19), one of the largest imaging registries of PH worldwide.
- Pectoralis muscles were automatically segmented using a deep learning model.
- Muscle quantity was assessed by volume and maximal cross-sectional area, indexed to patient’s height².
- Muscle quality was assessed by mean density (Hounsfield Units, HU) and intramuscular fat percentage (using established -190 to -30 HU threshold).
- Multivariable Cox regression adjusted for prognostic factors age, sex, WHO functional class, Pulmonary Vascular Resistance (PVR) and incremental shuttle walk test distance.

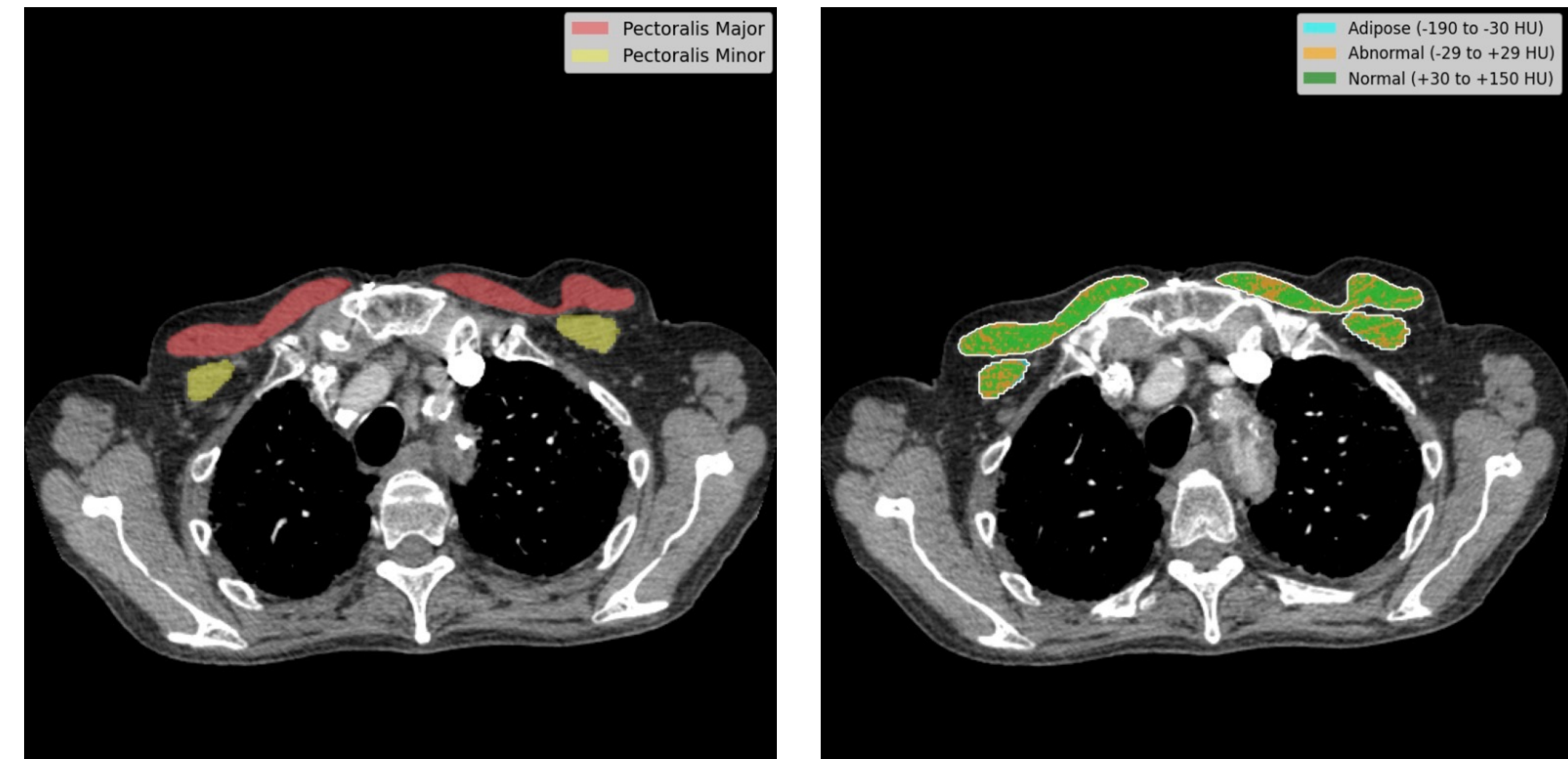


Fig 1: CT pectoralis muscle segmentation

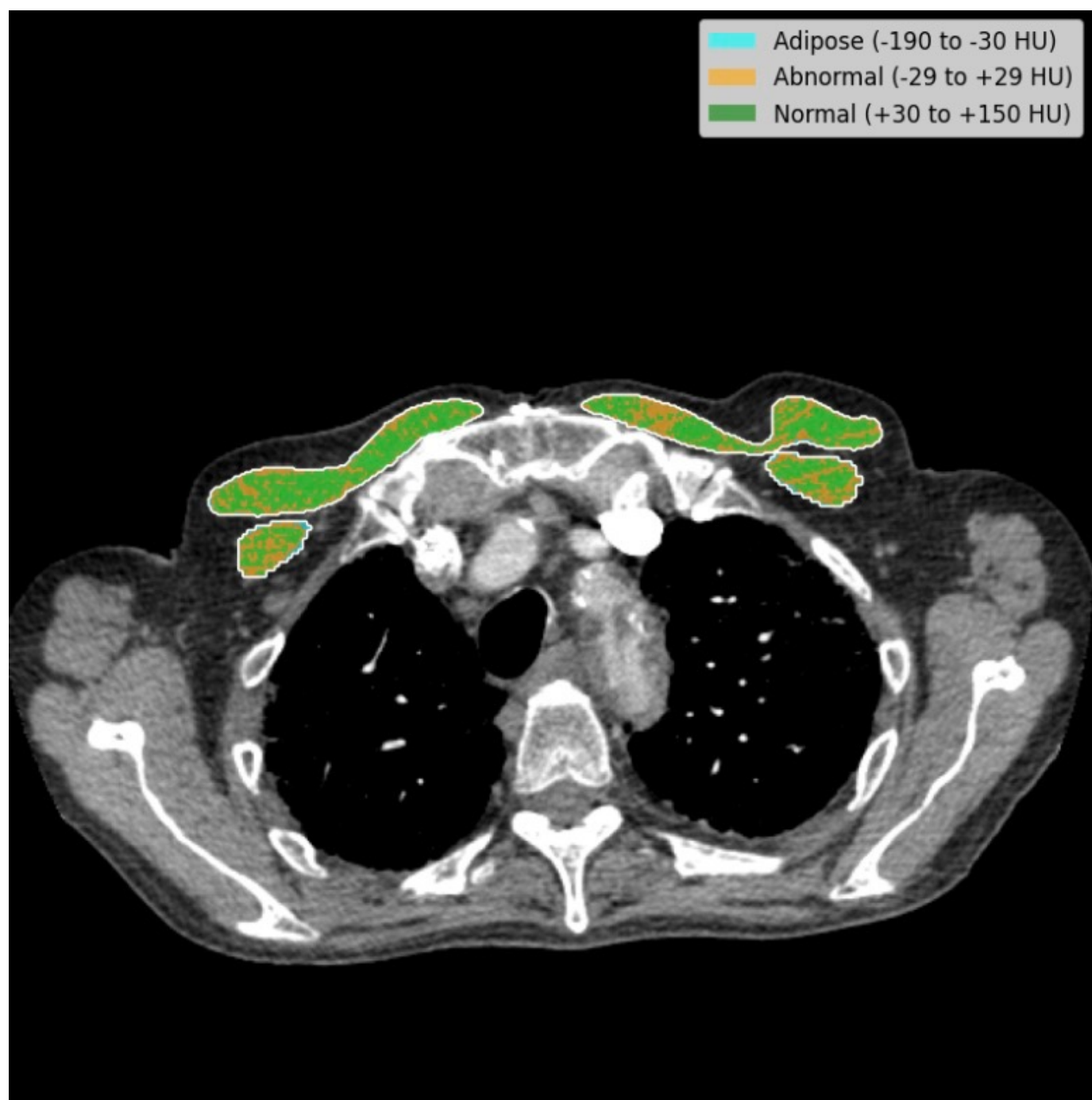


Fig 2: CT intramuscular fat quantification

Results:

- 185 patients (124 deaths) were identified.
- Muscle area independently predicted mortality (HR 0.94, p=0.040)
- Muscle volume was not prognostic.
- Muscle quality independently predicted mortality: mean density (HR 0.98, p=0.042) and intramuscular fat percentage (HR 1.03, p=0.015).
- Kaplan-Meier analysis demonstrated significantly worse survival with reduced mean density and increasing intramuscular fat percentage, when divided by tertile thresholds (as per Kaplan Meier curves)

Characteristic	N = 185 ¹
Age (years)	68 (61, 74)
Gender (female)	78 (42%)
WHO Function Class	
1/2	24 (13%)
3/4	161 (87%)
Incremental Shuttle Walk Test Distance (metres)	90 (40, 180)
Pulmonary Vascular Resistance (PVR)	5.8 (3.7, 8.7)
FEV1%	1.51 (1.06, 1.87)
¹ Median (Q1, Q3); n (%)	

Table 1: Patient characteristics

Characteristic	N = 185 ¹
Pectoralis area (cm ²)	36 (29, 43)
Pectoralis area indexed to height	13.06 (10.69, 14.87)
Pectoralis volume (cm ³)	295 (238, 369)
Pectoralis volume indexed to height	106 (90, 128)
Pectoralis intramuscular fat percentage (%)	12 (8, 17)
Pectoralis mean density (HU)	24 (14, 30)
¹ Median (Q1, Q3); n (%)	

Table 2: CT analysis results

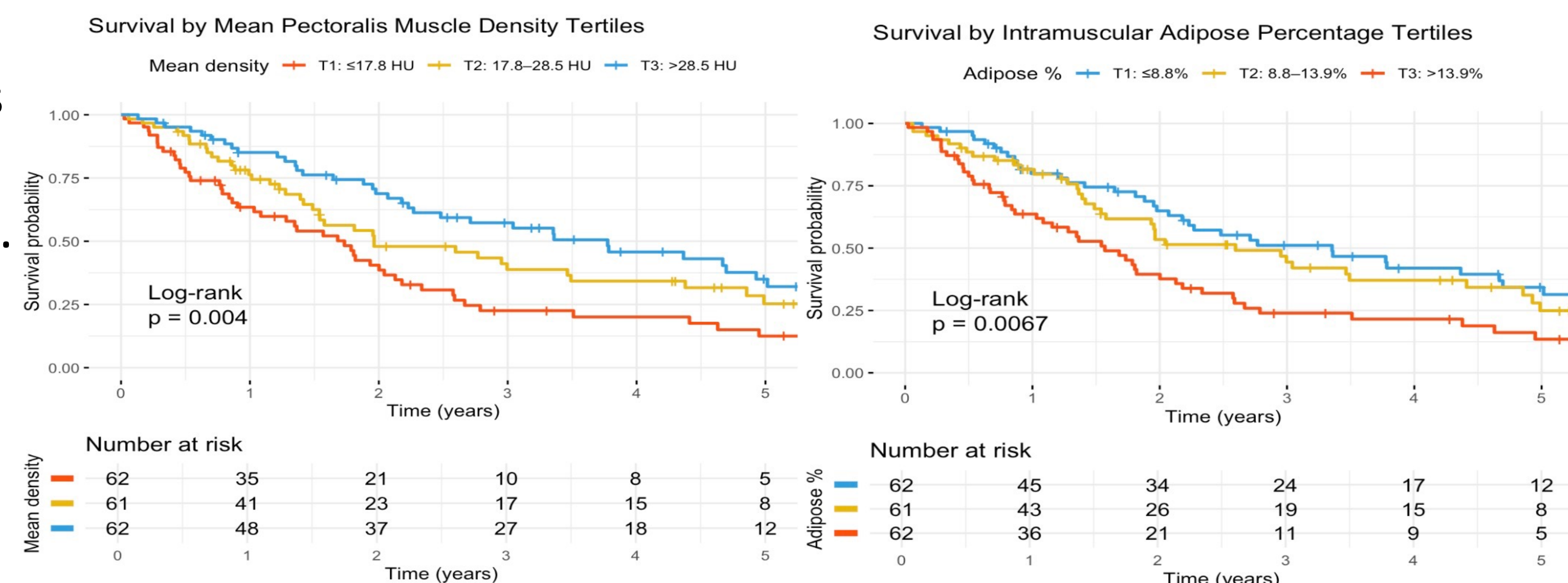


Fig 3: Kaplan Meir curves for survival

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Conclusions:

1. Pectoralis area, density and intramuscular fat percentage independently predicts mortality in PH-CLD
2. This is an important finding given the advent of novel antifibrotic and vasodilated therapies that require risk-stratification to identify patients that would most benefit from expensive therapies.
3. Comorbidities are increasingly recognised as important cofactor. This approach makes the most of data already within CT scans already acquired for all patients and could aid in assessment of the patient’s functional status.
4. Larger multi-centre studies to further validate the findings are warranted and in progress.