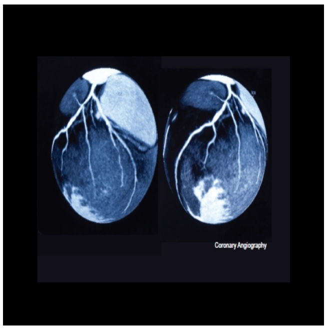
AI-Powered Body Composition Analysis from Cardiac CT Scans



Cardiac CT attenuation correction (CTAC) scans, routinely performed alongside myocardial perfusion imaging, have long been limited to basic functions such as attenuation correction and visual calcium assessment. Yet these low-dose scans, widely available and underused, hold a wealth of anatomical data. A new study proposes an artificial intelligence (AI)-driven method to automatically segment and analyse six body tissues from CTAC scans, uncovering their potential to predict all-cause mortality. This advancement could transform routine cardiac imaging into a more powerful diagnostic tool without additional procedures or radiation.

AI-Driven Body Composition Analysis

The core innovation lies in the development of an end-to-end, fully automated framework that segments six tissue types—bone, skeletal muscle, subcutaneous adipose tissue (SAT), intramuscular adipose tissue (IMAT), visceral adipose tissue (VAT) and epicardial adipose tissue (EAT)—from existing CTAC images. Using a model trained on prior CT data and refined through robust image processing techniques, the system accurately identifies anatomical landmarks between the T5 and T11 vertebrae to standardise analysis. In less than two minutes per scan, the AI extracts volumetric measures including attenuation, variability and volume indices.

The segmentation pipeline was validated across 9918 patients from four international centres, with scans obtained via varied imaging protocols and equipment. Despite such heterogeneity, the algorithm demonstrated high reliability and reproducibility. Importantly, this approach integrates seamlessly into existing clinical workflows, requiring no additional imaging or patient preparation. In practice, these measurements offer an efficient, scalable method for assessing tissue health and distribution—key indicators of a patient's physiological condition.

Linking Tissue Metrics to Mortality Risk

The study found significant associations between tissue characteristics and all-cause mortality. High attenuation in VAT, EAT and IMAT was linked with increased mortality risk, suggesting that these fat compartments may reflect underlying inflammatory or fibrotic processes. Conversely, higher skeletal muscle volume and bone density were protective. These associations remained significant after adjusting for traditional cardiovascular risk factors and other imaging biomarkers, underscoring the added value of body composition measures.

For example, patients with high VAT attenuation (> –80 HU) were over twice as likely to die compared to those with lower values. Similarly, elevated EAT and IMAT attenuations also predicted poorer outcomes. On the other hand, those with higher skeletal muscle volume indices had a substantially lower risk of death. This information enables more nuanced risk stratification, supplementing standard cardiac imaging parameters like perfusion deficit and ejection fraction with deeper insight into body tissue status.

The AI model's prognostic accuracy was affirmed across subgroups including age, sex, race, BMI and imaging protocol variations. Particularly, VAT attenuation was a consistent mortality predictor across all demographic and clinical categories. Furthermore, integrating body composition metrics into existing risk models improved predictive performance, as reflected in a notable increase in concordance indices for both male and female patients.

Clinical Implications and Broader Context

This research positions CTAC scans as a valuable source of prognostic insight, with applications extending beyond cardiology. By repurposing routine imaging for volumetric tissue analysis, clinicians can detect signs of sarcopenia, obesity, cachexia and even osteoporosis—all of which are linked to adverse outcomes. Given the increasing global prevalence of these conditions, such opportunistic use of existing data is both cost-effective and clinically impactful.

The method also provides a potential solution to the limitations of body mass index (BMI), which fails to distinguish between fat and muscle mass. For instance, some patients with high BMI may still face elevated mortality risk due to hidden sarcopenia or excessive visceral fat. Conversely, leaner patients with poor muscle density may be at risk despite a "healthy" BMI. This body composition framework allows clinicians to move beyond superficial metrics and make data-informed decisions tailored to the individual.

While abdominal CT has traditionally been the mainstay of body composition research, this study demonstrates the feasibility and value of chest-based analysis. Its regional focus (T5–T11) ensures compatibility with most cardiac imaging protocols, making it an accessible tool for broad implementation. Moreover, because the method uses non-contrast, non-gated, low-dose CT images, it can be readily applied in various clinical contexts without burdening patients or providers.

By transforming underutilised CTAC scans into a rich source of prognostic biomarkers, this AI-powered approach unlocks new possibilities for patient risk assessment. Its ability to analyse six key tissue types rapidly and automatically offers clinicians a powerful supplement to conventional cardiovascular metrics. As healthcare increasingly turns to precision diagnostics, integrating body composition analysis into routine cardiac imaging could help identify at-risk individuals earlier, guide treatment more effectively and ultimately improve outcomes without the need for additional imaging.

Source: **The Lancet Digital Health**

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