e24073 Publication Only

Technical performance of the L3 Skeletal Muscle Index in CT.

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Background: Skeletal muscle, beyond mobility, is now seen as a vital endocrine organ with significant metabolic roles affecting overall health. Assessing body composition is crucial for understanding muscle health, especially in sarcopenia—characterized by reduced muscle mass and function—which poses risks like osteoporosis or endocrine disorders. In oncology, sarcopenia impacts chemotherapy metabolism and survival. Imaging plays a key role, with CT-based L3-SMI emerging as a reliable sarcopenia biomarker. This study evaluates the technical performance of CT-derived Cross-Sectional Area (CSA) measurements at the L3 vertebra, from which L3-SMI is derived. **Methods:** We analyzed two datasets: (1) 100 multicentric scans from patients with NSCLC, CRC, adrenocortical carcinoma, and pancreatic cancer; (2) test-retest multicentric scans from 205 CRC patients. Segmentations were conducted manually (MAN) with LifeX software and automatically (AUTO) using TotalSegmentator (V 2.2.0). Expert MAN segmentations served as reference data. Intra- and inter-reader variability were assessed for MAN segmentations. AUTO segmentations were visually rated on a 1–5 scale (Perfect–Fail). We evaluated AUTO's accuracy, test-retest repeatability, and reproducibility across body regions and contrast phases. Linearity between AUTO and MAN was analyzed, and requirements for accurate L3SMI assessments were derived from visual ratings and outlier detection. We considered a 5% level of significance, evaluated the within Coefficient of Variation (wCV) and linearity using Passing Bablok regression. **Results:** Intra- and inter-reader variabilities were wCV=2.6% (95%CI: 1.7–3.4) and wCV=3.9% (95%CI: 2.6–5.3), respectively. AUTO segmentations were visually satisfactory in 90.0% (95%CI: 82.4–95.1) of cases, with a relative bias of -8.5% (95%CI: -9.8, -7.3). Reproducibility showed no significant impact from body coverage (p=0.06, N=30) or contrast phase (p=0.18, N=80). Repeatability featured an overall wCV of 3.2% (95%CI: 2.8–3.5), varying with CSA quartiles: from 4.0% to 2.7% (Table 1). Linearity between AUTO and MAN had an intercept of b_0=-12.8 (95%CI: -19.6, -6.4) and a slope of b_1=1.21 (95%CI: 1.16, 1.27), with Pearson's r=0.971. Proper field of view and patient positioning are essential, while liver disease compromises assessments. **Conclusions:** Our comprehensive evaluation of L3-SMI's bias, repeatability, reproducibility, and linearity establishes the basis for associating confidence intervals with its measurements. This enables the detection of significant patient changes, laying a strong foundation for L3-SMI's clinical qualification as a reliable biomarker in health assessments. Research Sponsor: None.

wCV as a function of CSA values.

CSA (cm^2)	66.3 – 90.6	90.6 – 107.3	107.3 – 134.5	134.5 – 213.9
wCV (%)	4.0 (3.2; 4.8)	3.4 (2.7; 4.0)	2.8 (2.3; 3.4)	2.7 (2.2; 3.3)

For each CSA quartile's interval (top row) we computed corresponding wCV (bottom row).