



Evaluating TotalSegmentator for Muscle and Fat Segmentation in Patients with Ascites

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Introduction/Background

TotalSegmentator (TS) is a public CT segmentation tool that can segment 117 anatomical structures. The dataset it was trained on was randomly sampled and contained patients with certain abnormality types (e.g., inflammation, trauma, bleeding). However, it is not known if patients with fluid retention, such as ascites, were excluded. Excess fluid in the peritoneal cavity (often seen in patients with liver fibrosis) can have visual similarities to visceral fat and can pose a challenge for TS, thereby impacting its segmentation performance. This study determines if TS over-segments muscle and fat (subcutaneous and visceral) into regions of ascites.

Methods/Intervention

285 CT scans of 140 female patients from the public TCGA-OV-AS dataset were used. This dataset contained only ascites labels that were manually annotated on a voxel-level (all slices, all volumes) and no other organ labels. TS segmented the muscle and fat (subcutaneous and visceral) regions in these volumes, and its outputs were compared against the manual ascites labels to determine any over-segmentations. In this context, a lower Dice score is desirable as it signifies less overlap between ascites and the structure segmented by TS.

Results/Outcome

TS often over-segmented muscle as it had the highest mean Dice score (0.00965 ± 0.0157), followed by visceral fat (0.00691 ± 0.0152), then subcutaneous fat (see Fig1 and Table 1). Significant over segmentation in muscle ($44.45 \pm 97.11\text{mL}$) into ascites was seen in 20 out of 285 scans (scans which exceeded 50mL, see Fig2).

Conclusion

TS is generally capable of accurately segmenting visceral fat, subcutaneous fat, and muscle in patients with ascites. However, it must be used with caution as significant over-segmentations can affect body composition measurements.

Statement of Impact

For population-based studies and opportunistic screening, body composition measurements (e.g., muscle and fat volume/attenuation) can be correlated with underlying disease conditions (e.g., Diabetes). They play a critical role in early interventions and patient management.

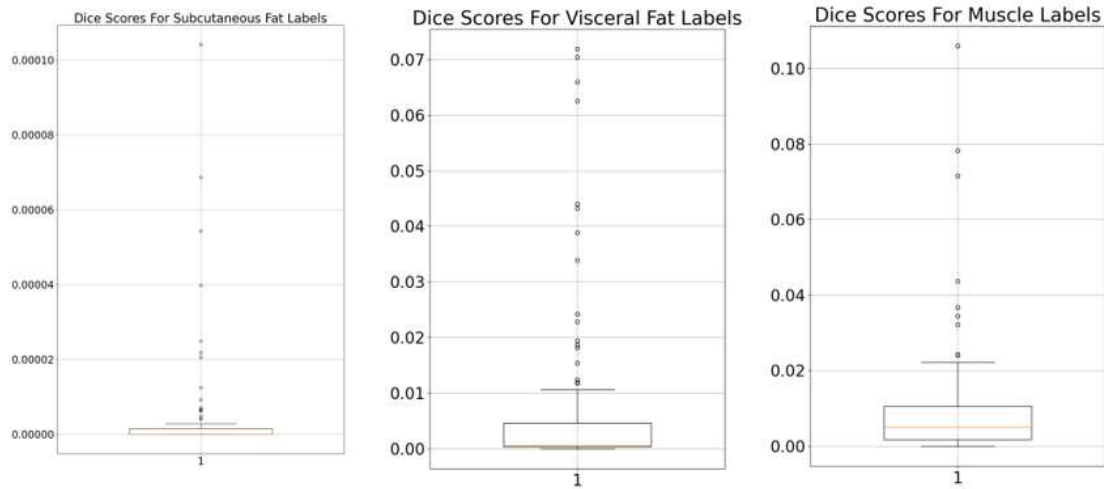


Fig. 1 Box plot showing the distribution of Dice scores for, L-to-R; (a) subcutaneous fat, (b) visceral fat, and (c) muscle.

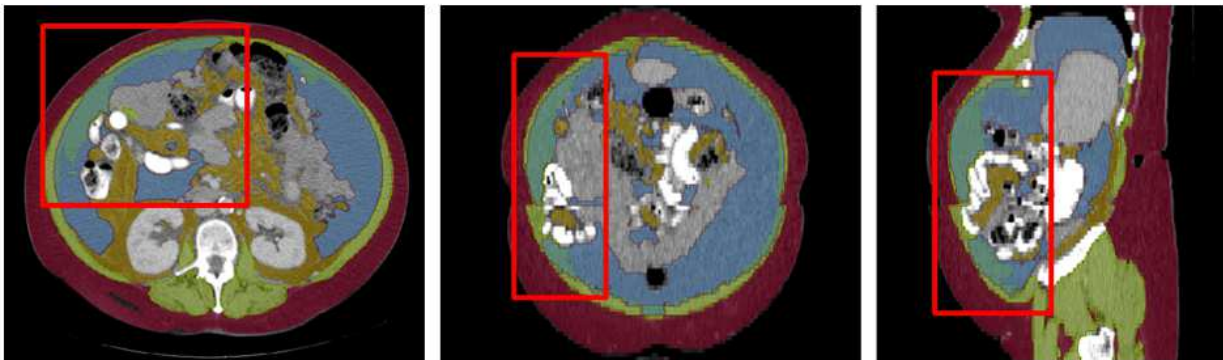


Fig. 2 Example segmentations of subcutaneous fat, visceral fat, and muscle on a contrast-enhanced CT image of a 63-year-old female patient with ascites from TCGA-OV-AS. The scan was acquired with a 5mm slice thickness. Dice score of muscle and ascites was 0.106, denoting the highest over segmentation of approximately 800mL. Colors represent different tissues: red for subcutaneous fat, yellow for visceral fat, green for muscle, and blue for ascites. Red box highlights the area of over-segmentation of muscle and ascites, shaded in olive green.

Table 1 Comparison of Dice coefficients measuring the overlap between structures (muscle, visceral fat, subcutaneous fat) predicted by TotalSegmentator and manual ascites labels in the public TCGA-OV-AS dataset. Values are presented as mean ± standard deviation and Interquartile Ranges (IQR). Note: Lower Dice scores are indicative of better performance as they signify minimal overlap between the structure and ascites.

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| | Dice Score | Volume Over-Segmented (mL) |
|------------------|--------------------------------------|--------------------------------|
| Muscle | 0.00965 ± 0.0157 [-0.00605, 0.02535] | 44.45 ± 97.11 [-52.66, 141.56] |
| Visceral Fat | 0.00691 ± 0.0152 [-0.00829, 0.02211] | 8.87 ± 19.76 [-10.89, 28.63] |
| Subcutaneous Fat | < .0001 | 0.016 ± 0.045 [-0.029, 0.061] |

Keywords

Ascites; CT; Segmentation; Muscle; Fat