Automating Multisite-Muscle Segmentation in Ultrasound via Deep Learning through a Standardized Framework for Sarcopenia Assessment Dawei Zhang, Chonglin Wu, Yuxuan Na, Wanrui Li, Ka-Shing Lee, Yu Sun, Yongping Zheng*. *Gerontechnology* 25(s*)*

Purpose Sarcopenia is receiving more and more emphasis nowadays. More than 29% of the elderly population suffers from sarcopenia (Cho et al., 2022). Ultrasound (US) has been attracting more and more attention for muscle quality and quantity assessment (Stringer & Wilson, 2018). While US is portable and radiation-free, its widespread use for sarcopenia assessment is affected by operator-dependent variability and time-consuming manual analysis. To address a critical unmet need in geriatric care of the lack of an accessible, tool for quantifying muscle health, this study aimed to unlock the full clinical potential of **US** by developing a deep learning framework that automates muscle analysis, thereby creating a practical tool for routine clinical use in screening, diagnosis, and follow-up assessment of sarcopenia, while linking to physical performance tested as recommended by Asian Working Group of Sarcopenia (Chen, et al., 2014). **Method** The ground truth of the images was annotated using the Software LabelMe (Version 5.5.0) under supervision of a ten-year experienced **US** medical doctor. We trained and validated deep learning models (U-Net and nnU-Net) on 2D **US** images from 94 adults (young: n=22; middle-aged: n=22; elderly: n=50). The training, validation and testing dataset was set into 70%, 10%, and 20%. The models automated the segmentation of five clinically relevant muscle groups (biceps, triceps, rectus abdominis (RA), rectus femoris (RF), and the peroneus longus and brevis muscles (PLPB)). The clinical utility of the AI-derived metrics (Muscle Thickness (MT), Cross-Sectional Area (CSA)) was established by correlating them with commonly used bioimpedance analysis (BIA) body composition data and key functional performance tests (Figure 1). **Results and Discussion** The primary finding of this study is the profound clinical utility of the automated framework. Our system successfully fills the gap between a simple US image and a comprehensive assessment of a patient's muscle health. This is evidenced by the moderate to strong correlations between deep learning-derived metrics and systemic biomarkers of sarcopenia. For example, a rapid scan of the thigh (RF) MT provided a reliable estimate of a patient's total Fat-Free Mass ($r = 0.4223$, $p < 0.001$), while an arm scan (triceps and biceps) robustly predicted total Muscle Mass ($r = 0.7849$ and 0.8212, $p < 0.001$). Crucially, the system moves beyond mere quantification to provide functional insight; PLPB were significantly associated with mobility and frailty indicators like the 5-time Sit-to-Stand test ($r = 0.7480$, $p < 0.001$). This robust clinical performance is built upon the model's high technical fidelity, confirmed by excellent Dice scores (0.826-0.920) against expert analysis. **Conclusion** This work demonstrates US as an accurate modality for sarcopenia management, and strong agreement was observed between US- and BIA-measured parameters. By automating and standardizing the analysis, our framework transforms a user-dependent US imaging technique into an objective, quantitative biomarker for muscle health. The clinical implications of the system enable feasible large-scale community screening for early detection, provide objective data to track patient progress and the efficacy of interventions, and offer point-of-care decision support for clinicians. This technology has the potential to fundamentally change how we approach muscle health in aging populations, making proactive and personalized sarcopenia care a reality.

References

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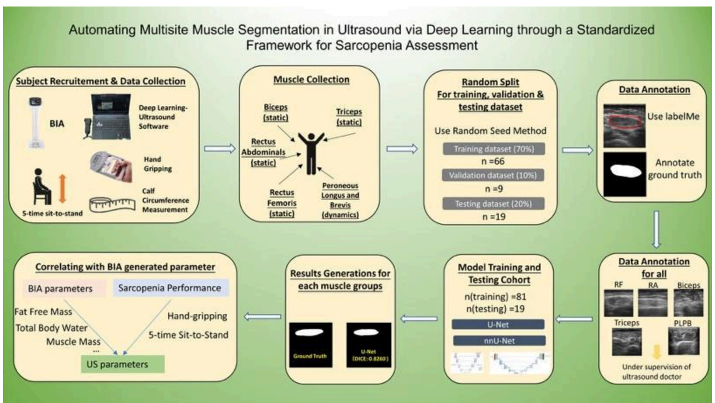

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