IOCBE 2024 Conference
The 1st International Online Conference on Bioengineering
16–18 October 2024 | Online
MDPI

Advancements in Medical Imaging Methods for Body Composition Assessment: A Literature Review

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INTRODUCTION & AIM

Body composition assessment is essential for improving health outcomes and optimizing clinical treatments and athletic performance. Traditional metrics, such as Body Mass Index (BMI), often fail to reflect an individual's body composition accurately, underlining the need for more advanced diagnostic tools.

This poster reviews the use of key imaging methods such as Dual-Energy X-ray Absorptiometry (DEXA), Ultrasound (US), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) to evaluate the body composition, focusing on the differentiation of fat distribution and muscle mass.

KEY IMAGING TECHNIQUES

DEXA:
- Provides measurements of bone mineral density, fat mass, and lean body mass.
- Highly effective for assessing subcutaneous and visceral fat, though limitations exist for highly obese patients due to accuracy issues and the need for standardized protocols across devices [1].
- Visualizes fat distribution across regions, particularly beneficial for clinical populations such as postmenopausal women and individuals with sarcopenia or obesity.

US:
- A non-invasive, portable, and cost-effective method that provides real-time dynamic assessment of muscle and fat tissues [2].
- Effective in evaluating subcutaneous adipose tissue (SAT) and muscle thickness, offering high accuracy in clinical and athletic settings [3].
- Its utility extends to measuring fat infiltration in muscles, with emerging use in sarcopenia assessment and post-surgical follow-up.

CT:
- Offers precise cross-sectional images for detailed differentiation regarding visceral and subcutaneous fat evaluation[4].
- Applied in research on body composition's role in chronic diseases, and in settings such as oncology for assessing treatment efficacy [5].

MRI:
- The gold standard for assessing muscle mass and visceral fat, provides high-resolution images without radiation exposure [6].
- It is particularly useful in longitudinal studies, helping to track changes in muscle and fat distribution, contributing to better treatment planning in clinical conditions like obesity and sarcopenia.

ADVANCEMENTS IN MEDICAL IMAGING METHODS

ARTIFICIAL INTELLIGENCE INTEGRATION
- AI-based models like deep convolutional neural networks automate the segmentation of MRI and CT images, enhancing the identification of visceral and subcutaneous fat, and muscle tissue, with greater precision and consistency.

ULTRASOUND ADVANCEMENTS:
- Improvements such as extended field-of-view ultrasound and auto measurement increase the reliability in measuring muscle thickness and SAT, even across different sonographers.

MRI AND CT INNOVATIONS:
- MRI techniques like chemical shift encoding and Dixon imaging provide more accurate fat and muscle quantification, while automated CT segmentation tools improve the precision of body composition analysis, including visceral and subcutaneous fat differentiation.

MULTIMODAL IMAGING APPROACHES:
- Combining different imaging modalities (e.g., DEXA with MRI or CT) has emerged as a powerful approach to overcome the limitations of individual techniques. For instance, DEXA provides detailed fat mass and bone density information, while MRI offers comprehensive muscle and visceral fat analysis without radiation exposure [6].

CONCLUSION

Medical imaging technologies have advanced body composition assessment by providing detailed insights into muscle and fat distribution. Ongoing AI-driven innovations promise even greater accuracy and broader applications in sports medicine, ultimately enhancing athletes' health and performance.

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