Chapter 11
Advancing Precision in Physical Education and Sports Science:
A Review of Medical Imaging Methods for Assessing Body Composition

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ABSTRACT

This chapter provides an overview of the current state of medical imaging methods in body composition analysis. It advocates a holistic approach that combines the strengths of different approaches and addresses their limitations. We discuss the importance of using standardized protocols to improve the accuracy of body composition studies across populations and settings. By examining the capabilities

and limitations of imaging modalities such as DEXA, MRI, CT, and ultrasound, we emphasize the need for a multidimensional approach to obtain body composition emphasis on complete understanding.

INTRODUCTION

The accurate assessment of body composition is important for enhancing health outcomes and optimizing performance and certain healthcare treatments. However, traditional methods such as weight, height, and Body Mass Index (BMI) offer a limited perspective, often failing to reflect true body composition accurately. This chapter proposes a multifaceted approach to body composition analysis, leveraging the strengths of various medical imaging methods such as Dual-Energy X-Ray Absorptiometry (DEXA), Ultrasound (US), Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). We begin by describing each one of them, with their potential advantages but also outlining the limitations of conventional metrics and the necessity for adaption of advanced diagnostic imaging tools for specific goals in providing a detailed body composition analysis and their potential health outcomes. For instance, bioelectrical impedance analysis (BIA) and DEXA are acknowledged for their capabilities in distinguishing fat mass, lean body mass, and bone mineral content, despite their inherent limitations influenced by factors such as hydration status and equipment accessibility (Branco et al., 2023; Dallman et al., 2023). In this context, medical imaging techniques such as Ultrasound, DEXA, MRI, and CT scans, can have an important role because of their incomparable depth in assessing not only the overall body composition but also the detailed distribution of adipose tissue, including the clinically significant visceral fat.

Therefore, we can highlight the main points for an appropriate evaluation of the body composition:

- Quantifying the muscular gain in terms of volume and specific physical training to meet some physical objectives;
- Quantifying the muscular loss in terms of volume in elderly patients, secondary to sedentarism or health conditions (stroke, cancer, others);
- Recognizing the subcutaneous fat tissue present in some key locations and quantify it and verify the specific locations where they accumulate; and
- Verifying the visceral fat amount, to calculate metabolic health risks or potential treatment efficacy.

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