Use of Bio-Electrical Impedance Analysis To Detect Changes in Bone Density Indicative of Osteoporosis

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Osteoporosis is difficult to diagnose since it does not show any signs or symptoms. Current commercially available options are expensive and must be conducted in a laboratory or clinical setting. Consequently, the majority of cases are only detected after a fracture has occurred. To determine if bio-electrical impedance analysis was effective at detecting changes in bone density, the densities of chicken bones were altered by dissolving them in hydrochloric acid solution for 15-minute intervals, with impedance and density readings taken at the end of each interval. The data yielded an R^2 value of 0.58 (p-value<0.0001) and a Spearman correlation coefficient of 0.75 (p-value<0.000001), both of which indicate a statistically significant positive correlation between impedance and bone density. Factors such as high anisotropy of bones, inconsistency in electrode placement and pressure, changes in moisture of the muscle tissue and bones, use of DC over AC current, and replacement of tissue for different trials are likely to have affected the correlation. Existing body fat and fat-free mass formulas were extended, and a novel formula was derived to predict bone mass loss based on height, weight, impedance, and waist, neck, hip circumferences. Previous studies compared DEXA (Dual Energy X-ray Absorptiometry) with Bioimpedance Analysis in a laboratory setting, using expensive equipment. This experiment demonstrated that low-cost tools and techniques could alternatively be used. The next step would be to conduct human trials to determine the constants that will be incorporated into the formula. Additionally, the technology can be integrated into a portable device with a preset baseline that can serve as an inexpensive, at-home diagnostic test for osteoporosis.

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