EVALUATION OF A RAPID 4-COMPARTMENT MODEL AND STAND-ALONE METHODS IN HISPANIC ADULTS

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Abstract

Background: A rapid 4-compartment (4C) model integrates dual energy X-ray absorptiometry (DXA) and multi-frequency bioimpedance analysis (MFBIA), which may be useful for clinical and research settings seeking to employ a multi-compartment model. **Objective:** The purpose of this study was to determine whether there is an added benefit of a rapid 4C model over stand-alone DXA and MFBIA when estimating body composition in Hispanic adults. **Methods:** One-hundred and thirty participants (n=60 male; n=70 female) of Hispanic descent were included in the present analysis. A criterion 4C model that employed air displacement plethysmography (body volume [BV]), deuterium oxide (total body water [TBW]), and DXA (bone mineral [M_O]) was used to measure fat mass (FM), fat-free mass (FFM), and body fat percent (BFP). A rapid 4C model (DXA-derived BV and M_O; MFBIA-derived TBW), and stand-alone DXA and MFBIA assessments were compared against the criterion 4C model. **Results:** Lin's concordance correlation coefficient values were > 0.90 for all comparisons. The standard error of the estimates ranged from 1.3-2.0kg, 1.6-2.2kg, and 2.1-2.7% for FM, FFM, and BFP, respectively. The 95% limits of agreement ranged from ±3.0-4.2kg, ±3.1-4.2kg, and ±4.9-5.2% for FM, FFM and BFP, respectively. **Conclusions:** Results revealed all three methods provided acceptable body composition results. MFBIA may be a more economically friendly option than DXA or when there is a need to minimize radiation exposure. Nonetheless, clinics and laboratories that already have a DXA device in place, or that value having the lowest individual error when conducting a test, may consider continuing to use the machine. Lastly, a rapid 4C model may still be considered useful for assessing the body composition measures observed in the current study as well as those provided by a multi-compartment model (e.g., protein).

Introduction

- We commonly see the 2-compartment model (2C) model used in research and clinical settings
- Based on assumptions that vary across different races/ethnicities (Hispanics in particular)
- A 4-compartment model (4C) can be used to get around this
- It accounts for variation, but is highly impractical in most clinical settings
- Rapid 4-C model works around this. Quick to administer, very convenient in clinical settings
- Remains accurate in Hispanic populations
- We hypothesized the rapid 4C model would provide better accuracy than stand-alone DXA and MFBIA since it does not assume FFM hydration

Purpose

- The purpose of this study was to determine whether there is an added benefit of a rapid 4C model over stand-alone DXA and MFBIA when estimating body composition in Hispanic adults

Methods and Procedures

- 130 Hispanic participants were included in the study
- 60 Males and 70 Females
- Included participants must be 1) 18-65 years of age and in good health. 2) <350 Lb. 3) Were not on medications or treatments that affect body composition
- Participants were fasted of food and drink for 8 hours prior and avoided exercise 24 hours prior.
- Medical history questionnaires were filled by participants (To ensure inclusion criteria were met) and consent forms were signed
- Urine Specific Gravity (USG) was determined from participants' samples and were limited to <1.029 for inclusion in the study (This measures hydration)
- Height of participants was also measured
- Deuterium Oxide (D_2O) was used to measure total body water (TBW). Urine samples were taken before and after D_2O ingestion and participants were instructed to empty their bladders as much as possible before ingestion
- Urine diluted D_2O was analyzed using an isotope-ratio mass spectrometer to calculate TBW
- To measure Body Volume (BV), participants were prepared for and sat in a BOD POD® (COSMED USA Inc, Concord, CA, USA) for 2 trials of 50 seconds each, and a third trial if necessary.
- Dual-energy X-ray Absorptiometry (DXA) was used to determine bone mineral content (BMC) in BOTH the criterion and rapid 4C model. BMC was then converted to total-body bone mineral (M_O)
- To compute BV in the rapid 4C model, this equation from Nickerson et al. was used: Volume (L) = (FM/0.91) + (LM/1.06) + (BMC/16.95) + 0.268.
- Multi-Frequency Bioimpedance Analysis (MFBIA) was used to compute TBW in the rapid 4C model.
- % Body Fat was collected for analysis from both the DXA and MFBIA scans.

CRITERION 4C MODEL:

FM (kg) = 2.748(BV) – 0.699(TBW) + 1.129(M_O) – 2.051(BM)
FFM (kg) = (BM-FM)
BFP = (FM/BM) x 100

Results

Methods	Metric	R^2
DXA compared with ADP	Body Volume	1.0
Criterion 4C vs. all other methods	Fat Mass	0.97-0.99
Criterion 4C vs. all other methods	Fat-Free Mass	0.96-0.98
Criterion 4C vs. all other methods	Body fat percentage	0.93-0.94

Figure 1: Relative accuracy of various methods compared to stand-alone methods

- We found there to be virtually no difference in accuracy between the conventional 4C model and stand-alone methods in determining various metrics of body composition in Hispanic adults.

Conclusion and Practical Applications

- The original study sought to determine the added benefit of a rapid 4C model over stand-alone DXA and MFBIA when estimating body composition
- We reject this hypothesis as per the results described above
- The results suggest that a stand-alone MFBIA would be more economically practical in most clinical contexts in determining an accurate measure of body composition
- DXA results show that it may serve the same purpose, but its high effort and cost to maintain and purchase make it less viable in many contexts.