VALIDITY OF THE BOD POD S/T TO PREDICT PERCENT FAT IN MALE AND FEMALE ATHLETES

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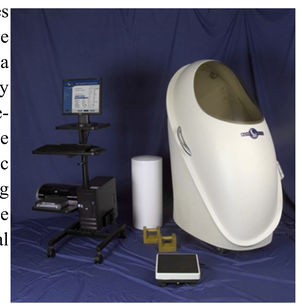
ABSTRACT

PURPOSE: To compare percent body fat estimations in male and female athletes using hydrostatic weighing (HW), BOD POD S/T (BPST), and the Siri three-compartment model (3C). METHODS: Ninety-eight subjects (male: n= 36; age=18.67 +/- 4.29 yrs; female: n= 62; age= 19.19 +/- 2.91 yrs) had their total body water measured via deuterium oxide and body volume measured via HW for the 3C model. BOD POD S/T measurements were performed prior to all HW measurements. RESULTS: HW produced less bias (all subjects=18.43+/- 7.39%, male=13. 06+/- 6.9%, female=21. 87+/- 5.39%) and higher r values (all subjects=0. 94, male=0. 92, female=0. 92) compared to the BPST (all subjects=15.3+/- 7.85%, male=11.34+/- 7.44%, female=17.61+/- 7.18%; r values: all subjects=0.8, male=0.91, female=0.67) and the Siri-3C model (all subjects=19.19+/- 7.67%, male=12.55+/- 6.55%, female=23.44+/- 4.76%). HW also produced lower SEE (all subjects=2.60%, male=2. 66%, female=1. 88%) and total error (TE) values (all subjects=2.68%, male= 2. 78%, female=2. 62%) compared to BPST (SEE: all subjects= 4.61%, male= 3.31%, female= 4.19%; TE: all subjects= 6.83%, male= 4. 52%, female= 7.86%). The BPST produced significantly higher mean differences compared to the 3C model (3. 14 +/- 6. 45%, $p \leq 0.001$) than HW (-0.51 +/- 5. 43%) in male athletes. BPST also produced larger limits of agreement (5.85 +/- 10.54%) compared to HW (1. 57+/- 4. 15%) in both male and female athletes when using the 3C model as a criterion. CONCLUSION: The results suggest that the BPST had a significantly higher predicted error in male and female athletes' %fat measurements when compared to HW and the 3C. Compared to a multi-compartment model, Individual errors may be twice as large when using the BPST (+/- 10.54%) over HW (+/- 4. 15%) in male and female athletes. Thus, the failure of the BPST to measure lung volume may result in greater variability between HW and ultimately a multi-compartment criterion method. The BPST does not appear to be a valid alternative to HW in an athletic population of men or women as predicting thoracic gas volumes appears to hinder the validity of the BOD POD.

INTRODUCTION

Body volume can be measured with air displacement plethysmography (ADP), thus determining body density (Db), and body fat (BF) is then estimated using general (1) or specific (2) 2C body-density conversion equations. Air-displacement plethysmography measured via BOD POD® is regarded as a substitute method to HW. In 1995, Dempster and Aitkens (3) introduced a new system named the BOD POD, which is a large, egg-shaped fiberglass chamber that uses air displacement and pressure-volume relationships to derive body volume (BV). BOD POD can quickly measure BV in a harmless and comfortable chamber with minimal skill necessary to operate the system, compared to the more complex and demanding HW method. (3, 4, 5). However, the validity of the BOD POD S/T (Self Tracking) is unknown and since Thoracic gas volume is estimated from an equation rather than being measured in the device, we hypothesized the errors would be larger than underwater weighing with a measurement of residual volume.



PURPOSE

The purpose of this study was to compare %fat estimations between HW and ADP via the BOD POD S/T to the Siri-3C model in young male and female athletes who were training for competition and were under thirty years old.

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METHODS

Descriptive characteristics of the subjects:

Variable	All Subjects (n = 98)	Men (n =36)	Women (n = 62)
Age (y)	19.00 +/- 3.47	18.67 +/- 4.29	19.19 +/- 2.91
Body weight (kg)	65.90 +/- 12.40	73.01 +/- 15.11	61.77 +/- 8.15
Height (cm)	170.34 +/- 8.69	176.84 +/- 8.19	166.57 +/- 6.50

PROCEDURES:

1. BOD POD Measurements (5-10min)

– The BOD POD (Model # S/T 2002a; Life Measurement, Inc., CA.) is an egg shaped pod with a front window and is used for measuring and tracking body fat and lean mass using patented air displacement technology.

2. Residual volume (15-20min)

– the amount of air left inside the lungs after the individual has blown out as much air as possible.

3. Hydrostatic weighing (underwater weighing) (15-20min)

– the weight of an individual underwater.

RESULTS

Validation of methods for predicting %fat compared with the Siri-3C model in all subjects (n = 98).

Method	X +/- SD	r	r^2	SEE	TE	Agreement CE/bias +/- (1.96 SD)	Upper Limits	Lower Limits	Trend
3C	19.19 +/- 7.67								
HW	18.43 +/- 7.39	0.94	0.89	2.60	2.68	0.76**+/- 5.07	5.83	-4.31	0.0383
BP	15.30 +/- 7.85	0.80	0.65	4.61	6.83	4.81*** +/- 9.55	14.36	-4.74	-0.0179

*Represents significance at ($p \leq 0.05$), **Represents significance at ($p \leq 0.01$), ***Represents significance at ($p \leq 0.001$)

Validation of methods for predicting %fat compared with the Siri-3C model in men (n = 36).

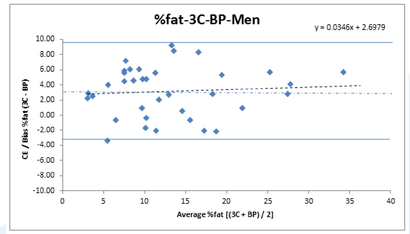
Method	X +/- SD	r	r^2	SEE	TE	Agreement CE/bias +/- (1.96 SD)	Upper Limits	Lower Limits	Trend
3C	12.55 +/- 6.55								
HW	13.06 +/- 6.90	0.92	0.84	2.66	2.78	-0.51 +/- 5.43	4.92	-5.94	-0.0545
BP	11.34 +/- 7.44	0.91	0.82	3.31	4.52	3.14*** +/- 6.45	9.59	-3.31	0.0346

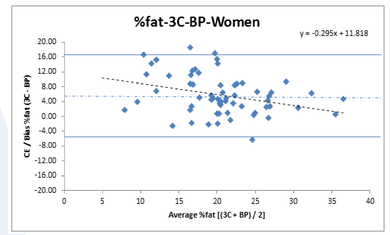
*Represents significance at ($p \leq 0.05$), **Represents significance at ($p \leq 0.01$), ***Represents significance at ($p \leq 0.001$)

Validation of methods for predicting %fat compared with the Siri-3C model in women (n = 62).

Method	X +/- SD	r	r^2	SEE	TE	Agreement CE/bias +/- (1.96 SD)	Upper Limits	Lower Limits	Trend
3C	23.44 +/- 4.76								
HW	21.87 +/- 5.39	0.92	0.85	1.88	2.62	1.57*** +/- 4.15	5.72	-2.58	0.1725*
BP	17.61 +/- 7.18	0.67	0.45	4.19	7.86	5.85*** +/- 10.54	16.39	-4.69	-0.295*

*Represents significance at ($p \leq 0.05$), **Represents significance at ($p \leq 0.01$), ***Represents significance at ($p \leq 0.001$)





BP %fat compared with the Siri-3C model in men, and women.

SUMMARY and CONCLUSIONS

When compared to the Siri-3C model, BP produced lower correlation and higher prediction errors than HW in all three groups. BOD POD S/T also produced significant CE values in all three groups and significant trend in women group, indicating that as %fat decreases, the greater the overestimating of %fat for female athletes. The major reasons influencing the results of BP measurements include: the current study used the BOD POD S/T as the measurement tool, this BOD POD model lacked the lung volume measurement which could be responsible for the greater errors compared to HW.

RECOMMENDATIONS

According to these results, the BODPOD S/T is not an acceptable alternative to HW in athletes and the BODPOD S/T may over predict body fat as much as +/- 9.55% fat compared to HW +/- 5.43 %Fat. Thus, the lack of thoracic gas measurements nearly doubles the individual errors compared to HW and significantly underestimated %Fat in groups of male and female athletes.

REFERENCES

1. Siri, W. E. (1961). *Body composition from fluid spaces and density: analysis of method. In: Brozek J, Henschel A (eds) Techniques for measuring body composition.* National Academy of Sciences, Washington, DC, 223–244.

2. Lohman, T. (1986). Applicability of body composition techniques and constants for children and youth. *Exercise and Sport Sciences Reviews, 14,* 325–357.

3. Dempster, P., & Aitkens, S. (1995). A new air displacement method for the determination of human body composition. *Medicine & Science in Sports & Exercise, 27,* 1692–1697.

4. McCrory, M. A., Gomez, T. D., Bernauer, E. M., & Mole, P. A. (1995). Evaluation of a new air displacement plethysmograph for measuring human body composition. *Medicine & Science in Sports & Exercise, 27,* 1686–1691.

5. Wagner, D. R., Heyward, V. H., & Gibson, A. L. (2000) Validation of air displacement plethysmography for assessing body composition. *Medicine & Science in Sports & Exercise,* 32, 1339–1344.