COMPARISON OF SYSTEMS TO MEASURE RESIDUAL LUNG VOLUME IN CHILDREN

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ABSTRACT

Valid assessment of body composition in pediatric populations require multi-compartment modeling techniques. Traditionally, many multi-compartment models utilized hydrostatic weighing derived body density (Db) measures, which require accurate residual lung volumes (RV;L) measurements. **PURPOSE:** The purpose of this study was to compare two systems to determine RV in children and to determine the impact of the different RV measurements on Db and percent fat (%Fat) using age and sex appropriate 2-compartment model body composition equations. **METHODS:** The subjects included 17 prepubescent (Tanner Maturational Stage ≤ 2) children ages 7-11 yrs. Each subject completed RV measurements using a Sensormedics Vmax 229 Series (Viasays Health Care Corp., Yorba Linda, CA ; S-RV) and an Exertech Body Density Measurement System, (Exertech, Dresbach, MN; E-RV) during a single testing session. **RESULTS:** Paired mean group (x ± SE), coefficient of determination (r^2), and total error (TE) analyses were used to determine if there were significant differences in RV, Db, and %Fat measurements obtained using the two systems. No significant differences were found between S-RV (0.55 ± 0.06 L) and E-RV (0.55 ± 0.04 L); S-Db (1.0113 ± 0.0058 g/cc) and E-Db (1.0110 ± 0.0059 g/cc); and S-%Fat (35.0 ± 3.0 %) and E-% Fat (35.2 ± 3.1 %). There were significant ($p < 0.01$) coefficients of determination found between the RV ($r^2 = 0.54$), Db ($r^2 = 0.98$) and % Fat ($r^2 = 0.98$) measurements. Total errors for RV, Db, and %Fat measurements were 0.04 L, 0.0010 g/cc and 0.5 %, respectively. **CONCLUSION:** In prepubescent children, the two systems compared produced similar RV measurements and did not significantly impact Db or %Fat measurements.

* Subject number increased from 17 to 24 children since abstract submission

INTRODUCTION

Estimating the RV of children introduces large random error and therefore measures of RV must be obtained to increase the accuracy of body composition assessments that require RV in this population. The system used to obtain RV measures in children needs to be accurate, reliable, and must be able to be accomplished rapidly and be easy enough for a child to complete the required procedures.

PURPOSE

The purpose of this study was to compare two systems to determine RV in children, and to determine the impact RV measurements have on Db and percent body fat using age and sex appropriate 2-compartment model body composition equations.

TABLE 1. Subject Characteristics

Characteristic	Mean ± SD N=34	Range N=24
Age (yrs)	9.0 ± 1.2	7.0 -11.9
Weight (kg)	52.7 ± 14.9	24.7 – 85.1
Height (cm)	142.2 ± 9.4	123.6 - 160.3
BMI (kg/m^2)	25.6 ± 5.3	16.0 – 33.4

TABLE 2. Residual Lung Volume, Body Density and % Fat Measurements

Characteristic	Sensormedic N=34	Exertech N=24	r^2	TE
Residual Lung Volume (L)	0.59 ± 0.05	0.59 ± 0.04	0.41*	0.04
Body Density (g/cc)	1.0072 ± 0.0045	1.0069 ± 0.0046	0.97*	0.0118
Percent Fat (%)	37.1 ± 2.3	37.1 ± 2.4	0.97*	0.4

% Fat determined using age and sex appropriate 2-compartment model body composition equations (Lohman, 1989)

* Sensormedics versus Exertech ($p < 0.01$)

METHODS

I. Subjects

24 prepubescent (Tanner Maturational Staging ≤ 2) children ages 7-11 years old
Boys = 12 Girls = 12

II. Residual Lung Volume Measuring Systems (Figure 1 and 2)

Sensormedics VMax 229 (Figure 1)
Viasays Health Care Corp., Yorba Linda, CA
Subjects performed 2-3 trails of the N_2 washout technique
The mean of the trials was used for subsequent analysis
VMax software version 05 was used

Exertech Residual Lung Volume System (Figure 2)
Exertech, Dresbach, MN
Subjects performed 2-3 trails of the O_2 dilution technique
The mean of the trials was used for subsequent analysis
DOS program created by the manufacture used

III. Statistical Analysis

Paired T-tests, coefficient of determination, and total errors (TE; standard error about the line of identity) were used to compare measures of RV, Db and % Fat obtained by the two systems

Bland-Altman plots were used to graphically demonstrate the differences between the RV, Db and % Fat measures using the two systems and display the 95th confidence intervals

Statview (SAS Institute, Inc., Cary, NC.) a computer based program, was used for all analyses

Figure 1. Sensormedic VMax 229

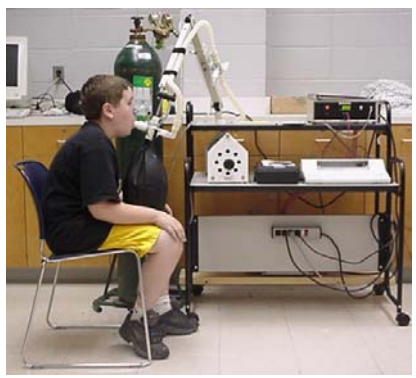

Figure 2. Exertech Residual Lung Volume System

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RESULTS

No significant differences were found between S-RV (0.59 ± 0.04 L) and E-RV (0.59 ± 0.04 L); S-Db (1.0072 ± 0.0045 g/cc) and E-Db (1.0069 ± 0.0046 g/cc); and S-%Fat (37.1 ± 2.3 %) and E-%Fat (37.1 ± 2.4 %) (Table 2)

There were significant ($p < 0.01$) coefficient of determination, found for the RV ($r^2 = 0.41$), Db ($r^2 = 0.97$) and %Fat ($r^2 = 0.97$) measurements.

The total errors (TE; standard errors about the line of identity) were 0.04 L, 0.0118 g/cc, and 0.4% for the RV, Db and % Fat, respectively.

Bland-Altman Plotting further demonstrated that the differences in S-RV and E-RV; S-Db and E-Db; and S-%Fat and E-%Fat measures all fell within the 95th percent confidence intervals.

Figure 3. Bland Altman Plot: Residual Lung Volume

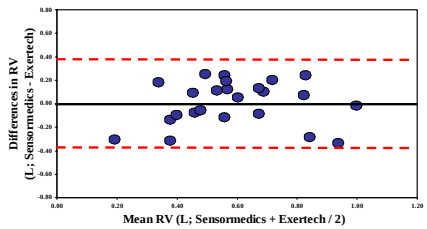


Figure 4. Bland Altman Plot: Body Density

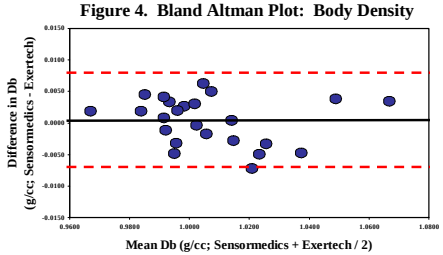
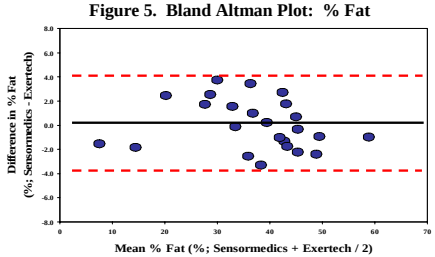


Figure 5. Bland Altman Plot: % Fat



CONCLUSIONS

The results demonstrated that the Sensormedics and Exertech systems produced similar results in the group of prepubescent children tested