INTRODUCTION

Both the Fit3D Body Scanner (3D SCAN) and LeanScreen 2D (2D APP) can be used to estimate body fat percentages (%BF).

2D APP is low cost and accessible to anybody with an iOS smart device.

3D SCAN is user friendly, commonly found in health centers, and yields fast results.

Purpose: Determine test-retest reliability of 2D APP and 3D SCAN and compare methods of %BF estimation against BOD POD.

METHODS

Subjects:

79 subjects (37 female, 42 males, 32.9 ± 12.4, 18-65 y; BMI 25.0 ± 4.9, 18.2-41.8 kg/m²)

Measurement protocol: Each subject was measured twice by the 3D SCAN and 2D APP. A single measurement by the BOD POD served as the criterion.

Equipment & Procedures:

1) Height and weight were measured.
2) Bod Pod Air Displacement Plethysmography (Figure 1) with measured thoracic gas volume was used to determine body density (Db).
3) Siri formula was used to convert Db to %BF.
4) Posture Co. LeanScreen 2D APP (See Figure 2)
5) Fit3D Body Scanner (See Figure 3)

Statistical Analyses:

1) Means ± 5D were calculated for all variables.
2) Test-retest reliability of the app and scanner were assessed with intraclass correlation (ICC) and standard error of measurement (SEM).
3) 2D APP and 3D SCAN validity was assessed against the Bod Pod with repeated measures ANOVA, linear regression, and Bland-Altman plots.

RESULTS

Descriptive characteristics of the sample are in Table 1.

- Test-retest reliability for both 2D APP and 3D SCAN were identical (ICC= 0.993, SEM <1% BF).
- All 3 methods highly correlated (r = 0.857 to 0.923).
- Mean %BF estimations were significantly different (p = 0.001) with the disparity between methods greater for males than females.

RESULTS 2D APP vs. BOD POD:

Mean %BF from 2D APP underestimated the Bod Pod results by 4.8% ± 6.8% BF.

RESULTS 3D SCAN vs. BOD POD:

Mean %BF from 3D SCAN was 9.4% ± 9.4% BF higher than the Bod Pod. The 3D SCAN underestimated fat participants while the Bod Pod overestimated lean participants.

Figure 1: BodPod

Figure 2: 2D APP

Figure 3: 3D SCAN

Figure 4. Top Left: Linear regression prediction of body fat percentage by the LeanScreen app.

Top Middle: Linear regression prediction of body fat percentage by the Fit3D body scanner.

Bottom Right: Bland-Altman analysis of the residual scores for the LeanScreen body scanner. Solid line is the constant error, and the dashed lines represent the 95% limits of agreement.

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- Mean %BF estimations were significantly different (p = 0.001) with the disparity between methods greater for males than females.

- The 2D APP and 3D SCAN are both very reliable, however, neither provided valid estimates of %BF compared to the Bod Pod.
- More research is needed to test the algorithms associated with imaging devices to see if they can be modified to be more accurate.

Table 1. Mean ± 5D of the study sample

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI (kg/m²)</th>
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<tbody>
<tr>
<td>Female (n = 37)</td>
<td>32.9 ± 13.1</td>
<td>166.0 ± 7.6</td>
<td>66.4 ± 13.4</td>
</tr>
<tr>
<td>Male (n = 42)</td>
<td>33.2 ± 11.9</td>
<td>179.3 ± 8.0</td>
<td>82.6 ± 13.2</td>
</tr>
<tr>
<td>Total (n = 79)</td>
<td>32.9 ± 12.4</td>
<td>173.0 ± 10.2</td>
<td>75.0 ± 15.5</td>
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</tbody>
</table>

SUMMARY AND CONCLUSIONS

- There was excellent test-retest reliability for both the 2D APP and the 3D SCAN.
- All 3 methods were highly correlated; however, the mean %BF of the app and scanner were significantly different than the Bod Pod with the 2D APP underestimating and the 3D SCAN overestimating %BF.
- Both methods had a systematic bias: overestimating lean participants and underestimate fat participants.
- The 2D APP and 3D SCAN are both very reliable, however, neither provided valid estimates of %BF compared to the Bod Pod.
- More research is needed to test the algorithms associated with imaging devices to see if they can be modified to be more accurate.