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Original Research Article

Ability of the LeanScreen App to Accurately Assess Body Composition

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Abstract

Introduction: Waist-to-hip ratio (WHR) and percent body fat (%BF) are commonly used to assess body composition in health and wellness settings. While there is only one commonly used method for measuring WHR, %BF can be determined many ways. However, the accuracy, cost, and ease of use of these methods vary greatly. The LeanScreen app is a new method designed to determine WHR and %BF using photographs. **Purpose:** This study was designed to assess the accuracy of the LeanScreen app to determine WHR and %BF against laboratory-validated methods. Eighty subjects (40 males; 40 females) participated in this study. Waist-to-hip ratio was manually measured and %BF was determined using the BOD POD. Photographs of each subject were taken from the front and side with the LeanScreen app according to the procedures demonstrated by the program software. **Results:** There was no significant difference in WHR between the LeanScreen app (.81 ± .078) and manual (.81 ± .087) WHR measurement (r=.83). Additionally, it was found that 73 subjects (91%) were within the 95% confidence intervals of the mean. Overall, %BF was significantly underpredicted by the LeanScreen app compared to the BOD POD (20.2 ± 7.74 vs. 21.6 ± 8.77). Although there was a high correlation between the two methods (r=.82), only 35 subjects (44%) were within ± 3% of BOD POD derived %BF and there was a high degree of variability between methods (SEE=5.1). **Conclusion:** Based upon the results of this study, the LeanScreen app accurately determines WHR, but does not accurately determine %BF on an individual basis.

Key Words: BOD POD, Body Fat, Obesity, Overweight

INTRODUCTION

Body composition is an important component of health-related fitness because of the relationship between excess body fat and chronic disease. Individuals classified as overweight or obese have a higher risk of developing a variety of diseases, including Type 2 diabetes, cardiovascular disease, and stroke[1]. Epidemiologically, the degree of overweight or obesity are often classified by body mass index (BMI) or waist-to-hip-ratio (WHR) because both methods are fast and easy to determine[2]. Body mass index is calculated by dividing body weight in kilograms by the square of height in centimeters, WHR is determined by dividing the circumference of a person's waist at the narrowest part by hip circumference of at the widest part[3]. There are a variety of other ways to measure body composition including skinfold measurements (SF), bioelectrical impedance (BIA), hydrostatic weighing (HW), dual x-ray densitometry (DEXA), near infrared interactance (NIR), and the use of a BOD POD (Life Measurement Inc., Concord, CA), but the accuracy, ease of use, and cost of using these methods can vary greatly. Personal trainers, nutritionists, physicians, and other professionals who use these methods of assessment would benefit from an inexpensive, accurate, and simple way of measuring body composition.

PostureCo (PostureCo, Trinity, FL) has developed an app for a phone or tablet that uses photographs to assess percent body fat (%BF), BMI, and WHR. PostureCo's LeanScreen app incorporates photographs taken from the front and side to determine these measurements. According to PostureCo's website, the LeanScreen app can predict these measurements to within 3% accuracy[4]. To our knowledge, the accuracy of the LeanScreen app has never been independently tested and validated. The purpose of this study was to assess the accuracy of the LeanScreen app to assess %BF and WHR by testing it against laboratory-validated methods.

METHODS

Participants

Subjects for this study were 40 male and 40 female volunteers, with a wide range of body types and ages. Descriptive characteristics of the subjects are presented in Table 1. The purpose and procedures of the study were explained to subjects and each subject provided written informed consent prior to undergoing any testing procedures. The study was approved by the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects.

Table 1. Descriptive characteristics of subjects (N=80).

Parameter	Female (n=40)	Male (n=40)
Age (yr)	35.3 ± 11.78	29.2 ± 12.89
Height (cm)	166 ± 6.60	179 ± 7.30
Weight (kg)	68.3 ± 10.94	82.8 ± 14.70

Data are reported as mean ± standard deviation.

Experimental Design

Height and weight were measured using a mechanical scale (Pellstar L.L.C. Health O Meter, McCook, IL). Height was measured in meters to two decimal points and weight was measured to the nearest kilogram with one decimal point. Waist-to-hip-ratio was determined by dividing the circumference of the subject's waist at the narrowest part by the circumference of their hips at the widest protrusion of the buttocks as recommended by the American College of Sports Medicine[3]. Circumference measurements were made to the nearest centimeter using a steel tape measure. The waist measurement was made at the narrowest part of the waist, just above the iliac crest. The subject stood with their feet shoulder width apart, exhaled completely, and the tape was wrapped around their body parallel with the ground. The tape was snug to the waist to ensure accurate measurements, but was not tight to the point of moving or displacing the skin. Hip measurements were made in the same manner except they were taken at the widest protrusion of the buttocks. Percent body fat was measured to one decimal point using a BOD POD, which measures the amount of air displaced by a person in a known volume of space. Although hydrostatic weighing is considered the gold standard for measuring %BF[5] research by Vescovi et al[6] , McCrory et al[7], Fields et al[8], Fields, Hunter and Goran,[9] and Nunez et al[10] have shown the BOD POD to be virtually identical to hydrostatic weighing as a means of measuring %BF, with correlations ranging from .90-.97.

Pictures of each subject were taken using the LeanScreen app on an iPad (Apple Inc., Cupertino, CA) following the procedures provided by PostureCo, Inc. Two photographs were taken from 12 feet away; one from the front and the other from right side of the subject's body. Reference lines were drawn onto the photos in the software program according to the directions given by the LeanScreen app. Using the photograph from the front-view, reference points were placed at each side of the neck, halfway between the sternum and umbilicus, at the level of the umbilicus, and at each side of the hips at the widest location. Reference points from the side-angle photograph were placed at the same locations as the front-view photograph. The subject's height, weight, age, and gender were also entered into the software program.

For all measurements, participants wore tight-fitting clothing (swimsuit or spandex shorts and a sports bra) and a swim cap. The reason for this is two-fold: tight clothing allows for more accurate placement of reference points on the LeanScreen app, and the wearing of a swim cap minimizes air displacement of the subject's hair during the BOD POD measurements.

Statistical analyses

Standard descriptive statistics were used to determine the baseline characteristics of the subjects. Paired-samples t-tests were used to compare %BF determined by the BOD POD and the LeanScreen app, and WHR determined by manual circumference measurements compared to the LeanScreen app. Pearson product-moment correlations were used to compare the relationship between BOD POD and LeanScreen %BF, as well as between manual WHR measurement and LeanScreen WHR. Standard error of the estimate (SEE) was determined using linear regression analysis. All data were analyzed using the Statistical Package for the Social Services (SPSS Inc., Chicago, IL) version 25. Alpha was set at .05 to achieve statistical significance.

RESULTS

Overall, %BF was significantly underpredicted by the LeanScreen app compared to the BOD POD (20.2 ± 7.74 vs. 21.6 ± 8.77). A plot of the data are presented in Figure 1. The correlation between the LeanScreen and BOD POD %BF was r=.82 and the SEE was 5.1%.

A plot of the differences between %BF determined by the BOD POD and the LeanScreen app is presented in Figure 2. Upon examination of the calculated differences observed in Figure 2, it was noted that people with a lower %BF (<10%) appeared to be overpredicted by the LeanScreen app, and people with a higher %BF (>30%) appeared to be underpredicted by the LeanScreen app. Thus, subjects were divided into three groups based on %BF as calculated by the BOD POD and means were compared for subjects with a %BF of <10%, 10%-30%, and >30%. It was found that for subjects with a %BF <10%, the LeanScreen significantly overpredicted %BF by an average of 4% (12.0 ± 1.63 vs. 8.0 ± 1.74). For subjects between 10%-30% body fat, there was no significant difference between the LeanScreen and BOD POD (18.5 ± 6.52 vs. 19.3 ± 5.12). In subjects with %BF >30%, LeanScreen significantly underpredicted %BF by an average of 5.7% (28.9 ± 5.26 vs. 34.6 ± 3.03).

The LeanScreen app claims to be accurate within 3 percent of actual %BF. Of the 80 subjects, only 35 (44%) had a %BF predicted by LeanScreen that was within ± 3% of BOD POD values.

Overall, there was no significant difference in WHR as determined by the LeanScreen app compared to manually measured values. The correlation between the LeanScreen app and manual measurement was r=.83 and the SEE was 0.04. Because the LeanScreen app rounds to only one decimal point when determining WHR, data are shown in straight lines on the vertical (y) axis, whereas manually measured WHR values were reported to two decimal points on the horizontal (x) axis. A plot of the data is presented in Figure 3.

Differences between WHR as determined by the LeanScreen app compared to manually measured WHR values are presented in Figure 4. The horizontal lines represent the 95% confidence intervals around the line of identity. Upon examination of the graph, 73 (91%) of subjects fell within this range.

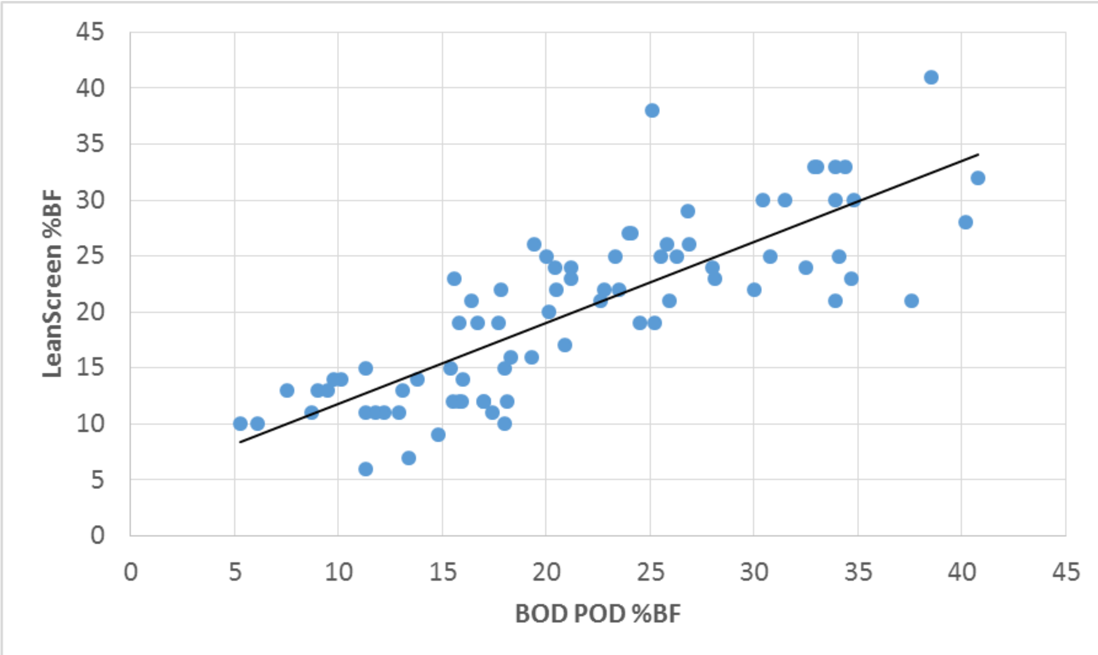

Figure 1. Relationship between percent body fat (%BF) determined by the BOD POD and the LeanScreen app.

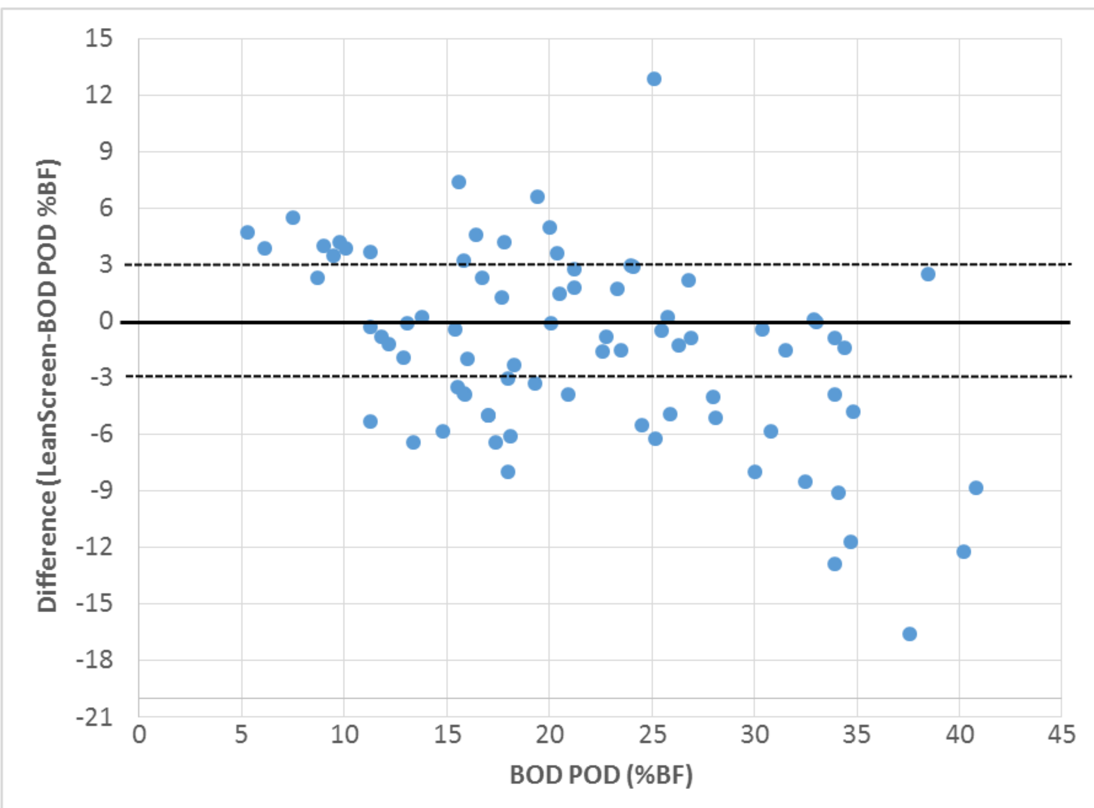

Figure 2. Difference between percent body fat (%BF) determined by the BOD POD and the LeanScreen app. Dotted lines represent ± 3% difference between the LeanScreen app and the BOD POD.

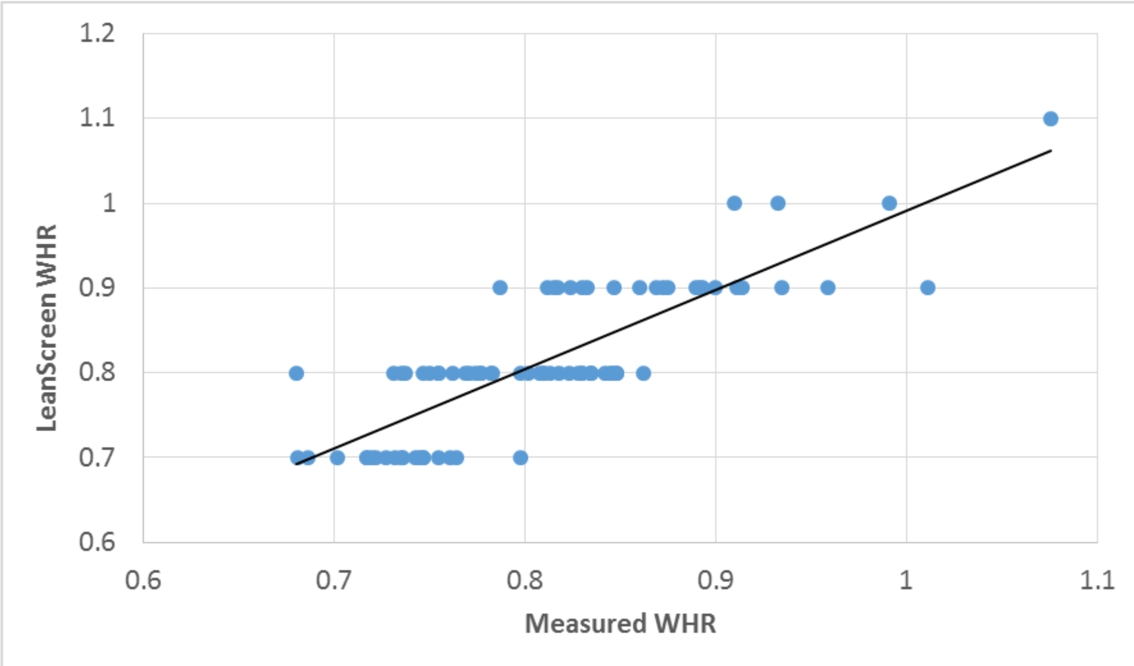

Figure 3. Relationship between manually measured waist-to-hip ratio (WHR) and WHR determined by the LeanScreen app.

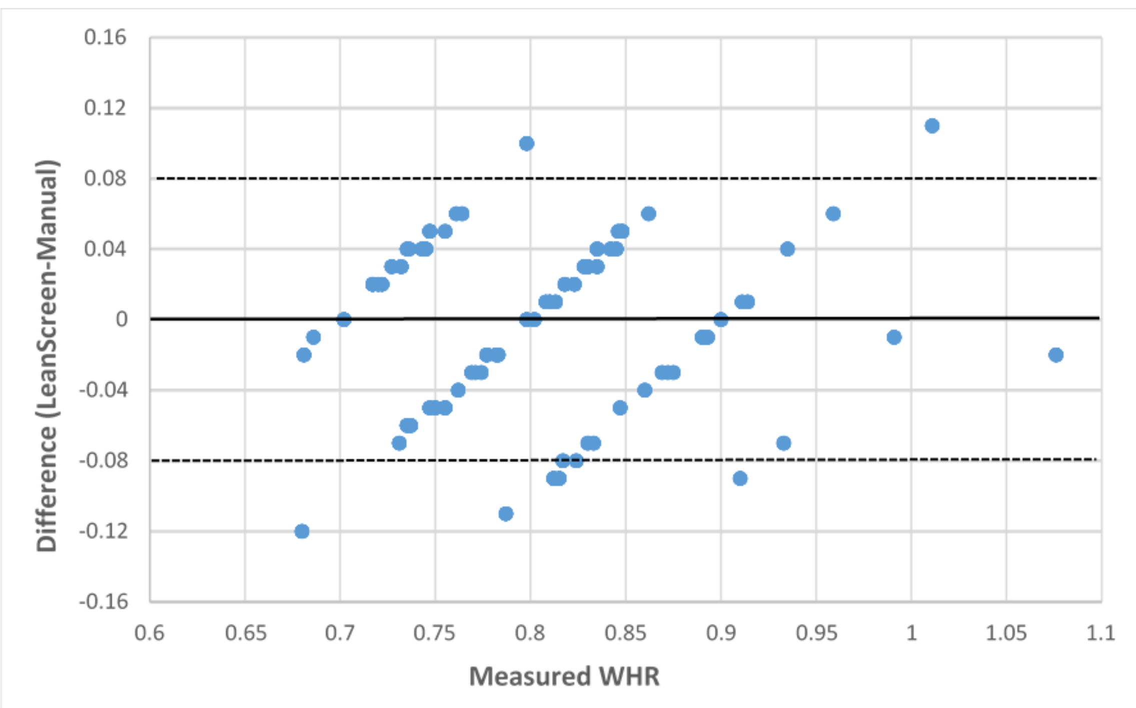

Figure 4. Relationship between measured waist-to-hip ratio (WHR) and the difference between measured WHR and LeanScreen-predicted WHR. Dotted lines represent the 95% confidence intervals around the line of identity.

DISCUSSION

The purpose of this study was to determine to accuracy of the LeanScreen app to accurately assess %BF and WHR by comparing these values to %BF measured by the BOD POD and a manual WHR measurement. The findings indicate that although the mean difference between the LeanSCreen app and the BOD POD for %BF was only 1.4% (20.2% vs. 21.6%), there was a wide variation in accuracy, depending upon the actual %BF of the individual. A review of the plot of residuals showed that the LeanScreen app significantly overpredicted %BF by an average of 4.0% for subjects who were less than 10% body fat according to the BOD POD, and significantly underpredicted %BF by an average of 5.7% for subjects above 30% body fat. Although there was a high correlation between the BOD POD and LeanScreen app (r=.82), there was a high degree of variability (SEE= 5.1%) and only 44% of subjects were within ± 3% of BOD POD %BF. PostureCo, Inc. (PostureCo, Trinity, FL), the maker of the LeanScreen app, reports the accuracy to be within ± 3% of the HW method of determining %BF. Hydrostatic weighing is considered the "gold standard" for determining body composition[5]. In the current study, we used the BOD POD for comparative purposes. Numerous studies have found that the BOD POD results in virtually identical %BF values compared to HW, with correlations ranging from r=.90-.97 and SEE values ranging from 1.68-1.81%[6-10].

The high SEE value of 5.1% found in the current study is higher than most other commonly used methods for measuring %BF. The accuracy of %BF determined by SF (2.0-3.5%), BIA (3.5-5%), DEXA (1.5%), and NIR (3-5%) all provide better estimates of %BF than those provided by the LeanScreen app[11].

In respect to WHR, no significant difference was found between manually measured WHR values and those reported by the LeanScreen app, and there was a high correlation (r=.83) and low SEE (0.04) between the two methods. A plot of the residuals revealed an equal distribution of data around the line of identity. In total, 73 of the 80 subjects (91%) had WHR values predicted by the LeanScreen app that were within the 95% confidence intervals of manually measured WHR values, indicating a high degree of accuracy by the LeanScreen app. A potential problem with the LeanScreen app is that the software only rounds to the nearest one decimal point (e.g.; 0.7, 0.8, 0.9). Most guidelines for WHR are carried out to two decimal points. For instance, ACSM states that a WHR above 0.95 for men and 0.86 for women correlates to a higher risk of chronic disease[3]. Because the LeanScreen app only rounds to one decimal point, some people may be misclassified simply because of rounding error.

CONCLUSIONS

Although overall %BF values were similar between the BOD POD and the LeanScreen app, there was considerable variability, especially for individuals with lower and higher %BF values. Only 44% of subjects were within ± 3 %BF as reported by PostureCo, Inc. and the SEE was 5.1 %BF, which is higher than most methods for predicting body composition. The LeanScreen app accurately predicts WHR, although because the software only rounds to one decimal point, a small amount of people may be misclassified due to rounding error.

Disclosures

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