Comparing Validity of Body Composition Measuring Tools

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This project makes no effort to suggest generalizability. Instead, it was designed to demonstrate competency using lab equipment, capacity to integrate knowledge with application, and understanding of the scientific method.

Introduction

In physical fitness, body composition is the proportion of fat and fat-free mass in the human body. It is measured to assess and calculate a person's overall health and fitness level. Body fat percent is the measurement of body composition that tells a healthcare professional how much of the weight of the body is fat. Body fat can be found in muscle tissue. Fat free mass includes bone, water, muscle, organs, and tissues. There are different factors that affect body composition which are age, sex, genes, and hormones. The methods that were used to measure body composition for this study were Bod Pod and Bioelectrical Impedance Analysis.

The Bod Pod is an air displacement plethysmograph densitometry to determine body composition. "Air displacement plethysmograph has been used to measure human body composition for nearly a century, but has not developed into viable system for routine use until the mid-1990s" (Fields, Goran, & Mccrory, 2002) The Bod Pod method uses air to measure volume. The subjects in this study that were tested by the Bod Pod had to enter a small chamber like structure to get an accurate body fat percent reading. The machine has to go through a calibration process in order for the results to be accurate. The changes in the chamber's pressure are recorded to determine body volume. This method is highly accurate and can detect risk factors for major diseases and obesity. The range of error for this test is 1% to 2.7%.

"Bioelectrical impedance analysis (BIA) is a relatively simple, quick and non-invasive technique, to measure body composition" (Dehghan & Merchant, 2008). There are different types of of bioelectrical impedance analysis devices that can be used to test for body composition. The two devices that were used in this study was the Omron HBF 306 and the Omron HBF 541C. The difference between the two devices is the particular body part that is being used to measure body composition. When using the Omron HBF 306 subjects had to use their hands to get accurate body fat percent readings, a hand-held BIA. When using the Omron HBF 541C subjects had to use their feet and hands to get accurate body fat percent readings, a hand-to-foot BIA. The Omron HBF 306 sends electrical currents through the hand grip electrodes. The Omron HBF 541C sends electrical currents between the feet. This method is moderately accurate for estimating body fat. The range of error for individuals using this particular method is 4-8%.

The purpose of this study was to test the validity of body composition measuring machines by finding the error in percent difference. It was hypothesized that the Bod Pod would provide more valid percent body fat estimates than the Omron 306 and the Omron HBF541C.

Methods

To conduct this test, the team will arrive at the HSB building one hour before the subjects arrive to calibrate the Bod Pod. During this time, one team member will calibrate the Bod Pod, while the other two gather the Omron 306 and HBF541C devices. This process should take about 45 minutes. All subjects should arrive around the time the calibration is being finished. One team member will take the height of the client on the beam scale and ask the demographic questions for the Bod Pod. Once completed, the first subject will get into the Bod Pod, this should take 10 minutes. This process will repeat for all three subjects. After completing the Bod Pod, subjects will complete the Omron 306, this will take 3 minutes. Lastly, the subjects will do the Omron HBF541C, this will also take 3 minutes. All subject data will be exported to an Excel spreadsheet.

Body Composition Tools

Figure 1. Bod Pod Machine

Figure 2. Omron 360

Figure 3. Omron HBF541C

Results

Table 1 shows the percent body fat measurements for all four subjects on each of the three devices. Table 2 shows the percent differences of body fat readings between the Bod Pod and the Omron devices. Overall, The Omron HBF541 showed the greatest percent error when compared to the Bod Pod. This device was shown to overestimate the body fat readings. The average difference in error for the Omron 306 was 18% while the average difference in error for the Omron HBF541C was -32%. The lowest percent error was -3% for the Omron 360 while the highest percent error was 33%. With the Omron HBF541C, the lowest percent error was 2% with the greatest percent error being -70% .

Table 1

Subjects	Bod Pod	Omron 360	Omron 541
1	34.5%	29.0%	35.5%
2	25.4%	26.1%	43.2%
3	13.3%	8.9%	13%
4	11.9%	8.7%	18.5%

Table 2

Subjects	Percent Difference: Bod Pod vs. Omron 360	Percent Difference: Bod Pod vs. Omron HBF541C
1	16%	-3%
2	-3%	-70%
3	33%	2%
4	27%	-55%

Discussion

Based on the results from this study we can conclude that neither Omron testing method was accurate when compared to the Bod Pod. However, if looking for a cheaper alternative to analyze body composition it is suggested to use Omron 306 because the percent error from this device was half that of the other; 18% with the Omron 306 and -32% with the Omron HBF41C. Our research contrasts that of the study conducted by Montgomery and Marttinen (2017) who concluded there would be a much smaller difference in body composition calculations using the Bod Pod and Omron device at 0.8% to 3.6%. Their research also suggested the Bod Pod would have lower body composition calculations than other testing devices. A study conducted by Bujko, Kasperzak, Houlshof, and Schreurs (2006), stated that the Bod Pod has a lesser margin of error compared to other body composition measuring tools.

A limitation of this study was the population size of only 4 people. With a small participant group results were not conclusive. Also, because both males and females were included and there was no distinguishing in the results between the two genders we were not able to conclude any gender differences. Each participant was only assessed by each device once meaning we could not test the reliability of our testing devices. Future research should be included with more participants and more devices.

Conclusion

Our research concluded that Omron HBF541C would over calculate body composition while the Omron 306 would under calculate it. It was hypothesized in our study that both Omron devices would provide more valid results for body composition when compared to the Bod Pod but testing did not support the hypothesis. Had both Omron devices provided similar results to one another then more testing could be done to see if the Omron or Bod Pod devices were producing correct calculations. Since one Omron device underestimated and the other overestimated body composition it can be concluded that neither was valid when compared to the Bod Pod. Further testing will need to be done to confirm these results including more participants.

References

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