

Comparison of Percent Body Fat Measured by Ultrasonography, Skin Fold, and Bioelectrical Impedance Analysis in High School Wrestlers

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Context: Prevention of unsafe weight loss practice of wrestlers involves body composition assessments at the beginning of the season to determine the lowest weight class for each wrestler. Skin fold (SKF) and bioelectrical impedance analysis (BIA) are feasible field methods to assess body composition, and have been widely utilized. Ultrasonography (US) is an alternative noninvasive method of measuring the thickness of subcutaneous fat. The studies validating the use of US are limited to college athletes, and no studies have examined the efficacy of these methods in adolescent population. **Objective:** To compare the percent body fat (%BF) measured by US, BIA, and SKF in adolescent wrestlers. **Design:** Repeated measures **Setting:** High school **Participants:** 333 high school wrestlers (male=226, female=107, mean age:15.3±1.2y/o) **Interventions:** Following the hydration assessment, %BF of each participant was measured using SKF, BIA (TBF-300WA Plus, Tanita), and US (BodyMetrixWR, IntelaMetrix). For SKF and US, Loman equation for male and Jackson-Pollocke equation for female were used to calculate the body density with Brozek equation to calculate %BF. Subcutaneous thickness was measured at triceps, subscapular, and abdomen for male and triceps, abdomen, suprailiac, and thigh for female. Same trained examiner conducted each testing. **Main Outcome Measures:** Dependent variables were %BF measured by three different methods. Intraclass correlation, standard error of measurement, and Bland-Altman plot were used for reliability assessment. Mixed method ANOVA was used to assess gender effect. **Results:** Intraclass correlation revealed high reliability among three methods ($ICC_{(2,3)}=0.89$) with standard error of 4.0%. Bland-Altman plot revealed that US over-estimated %BF compared to BIA and SKF by $3.27\pm 5.93\%$ and $3.01\pm 4.43\%$, respectively, and demonstrated wide 95% limits of agreement (range: 23.1% and 16.5%, respectively). Mixed method ANOVA revealed significant gender interaction effect ($p=.000$). Post-hoc pairwise comparisons for male indicated all three methods were significantly different from each other (US: $18.8\pm 9.0\%$, BIA: $13.6\pm 6.9\%$, SKF: $15.8\pm 7.3\%$, $p=.000$ for each pairwise comparison). The %BF measured by US was significantly higher than BIA (mean difference: 5.2%, 95%CI: 4.6-5.9%) and SKF (mean difference: 3.1%, 95%CI: 2.5-3.6%); SKF was significantly higher than BIA (mean difference: 2.1%, 95%CI: 1.7-2.6%). For female, US was significantly higher than SKF (US: $27.5\pm 5.8\%$, SKF: $24.6\pm 6.5\%$, $p=.000$, mean difference: 2.9%, 95%CI: 2.1-3.6%), and BIA was significantly higher than SKF (BIA: $28.3\pm 8.6\%$, SKF: $24.6\pm 6.5\%$, $p=.000$, mean difference: 3.7%, 95%CI: 2.8-4.6%); there was no difference between US and BIA ($p=.14$). **Conclusions:** Although ICC demonstrates high reliability, the standard error of 4.0% is rather clinically significant. Athletic trainers and administrator must realize

that over-estimation of %BF could place a high school wrestler in a lower weight class. Further validation study using gold standard method is warranted to identify the most accurate method for the adolescent population. **Word Count:** 421