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Validity of Body Density with Methods of Body Mass Index, Skin Fold, Bio- Electrical Impedance & Criterion Method of Hydrostatic in Men Athletes of Swimming

Abstract

The goal of present research is estimating and validity of body density with methods of Body Mass Index, Skin Fold, Bio-Electrical Impedance and Criterion Method of Hydrostatic in men athletes of swimming. The present research has been conducted with semi-experimental and functional method. For doing so 25 men swimming athletes were randomly selected (N= 120). Statistical analysis was conducted with Pearson coefficient, correlated T-test, TE & SEE. The results of statistical analysis show that the method of Skin Fold Stat with hydrostatic criterion method has meaningful difference in society of swimmers. Also there is meaningful difference between body mass index and criterion method. There was not any meaningful difference between bio-electrical impedance and criterion method in swimmers. (TE=3.01, SEE=2.91, R=0.924, P=0.064). The findings show that that bio-electrical impedance in swimmer athletes is more suitable method.

Keywords: Body Density, Body Mass Index, Skin Fold, Bio-Electrical Impedance, Hydrostatic

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Introduction

The body structure is very important for most of athletes. Specially those athletes who are involved with their weight classification in field of sport (like swimming) and weight shall be carefully observed(1). Whereas body mass index will be increased with both fat tissue and free fat tissue, a person with high masculine mass and low fat mass will be regarded as person having excess obesity. This limitation will be problem making for athletes who intend to have masculine and fitness body. The anthropometric methods like weight, height, skin fold can give us good descriptive information in relation to classification of body shape. Measuring weight underwater is the most exact method for measuring body fat that is regarded as a standard method. Other methods like potassium 40, computerized tomography, attracting ineffective gas and bio-electrical impedance are being used that are valuable but expensive; also computerized tomography method will expose person in front of radiation ray(1). Also comparison between methods have shown considerable difference; so that the hydrostatic method will show body structure completely different with measuring the thickness of skin's winkles and bio-electrical impedance among athletes of fields like water polo, judo, karate so that these methods can not be used instead of each other(4). As it was mentioned researchers are using different methods for evaluating body density and up to now a specified method has not been suggested. This has result in confusing researchers in relation to using diverse methods and not specifying a particular method for evaluating body density of athletes. The most important issue in this research is first to specify the body density and percentage of fat in athletes with methods including body mass index, hypodermis fat, bio-electrical impedance and underwater distribution(hydrostatic) among men athletes of swimming field. Second; the researcher tries to find out an answer for this question: is measuring body density and percentage of body fat with method including body mass index, skin fold, bio-electrical impedance and underwater distribution different among men athletes for field of swimming? According to cheap and accessible methods of body mass index, skin fold, bio-electrical impedance and also limitation of hydrostatic method from view point of cost, time and place in relation to the above mentioned methods, what is the best and the most suitable method for measuring body density and percentage of fat in men athletes of swimming field? The goal of present research is specifying body density and percentage of fat with using body mass index, skin fold, Bio-electrical impedance and hydrostatic in men athletes of swimming field.

Research Methods

The present research has been prepared with of semi-experimental and applied method that for describing and analyzing data the SPSS software and Pearson coefficient, total and standard method has been used.

Society and Sample of Research:

The statistical society in this research is all men athletes of swimming field (120 athletes). Among statistical society 25 persons have been randomly selected as sample according to prepared questionnaire. The record of testable items according to offered questionnaire about testable activities is at least 2 hours daily, 6 days of week during preparation course for tournament that shall have at least 4 years record in their sport field.

Research Tools:

Reference calipr is Harpenden model, Seca medical scale for distributing weight of testable items, equipment for measuring height while being standing up, bio-electrical impedance equipment, equipment for digital distribution of hydrostatic, pond 1.2 * 1.2 * 1.5m2, spirometer machine for approximating remained volume of lung

Measuring Method and Kind of Gathering Information:

All tests (HW, BIA, SKF, BMI) were conducted in one day for persons attending in test and 12 hours before conducting any test; it was requested from attendances to prevent from consuming any nutrition materials and performing any sport activities. In the Skin Fold measuring method via 2 subject equation special for Stat and coworkers(2000) for young men athletes swimmers(16-26) (Y=upper pelvis + 3 heads),
BD= 1.056-0.00098(3 heads)+ 0.000132(age)-0,0017(upper pelvis)+0.00031(weight), the body mass index can be calculated as dividing weight based on kilogram to square of height based on meter and remained lung volume will be calculated by Spirometer machine. Bio-electrical impedance will be measure by Body Composition Analysis and method for criterion of hydrostatic will be calculated via Goldman and Boskrit formula.

$$BD = \frac{W_b}{\dfrac{w_b + w_w}{D_W} - (RV + 100)}$$

For exchanging to percentage of fat this formula can be used.
BF%= [4.95/BD – 4.5] * 100

Findings and Results
1- In table 1-1 descriptive findings related to swimmer samples are offered. In table 2-1 descriptive findings related to swimmer samples in test for body density and percentage of fat are offered. In relation to durability of knots test and measuring tool it must be said that the
Inter-group durability section in first turn test and second correlation test is between R= 1-0.87 and small fault has been founded that all tests have tolerance at natural level. The outer-group durability test for approximating percentage of fat and correlation of first and second turn tests is between R= 1-0.88 with low amount of fault.

2- There is difference in assessing body density of men swimmer athletes with Stat equations and criterion method. (P= 0.000)(Table 2-1). The average of hypoderm fat percentage via Stat 2 subject's equation and test of criterion method is 13.4%, 15.74% respectively). These 2 averages had meaningful difference i.e. P= 0.000
3- There is correlation between densities of swimmer men athletes with Stat equation and criterion method (table 2-1).
TE=0.0092, SEE=0.0081, R=0.853, R2=0.751). There is meaningful correlation between assessing percentage of fat of attendances in Stat 2 subject equation and criterion method test.
TE=4.42, SEE=3.31, R=0.781, R2: 0.746
4- There is not difference in assessing body density of men swimmer athletes with methods of criterion and bio-electrical impedance that according table No.2-1 the percentage of received fat via criterion and bio-electrical impedance are the same; that there is not considerable difference between these 2 methods
5- There is high level of correlation between body densities of men swimmer athletes with via criterion and bio-electrical impedance method
TE=3.01, SEE=2.91, R=0.924, R2=0.841
6- There is difference between assessing of body density of men swimmer athletes with method of criterion and bio-electrical impedance. According to table No.2-1, the percentage of fat with method of body mass index and criterion test is 22.6% and 15.74% respectively that shows meaningful difference
7- In table 2-1 according to probability level P< 0.05 there is low correlation between fat percentage of attendances in test and criterion method of swimming. TE=6.7, SEE=5.2, R=0.468, R2=0.411.

Table 1-1: Descriptive Findings of Swimmer Athletes

Variable/ Statistics	Average SD	Minimum Amount	Maximum Amount
Age	21/64 +- 4.16	15	26
Height	173.09 +- 5.92	152	181
Weight	63/87 +- 7.33	52	73

Table 2-1: Findings Related to Swim Field

Statistics/ Variable	R	R^2	TE	SEE	T	P	M +- SD	RANGE
$BF_3\%$	0.781	0.746	4.42	3.31	6.3	0.000	13.4+-6.71	4.7-21.62
BD_3	0.853	0.751	0.0092	0.0081	4.23	0.000	1.0731+-0.0093	1.0422-1.0921
BIA	0.924	0.841	3.01	2.91	2.61	0.064	15.11+-4.2	6.4-23.57
BMI	0.468	0.411	6.7	5.2	33.00	0.000	22.6+-2	17.8-29
$HW_{\%bf}$							15.74+-5.7	6.81-24.16
HW_{bd}							1.0465+-0.0085	1.0382-1.0811

Conclusion

The average body density via 2 subject equation of Astat is 1.0731 and in criterion method test in swimmer athletes is equal to 1.0465 that these 2 averages have meaningful difference. It means that received body density via 2 subject equation of Astat is equal to received amount via criterion method (HW %). Also the average percentage of hypoderm fat via 2 subject equation of Astat is 13.4% and for criterion method test is 15.74% that these 2 averages have meaningful difference. The correlation coefficient of body density with Astat equation and criterion method test for swimmer athletes is R= 0.853. from comparison of this correlation coefficient at probability level P< 0.05 it is concluded that there is meaningful correlation between 2 methods of BD and amount of specifying coefficient R^2= 0.751 shows suitable linear relation. It must be mentioned that approximating standard error 0.0081 g/cc (SEE) and total error 0.0092/cc (TE) is received. Correlation coefficient for percentage of fat in 2 subject equation of Astat and criterion method in swimming is R= 0.781. According to level of probability P< 0.05 there is meaningful correlation between assessing the fat percentage of participants and 2 subject equation of Astat and criterion method. The results shows that there is meaningful relation between 2 subject Astat skin fold equation with criterion method P=0.000 and also there is high level of correlation between criterion method that shows authenticity of these equations. Meanwhile we can not completely trust to these equations since used coefficient in these equations are not for Iranian population and is not suitable Iranian society. Jafari and Youhanson in the year 1995 in their researches reached to this conclusion that it is not possible to use a special equation for measuring hypoderm layers of fat for all populations(7). Astat in

relation to errors of BD anticipation via skin fold method has said the following points:

1- The technical errors go back to difference in kind of Kaliper or experience and skill of person holding test

2- Biological difference of participants like difference is distributing body fat percentage is effective in BD approximation(9).

The average fat percentage via bio-electrical impedance method is 15.11% and criterion method test is 15.74% for swimming that there is not any meaningful difference between them.

The correlation coefficient for percentage of body fat via bio-electrical impedance method and criterion method for swimming is R=0.924. According to level of probability P<0.05 between assessing fat percentage of participants there is high level of meaningful correlation between bio-electrical impedance method and criterion method. The specifying coefficient is R^2= 0.841 that shows good linear relation between 2 testing method.

Segal in the year 1996 in his revised article has written that bio-electrical impedance is used as a method for evaluating body structure of athletes in the field of sport and practice. There are several problems in relation to function of BIA in sport and practice and several issues shall be studied for future researches. Generally there are 2 problems, one is changing physiological factors and second is limitation in anticipation equations that has result if statistical problems. Several physiological points must be observed while applying BIA in athletes for controlling test conditions like body water, time of last practice, glycogen reserves, and chemical maturation. In youth athletes exactness and validity of BIA method will only reported when laboratory condition are carefully controlled(10).

The average fat percentage with body mass index method is 22.6% and criterion method test is 15.74% for swimming that

there is meaningful difference between these 2 methods. The correlation coefficient for fat percentage with body mass index method and criterion method for swimming is R= 0.468, according to probability level P< 0.05 for assessing fat percentage of participants there is low meaningful correlation between body mass index and criterion method.

Garen, Leonard, Hawthron(1686) showed 0.65% correlation in men between pure body mass and body mass index and criterion and said that BMI will reflect partial weight of both pure body mass and body fat(11). Novil and his coworkers (2006) and Vit & Boush in their research that is similar to research of Jashua and his coworkers showed that increase in body mass index is not necessarily indicator of excess fat in athletes society(11). Astat (1981) offered two reasons for limitation of body mass index in anticipating fat percentage. First, it is clear that body weight is under effect of volume of muscle, body organs and bones and will be regarded as fat. Thus a person with muscular body- bulky skeleton in relation to height can be regarded as fat person in BMI measuring system without having additional weight. So a person with small skeleton in relation to short height will show lower fat percentage(12). With high level of correlation in Dornin and Morsly research in the year 1977 again approximation of error was high. The answer of question is that according to SEE we see that the ability to approximating body fat by body mass index when using from an age group is better than using a vast domain of ages(13). According to comparison of under study methods and criterion method on athletes some results have shown that they can effectively anticipate valid equations in tribe, race and genetic groups. Based on these theories only the bio-electrical impedance method has authorized and acceptable P for swimming.(TE=2.61, SEE=2.03, R=0.924, P=0.064). This shows that in spite of high correlation of bio-electrical impedance method with criterion method with having

small amount of error (SEE, TE) there is not meaningful average difference in selected method and bio-electrical impedance method has got high level of validity and it is suggested to be used for athletes. The Skin Fold Stat equation is not valid and there is meaningful difference in 2 subject equation of Stat among swimmers and this equation can not be used for men swimmer athletes.

According to results of present research the body mass index has got low level of correlation in these groups in comparison to criterion method and has got meaningful average difference with criterion method and has high level of total and standard error that this method can not be trusted for being used in swimming.

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