75 - CONTAST ERROR FROM THE PERCENTUAL OF FAT AND FAT MASS ANALYSED BY DIFFERENT MATHEMATICAL MODELS APPLYED TO PROFESSIONAL FOOT-BALL ATHLETES

PAULO HENRIQUE SANTOS DA FONSECA
KENJI FUKE
GIANCARLOS B. M. BRUNO
UNIVERSIDADE FEDERAL DE SANTA CATARINA FLORIANOPOLIS - SC BR
paulo.phsf@gmail.com

1. Introdution

The foot-ball evolved don't accepting anymore the empirical ideas of training (Barros et al, 1996). Even though the foot-ball got the attention paid by scientific community, many are the gaps to be answered in order to an understanding to this sport.

On of the areas which helps to the performance in that sport is linked to the athlete's morpho-physiological aspects, taking into account that currently, professional whom work with foot-ball use as are of their methodologies of training the physical evaluations, assisting in this way into the diagnosis, in the prescription and control of training's burder (Vicente et al, 2000).

The published works in periodicals which describe the foot-all athletes morphological features in their great majority use a method which is named anthropometry, this utilizes the quantification of the measure in the study of the size, of the shape, proportionality, of in composition and human body's maturation (Lohman, 1952).

After the obtention of the size's values these are substituted in mathematical models, in this way quantifing the corporal composition in fat mass, muscular, osseous and residual mass, thus making relative in percents with the value of corporal total mass.

To utilize an mathematical model in a determinate population is necessary that this model had reached a standard of scientism to that population, otherwise it lead a mistaken prescription and control's training (Di Salvo et al, 2001).

Therefore, the aim of this study is to analyze the constant error of the percentual of fat and fat mass of the combination of 11 mathematical models, which value a corporal density with 4 mathematical models, which convert the corporal density in the percent of fat, compare them with the hydrostatical weighing technique.

2. Methodology

2.1 Model of study

The research is the descriptive kind, because it analyzed the variation between the values of percent of fat and fat mass, utilizing different mathematical models, while compared to the gold standert method, in this case the hydrostatical weighing.

2.2 Group of studied athletes

Were studied 25 professional foot-ball athletes with mean age of 22,7 ± 4,4 years old and comprehended between 18 and 32 years old, with, with in the least 2 months of training and spending 4 hours in daily training, inserted in the period of competition promoted by Federação Gaúcha de Futebol in 2004.

2.3. Protocol of Mensuration

2.3.1 Anthropometrical Mensuration

It was utilized the protocol suggested by Ross and Marfell-Jones (1991) with adaptation respecting the procedure of measurement while in the validation of the original equation. The analysed measurement were: corporal mass (MC) and the height (EST) through of balance and estadiometer (RIW 200, Welmy, Brasil).

The measured perimeters were of the forearm (PAT) and abdomen (PAB) by tape measure (Cescorf Cientifico, Cescorf, Brasil). To the cutaneous plications we opted by register of the triceps (DCTR), biceps (DCBI), scapular (DCSE), pectoral (DCPR) medium axilar (DCAX m) through of the comp, supra-ilium (DCSI), horizon abdominal (DCABh) , vertical abdominal (DCABv), medium thigh (DCCXm), medium leg (DCPM) trough the compass of the cutaneous plications (Cescorf Científico, Cescorf, Brasil).

The anthropometrical procedures adapted included in all of measures the right side, being carried out in the rotational system, with three measurements, and it was utilized a mean as final measurement. The same were measured by an only evaluator. The non-realization of physical activities of training, with at least of 4 hours before the collection of data, the calibration of the utilized equipments, as the temperature of the site's collection, which was standardized between 24°C and 26°C.

Complementing the previous procedures, it was tested the trustworthiness of only evaluator envolved in the process of collect of data.

2.3.2 Mensuration of Hydrostatical weight

It was utilized a balance with the resolution of 50g and capacity of 6 kg and tank (sink) of 1 meter and 50 centimeters height, where two evaluators explained, assisted and made the measurement (Filizola L, Filizola, Brasil). The evaluated person was measured wearing swim trunks, in the grouped position suggested by Petroski and Pires-Neto (1993), was utilized as position in the submersion.

After the maximum expiration, breathings was held blocked for about 5-10 seconds, to the balance's stabilization and to readings of weighing, the procedure was repeated for 6 to 10 times. The media of the three higher readings was used as the value of the hydrostatic weighing. When the values from the three hast bigger weighings deviated in more than so grammes, add trance trials were carried out. The temperature of the water was standardized in 31ºC and measured by a thermometer (Incoterm, Brasil), we also tried to control if the individuals there weren't carried out physical activities and/or had had some meal before the evaluation, as well the checking of utilized equipment.

2.3.3. Mensuration of the Residual Volume

The residual volume was obtained through the equation proposed by Goldman and Becklace (1959).

Men: 0,017* (age, in years) + 0,027* (stature, cm) 3,477

2.3.4. Corporal Composition

After to take the hydrostatical weight and to take the residual volume, the values were substituted in the equation which determine the corporal density:

$$DCm(g/cm^3) = \frac{MC}{MC - Pa)/Da] - (VR + 0,1)}$$

Where: DCm = Corporal density in g/cm³;
MC: Corporal mass in kg in the air;
Pa: Weight in to the water in kg;
Da: Density of water (corrected by temperature);
VR: Residual volume, liters;
0,1: Constant of gastrointestinal gas (100 ml).

2.4. Procedure of Valuation

The objective of this study was presented to the athletes as well the methodological procedures to be developed. Subsequently the athletes signed their accordance in the research. In the collect of data was took firstly the anthropometrical measures and subsequently the hydrostatical weighing.

2.5. Mathematical models utilized in the study:

In the table 1 are related the 11 mathematical models utilized to the calculation of the corporal density, their authors and the age of the sample utilized in the validation. In the table 2 there are the mathematical models which calculate, through the corporal density, the percentual of fat, including their authors.

Table 01: Authors, equations and samples age of the mathematical models utilized to the validation.

Authors (Fount)	Mathematical Models	Age(years)
Durnin & Rahman – 1967 (2)	1,161 – 0,0632 *LOG10 (DC BI + DC TR + DC SE + DC SI)	18 – 34
Sloan – 1967 (2)	1,1043 – 0,001327 * (DC CXm) – 0,00131 * (DC SE)	18 – 26
Forsyth & Sinning – 1973 (2)	1,103 – 0,00168 * (DC SE) – 0,00127 * (DC AB)	19 – 22
Katch & McArdle – 1973 (1)	1,09665 – 0,00103 * (DC TR) – 0,00056 * (DC SE) – 0,00054 * (DC AB)	18 – 24
Durnin & Womersley– 1974(1)	1,1765 – 0,0744 * LOG (DC TR + DC SE + DC SI + DC BI)	17 – 72
Lohman – 1981 (3)	1,0982 – 0,000815 * (DC TR + DC SE + DC AB) + 0,00000084 * (DC TR + DC SE + DC AB)^2	-
Thorland et al. – 1984 (2)	1,1136 – 0,00154 * (DC TR + DC SE + DC AXm) + 0,00000516 * (DC TR + DC SE + DC Axm)^2	14 – 19
Guedes – 1985 (1)	1,17136 – 0,06706 * LOG (DC AB + DC SE + DC TR)	17 – 27
Petroski 1995 (1)	1,09255357 – 0,0006798 * (DCTR + DC SE+ DC SI + DC PM) + 0,00000182 * (DCTR + DC SE + DC SI + DC PM)^2 – 0,00027287 * (ID) + 0,00204435 * (P. AT) – 0,00060405 * (P. AB)	18 – 66
Jackson & Pollock 1978 (2)	1,112 – 0,00043499 * (DC PT + DC AXm + DC TR + DC SE + DC AB + DC SI + DC CXm) + 0,00000055 *(DC PT + DC AXm + DCTR + DC SE +DC AB + DC SI + DC CXm)^2 – 0,00028826 * (ID)	18 – 61
Jackson & Pollock 1978 (2)	1,10938 – 0,0008267 * (DC PT + DC AB + DC CXm) + 0,0000016 * (DC PT+ DC AB + DC CXm)^2 – 0,0002574 * (ID)	18 – 61

Fount: (1) Original; (2) Petroski (1995); (3) Petroski & Pires Neto (1996).

Table 02: Author, year and utilized equations to the convertion of corporal density to the percentual of fat.

N.°	Author	Year	Mathematical Models
01	Rathburn & Pace	1945	%G= (554,8/D) – 504,4
02	Keys & Brozek	1953	%G= (420,1/D) – 381,3
03	Siri	1961	%G= (495/D) – 450
04	Brozek et al.	1963	%G= (457/D) – 412,4

Fount: Petroski (1996), Glaner & Rodriguez-Añez (1999).

2.6. Statistic

It was utilized the descriptive statistic from the anthropometrical variable (corporal mass, stature, cutaneous plait and perimeters), in order to characterize the sample. It was used the constant error to analyze the variation between mathematical models in relation to pattern measure.

To analyze the reliability, which consists in the capacity to reproduce the results from the evaluator, was carried out a evaluation pre-test and pos-test and checked his results by the statistical process correlation Pearson's moment and test "t" resembled with the level of significance of $p<0,05$.

3. Results and Discussion

The results of the study will be demonstrated in form of table, regardings the table 3 shows the descriptive features of the professional athletes group used in research. In the table 4 are the hydrostatical weighing and the 11 mathematical models. That estimate the corporal density with 4 mathematical models which estimate the percentual of fat by corporal density.

The values of test and re-test out-point high reliability from the evaluator. The statistical tests of correlation and the test "t" resembled don't present differences between the pre-test and pos-test, showing all the values statisticly significative ($p<0,05$). These results assure the confidence of The values obtained by anthropometry, allowing the use of data of evaluation.

Table 03: Descriptive features of the professional athletes group used in the study.

	Média	s	Variação	CV(%)
Idade (anos)	22,7	4,4	18 – 34	-
Tempo de prática Profissional de futebol (anos)	6,0	4,2	1 –14	-
Massa Corporal (MC) (kg)	73,9	6,6	57,0 – 86,4	09,25%
Estatura (ET) (cm)	177,8	5,5	165,0 – 186,0	03,05%
Densidade Corporal (Dm) (g/cm³)	1,0833396	0,005922	1,0684 – 1,0931	00,55%

The athletes have as mean of age 22,7±4,2 Years, and they have as practical time in professional foot-ball 6,0±4,2 years. The corporal density achieve the mean of 1,0833396±0,005922 g/cm³ with CV of 00,55%. The results found to the

corporal mass and stature were 73,9±6,6 kg and 177,8±5,5 cm with CV of 09,25% and 03,05% respectively.

The results found to the corporal mass and stature, 73,9±66 kg and 177,8±5,5 cm respectively are normal when compared with other national athletes (Silva et al., 1997; Schwingel et al., 1997; Arruda & Rinaldi, 1999; Osiecki et al., 2002;) and international (Meyer et al., 2000; Chmura et al., 2001; Helgerud et al., 2001; Dauty et al., 2002).

Table 04: The analyses of the crossed values between the hydrostatical weighing and the 11 mathematical models. Which estimate the [illegible] corporal density.

Equation	Equation which calculate the percentual of fat though the Density											
	Rathburn & Pace			Keys & Brozek			Siri			Brozek et al		
	%	Kg	EC (kg)	%	Kg	EC (kg)	%	Kg	EC (kg)	%	Kg	EC (kg)
PH	7,73 ±2,80	5,51 ±1,99	_	6,49 ±2,12	4,62 ±1,51	_	6,93 ±2,50	4,94 ±1,78	_	9,45 ±2,31	6,73 ±1,65	_
EQ1	17,30 ±2,93	12,84 ±2,74	7,33	13,71 ±2,21	10,17 ±2,10	5,55	15,46 ±2,61	11,48 ±2,44	6,54	17,21 ±2,41	12,77 ±2,39	6,04
EQ2	11,28 ±3,53	8,43 ±3,05	2,92	9,15 ±2,67	6,88 ±2,33	2,21	10,10 ±3,15	7,54 ±2,72	2,60	12,25 ±2,90	9,13 ±2,63	2,40
EQ3	15,17 ±5,69	11,27 ±4,58	5,76	12,10 ±4,31	8,98 ±3,48	4,36	13,56 ±5,07	10,08 ±4,09	5,14	15,45 ±4,68	11,47 ±3,86	4,74
EQ4	11,38 ±2,98	8,43 ±2,48	2,92	9,22 ±2,25	6,84 ±1,89	2,22	10,18 ±2,66	7,55 ±2,21	2,61	12,33 ±2,45	9,14 ±2,14	2,41
EQ5	18,27 ±3,46	13,56 ±3,14	8,05	14,44 ±2,62	10,72 ±2,40	6,10	16,33 ±3,09	12,12 ±2,80	7,18	18,01 ±2,85	13,36 ±2,72	6,63
EQ6	8,35 ±1,01	6,19 ±1,01	0,68	6,94 ±0,77	5,14 ±0,79	0,52	7,48 ±0,90	5,54 ±0,90	0,60	9,84 ±0,83	7,29 ±0,98	0,56
EQ7	12,38 ±3,81	9,20 ±3,17	3,69	9,98 ±2,89	7,42 ±2,42	2,80	11.08 ±3,40	8,23 ±2,83	3,29	13,16 ±3,14	9,77 ±2,71	3,04
EQ8	13,83 ±4,61	10,26 ±3,70	4,75	11,08 ±3,49	8,22 ±2,82	3,60	12,37 ±4,11	9,18 ±3,30	4,24	14,35 ±3,80	10,64 ±3,14	3,91
EQ9	14,02 ±3,37	10,40 ±2,84	4,89	11,23 ±2,55	8,33 ±2,17	3,71	12,54 ±3,00	9,30 ±2,54	4,36	14,51 ±2,77	10,76 ±2,45	4,03
EQ10	8,72 ±4,11	6,50 ±3,30	0,99	7,21 ±3,11	5,38 ±2,51	0,76	7,81 ±3,67	5,83 ±2,94	0,89	10,14 ±3,38	7,55 ±2,81	0,82
EQ11	6,63 ±3,97	4,94 ±3,09	-0,57	5,63 ±3,00	4,20 ±2,36	-0,42	5,95 ±3,54	4,43 ±2,76	-0,51	8,42 ±3,27	6,26 ±2,62	-0,47
MÉDIA	13,75 ±2,84	10,21 ±2,11	4,74 ±2,02	11,02 ±2,15	8,18 ±1,59	3,59 ±1,53	12,31 ±2,54	9,13 ±1,88	4,23 ±1,80	14,29 ±2,34	10,60 ±1,73	4,00 ±1,67

EC = kg esteemed kg mensurable

The table 4 checked the differences when used the mathematical models that estimate the corporal density crossing with the four mathematical models which calculate the percentual of fat taking as predictor variable the corporal density. The mathematical models EQ6, EQ10 and EQ11 are the ones which obtained the minor differences of fat.

It's perceived that when crossed the value of the models EQ6, EQ10 and EQ11 with the proposed models by Keys and Brozek (1953) these values reach the obtained result by the pattern method.

It's interesting to emphasize that the mathematical model EQ6 and EQ10 tend to overestimate the percentual of fat and consequently the fat mass, while the equation EQ11 underestimate those values.

The mathematical model EQ5 presents the higher constant error to the percentual of fat and fat mass when compared with the pattern method. The value of this model when crossed with the Rathburn and Pace equation (1945) tend to raise its difference with the hydrostatical weighing.

It's seen that EC (EQ PH = x kg) can reach hill 8,05 kg from the crossing of equation (1945) in relation to the pattern method, this differences become more absurd when compared whit the crossing of the equation EQ11 with the Keys and Brozek equation (1953) which has a EC of -0,42 kg in relation to the pattern method, showing an exorbitant difference when compared two groups using this crossing of equations.

It was concluded that the best mathematical models to be utilized are EQ10 and EQ11 proposed by Jackson and Pollock (1978) and EQ6 proposed by Lohman (1981), because they obtained constant errors mirror than one (1) kg and this constant error is considered acceptable in order that there not be mistaken evaluation on the athlete. But it's important to emphasize that this last model don't show itself valid in the determination of corporal density in foot-ball athletes (Fonseca, 2005).

In this way the study enhance the care that have to exist when we use mathematical models ron-valid to determinated population, because these results will affect in a negative way in the evaluation mode.

References

BARROS, T.L; LOTUFO, R.F.M. & MINE,F. Consumo máximo de oxigênio em jogadores de futebol. **Revista Treinamento Desportivo.** v.1, n.1, pág. 24-26, 1996.

BROZEK, J. & KEYS, A. The avaluation of leanness fatness in man: norms and interrelationship. **Br. Journal Nutrition.** v. 5, pág. 149 206, 1953.

BROZEK, J.; GRANDE, F.; ANDERSON, J.T. & KEYS, A. **Densitometric analysis of body composition: Revision of some quantitative assumptions.** Annals New York Academy Science. v. 110, pág. 113 140, 1963.

CHMURA, J; NAZAR, K; KACIUBA-USCILKO, H; PILIS, W; AUST, F. & WISNIK, P. Psychomotorischer leistungsfähigkeit und laktat- sowie adrenalin und noradrenalinschwelle bei fuBballspielern im verlauf ansteigender belastungsintensität. **Österreichisches Journal für Sportmedizin.** v. 2, pág. 30, 2001.

DAUTY, M.; BRYAND, F. & POTIRON JOSSE,M. Relation entre la force isocinétique, le saut et le sprint chez le footballeur de haut niveau. **Science & Sport.** v. 17, pág. 122 127, 2002.

DI SALVO, V; FAGNANI, F. & DE SANCTIS, A. Functional assessment in football players. **Österreichisches Journal für Sportmeidizin.** v. 2, pág. 13 16, 2001.

DURNIN, J.V.G.A. & WOMERSLEY,J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. **British Journal of Nutrition.** v.32, pág. 77 92, 1974.

FAULKNER, J.A. Physiology of swimming and diving. In: FALLS, H. **Exercise Physiology.** Baltimor: Academic Press, 1968.

FONSECA, P.H.S. Validação de modelos matemáticos determinante da densidade corporal para atletas de futebol. **Monografia de Especialização.** Universidade Federal de Viçosa UFV, 2005.

GOLDMAN, H.I. & BECKLAKE, M.R. Respiratory function tests: normal values of medium altitudes and the prediction of normal results. **Am Rev Respir Dis.** v. 79, pág. 457 467, 1959.

KATCH, F.I. & McARDLE, W.D. Prediction of body density from simple anthropometric measurements in college-age men and women. **Human Biology.** v.45, n. 3, pág. 445 454, 1973.
KEYS, A. & BROZEK, J. Body fat in adult man. **Physiological Review.** v. 33, pág. 245 325, 1953.
LOHMAN, T.G. Advances in body composition assessment. **Ed. Champaig**. Human Kinetics Publishers, 1992.
MAYER, T; OHLENDORF, K. & KINDERMANN, W. Konditionelle fähigkeiten deutscher spitzenfuBballer im längsschnitt. **Deutsche Zeitschrift für Sportmedizin.** v. 51, pág. 271 277, 2000.
OSIECKI, R.L.; GOMES. A.C,; MEIRA, A.L.J.; ERICHSEN, O.A. & SILVA, S.G. Estudo comparativo dos aspectos funcionais e de composição corporal entre atletas de futebol de diferentes categorias. **Revista Brasileira de Fisiologia do Exercício.** v. 1, n. 1, pág. 75-87, 2002.
PETROSKI, E.L. & PIRES NETO, C.S. Análise do peso hidrostático nas posições sentada e grupada em homens e mulheres. **Resista Kinesis,** v. 10, pág. 49-62, 1992.
PETROSKI, E.L. Desenvolvimento e validação de equações generalizadas para a estimativa da densidade corporal em adultos. **Tese.** Universidade Federal de Santa Maria, 1995.
PETROSKI, E.L. & PIRES-NETO, C.S. Validação de equações antropométricas para a estimativa da densidade corporal em homens. **Revista Brasileira de Atividade Física e Saúde.** v. 1, n.3, pág. 5-14, 1996.
RATHBURN, E. & PACE, N. Studies on body composition. The determination of total body fat by means of the body specific gravity. **Journal Applicad Physiologi.** v. 158, pág. 667 676, 1945.
ROSS WD, MARFELL-JONES, MT. Kinanthropometry. In. MacDougall JD, Wenger HÁ, Green HJ. **Physiological testing of the high-performance.** 2 ed. Champaing, Illinois. Human Kinetics, 1991.
SCHWINGEL, A. C.; PETROSKI, E. L.; VELHO, N.M. Análise morfológica de jogadores profissionais de futebol de campo. **Revista da APEF.** v. 12, n. 1, pág. 05-11, 1997.
SILVA,S.G.;PEREIRA,J.L.;KAISS,L.;KULAITIS,A.& SILVA, M. Diferenças antropométricas e metabólicas entre jogadores de futebol das categorias profissional, Junior e juvenil. **Revista Treinamento Desportivo.** V.2, n.3, pág. 35-39, 1997.
SIRI, W.E. Body composition from fluid space and density. In: BROZEK, J. & HANSCHEL, A. **Techniques for measuring body composition.** Washington, D.C. National Academy of Science, 1961.
VICENTE, J.G.V.; LÓPEZ, J.G. & PASCUAL, C.M. Influencia de una pretemporada en el perfil cineantropométrico de futbolistas. **Archivos de Medicina del Deporte.** v. 17, n.75, p.9-20, 2000.

Paulo H. S. da Fonseca. Fone: (55)3222-5913, e-mail: paulo.phsf@gmail.com
End: Avenida Medianeira, número 1879, Apt. 603. CEP: 97120-000 Santa Maria -RS- BR
Orientador: Giancarlos B. M. Bruno -- Universidade Federal de Santa Catarina.

CONTAST ERROR FROM THE PERCENTUAL OF FAT AND FAT MASS ANALYSED BY DIFFERENT MATHEMATICAL MODELS APPLYED TO PROFESSIONAL FOOT-BALL ATHLETES

Abstract

One of the areas which helps the performance in the sport is linked to the athletes morphologic aspects. In this way, the aim of this study was to analyze the Constant Error (EC) of the percentual of fat and fat mass of 11 mathematical models which utilized anthropometrical measures in order to value the corporal density with 4 mathematical models which convert the corporal density in percentual of fat comparing them with a hydrostatic pratice (technique) (PH). The group of the studied athletes were constituted of 25 subjects professional athletes of foot-ball, with an average of age of 22,7 ± 4,4 years old. It was collected the anthropometrical measurements and the hydrostatical weighing and analyzed through of the average, pattern deviation, and throug the Constant Error (EC), using the statistical program SPSS 80. The results show that the mathematical models proposed by Lohman (1981) and Jackson and Pollock (1978) are those which obtained the smallest constant errors, independently of which model was utilized to the conversion of the corporal density to the fat percentual. In these inverse of this result, where are included the other mathematical models proposed, outstanding the Durnin and Womersley's model (1971), which presented the biggest constant error to the fat percentual and fat mass, load to an error of valuation when compared the pattern method. It was concluded that the mathematical models, proposed by Jackson and Pollock (1978) and Lohman (1981), presented themselves, as the best, indepently of the used equation to convert the corporal density in percentual of fat in the fractionalization of the corporal composition in professional athletes of foot-ball.

Key-words: Athlete, Foot-ball, Anthropometry.

ERREUR CONTAST DU POURCENTAGE DE GRAISSE ET DE MASSE GROSSE ANALYSÉR PAR LES DIFFERENT MODÈLES MATHÉMATIQUES APPLYED AUX ATHLÈTES PROFESSIONNELS DU FOOTBALL.

Résumé :

Dans le cadre de la performance sportive, l'une des techniques est relacionée aux aspects morpho-physiologiques des athlètes. Ainsi l'objetif de cet étudie a été analyser l'Erreur Constant (EC) du pourcentage de graisse et masse grosse de la combinaison de 11 modèles mathématiques qu'on utilise de mesures anthropometriques pour estimer la densité corporal avec autres 4 modèles mathématiques. Ces derniers modèles convertissent la densité corporal en pourcentage de graisse en faisant la comparation avec la technique de Mesure de Poids Hidrostatique (MPH). Le group d'athlète étudié a été constitué par 25 personnes, athlètes profissionnels de football, avec une âge moyenne de 22,7± 4,4 ans. On a quêté les mesures anthropometriques et la Mesure de Poids Hidrostatique et on a analysé, à partir de la moyenne, le deplacement modèle et l'erreur constant (EC) en tout se servant du programme statistique SPSS 8.0. Les resultats montrent que les modèles mathématiques proposés par Lohman (1981) et Jackson & Pollock (1978) sont ceux qui ont eu moins d'erreurs constants, indépendant du modèle utilisé pour la conversion de la densité corporal et pour le pourcentage de graisse. Par contre, les autres modèles mathématiques proposé, on remarque celui de Durnin & Womersley (1974), ont eu un resultat contraire. Le modèle cité a presenté plus d'erreur constant que l'autre pour le pourcentage de graisse et masse grosse, ce que nous conduiserait à un erreur d'évaluation quand comparé avec la méthode modèle. On conclu que les modèles mathématiques proposés par Jackson & Pollock (1978) et Lohman (1981) sont les meilleurs, indépendant de l'equation utilisé pour convertir la densité corporal en pourcentage de graisse, dans le fractionament de la composition corporal chez les athlètes profissionnels de football.

Mots clés : Athlète, Football, Anthropométrie.

ERROR CONSTANTE DEL PERCENTUAL DEL GRASA Y MASA DEL GRASA ANALISADAS POR DIFERENTES MODELOS MATEMATICOS APLICADOS A LOS ATLETAS PROFESIONALES DE FUTBOL

Resumen

Una de las areas que auxilia para el rendimiento em el deporte esta relacionado a los aspectos morfofisiologicos de los atletas. De esta forma el objectivo del estudio fue el de analisar el erro constante (EC) del percentual de grasa yel peso de la misma de la combinacion de 11 modelos matematicos que se utiliza de las medidas antropometricas para estimar la densidad corporea con 4 modelos matematicos que convierten la densidad corporea en percentual de grasa comparando-los

com la tecnica del pesaje hidrostatico (PH). El grupo de atletas estudiado se constituy de 25 individuos atletas profesionales de futbol, con edad media de 22,7±4,4 años. Fueros colectadas las medidas antropometricas y del pesaje hidrostático y analisada atraves de la media, desvio padron y el error constante (EC) utilizando el progama SPSS 8.0. Los resultados muestran que los modelos matematicos propuestos por Lohman (1981) y Jackson y Pollock (1978) son los que obtuvieron los menores errores constantes, independiente de qual modelo se ha utilizado para la conversion de la densidad corporea para el percentual de grasa, al inverso esto resultado los demas modelos matematicos propuestos, destacandose el de Durnin y Womersley (1974) que presento el mayor error constante para el percentual de grasa y el peso gordo, conducirían a um error de evaluacion cuando comparado com el metodo padron. Se concluye que los modelos matematicos propuestos como los mejores, independiente de la equacion utilizada para convertir la densidad corporea en percentual de grasa, en el fraccionamiento de la composión corporea em atletas profesionales del futbol.

Palabras chaves: Atleta, Futbol, Antropometria.

ERRO CONSTANTE DO PERCENTUAL DE GORDURA E MASSA GORDA ANALISADAS POR DIFERENTES MODELOS MATEMÁTICOS APLICADOS À ATLETAS PROFISSIONAIS DE FUTEBOL

Resumo

Uma das áreas que auxilia para a performance no esporte esta relacionada aos aspectos morfofisiológicos dos atletas. Desta forma o objetivo deste estudo foi o de analisar o Erro Constante (EC) do percentual de gordura e massa gorda da combinação de 11 modelos matemáticos que utiliza-se das medidas antropometricas para estimar a densidade corporal com 4 modelos matemáticos que convertem a densidade corporal em percentual de gordura comparando-os com a técnica da Pesagem Hidrostática (PH). O grupo de atletas estudado foi constituído de 25 sujeitos, atletas profissionais de futebol, com idade media de 22,7 4,4 anos. Foram coletadas as medidas antropometricas e da Pesagem Hidrostática e analisada através da média, desvio padrão e o erro constante (EC) utilizando o programa estatístico SPSS 8.0. Os resultados mostram que os modelos matemáticos propostos por Lohman (1981) e Jackson & Pollock (1978) são os que obtiveram os menores erros constantes, independente de qual modelo utilizado para a conversão da densidade corporal para o percentual de gordura, ao inverso deste resultado os demais modelos matemáticos propostos, destacando-se o de Durnin & Womersley (1974) que apresentou o maior erro constante para o percentual de gordura e massa gorda, levariam a um erro de avaliação quando comparado com o método padrão. Conclui-se que os modelos matemáticos propostos por Jackson & Pollock (1978) e Lohman (1981) apresentaram-se como os melhores, independente da equação utilizada para converter a densidade corporal em percentual de gordura, no fracionamento da composição corporal em atletas profissionais de futebol.

Palavras-Chaves: Atleta, Futebol, Antropometria.