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The National University of Malaysia

Proceeding

International Scientific Seminar on

SPORT AND SPORTSCIENCES

"The Role And Contribution Of Sport And Sportsciences In Enhancing A Better Quality Of Life"

Kerjasama antara
Universitas Negeri Padang dan
Universiti Kebangsaan Malaysia

Pangeran Beach Hotel
Padang, 12 – 13 September 2013

PROCEEDING

INTERNATIONAL SCIENTIFIC SEMINAR ON SPORT AND SPORTSCIENCES

The Role and Contribution of Sport and Sportscience in Enchancing A Better Quality of Life

Dr. Norlena Salamuddin
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KATA PENGANTAR

Puji syukur kehadirat Allah SWT karena atas perkenan-Nya telah dapat menyusun Prosiding Seminar Internasional dengan tema ***"The Role and Contribution of Sport and Sportscience in Enchancing a Better Quality of Life"*.**

Seminar Internasional ini merupakan bagian dari kontribusi Fakultas Ilmu Keolahragaan Universitas Negeri Padang yang bekerjasama dengan Universiti Kebangsaan Malaysia untuk melakukan diseminasi dan mengkomunikasikan serta bertukar fikiran mengenai topik-topik terbaru dari olahraga dan ilmu keolahragaan dan untuk selanjutnya mencari jalan keluar terbaik dari masalah-masalah yang aktual melalui pendekatan inter-disipliener.

Untuk itu, kami menghaturkan terima kasih kepada Universiti Kebangsaan Malaysia (UKM) yang sudah dapat melakukan kerjasama dengan Fakultas Ilmu Keolahragaan Universitas Negeri Padang (UNP), dalam hal ide pelaksanaan kegiatan seminar ini, pemerintah provinsi Sumatera Barat, pemerintah kabupaten/kota se-Sumatera Barat, DPRD provinsi Sumatera Barat, pimpinan Universitas Negeri Padang, pimpinan Universiti Kebangsaan Malaysia, pimpinan Fakultas Ilmu Keolahragaan UNP, Bank Nagari Cabang UNP, para penyaji makalah, dan peserta seminar. Semoga amal baik Bapak/Ibu memperoleh balasan baik yang berlipat ganda dari Allah SWT.

Padang, September 2013
Dekan FIK UNP,

Drs. Arsil,M.Pd
NIP. 19600317 198602 1 002

KATA SAMBUTAN
KETUA PANITIA PELAKSANA

Walaupun bukan segala-galanya, kebermanfaatan olahraga tidak hanya dapat difahami dan dirasakan secara teoretik semata tetapi harus dapat diaplikasikan ke dalam kehidupan yang nyata. Bagaimanapun juga kajian-kajian secara teoretik masih diperlukan untuk hal-hal yang dapat diterima, secara rasional sehingga olahraga dapat diterima tidak saja secara empirik tetapi juga secara teoretik.

Perkembangan dunia yang begitu sangat pesat, memaksa kita mempersiapkan sumber daya yang memiliki daya saing yang tidak saja secara local tetapi juga harus bersifat universal. Era Globalisasi dan persaingan pasar bebas, telah menjadi ancaman dan sekaligus tantangan untuk bisa bersaing dengan bangsa-bangsa di belahan dunia lainnya. Seluruh aspek kehidupan akan terkena imbasnya tidak terkecuali dalam aspek pendidikan mulai dari tingkat pendidikan paling rendah sampai ke tingkat yang paling tinggi.

Seiring dengan perkembangan dunia saat ini, perkembangan olahraga sangatlah pesat. Perkembangan ini diiringi dengan bermunculan *issue* dan pengetahuan di bidang olahraga. Informasi-informasi yang aktual seputar olahraga bermunculan. Diharapkan forum seminar ini mampu memberikan wadah untuk dapat mengkomunikasikan serta bertukar fikiran mengenai topik-olahraga dan ilmu keolahragaan dan untuk selanjutnya mencari pemecahan masalah.

Perguruan Tinggi khususnya Fakultas Ilmu Keolahragaan Universitas Negeri Padang (FIK UNP), juga ikut bertanggungjawab dan terjun langsung dalam rangka mempersiapkan SDM di atas melalui penyiapan generasi menghadapi *issue-issue* yang muncul dalam dunia olahraga. Sehingga out come yang dihasilkan bisa disejajarkan dan memiliki daya saing yang handal dalam menjawab tantangan era globalisasi dan persaingan pasar bebas.

Untuk tujuan itulah, FIK UNP melakukan perintisan awal melalui kegiatan seminar internasional yang bertemakan **"*The Role and Contribution of Sport and Sportscience in Enchancing a Better Quality of Life*".** Tujuan Seminar adalah untuk mengkomunikasikan dan bertukar pengalaman topik-topik terbaru dari olahraga dan ilmu keolahragaan dan mencari jalan keluar terbaik untuk masalah-masalah yang aktual melalui pendekaan interdisipliner .

Seminar ini dilaksanakan pada tanggal 12 dan 13 September 2013. Seminar ini bertempat di Pangeran Beach Hotel Kota Padang Provinsi Sumatera Barat. Sebagai Ketua Pelaksana kegiatan ini, saya ingin menyampaikan penghargaan yang setinggi-tingginya kepada FIK UNP Padang, serta kepada Universiti Kebangsaan Malaysia dan semua anggota panitia yang telah berupaya sekuat tenaga, menyisihkan waktu dan tenaganya dalam rangka mensukseskan acara ini. Terima kasih atas kerjasama dan komitmennya.

Terakhir saya menyampaikan rasa terima kasih yang paling dalam khususnya kepada para pembicara kunci yaitu Dr. Ir. Roy Suryo, Menteri Pemuda dan Olahraga, Prof. Dr. Phil Yanuar Kiram Rektor UNP Padang, Prof. Dr. Hemut Digel Universitas Tubingen, Prof. Dr. Jackueline D. Goodway, OHIO State University USA, Dr. Mohd. Taib Harun, Universiti Kebangsaan Malaysia, Dr. Michael Koh, Republic Polytechnic Singapore, Dr. Norlena Salamuddin, Universiti Kebangsaan Malaysia, Prof. Dr. Joko Pekik Irianto, Deputi Peningkatan Olahraga Prestasi Kemenpora, Dr. Ian Harris Sujae, Republic Polytechnic Singapore, Robert Jhon Ballard Australian Strength and Conditioning Assosiation dan khususnya kepada para pembicara kunci yang datang dari luar negeri, saya berharap semoga selama keberadaan di kota Padang, memperoleh pengalaman yang baik dan menyenangkan dan diiringi doa semoga selamat kembali pulang menuju rumah dan keluarga masing-masing Semoga hasil seminar ini akan membawa pencerahan bagi kita semua, bagaimana upaya yang harus dilakukan oleh Perguruan Tinggi khususnya FIK UNP Padang dalam membentuk manusia Indonesia yang berdaya saing tidak saja secara local tetapi juga internasional.

Semoga amal baik Bapak/Ibu memperoleh balasan baik yang berlipat ganda dari Allah SWT.

Ketua Pelaksana,

Prof. Dr. Sayuti Syahara, M.S., AIFO

KATA PENGANTAR EDITOR

Pertama dan yang paling utama, kami panjatkan puji syukur kehadirat Allah SWT, atas petunjuk dan karunia-Nya, sehingga Prosiding Seminar Internasional Olahraga dan Ilmu Keolahragaan dengan tema **"*The Role and Contribution of Sport and Sport Science in Enchancing a Better Quality of Life*"** yang akan dilaksanakan pada tanggal 12 s/d 13 September 2013 dapat diselesaikan dan diterbitkan.

Seminar tersebut terselenggara berkat kerjasama antara Universitas Negeri Padang dengan Universiti Kebangsaan Malaysia yang mengundang keynote speaker sebanyak 8 (delapan) orang yang berasal dari Jerman, Amerika, Australia, Malaysia, Singapura dan Indonesia serta didukung oleh 62 makalah teknis yang disampaikan dalam sidang paralel. Di dalam prosiding ini berisi 4 makalah keynote speaker dan hasil karya tulis ilmiah lainnya yang berasal dari berbagai institusi yaitu; 1) University of Tübingen, 2) The Ohio State University, 3) Universiti Kebangsaan Malaysia, 4) Universitas Padjadjaran, 5) Universitas Negeri Medan, 6) Universitas Negeri Jakarta, 7) Universitas Negeri Padang, 8) Universitas Negeri Manado, 9) Universitas Pendidikan Indonesia, 10) Universitas Negeri Yogyakarta, 11) Universitas Negeri Semarang, 12) Universitas Cendrawasih, 13) Universitas Pendidikan Ganesha Singaraja, 14) Universitas Bina Darma Palembang, 15) KONI Provinsi Sumatera Barat, 16) KONI DKI, 17) Sekolah Dasar Negeri 7 Keliat Ogan Ilir Palembang.

Prosiding ini telah melalui proses editing oleh dewan editor/penilai karya tulis ilmiah serta dilengkapi dengan diskusi dan tanya jawab pada saat seminar berlangsung. Semoga penerbitan prosiding ini dapat memberi manfaat dan dapat dijadikan acuan dalam pengembangan penelitian yang terkait dengan perkembangan dunia keolahragaan. Kami mengucapkan terima kasih yang sebesar-besarnya kepada semua pihak yang terlibat dalam penyelesaian penyusunan prosiding ini dan mohon maaf atas ketidaksempurnaan dalam penerbitan prosiding ini.

Editor

1. Dr. Norlena Salamuddin
2. Dr. Mohd Taib Harun
3. Prof.Dr.Sayuti Syahara, MS, AIFO
4. Dr. Syahrial B, M.Pd
5. Drs. Arsil, M.Pd
6. Drs. Syafrizar, M.Pd

JADWAL KEGIATAN SEMINAR INTERNATIONAL
PADANG, 12 - 13 SEPTEMBER 2013

HARI/ TANGGAL	WAKTU	KEGIATAN	KETERANGAN	PENANGGUNG JAWAB
HARI KE 1				
Kamis, 12 September 2013	08.00 - 09.00	**PENDAFTARAN/REGISTRASI**		Seksi Acara
		PEMBUKAAN/PERESMIAN		Seksi Acara
		Laporan Ketua Panitia	Prof. Dr. Sayuti Syahara, MS.,AIFO	
		Sambutan	Prof. Dr. Phil. Yanuar Kiram (Rektor UNP)	
		Sambutan	Prof. Dr. Irwan Prayitno, M,Sc (Gubernur Sumbar	
		Sambutan dan Pembukaan Seminar	Dr. Ir. Roy Suryo (Menpora)	
	10.00 - 10.30	**ISTIRAHAT/ TEA BREACK**		
	10.30 - 12.30	**PLENARI I/ PLENO I**		
		1. Prof. Dr. Helmut Digel	Universitat Tubingan - Germany	Ruri Famelia
		2. Prof. Dr. Jackie Goodway	OHIO State University - USA	
		3. Prof. Dr. Joko Pekik Irianto, M.Kes.,AIFO	Deputi Peningkatan Olahraga Prestasi Kemenpora - INA	
		4. Dr. Michael Koh	Republic Polytecnic Singapore	
	12.30 - 14.00	**ISTIRAHAT/ LUNCH BREAK**		

	14.00 - 17.00	**PARALLEL SESSION I :**		
		RUANG 1.	Physical Education	Bafirman
		RUANG 2.	Physical Education	Khairuddin
		RUANG 3.	Psychologi	Wilda Welis
		RUANG 4.	Psychologi	Umar
	17.00 - Selesai	**ISTIRAHAT/MINUM PETANG**		
HARI KE 2				
Jum'at, 13 september 2013	09.00 - 11.30	**PARALLEL SESSION II :**		
		RUANG 1.	Management	Bafirman
		RUANG 2.	Physical Education	Khairuddin
		RUANG 3.	Psychologi & Recreation Sport	Wilda Welis
		RUANG 4.	Training Theory	Umar
	12.00 - 14.00	**ISTIRAHAT / LUNCH BREAK**		
	14.00 - 16.00	**PLENARI II/ PELNO II**		
		1. Dr. Taib Harun	Universitas Kebangsaan Malaysia	Rina Ambarwati
		2. Mr. Robert John Ballard	Australian Strenght Conditioning Assoconiation	
		3. Dr. Noerlena Salamuddin	Universitas Kebangsaan Malaysia	
		4. Prof. Dr. A. Purba, MS.,AIFO	Universitas Padjajaran	
	16.00 - Selesai	**PENUTUPAN**		

DAFTAR ISI

Hal

CORRELATION BETWEEN THE SUM OF 8SKINFOLDS TO PREDICTED % BODY FAT RANGE, EXCLUDING BMI AS A RELIABLE MEASURE OF BODY COMPOSITION ASSESSMENT FOR WELL-TRAINED ATHLETES.

Authors: Ballard R. J. [1], Dewanti R. A.[1, 2], Sayuti S.[1, 3], Umar N.[1, 3].[1]*Sport Science Department, KONI (Komite Olahraga Nasional Indonesia) Provinsi Sumatera Barat, Indonesia,*[2]*Facultas Ilumu Keolahragaan Universitas Negeri Jakarta, Jakarta, Indonesia,* [3]*Facultas Ilumu Keolahragaan Universitas Negari Padang, Sumatera Barat, Indonesia.*

Abstract: The purpose of this study was to examine if relationship trends between the mean of 3 predicted % body fat (%BF) equations (MS) and the sum of 8 skinfold (SKF) measures existed for well trained athletes as apposed to BMI as an assessment of body composition.Two (2) test periods were conducted 4 months apart collecting 8 SKF measuresfrom 35 full-time athletes (21 male 26.05 ± 5.07 and 14 female 24 ± 4.15), 17 athletes were tested at both periods.Predicted %BF calculation was the mean score (MS) of three (3) equation predictors – Durnin and Womersley (DW) 4 Site SKF Test[1] (Standard Error of Estimate (SEE) 3.5% for female: 4.0% for male),Jackson and Pollock (JP) 3 site SKF Test[2] (SEE 3.9% for female : 3.4% for male), andYuhasz SKF Test[3] (Total Error (TE) 3.5% for male).Easton et al (1995) indicated JP& DW over and underestimated %BF, which suggests the mean may reduce the error of calculation. This analysis did support Easton et al observations with mean results for male 8.71±5.11 (16.01%<MS) JP, 12.80±5.56DW (23.36%>MS), 9.61±3.16 Yuhasz and MS of 10.37±4.55; female 17.41±6.22 (4.08%<MS) JP, 23.86±6.67 (31.42%>MS) DW, 13.19±7.50 Yuhasz and MS 18.15±6.72. The correlation co-efficient relationships for all equations were significant from *r* = 0.965 to*r* = 0.983 for males and *r* = 0.961 to*r* = 0.992 for female. The MS data indicated range trends to link the sum of 8 SKF measures to a prediction range of %BF. However the data sample of 52 is small in determining definitive conclusions, this warrants further data collection to validate the range trend findings. The datafrom the 17 subjects highlighted BMI has deficiencies in determining a true reflection of a well-trained athletes body composition.

Introduction

Many coaches, athletes, sporting committee boards etc. are still keen on the %BF of an athlete and not satisfied with the sum of skinfolds or BMI indicators. So the purpose of this analysis was to determine if there are

suitable range scores in the sum of 8 SKF measures that link to a %BF range score to access a more consistent prediction of body composition for athletes and to determine if BMI method is an appropriate assessment indicator of body composition for athletes.

The BMI was invented by Adolphe Quetlet in the mid 19th Century. Although the index does not measure the percentage of body fat, it is used to estimate a healthy body weight based on a person's height. It is the most widely used metric for identifying individuals with weight problems within a population due to its ease of measurement and calculation.[4] BMI was originally called the Quetelet Index until it was termed the Body Mass Index in 1972 by Ancel Keys, for his application of comparative statistics to social conditions and moral issues.[5] A focus of this analysis was to determine if BMI was a reliable measurement of body composition for well-trained athletes. The digital pictorials[5,6] of male and female as shown in digital diagrams 1 and 2 detail the BMI guidelines of body weight and height scores (Kg/m^2), range terminology and pictorial progressions <17.5 Anorexia, 17.6 - 18.5 Underweight, 18.6 – 22 Lowest Normal, 22.1 – 24.9 Middle Normal, 25 -30 Overweight Obesity, >30 Overweight Morbid Obesity. BMI is certainly the easiest and most basic of measurements of estimating body composition however BMI does not take into account the difference in lean body mass (LBM) such as a well trained athlete may posses. BMI is calculated on Mass and Height ($Mass/m^2$) whereas anthropometric (skinfold) measurement methodsare more specific in estimating LBM body composition through a regression equation. Such as the SKF measurements developed for adult males and females by Jackson and Pollock (1978) in which there are other such equations of skinfolds for determining %BF all of which are reported to be more reliable than the BMI method and can be completed out of a laboratory relatively easily[7] SKF use for the Prediction %BF has been researched and debated significantly for decades. While todays modern technological advances with controlled high tech methods conducted under laboratory conditions producing higher reliability and more accurate prediction of % BF is available such as DEXA (Dual energy x-ray absorptiometry) and Hydrodensitometry (underwater weighing) methods. Unfortunately much of this technology is out of reach for a majority of athletes and coaches, be it a cost factor or availability to such technologies. This analysis was attempting to find a way to minimize the error of SKF % calculations by using the MEAN SCORE (MS) of current researched and documented protocol SKF equations Jackson and Pollock, Durnin and Womersley & Yuhasz methods. Understanding each one has variations in SEE (standard error of estimate) and TE (total error) for either over or underestimating %BF, as supported by Eston RG et al (1995)[8] stating, "*It is concluded that the Durnin and Womersley and Jackson and Pollock equations tend to overestimate and underestimate percentage fat, respectively, when compared with hydrodensitometry"* and *"The equation of Durnin and Womersley accuracy (standard error of estimate (SEE)) is*

reported to be 3.5% for women and 4.0% for men.". For reference the SEE of Jackson and Pollock (3 site) is reported to be 3.9% for female and 3.4% for male.[9,10,] TE (total error) for Yuhasz is reported to be 3.5% for men.
Hypothesis: that the mean score (MS) of 3 prediction %BF equations may reduce the error in %BF with the relationship of the MS and sum of 8 SKF measures.

Methods

Overview

Two (2) test periods 4 months apart were conducted as per the protocols of a comprehensive physical performance measurement procedural manual[11] specifically compiled and written including all protocols of a large battery of tests covering: body composition, speed, power, strength, aerobic power, core control/stabilization aligned to set target parameters to meet expected performance goals. For the purposes of this study, all SKF measures were collated and analysed from the 2 test periods to determine if any range trends were present within the sum of 8 SKF measures compared to the predicted %BF range of the subjects, additionally comparing if BMI was a reliable indicator of body composition for well-trained athletes.

Subjects

The subjects for this analysis were province, national and international Indonesian sportsmen and women in full training for their Quadrennial National Multi-sport Championships. A total of 35 subjects from a number of sporting disciplines – Combats sports (24)(68.57%) - Pencat Silat, Kempo, Wrestling, Tarung Derajat, Tae Kwon Do, Karate, Boxing, Power lifting (1), Gymnastics (6), Track and Field (3), Ten Pin Bowling (1) = 35
The 35 subjects (21 male and 14 female) training schedule consisted of 10-12 sessions per week including technical, tactical and strengthsessions, amassing 25-30 hours of training per week. 17 of the 35subjects (48.57%) had SKFmeasuresrecordedat both test periods to provide a sample total of 52 data assessments.

Athlete profile characteristics

	Height	**Mass**	**Age**
Male	168.83 ±7.06	67.57±11.01	26.05 ±5.07
Female	154.09 ±4.40	53.35±8.80	24 ±4.15

Procedures

All athletes prior to SKF measurement had been taken through a standardized warm up over 20 minutes consisting of easy to moderate movement, dynamic drills and stretches all completed indoors to raise body temperature in preparation for the full session of performance tests to

be conducted. As per the testing procedural manual 8 SKF measures were recorded, and calculated for estimated %BF including BMI calculations. All completed SKF measures for male and female subjectswere conducted by the same tester at both testing periods and overseen by the same supervisor.

***Height recording**:*
Athletes were required to be barefoot and standing straight against an already marked out height chart on a solid cement wall. The wall chart was re-check with a metric tape measure to ensure accuracy was maintained. A slide square was use against the wall and placed on top of the athletes head at the sametime and the height was recorded as displayed on the wall chart where the slide square had stopped.

***Body weight recording**:*
Standard bathroom scales were used, placed on a flat tiled floor for the recording of body weight. The scales were checked and centre after each recording, all athletes were weighed in their under garments only.

***SKF measurement**:*
The calipers used for the SKF measurement were the Slim Guide Caliper and used at both testing periods 8 measures were recorded; Triceps, Subscpula, Biceps, Suprailiac, Chest (for men), Rear Thigh (for women), Abdomen, Front Thigh and Calf. All site locations were as per the procedural manual protocols and calculated into 3 predicted %BF equation methods with the mean of the 3 equations recorded as the final result.

Testing procedure for all 3 Protocol tests:[1,2,3,4]

1. All SKF measures were located on the right side of the body and results recorded in millimetres
2. Pick up the skinfold between the thumb and the index finger so as to include two thicknesses of skin and subcutaneous fat
3. Apply the callipers about one centimetre from the fingers and at a depth about equal to the thickness of the fold
4. Very slightly release the pressure of the fingers so the greater pressure is exerted by the calliper
5. Repeat the procedure three times as the measurement may vary and record the average value
6. Add the results of each measurement to get a total value in millimeters

Protocol 1 – Durnin and Womersley *4 site SKF test*

Triceps	Biceps	Subscapular	Suprailiac

Protocol 2 - *Jackson and Pollock 3 site SKF Test*

Male	Chest	Abdomen	Thigh (Front)
Female	Triceps	Thigh (Front)	Suprailium

Protocol 3 - *Yuhasz SKF Test* (requires six (6) measurements.

Triceps	Subscapular	Suprailiac	Abdomen	Front Thigh	Chest (male)
Triceps	Subscapular	Suprailiac	Abdomen	Front Thigh	Rear thigh (female).

Data analysis

All male and female data from the 2 test periods were collated, separated and recorded on an excel spreadsheet. Additional to raw data the data wasrecorded as a mean ± standard deviation (STDEV) for each group of males and females.The skinfold scores were individually entered into an additional spreadsheet containing the formulas of each of the 3 %BFProtocols and a mean of the 3 protocols was recorded as the final result of predicted %BF (MS). BMI was calculated and recorded from the mass and height data on the spreadsheet for later comparison and analysis.

Statistical correlation co-efficient (*r* value) was conducted on all 3 equations and the MS for both male and female groups to determine the statistical significance of the relationship between SKF SUM : %BF. The significance level set used alpha level of $\alpha = 0.05$ with *df* = 27 male and 21 female giving

an r level of significance @ r = 0.367 male and r = 0.413 female.

Results

8 SKF measures: All measurement recordings from the two test periods were entered into an excel spreadsheet to give sum totals of each athletes 8SKF and a formulae to transfer the appropriate site measures to the prediction %BF equations to calculate individual results and group means.

Table 1 **MEAN and STDEV of all results**

	Male	Female
Sum 8 SKF	71.03 ± 33.97	96.87 ± 39.23
Body Fat % MS	10.37± 4.55	18.17± 6.70
BMI	23.63 ± 2.99	22.51 ± 3.87
*n**	29	23

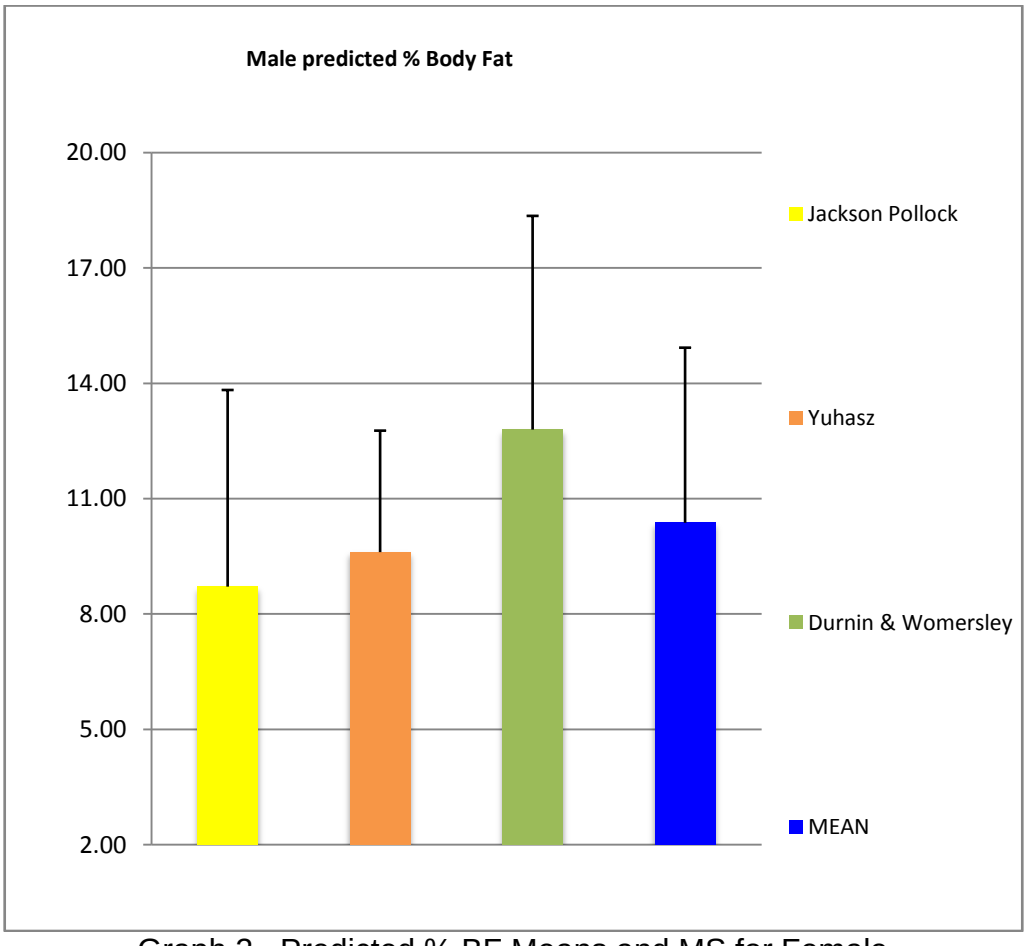
**n = number of 8 SKF recordings*

3 Protocol Predicted % body fat equation Results: All 3 protocol equations derived at a different MEAN result for both male and female calculations as per table 2 and Graphs 1 & 2.

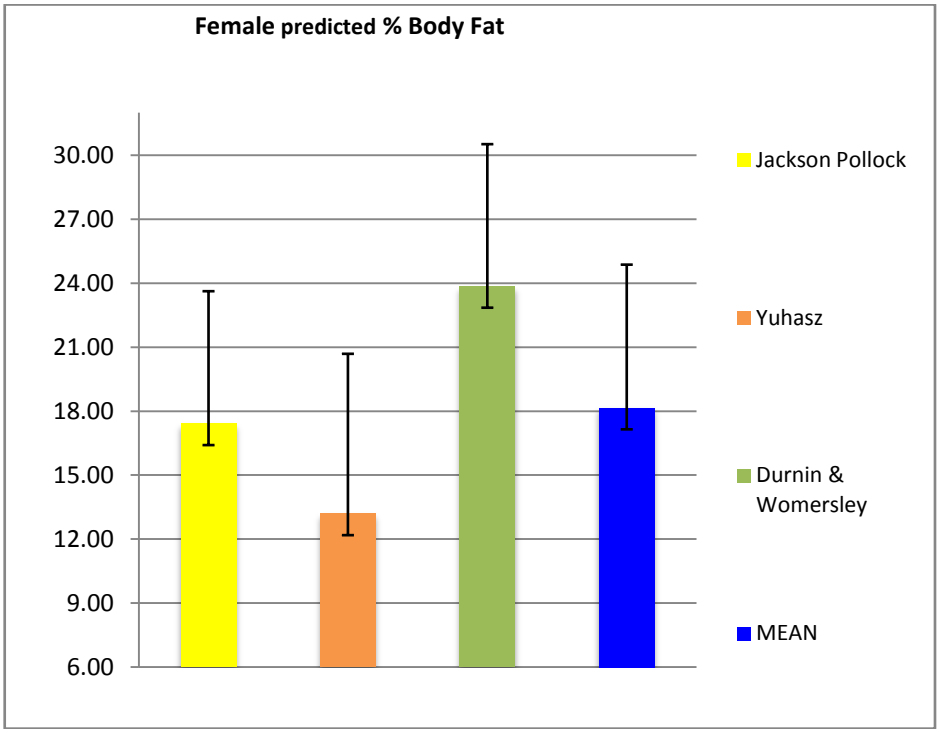
Table 2 – predicted %BF equation means.

	Jackson & Pollock	Durin &Womersley	Yuhasz	Mean Score (MS)
Male	8.71% ± 5.11	12.80% ± 5.56	9.61% ± 3.16	10.37 ± 4.55
Female	17.41% ± 6.22	23.86% ± 6.67	13.19% ± 7.50	18.17 ± 6.70

Graph 1 –Predicted % BF Means and MS for Male



Graph 2 –Predicted % BF Means and MS for Female



Male & Femalemeansfor JP and Y equations underestimated %BF: MS by 16.01% & 7.35% respectively while DW overestimated %BF: MS by 23.36% for males. Similarly JP and Y equations underestimated %BF: MS 4.08% & 27.34% respectively while DW overestimated %BF: MS by 31.42% for female (see table 3),these results supporting the findings of Easton et al (1995).

Table 3 - % of Mean Score

	Jackson & Pollock	**Yuhasz**	**Durnin & Womersley**	
Male	**83.99%**	**92.65%**	**123.36%**	
Female	95.92%	72.66%	131.42%	

Relationship trends;

Areviewof trendsfrom the individual MS arelisted as per tables 4&5: Note the relationship with the range of the sum of 8 SKF'saligned to a predicted %BF range. Highlighted in each table is the ***mean*** of the SKF's and **MS** (mean score) predicted %BF for both male and femalefalling into line with the range trends from the recorded test data.

Table 4: Summary review for women and suggested pattern range calculations

WOMEN'S SUMMARY REVIEW											
ESTIMATED RANGE VALUES											
% Body Fat Range	<6.5	6.5 – 8%	8.1 – 10%	10.1-12%	12.1-14%	14.1-16%	*16.1-19%*	19.1-22%	22.1-25%	25.1-28%	28.1-31%
Sum 8 SKF Range	< 35	36 - 40	41 - 50	51 - 60	61 -70	71-80	*81-100*	101-120	121-140	141-160	161-180

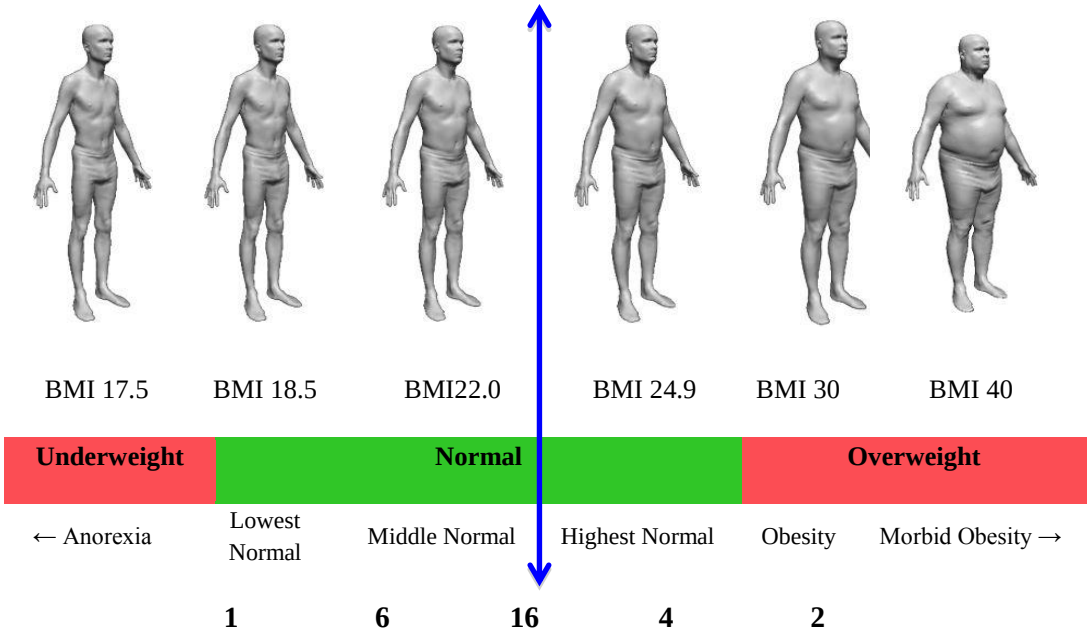
Table 5: Summary review for men and suggested pattern range calculations

MENS SUMMARY REVIEW											
ESTIMATED RANGE VALUES											
% Body Fat Range	<4.5	4.5-5.5%	5.51-6.75%	6.76-8%	8.1-9.5%	*9.51 - 11%*	11.1-13%	13.1-15%	15.1-17.5%	17.6-23%	>23%
Sum 8 SKF Range	<35	35-40	41-45	46-50	51-60	*61-75*	76-90	91-110	111-135	136-160	>160

BMI score comparison to Body Fat % results:

Digital diagrams 1 & 2 illustratethe male and female results with a cross-sectional line indicating the BMI mean. The diagrams showan extreme range of from anorexia to overweight obesity with the mean of males towards end range of middle normal and females mean of middle normal.

Male – digital diagram 1



Female – digital diagram 2

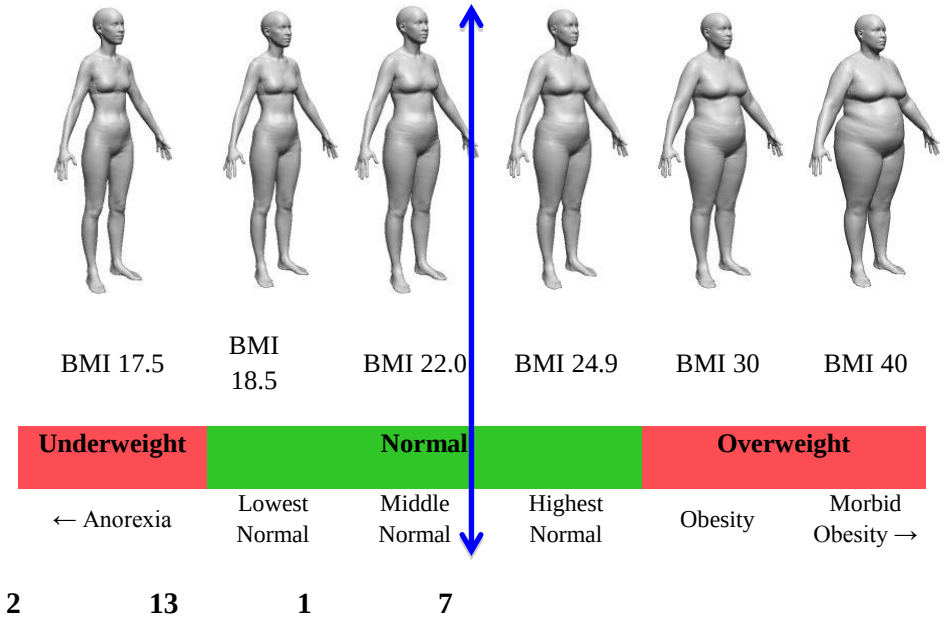
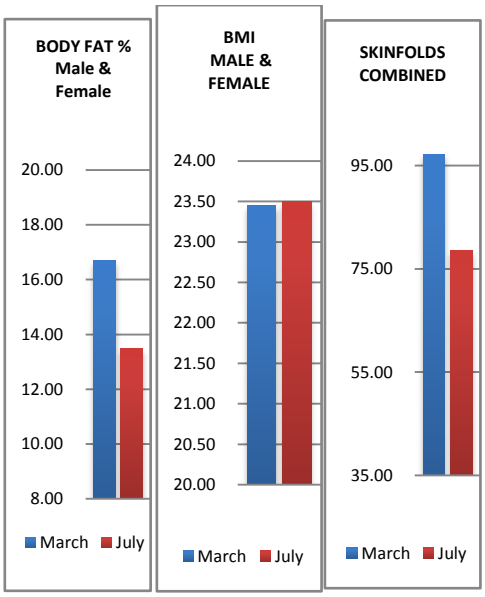


Table 6 and graphs 3, 4, 5 display the result comparisons of the 17 subjects who had data recorded at both test periods. These resultsshow there were significant changes in thesubjectspredicted %BF scores while maintaining bodyweight.

	July			March		
	BF %	SKF	BMI	BF %	SKF	BMI
MALE	7.50	49.5	24.77	8.05	54	24.44
	7.32	47.5	22.21	9.14	61	22.39
	13.66	97.5	30.99	15.91	118	32.21
	6.32	41.5	22.79	8.24	47.5	22.31
	8.21	52	21.39	9.04	58	21.39
	14.58	88	23.62	16.14	97	24.01
	11.42	82	22.84	10.15	69	22.49
	14.71	103	24.68	17.38	134	24.31
FEMALE	8.63	43	20.45	9.75	46	20.45
	16.95	86	21.5	23.17	135	21.93
	22.15	123	25.63	26.29	144	26.06
	12.37	70	20.61	21.32	109	20.17
	21.59	103	28.83	29.90	161	28.83
	23.49	128	22.35	24.81	135	21.5
	22.49	127	29.43	27.17	156	28.13
	6.87	37	16.82	11.60	55	17.43
	10.55	56	20.61	15.88	73	20.61
AVE;	13.46	78.47	23.50	16.70	97.21	23.45
ST-DEV	5.97	31.56	3.62	7.44	41.43	3.66

Table 6 - 17 athletes with 2 data recordings

Graphs 3, 4 & 5 – displaying the comparisons of table 4



Strength of significance:

All the r-values of the correlation co-efficienthad a very strong relationship of significance with *r* = 0.965 to *r* = 0.983 for males and *r* = 0.961 to *r* = 0.992 for female.It is well accepted with an increase in SKF sum will directly relate to and increase in %BF; Refer to charts 1- 4 for Male and 5 – 8 for Female

Correlations for Male SKF : %BF –

Chart 1: Jackson and Pollock **r = 0.976 JP**

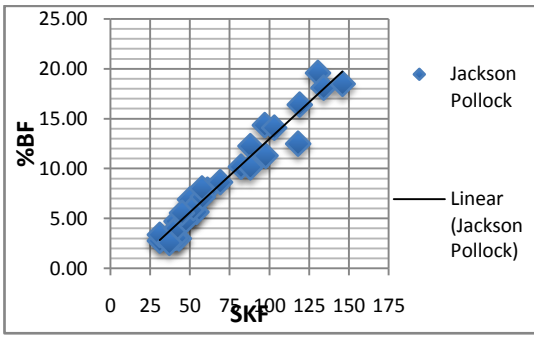


Chart 2: Durin Womersley **r = 0.965 DW**

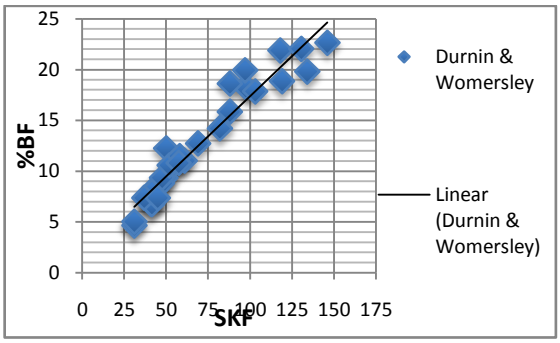


Chart 3: Yuhasz **r = 0.971 Y**

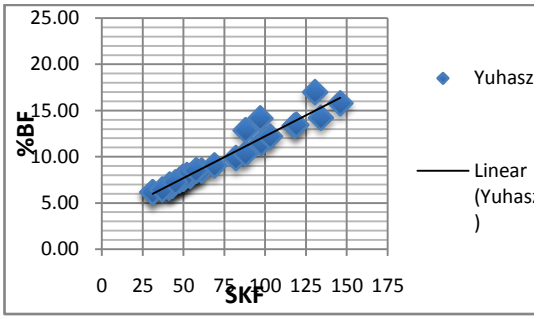
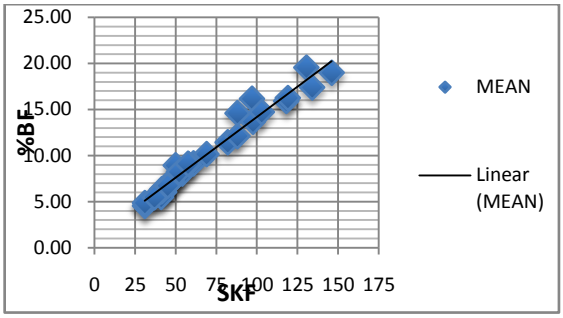


Chart 4: Mean Score **r = 0.983 MS**



The MS displays the highest relationship of significance for males, acknowledging the MS has of a higher reliability relationship of significance than each individual equation.

Correlations for Female SKF : %BF;

Chart 5: Jackson and Pollock **r = 0. 981 JP**

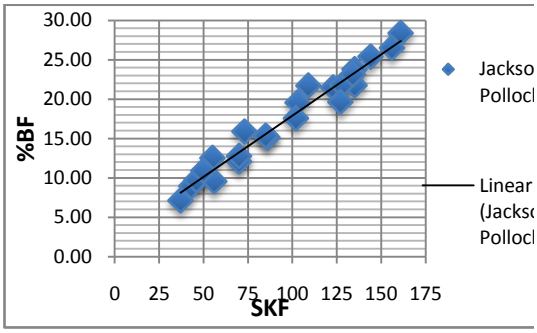


Chart 6: Durin and Womersley **r = 0.961 DW**

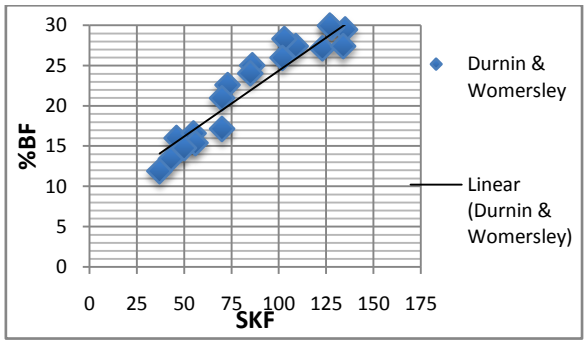


Chart 7: Yuhasz **r = 0.992 Y**

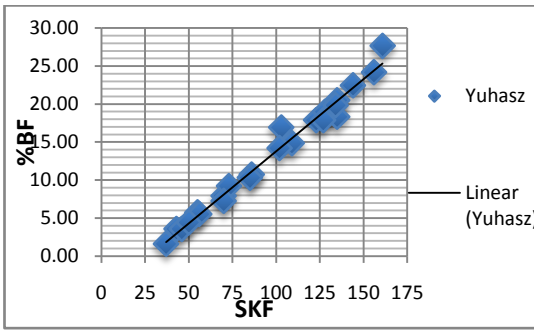
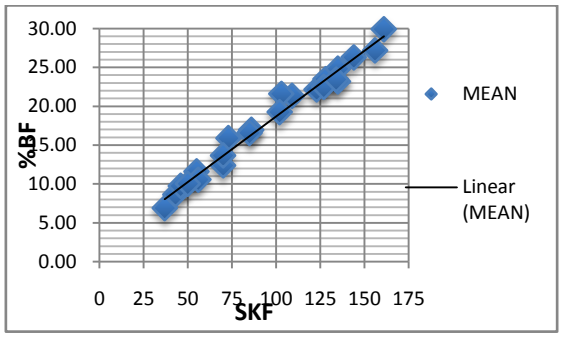


Chart 8: Mean Score **r = 0.989 MS**



The MS and Y displayed very high relationships of significance for females, acknowledging their reliability relationship of significance of SKF to %BF.

Discussion

How do we interpret the BMI digital diagrams and what do the results really tell us in reference to well-trained full time athletes in recording and measurement of their body composition? And how can this assist in reliability of future comparisons? Digital diagrams 1 & 2 express concerns especially for 5 of the athlete scores - 3 Underweight, 2 overweight and additionally another 11 athlete scores at the high end of normal nearing overweight.

Are there significant changes to be made for these athletes and sending them to medical personnel and dietitians to address these concerns? As being categorised anorexia and obese are serious health issues. However before making any conclusions, it is important to compare the data of predicted %BF and to look at the athletes who were tested at both periods.Table 6 illustrates you can measure improvement gains of LBM (less %BF) whilst maintaining bodyweight, which is critical for athletes in combat sports dependent on weight divisions and aiming for increases in power to bodyweight ratios. Whereas the BMI scores had little or no change suggesting I's inability to determine reliable measureable assessment of changes in body composition of well-trained athletes such as the subjects in this study analysis. N.B. The predicted %BF of the subjects in the BMI ranges of anorexia, high range normal and obese had very suitable predicted %BF from the MEAN of the 3 protocol equations, indicative for there chosen sport and division as set out in the tables 4&5.Deurenburg et al[12], derived at a BMI prediction %BF formulae with age and gender input being: BMI Adult Fat % = (1.20 x BMI) + (0,23 x Age) – (10.8 x SEX) – 5.4 (sex values – Male = 1, Female = 0).

Still with this formulae the male and female mean BMI scores and mean age of this analysis have the well trained athletes predicted %BF over

estimated at 18.15% (Male) and 27.12% (Female)compared to the 3 Protocol SKFequations MS of predicted %BF 10.91 ± 3.94 & 18.20 ± 6.25 respectively. Suggesting the use of BMI in an equation falls short of addressing the physical make up of a well-trained athlete regarding LBM.The hypothesis wasthe MS (of the 3 predictors) wouldreduce the variationinerror of over or underestimating %BF with the goal to link the relationship of the MS to the sum of the 8 SKF measuresestablishingestimation guidelineparameters of SKF SUM to % BF. There will always be concerns expressing the difficulties of accurate recordings of SKF measures due to human error, calibration errors of calipers and SEE of the BF prediction equations. The key is to regularly conduct measurements to minimize inaccuracies in the tester and record the data to enable plotting a trend-line of the recordings to indicate the movement trends of the athletes SKF SUM linked to predicted % BF guidelines.Graphs 1 & 2 detail the MEAN of each predicted % BF equation and the MS of the 3 equations for both male and female. As noted earlier from Eston RG et al (1995), Jackson and Pollock and Durnin and Womersley equations over and underestimated predicted %BF as compared to the MS respectively for both male and female. The Yuhasz equation for males revealed to be the most consistent in results of predicted % BF of well trained athletes producing the lowest of all STDEV of just 3.16 with just 0.65% difference in BF to the overall MS.
Indicating this to be a suitable equation for athletic males, Candido et al[13] also supports this stating *"The Yuhasz equation may be a good option for estimating F% in young, physically trained men"*. However the Yuhasz equation did not have the same impact for females indicating quite the reverse with a raw %BF range from 1.61% to 27.66% for the 23 SKF calculations and having the highest STDEV of 7.50, indicating the Yuhasz equation has difficulty in consistency in the prediction of %BF in athletic females. Malepredicted %BF means of each equation compared to the MS was relatively small in variance suggesting you coulduse these 3 equations as suitable field predictors of %BF for well-trained male athletes with the mean of all three to be more reliable. If you were to use just one equation because of the low STDEV of the Yuhasz SKF Test of 3.16 as apposed to STDEV of 5.11 JP and 5.56 DW the Yuhasz equation for well-trained male athletes should produce a more consistent %BF prediction with less ± variation.However the 3 protocol equations used in this study for prediction % BF for well trained athletic males can be considered as a worthy measure for future data recordings and assessment. Other research articles such as Moon et al 2009[14] and Loenneke et al 2013[15] offer further support to the Jackson and Pollock and Durnin and Womersly equations as appropriate estimators for field-testing compared with reliability and validity of BIA and 4 component body fat prediction.The female equations displayed some different variations with a high % under and over estimation of %BF for the Y and DW equations whereas the JP 3 site equation produced more reliable and consistent prediction of %BF,

very close to the MS. Reviewing the individual raw data predicted %BF of the Y equation for female subjects, 6 subjects were under 5.73% BF (with 1 @ 1.61%BF, 2 @ 3.56%BF) suggesting there are some deficiencies in predicting %BF of athletic females as these 6 subject estimates were obvious standout errors, whereas the JP was a very close predictor of %BF to the MS for athletic females.

In consideration of these findings for future SKF equation recordings of athletic female subjects if the protocol is to continue with 3 equations it may be appropriate to replace the Yuhasz equation with another prediction %BF equation or alternatively the MS of the Jackson and Pollock and Durnin and Womersleyequations may suffice.

Conclusions

1. **Correlation between theSum of 8 skinfold range to predicted % body fat range in well-trained athletes.**
An objective of the analysis was to seek a suitable method as a field test for prediction of %BF to be used as a monitoring training tool for sports performance practitioners in addressing abnormalities in %BF. It's understood there is a reasonable error % in determining %BF through anthropometric SKF's in field-testing with the use of calipers and human error. The findings of this study suggestthere are encouraging correlation trends forming as detailed in tables 4 and 5 of the article with the use of recording the MS of 3 SKF equations to minimize error calculations and the data analysis displays trends linking the sum of 8 SKF measures to a predicted %BF range. It is recommended the data sample should be enlarged before determining definitive conclusions. Thereforeit would be advantageous to gather a larger database to validate credibility and reliance of a predicted %BF range linked to the sum of 8 SKF range for future research.

2. **Excluding BMI as a reliable measure of body composition for well-trained athletes**
This article supports other research studies thatBMI is not an appropriate measure of body composition assessmentfor well-trained athletes and should not be used as thus for sports people as a performance measurable assessment protocol. This study analysis has displayed the inconsistency and inaccurate measures of the BMI method,indicating BMI can be misleading categorising a significantly high % of well-trained athletes into the end stages of normal, over weight or obese, whereas this is contradictory to the equation predictions of % BF of SKFequations. Demonstrating BMI method gives no allowance for improvement of an athletes' reduction of body fat and an increase in muscular development (LBM) whilst maintaining body weight. Highlighting BMI has deficiencies in determining a true reflection of a well-trained athletes body composition.

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