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Body Fat Changes Among Premenopausal Women Following 24 Weeks of Exercise Training: Is Intensity Important?

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F-28 SLIDE BODY COMPOSITION

846 ESTIMATED COMBINED MUSCLE AND BONE VOLUME BY ULTRASOUND AND ANTHROPOMETRY VALIDATED AGAINST CADAVER EVIDENCE,

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The efficacy of ultra-sound (U/S) and anthropometry (ANTHRO) for predicting combined muscle and bone (M/B) segment volumes in the extremities was examined. Segments, 2.5 cm high, were identified in the middle of the upper arm and thigh and at the maximum circumference of the forearm and calf on the right arms and legs of three unembalmed cadavers. The circumference and overlying skinfold thickness at these sites were measured and M/B areas and volumes estimated by geometry. The proximal and distal section of each segment were ultrasonically scanned in real-time. M/B area was calculated from a tracing of the fascial boundary and volume was estimated by geometry. The limbs were sectioned and the muscular margin was digitised from a photograph of the proximal and distal surfaces to determine criterion M/B areas. Each segment was dissected and the mass and volume of each tissue component was measured. Analysis of variance showed that there was no difference ($\alpha \leq 0.05$) between the areas and volumes determined by U/S and dissection. There were differences between ANTHRO estimated and dissected M/B area ($p=0.037$) although estimated volume was not different from the criterion. Results indicate that real time sonography is a valid method for imaging M/B compartment areas from which geometric prediction of small volumes may be accurately estimated. U/S appears to have potential as a relatively low cost and highly accessible method for studying aspects of in vivo body composition.

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847 BODY FAT CHANGES AMONG PREMENOPAUSAL WOMEN FOLLOWING 24 WEEKS OF EXERCISE TRAINING: IS INTENSITY IMPORTANT?

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A 1992 survey of obesity experts in America who expressed their opinion regarding the importance of four commonly used weight loss treatments (exercise, diet, drugs, surgery) rated exercise as the most important (Am J clin Nutr 1992, 55:151S). However, an important question (particularly among females) remains unresolved; does intensity of exercise affect body composition/weight (BCW) changes? The purpose of the present study was to determine whether BCW changes after 24 weeks training differed depending on the intensity of each exercise session. Accordingly, 104 sedentary, premenopausal women, 20 to 40 years of age, were randomized to 1 of 4 treatment groups; 59 completed the study (8km/h n=16; 6.4km/h n=12; 4.8km/h n=18; and sedentary controls n=13). Each of the exercise groups walked 4.8 km per day, 5 days per week, at their assigned intensity for 24 weeks. Mean changes in BCW and fitness (VO2 max) are shown below:

	Controls	4.8km/h	6.4km/h	8km/h
VO2 max (ml/kg/min)	-1.7	+1.4*	+3.0**	+5.0**
Body fat (%)	+1.3	-1.7*	-1.4	-1.1
Body weight (Kg)	+4.2	+0.8	+0.1	+1.1

note: *p<.05 ** p<.01

While changes in BCW after training showed the following order of magnitude (4.8km/h > 6.4km/h > 8km/h), measured energy expenditure expressed as kilojoules per session revealed an inverse order of magnitude (8km/h (1416 Kj) > 6.4km/h (1132 Kj) > 4.8km/hr (927 Kj); p < .05), despite all groups exercising the same distance (4.8 km/) per session. Total dietary intake expressed by quantity (Kj/day) or composition (i.e. fat, carbohydrate, protein) assessed by 3-day dietary recall did not differ between exercise groups. These data suggests the relationship between exercise intensity and BCW changes in women may be more complex than previously hypothesized.

848 VALIDATION OF NEAR-INFRARED INTERACTANCE(NIR) AND SKINFOLD(SKF) METHODS FOR ESTIMATING BODY COMPOSITION OF AMERICAN INDIAN WOMEN

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This study tested the predictive accuracy of Jackson's et al.(SKF) equations ($\sum$7SKF & $\sum$3SKF), the NIR single-site (Futrex-5000), and the NIR multi-site equation (Heyward et al.) in estimating body composition of American Indian women (N=158, 18-60 yr). Criterion D_b was obtained from hydrodensitometry. Residual volume was measured by helium dilution. Siri's model was used to convert D_b to %BF for cross-validation of the Futrex-5000 NIR equation. $\sum$7SKF significantly ($p<.05$) underestimated D_b. $\sum$3SKF and multi-site NIR equations significantly ($p<.05$) over estimated D_b. Futrex-5000 NIR equation significantly ($p<.05$) underestimated %BF. Prediction errors for SKF and multi-site NIR exceeded .0080 g/ml. The SEE for Futrex-5000 was 5.5% BF. Thus, race-specific NIR & SKF equations were developed. For the SKF model, the $\sum$3SKF (triceps, axilla, & suprailium) and age explained 67.3% of the variance in D_b: $D_b = 1.061983 - .000385(\sum 3SKF) - .000204(Age)$. Cross-validation analysis yielded r=0.88, SEE=.0068 g/ml, E=.0070 g/ml and no significant difference between predicted and criterion D_b. For the NIR model, the hip circumference, $\sum 2\Delta OD_2$ (biceps & chest) FIT index, age, & height explained 73.9% of the variance in D_b:
$D_b = 1.070761 - 0.000987(Hip\ C) - 0.036986(\sum 2\Delta OD_2) + 0.000417(HT) + 0.000087(FIT\ Index) - 0.000189(Age)$. Cross-validation yielded r=0.85, SEE=.0076 g/ml, E=.0079 g/ml and a small, but significant difference between predicted and criterion D_b. These race-specific equations are recommended for estimating body composition for American Indian Women.

849 CROSS-VALIDATION OF BODY COMPOSITION EQUATIONS ON JAPANESE OBESE WOMEN

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While generalized regression equations exist for body composition assessment of Japanese men and women, the applicability or precision of such regression equations for particular sub-populations (e.g., athletes, cardiac patients or obese individuals) is questioned. The purposes of this study were, therefore, to determine the cross-validity of a variety of existing regression equations with bioelectric impedance and/or anthropometric variables as predictors, and to develop a new regression equation that would sufficiently predict body composition of Japanese obese women. One-hundred and three women with a body fat content of 25.1-60.1% underwent measurement of bioelectrical impedance (Selco, SIF-891), various anthropometric characteristics and body density (Db: by underwater weighing) with corrections for residual lung volume based on helium dilution procedures. Cross-validation of 14 equations revealed validity coefficients (R^2) of 0.52-0.79 and standard errors of estimate of 0.007-0.009 g/cm³. Of the 14 equations compared, only those developed by Segal et al., Gray et al. and Tanaka et al. demonstrated correlations of greater than 0.80 with densitometrically determined Db. When the cross-validation sample (n=50) and the validation sample (n=53) were combined to develop a recommended equation for estimating Db, R^2 of 0.44-0.71 and SEE of 0.007-0.010 g/cm³ were obtained. As a result of all analyses, we recommend the equation Db = -0.0535(BM·Z/S²)-0.0005(triceps skinfold)-0.0003(age)+1.1171. We suggest that body composition of Japanese obese women can be predicted with relatively high accuracy by equations of Segal et al. or Gray et al., or by a combination of BM·Z/S² with the triceps skinfold thickness and age.

850 INFLUENCE OF CARDIORESPIRATORY FITNESS ON MEASURES OF OBESITY AND FAT DISTRIBUTION IN MEN

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The association of obesity and abdominal fat distribution with an increased incidence of NIDDM and coronary heart disease (CHD) is well established. This study cross-sectionally examined the relationship between fitness and indices of obesity and fat distribution in men asymptomatic for CHD. Based on Balke treadmill time, 364 men (age 21 - 70 y) were categorized into fitness quintiles (Q). Body fat (%), fat mass (FM), and fat free mass (FFM) were computed after hydrodensitometry. Fat distribution was assessed with waist-to-hip ratio (WHR; umbilicus/maximal hip) and umbilical girth (UG) since these measures had the highest correlations with plasma levels of lipids and lipoproteins. The Table shows the results of the one-way ANOVA. Follow-up

Fitness	N	Mass (kg)	Fat (%)	FM (kg)	FFM (kg)	BMI (kg·m⁻²)	WHR -	UG (cm)
Q1	73	93.9	28.0	26.6	67.3	30.3	.95ª	102.8
Q2	73	88.4ª	25.3	22.6	65.8ª	28.3ª	.95ª	98.9ª
Q3	72	85.9ªᵇ	23.1	20.1	65.8ª	27.3ªᵇ	.95ª	96.5ª
Q4	73	83.4ᵇ	20.8	17.6	65.8ª	26.4ᵇ	.92	93.3
Q5	73	76.3	14.3	11.0	65.3ª	24.4	.88	84.4

Means in the same column with same superscript are not significantly different (P > .05)

ANCOVA using age as a covariate had no significant impact on the findings. These data suggest a strong positive influence of cardiorespiratory fitness level on obesity and fat distribution in asymptomatic men.

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851 ESTIMATION OF INTRA-ABDOMINAL AND PERCENT BODY FAT USING SEGMENTAL MULTIFREQUENCY BIOELECTRIC MEASURES

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Previous work in this lab indicates that a segmental 50 KHZ bioimpedance (BIA) holds promise for estimating percentage body fat (% fat) as well as abdominal fat patterning. The purpose of this study was to explore the potential for using segmental multifrequency BIA in estimating % fat and intra-abdominal fat (IAF). Thirteen male subjects had their % fats measured by hydrostatic weighing, IAF determined by computed tomography, and BIA measured at 16 different frequencies varying from 1 to 1348 KHZ. Bioimpedance was measured from the wrist to ankle, from the shoulder to ankle, from the shoulder to opposite waist, and across the waist (waist). Intercorrelations were run to identify BIA variables that had high correlations with IAF and % fat and relatively low correlations with each other. Three BIA variables plus height and weight were entered in a stepwise multiple regression procedure for estimating % fat. Waist 1012 KHZ phase angle and weight entered in a solution that accounted for over 92% of the adjusted variance for estimating % fat. Height and weight and six BIA variables were entered into a stepwise multiple regression procedure for estimating IAF. Waist 5 KHZ resistance, height, and weight entered in a solution that accounted for over 88% of the adjusted variance for estimating IAF. The small sample size limits the application of the present results. However, the large adjusted variances accounted for indicates that segmental multifrequency BIA may hold promise for the estimation of IAF and % fat.