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RESEARCH ARTICLE

Assessment of Physical Fitness in Female Adults Using Treadmill in Relation to Lean Body Mass

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Abstract

LBM is a component of body composition, calculated by subtracting body fat weight from total body weight. Loss of lean body mass (LBM) is a hall mark of aging and of acute and chronic illness. Loss of more than 40% of lean mass is not compatible with life. The present study was conducted in 30female adult subjects to explore relation between physical fitness using treadmill in relation to Lean Body Mass and the results revealed Positive correlation was observed in L1 to L3 load exercise, significant(5 per cent) negative correlation was observed between LBM and TEE, highly significant (1 per cent) correlation was observed between BMI and LBM, no correlation was observed between BMR and LBM, and no significant negative correlation was observed between Hb levels and LBM.

INTRODUCTION

With increasing age, there is a decline in lean body mass (LBM) and very often an increase in adiposity (Visvanathan and Chapman, 2010). LBM is a component of body composition, calculated by subtracting body fat weight from total body weight. The mammalian body can be divided into two major compartments: lean body mass (LBM) and fat mass. LBM comprises the body cell mass and the intercellular connective tissue and accounts for approximately 95% of the body's metabolic activity (Roubenoff and Kehayias 1991). The decline in LBM may also be accompanied by a reduction in physical function and when a pathological threshold is reached, the person is said to have sarcopenia (Cruz_Jentofit etal, 2010).

Sarcopenia, or the loss of muscle mass and strength that occurs with aging, causes functional impairment and directly or indirectly contributes to failing health among the elderly. Protecting the body’s lean or muscle mass is thought to promote health through a variety of mechanisms. There are multiple factors which cause the loss of muscle mass that occurs with increasing age. The aging process by itself causes of loss of muscle. This process may be mediated by increased peroxidative damage of muscle fibers (Pansarasa et al., 1999) or by an increased production of inlerleukin-6, that mediates proteolytic systems in muscle (2RRoubenoff et al., 1998; Tsujinaka et al., 1996). Loss of muscle mass also results from environmental factors which limit physical activity and nutrient intake.

Total body weight consists of fat mass and fat free mass. Fat free mass (FFM) consists of bone, muscle, vital organs and extracellular fluid. LBM differs from FFM in that lipid in cellular membranes are included in LBM but this accounts for only a small fraction of total body weight (up to 3% in men and 5% in women) (Janmahasatian et al., 2005). In the literature, bone mass has at times been included in LBM and at other times not included (Prado et al., 2009; Mourtzakis et al., 2008). Physical fitness is a positive quality of life, extending on a scale from death to "abundant life". We living individuals have some degree of physical fitness which varies considerably in different people and in the same individuals at different times. Physical fitness is the capacity for sustained physical activity without excessive fatigue or as the capacity to perform every day activities with reserve energy for emergency situations. Physical fitness is a product of physical activity that includes a set of attributes that people have or achieve relating to their ability to perform physical activity (USDHHS1996)

The aim of this work was to relate lean body mass with muscle strength and functional status and insulin sensitivity in a group of healthy free living Chilean elderly subjects.

REVIEW OF LITERATURE:

In this study compared the effects of habitual physical activity (PA) and lean mass, as surrogates of weight-bearing and muscle forces, and of physical fitness (aerobic and muscle capacity of lower and upper limbs) on bone mineral content (BMC) and size of total body, lumbar spine, femoral neck, and 1/3 radius in 53 girls and 64 boys from 7.9 to 9.7 years of age. After controlling for bone age, body mass, body height, and calcium intake, lean mass was the most important predictor of bone size and/or mineral in both genders ($p < 0.05$), while habitual weight-bearing PA positively influenced BMC in boys ($p < 0.05$). The effect of muscle in bone was not determined by PA and fitness score did not explain bone variability. Femoral neck was the bone site more closely associated with mechanical loading factors; boys with a PA > 608 counts/min/day (~105 min/day of moderate and vigorous intensity) showed 13-20% more BMC than those with less physical activity, and girls with a lean mass >19 kg showed 12-19% more BMC than those with less lean mass. These findings suggest that lean mass was the most important predictor of bone size and/or mineralization in both genders, while habitual weight-bearing PA appears to positively impact on bone mineral in prepubertal boys and that both lean mass and PA need to be considered in physical education curricula and other health-enhancing programs.-- Baptista F1 et al J Bone Miner Metab. 2012 Jan;30(1):100-8. doi: 10.1007/s00774-011-0294-4. Epub 2011 Jul 7.

The present study was conducted for assessing physique and fitness status of university active female students. For that, forty University active female students studying with physical education subject who regularly participated in physical education exercise programme, were selected as subjects of the study. Selected variables of physique were Height, Weight, Body Mass Index (BMI), Percentage Body Fat (%BF), Fat Mass (FM), and Lean Body Mass (LBM). Among Physical Fitness components only strength and flexibility were selected for this study. Results of the study revealed that – Height and weight of the subjects were in normal stature as Indian female, mean of height and weight were 153 Cm and 46 Kg respectively. Majority of the female students (52%) were in healthy category in respect of BMI according to norms. In case of %BF, most of the subjects (65%) were belonging in lean category. There was a negative relationship between body fat and flexibility. There were a significant positive relationship between height and weight, between body weight and all selected variables of physique. 48% active female students were in excellent category of showing performance in leg explosive strength-- Karuna Sana, Krishna Banerjee International Journal of Multidisciplinary Research and Development 2015; 2(1): 138-140

In this study examined about multidimensional aspects of fatigue, and the association between lean body mass and physical activity and. Results showed that physical activity and fatigue scores had no significant correlation, P>0.01. Physical fatigue was most prevalent. The relationship between lean body mass and physical activity was tested. A strong correlation was seen P=< 0.01. Independent t-tests were also carried out. Results as shown highlight that P=1 and therefore no significant differences in physical activity levels between males and females were seen.-Anonymous, (2011) The Relationship Between Lean Body Mass, Fatigue Scores and Physical Activity in Healthy Individual- ethesis

In this study examined the association of lean body mass with nutritional, social and economic factors and its functional consequences in free living healthy elderly subjects. Nearly One hundred and nine subjects (56 women), aged 75 ± 4 years old were studied and results found that the Lean body mass was 34.1 ± 4 and 49.2 ± 5.4 kg in women and men respectively ($p< 0.001$), fat mass was 22.8 ± 7.1 and 20.7 ± 6.4 kg in women and men respectively (p= NS). Lean body mass correlated with hand grip, quadriceps and biceps muscle strengths in men and with quadriceps and biceps strength in women. Men that exercised regularly had higher quadriceps strength and maximal expiratory pressure. Total body fat correlated positively with fasting and postprandial serum insulin levels- D. BUNOUT et al The Journal of Nutrition, Health & Aging© Volume 8, Number 5, 2004

A study was conducted on "Effect of Lean Body Mass, Fat Mass, Blood Pressure, and Sexual Maturation on Left Ventricular Mass in Children and Adolescents" and the materials and results of this study was a cross-sectional evaluation of the relationship of left ventricular mass determined by echocardiography with lean body mass and fat mass determined by dual-energy x-ray absorptiometry, which is the most valid and reliable method for determination of body composition in children and adolescents. The relationship of left ventricular mass with the stage of sexual maturation and with systolic and diastolic blood pressure was also evaluated. Two hundred one subjects (105 boys, 96 girls; 103 white and 98 black) 6 to 17 years old were studied. Age (r=.72), height (r=.81), weight (r=.84), body surface area (r=.87), sexual maturation (r=.75), lean body mass (r=.86), fat mass (r=.54), systolic BP (r=.58), and diastolic BP (r=.48) were all univariate correlates of left ventricular mass. In a multiple regression analysis, only lean body mass, fat mass, and systolic blood pressure were statistically significant independent correlates of left ventricular mass. Lean body mass alone explained 75% of the variance of left ventricular mass, whereas fat mass and systolic blood pressure explained only 1.5% and 0.5% of the variance, respectively. Lean body mass was the strongest determinant of left ventricular mass in all four race-sex groups.-- Stephen R. Daniels et al - circulation by American Heart Association August 16, 1995

A research article published by Sankar D Navaneethan1,on Adiposity measures, lean body mass, physical activity and mortality: NHANES 1999–2004 and results found that In a representative sample of the US population, higher LTPA levels and lean body mass were associated with lower mortality in those without kidney disease. In CKD, higher LTPA was associated with lower risk of death. There was no association between adiposity measures and death in those with and without CKD except for lower mortality associated with overweight among those without CKD. The data suggests the need to develop programs to facilitate an increase in physical activity in people with and without kidney disease.- Navaneethan et al. BMC Nephrology 2014, 15:108

MATERIAL AND METHODS

In the present study 30 female postgraduate and Ph.D students were selected from Acharya N.G.Ranga Agricultural University and all the subjects were in the age group of 20 to 30years. The body composition such as total body fat(BF), lean body mass(LBM), total body water(BW), and Basal Metabolic Rate (BMR)were measured using body composition measuring equipment "Bioelectrical Equipment" named as "Body Stat". The heart rates were monitored on a online polar heart rate monitor throughout the exercise period and recovery time. Physical fitness was tested in lab conditions with the help of Graded maximal exercise test (GXT) under laboratory conditions using standard Bruce protocol on the treadmill.

RESULTS

The details pertaining to subjects grouping basing LBM were presented in table 1

Table 1. Number of Subjects according to BMR, and their mean

LBM Ranges	No	Per cent	Mean ±SD
55 – 65	3	10	61.96 ± 3.72
65 – 75	20	67	71.04 ± 2.40
>75	7	23	76.74 ± 12.5

The subjects were grouped depending on the status with regard to LBM and results indicate that Majority of subjects ranged form 66 to 75 (67 per cent) followed by > 75 (23 per cent) and 55 to 65 (10 per cent).

Changes in various parameters basing on LBM in subjects during Treadmill test was assessed and is presented in table 2.

Table 2. Changes in parameters of subjects during Treadmill test, basing on LBM

Parameters	LEAN BODY MASS Ranges			Correlation	Regression
	> 75 (7)	65 – 75 (20)	55 – 65 (3)		
Heart rates during workloads (bpm) :					
Rest	76 ± 5.79	81 ± 7.08	82 ± 8.63	0.1132	-0.723
L1	117 ± 9.13	126 ± 18.8	123 ± 14.38	0.0866	-0.621
L2	131 ± 91.4	133 ± 11.97	134 ± 19.64	0.0083	1.707

L3	151 ± 7.85	150 ± 11.80	155 ± 10.33	0.0769	-0.032
L4	180 ± 7.07	175 ± 9.61	173 ± 10.33	-0.1495	-1.104
L5	192 ± 5.98	185 ± 7.20	172 ± 0.00	-0.3606	-0.823
L6	196	197 ± 0.70	-	-0.2604	-0.274
AT	13.8 ± 1.72	12.3 ± 1.56	11.5 ± 1.22	-0.3747*	-
TEE	83 ± 5.63	70 ± 16.36	63 ± 10.8	-0.3814*	-1.713
Heart rate (bpm) recovery time (mt) :					
15	109 ± 4.32	108 ± 6.70	116	0.038	0.818
20	109 ± 2.25	102 ± 6.16	103 ± 7.00	0.2316	1.313
25	109	105 ± 0.00	-	-0.3846*	0.981
B.P Systolic (mm Hg) :					
Before	108 ± 6.63	106 ± 6.55	109 ± 8.17	0.1026	1.544
After	133 ± 8.76	128 ± 8.67	125 ± 11.57	-0.0316	-0.49
B.P Diastolic (mm Hg) :					
Before	72 ± 8.76	71 ± 4.73	72 ± 5.24	-0.0924	0.183
After	79 ± 10.67	74 ± 6.96	72 ± 4.96	-0.1955	0.08
Pulse rate (bpm) :					
Before	78 ± 7.97	81 ± 18.2	83 ± 13.76	0.0683	2.519*
After	134 ± 14.41	122 ± 12.4	119 ± 11.11	-0.0397	-1.872
BMR (K.cl/24Hr)	1374 ± 99.7	1285 ± 80.93	1303± 180.3	-0.1363	-
BMI	20 ± 2.12	22 ± 1.87	26 ± 5.27	0.6262**	-
Body Composition (Per cent) :					
LBM	77 ± 1.07	70 ± 2.40	62 ± 3.72		-
Fat	23 ± 4.64	30 ± 2.70	38 ± 3.79	-0.3692*	-
Body Water	54 ± 1.33	52 ± 3.40	47 ± 5.28	-0.7484**	-
Hb(g/dl)	12 ± 2.13	11 ± 1.67	9 ± 1.51	-0.2765	-
F = 1.95836 NS		* Significance at 5%,		** Significance at 1%	
AT : Activity time (mt)		- Negative correlation & regression			
#Values in parenthesis indicate number of subjects				NS: Not significant	
TEE : Total Energy expenditure (K.cal / AT)					
L1 to L6 are workloads with 3 mt increase					

The heart rates during rest period were lower (76 bpm) in higher range (>75) group but higher (82 bpm) in lower range (55 – 65) LBM group initially. At the end of load exercise, the increase in heart rate was greater (197 bpm) in middle range group followed by higher range (196 bpm) and lower (172 bpm) lower range group. The lower range group could perform load exercise upto L5 level only. Positive correlation was observed in L1 to L3 load exercise and after that negative correlation was observed but correlation was insignificant.

AT was more (13.8 mt) in higher LBM group and low (11.5 mt) in middle (>65 – 75) and low (55-65) range LBM group. Correlation was not observed between LBM and AT.

A trend was observed with total energy expenditure and LBM. As TEE (83 K.Cal / AT) was higher in higher LBM group and low (63 K.Cal / AT) in lower range group (55 – 65). A significant (5 per cent) negative correlation was observed between LBM and TEE.

Subjects falling under higher and middle LBM range recovered in 20 to 25 mt, while lower range group subjects recovered in 15 to 25 mt. The recovery after 25 mt rest significantly (5 per cent) and negatively correlated to LBM.

Initially systolic B.P was almost similar (106 – 109 mm Hg) in all LBM groups. After exercise, increase in systolic B.P was greater (133 mm Hg) in higher LBM group and similar trend was observed with diastolic B.P also. The rate of increase in diastolic B.P proportionately increased with increasing LBM and negatively correlated to LBM but not significant.

Pulse rate of subjects was lower (78 bpm) in higher range group and higher (83 bpm) in lower range of LBM. After load exercise, the rate of increase in pulse rate was greater (134 bpm) in subjects with higher LBM range and lower (119 bpm) in subjects having lower LBM range. Pulse rate initially correlated significantly (5 per cent) with LBM and negatively but significantly correlated after exercise with LBM.

The BMR was almost similar in all LBM ranges, and hence correlation was not observed between BMR and LBM.

The BMI increased (20 to 26) with decrease in LBM and thus highly significant (1 per cent) correlation was observed between BMI and LBM.

The Lean body mass decreased with decrease in range that is from 77 per cent to 62 per cent (Higher range to lower range). Majority (20) of the subjects were having middle (65-75 per cent) range of LBM. Body fat content showed reverse trend that is low (23per cent) in low LBM and high (38 per cent) in higher (>75 per cent) LBM group. The body fat content significantly (5 per cent) and negatively correlated to LBM. The body water was proportionate to lean body mass in all the subjects and ranged between 47 and 54 per cent. Negative significant (1 per cent) correlation was observed between LBM and body water.

Haemoglobin level was lower (9 g/dl) in lower range LBM group and normal in other two groups. Negative correlation was observed between Hb level and LBM but correlation was not significant.

CONCLUSION:

Majority of the subjects were having middle range of LBM. Body fat content showed reverse trend i.e. it is negatively correlated to LBM and significant at 5% level. The body water also negatively correlated at 1% level, whereas no significance was found in relation to hemoglobin.

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