CHAPTER II

REVIEW OF RELATED LITERATURE

The development of Sheldon's system, researcher is proposed to study & analyse the effect of selected Yogic Practices (Asanas & Pranayama) & Aerobic exercise on Somatotype Components and relationship with selected Health Related Physical Fitness Components such as Muscular Strength & Endurance (Arm strength), Cardiovascular Endurance (Twelve minutes run), Muscular Flexibility (Flexibility Measures) & Body composition (Percent Body fat) and Biochemical (lipid profiles-TG, LDL, HDL, TG, TC, FBS and Hb).

Benson and Tovee\(^1\) presented a novel approach for measuring body size estimation in normal and eating-disordered women and men. Clinical categories of body types were used as prototypes. By comparing the subjective appearance of a person's body with prototypes, we can understand how different attributes of his or her body shape contribute to perception of body size. Body composition, Body-Image computer-graphics and eating disorder were analyzed. After lifelike random distortions have been applied to parts of their body

\(^1\) Benson P J and Tovee, “A computer-graphic technique for the study of body size perception and body types”, MEDLINE (R), 31(3), (August, 1999): pp.446-54.
image, individuals adjust their body shapes until they converge on their perceived veridical appearance. Exaggeration and minimization of particular body areas measured with respect to their true shape and with different prototypes can be expressed as numerical deviations. In this way, perceived body size and body attractiveness can be appraised during the course of diagnosis and treatment of eating disorders.

Dolgener, et.al.,\textsuperscript{2} stated that a series of body build composition variables were determined on a group of 29 female ballet and modern dancers. The purpose of this study was to quantify the components of body build and physique of group of high ability female ballet and modern dancers. All measurements were obtained with the subjects wearing two piece bathing suits. Body weight and height, body diameters, circumferences and skinfold were measured. Skinfold such as chest, mid auxiliary, triceps, subscapular abdominal super-iliac, thigh, calf, knee and diameter such as deltoid, biaxial, chest-iliac, bitrochanteric knee, ankle, elbow, wrist, Girths such as neck, shoulder, chest, minimum abdomen maximum abdomen, hips, thigh, knee, calf, deltoid, biceps, extended biceps flexed, forearms, wrist. The average of trials was used as the measurement at each site. T-Test was computed

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between the two groups on all the measured and computed variables to determine if differences existed between the modern and ballet dancers. Somatogram, which represents a comparison of ballet dancers with a group of non-dancers as described by Behnke and Wilmore, indicated that the dancers are different from the non-dancers in body build.

Solley’s study was made to further analyze factors in physical role played by this growth that would enable the teacher to understand better for the factors in the growth of children. The purpose was to determine the status of physique, change in physique and speed in growth pattern of children in a typical elementary school. The wetzel Grid was introduced as a diagnostic instrument in the first four grades of the campus school, Wisconsin State College at River Falls. Measurement of height and weight were made within one week of January 15 each year. Therefore, progress of growth as studied in that over one year period ranging from January to January. All ages were scored from school record. After each measurement period, growth curves were plotted on the Grid. The proposition of students the significance of the relationship between the growth factors was further analyzed for the proportion. The chi-square test of independent was employed to

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determine the significance of relationship that existed among physique, change in physique and speed and among these factors and sex and grade level. Change of physique and speed of growth also showed a significant relationship. The relationship between speed and sex were statistically significant while speed and grade level appeared to be non-related.

Brown⁴ was designed to determine the relationship between body type and body alignment and center of balance. The purpose of this study was to determine if there was any relationship between the constitutional body type and the static postures of adult college women. The subjects participating in this investigation were 58 volunteer, young adult, college women at the Washington State University. There were 27 subjects either majoring or minoring in Physical Education. The remaining 31 had various other major. The subjects had a mean age of 20.15 years, a mean height of 65.6 inches and mean weight of 139 lbs. Each individual was somato typed according to the photographs, the center of balance was determined utilizing the Lovett and Renold technique and the body alignment was taken by utilizing the modified Howland alignometer. It was concluded that somato typed for young adult women was not related to body alignment since

other studies have found significant relationship between body type and body alignment in men.

Pierson selected twenty-one untrained subjects, based on body build to investigate certain relationships between heights, lean body mass, body fat, reaction time and over-all body speed of untrained subjects. Subjects were selected to represent the following body builds: short and heavy, short and light, tall, heavy, tall, and light. There were five, four, five and seven subjects respectively in each group. After the subjects' height and weight were coded, simply reaction time was measured. This involved finger lift in response to a visual stimulus and to distinguish it from RT measured in conjunction with over-all body speed was designated by laboratory RT. The time of a sprint start was then read from the first chronoscopic and over-all body speed in second. Reaction time as thus measured was designed operational RT. The present study may be interpreted as indicating that the speed, which the untrained individual can react, has little relationship to his size or composition.

Laubach and Conville study was to investigate the relationship between various aspects of flexibility and selected anthropometric

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measurements and the somatotype of college men. Sixty three Antioch College male students’ volunteers, who were paid for their participation in this study, were used as subjects. Ages of the students ranged from 16 to 25 years. Forty-six anthropometric measurements were measured. The means, standard deviation, and coefficients of variation were computed for the fourteen flexibility measurements. The Sheldon method was used for the somatotype assessments, the fourteen-flexibility measurement significant beyond the 0.01 level of confidence. There was a general lack of relationship between flexibility measurements and somatotype components. High coefficients of correlation between the anthropometric measurements utilized in the study and the somatotype components.

Slaughter and Loheman's study was to determine the association of somatotype and body composition in boys of 7 to 12 years old. Somatotype was measured by two methods. Sheldon’s revised trunk index method and Heath – Carter’s anthropometric method were used. Body composition was estimated as fat and lean body mass using a whole body method. The subjects were 45 young boys with a mean age of 10.04 years ranging from 7.25 to 12.59 years. These boys participated in the University of Illinois sports- fitness program during the

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summer of 1975. Heath-carter’s first component and Ectomorphy. Percent body fat was significantly related to all somatotype components of both methods except for Sheldon’s mesomorphy. Absolute lean body mass was significantly correlated with Sheldon’s Ectomorphy. It was concluded that the Endomorphy, the first component reflect body fatness to a considerable extent, but that little association between lean body mass and mesomorphy existed among children.

Marcel Hebelinck and Postma study was to determine number of physical characteristics and somatotype rating of College physical education Majors in South Africa. Among these characteristics and rating of college Physical education major at the University of Stellenbosch and the relationship of these characteristic and ratings with certain, motor fitness tests were analysed. Physiological factors, such as muscle action and efficiency of the circulatory and respiratory systems and psychological data were obtained from fifty-two male physical education majors. All were junior and seniors in the Department of Physical Education and aged from 18 to 25 years. Height, weight, shoulder width, neck girth, waist girth, shoulder width, neck girth, waist

girth, reciprocal ponderal index and waist neck girth index were taken. The Sheldon method was used for the somato typing and points were allocated for endomorphic, mesomorphic and Ectomorphic characteristics. The fitness tests were administered such as 60 yard dash, chinning, dipping, standing vertical jump, standing broad jump and putting the shot. The sum of these scores for the six tests used indicated the total motor fitness in this investigation. The result showed that the mesomorphic type has the better motor fitness scores.

Herman et.al.,\textsuperscript{9} studied on body size was determined by measurement characteristic such as height, weight, muscle development of adipose tissue and skeletal or body structure. The study was to identify the relationship of extreme body type to range of flexibility at Pennsylvanian State University in 1953. It was also to determine whether some prediction could be made about flexibility in terms of known body size. Thirty-five of thinnest fattest and most muscular students were selected. Ages ranges from 18 and 22 years. They were judged whether their body type related to ectomorphy or mesomorphy or endomorphy. A black and white grid with horizontal diameter and perpendicular planes were placed behind it to be used. Later, as a guide for photogrammetric purpose the relaxed pose of

different measurement were taken. The Panatonic X-ray films was used with en-posture time set 1/25 seconds and the lens stopped down, \( f = 4.5 \). Five breath measurements taken in rear pose. In statistical technique their correlation to determine flexibility and somatotype variable, somatotype and flexibility multiple correlation caused to show predictive value of flexibility, when associated with somatotype criteria. To determine the possible extent of influence of similar flexibility traits in different body type chi-square was used. The 't' was used value to determine significant of differences between the group means of the three-body type. It concluded that the significant difference between two laterals types such as endomorphy and Mesomorphy were found.

Lan Bach and convellee\(^{10}\) pointed out the relationship between flexibility and anthropometry using lighter technique of 63 college male students as subjects by excluded the subject with physical deformities and organic deficiency. The subject age ranged between 16 to 25 years with mean age of 19 years. He computed lean body mass from different skinfold measurements. It was concluded that the body fat as measured by skinfold caliper yielded fairly high significant, negative correlation with flexibility measurement.

\(^{10}\) Lloyd L Lanbach, Jhohn Mc convellee J., “Relationship between flexibility and Anthropometry and the somatotype of college Men” Research Quarterly, 37(March 1966), P.241.
Rider and Daly\textsuperscript{11} conducted an experiment study on the effect of flexibility on enhancing spinal mobility in older women. Ten week flexibility training program was given to female old women with mean age of 71.8 They were randomly assigned to either the experimental group (Flexibility Training) or control group (no training). Prior to initiation of training, all subjects were rested for total spinal mobility the combined sum of spinal flexion and extension. After final test it was found that a significant improvement in the spinal mobility accord due to flexibility training.

Cureton, et.al.,\textsuperscript{12} studied on the body fatness and performance difference between men and women. For the purpose the physical performance test and the percent body fat were tested. The Skinfold thickness measured to find out percent body fat and the physical performance by modified pull-ups, Vertical jump, 50 yard dash; 12 minutes run were measured for 55 male college students. It was concluded that greater body fatness was lesser the physical fitness. This partly explains why women on an average do not perform as well as men on strenuous task requiring movements of body weight.


Madanmohan, et.al.,\textsuperscript{13} conducted study to determine the effect of yoga training on reaction time, respiratory endurance and muscle strength. For this investigation they selected 27 male medical students volunteer residing in the college hostel. Their age was 18-21 years, weight 50-69 kg and height 161-179 cm. The experimenting subjects were tested on visual and auditory times (RT.), maximum expiratory pressure (MEP) maximum inspiratory pressure (MIP), 40 mm Hg test, breath-holding time after expiration (BHT exp), Breath holding time after inspiration (BHT insp), and hand grip strength (HGS). The researchers found out that there was a significant decrease in visual RT as well as auditory RT (from 194.18 + 126.46 + 10.75 mmHg) while MIP increased from 72.23 + 6.45+ 90.92 +60.03 mm Hg. Both these charged being statistically (P<0.001) from 36.57 ± 83.36 + 3.95s and 13.78± 0.58 to 16.67) 0.47 Kg respectively BHT exp. Increased from 32.15 ± 1.41 to 44.53 ±3.78 (P<0.01 and BHT insp. Increased from 63.69 ± 5.38 to 89.07 ± 9.61 (P<0.05). They concluded that yogic practice showed a significant reduction in visual and auditory RT and significant increase in respiratory pressure breath holding times and Hand grip strength.

Gopal et al.\textsuperscript{14} studied the effect of Yogasanas and Pranayama on blood pressure, pulse rate and some respiratory function. Two groups of male volunteers of 20-33 years in age and having the same averaging height and weight were studied. The experimental group of 14 subjects in Yogasanas and Pranayama for a period old six weeks. The control group consisted of 14 normal untrained subjects, who carried out non-yogic exercise i.e. involved in long walk and light games. Pre-test and post-test were conducted to both the groups before and after training. The result showed that a corresponding increase in respiratory function.

K.N.Udappa et.al.\textsuperscript{15} carried out a comparative study on the effect of yogic postures namely sarvangasana, shirshasana and halasala along with their complementry postures namely matayasana, mayurasana and pashchimathanasana on physical, Physiological endurance and metabolic changes. The subjects were six healthy young males of average age of 20. At the end of every third month the under mentioned physical and physiological factors, such as body weight, abdominal girth, chest girth, rate of inspiration, breath - holding time, vital capacity, pulse rate and blood pressure were assessed.


Simultaneously the volunteers were tested with biochemical investigation, such as fasting blood sugar, total serum lipid, total serum protein, Plasma cortisol, urinary 17-hydroxycorticosteroids, urinary 17-betaestriods and urinary catecholamines (UMA). The training on sarvangasana appears to induce prominent physiological effect, especially in cardio-respiratory system with fewer amounts of physical changes. It also produces some important endocrine and metabolic effects. The remaining two types of practices produce more of physical effects and lesser amount of physiological changes.

Khanna et.al.,16 studied on a cross-sectional sample comparison of 313 subjects of 8-14 years of ages. The subjects of the study participated actively in some other physical activity. Cycle ergometer was used to evaluate cardio-pulmonary responses. Each subject were given a graded protocol exercise starting with an initial work of 1W/Kg of body weight and thereafter every two minutes work load was increased by 0.5w/kg till exhaustion. Oxygen consumption, carbon-di-oxide production, ventilation, heart rate and oxygen pulse were recorded after every 30 seconds on a computerized ergoneumo test during exercise and recovery of Oxygen was computed. It had been

concluded that VO$_2$/min and HR at 2 W/Kg of work Load can best predict maximum aerobic capacity and oxygen debt. Recovery VO$_2$ value at 2$^{nd}$ min can predict VO2 max and O2 debt VCO2 /min, max and O2 pulse have highest.

Ashok and Rupiner$^{17}$ studied to examine the distribution of subcutaneous fat in young adult physically active 50 males and 50 females and aged 18-24 years. The conditioning program consisting of exercises targeted to improve flexibility, Strength and cardio respiratory endurance for 90 days. The data significantly analyzed by using the SPSS X Software. The ANOVA and Scheffe Post hoc tests were used to derive the result. The result showed that the distribution pattern of subcutaneous fat in the form Skinfold thickness in males was sub scapular (maximal) followed by calf, triceps suprailliac, biceps (minimal). The subcutaneous Skinfold thickness from the observed body sites significantly decreased (except Subscapular in females) with the progression of a conditioning program but it could not change the preconditioning distribution pattern of subcutaneous fat in both males & females. Whereas the Body fat Percentage significantly decreased and LBM% significantly increased only in females after conditioning program. These findings indicated that a conditioning program on the one hand

lowers the total body fat by mobilizing and using the subcutaneous fat and on the other hand increase lean body mass (LBM) both in males & females.

Ravinderan et al. studied to assess the changes in blood glucose level before and after the aerobic exercise with two types of recovery periods 20 min and 60 min respectively. Ten men students were randomly selected as subjects from 50 students of department of physical Education, Annamalai University. Their age ranged 19-22 years. For aerobic Conditioning, inclination of treadmill set at 5.5percent and speed was 10 km/hr for 15 minutes on completion of the aerobic exercise, post blood samples (ante-cubital vein were collected from Group I & Group II with a recovery of 20 minutes & 60 minutes respectively. The result shows that t ratio for the difference between pre and post test for 20 minutes test on blood glucose level was decreased after aerobic exercise at different condition of recovery period. The longer recovery after aerobic activity impacted on re-synthesis of glucose.

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Bowman et al. studied to find whether the age-associated reduction in baroreflex sensitivity was modifiable by exercise training. The purpose of the study was to find the effect of the Aerobic exercise and the Yoga, a non-aerobic control intervention, on the baroreflex of elderly persons was determined. Baroreflex sensitivity was quantified by the α-index, at high frequency and mid-frequency, derived from spectral and cross-spectral analysis of spontaneous fluctuations in heart rate and blood pressure. Twenty-six (10 women) sedentary, healthy, normotensive elderly and the mean age of 68 years and range from 62–81 years subjects were selected for the study. Fourteen (4 women) of the sedentary elderly subjects completed 6 weeks of aerobic training, while the other 12 subjects (6 women) completed 6 weeks of yoga. Heart rate decreased in following yoga but not aerobic training. \( \text{VO}_2 \text{max} \) increased by 11% following yoga and by 24% following aerobic training. No significant change in \( \alpha_{MF} \) occurred after aerobic training. Following yoga, but not increased. Short-duration aerobic training does not modify the α-index at \( \alpha_{MF} \) or \( \alpha_{HF} \) in healthy normotensive elderly subjects. \( \alpha_{HF} \) but not \( \alpha_{MF} \) increased following yoga, suggesting that these parameters are

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measuring distinct aspects of the baroreflex that are separately modifiable.

Gilliam and Burke 20 analysed the effect of exercise on serum lipids in a six-week study involving 14 females ages 8-10 years. The subjects participated in various aerobic activities for 35 minutes per session. The results showed that a significant increase in HDL-C levels with no change in TC levels. The main flaw in this study was a lack of a control group. Additionally, intensity was described as “strenuous” but was not quantified, the length of the study was short (six weeks) and the frequencies of the exercise sessions were not reported.

Linder et. al.,21 examined the effect of an eight-week walk/jog program at heart rate (HR) intensity of 80 % of peak HR on 29 boys, ages 11-17 years. No effect was observed for TC, TG, HDL-C, or LDL-C. The inherent problem in this study was the inclusion of boys who are at differing maturational stages.


Savage et. al.22 walk/jog/run program with 8-9 year old boys resulted in no alterations in TC or LDLC or HDL-C levels after the 11-week study. However, they did note an overall improvement in the TC/HDL ratio.

Ignigo and Mahon 23 examined the effects of ten week exercise-training program on TC, TG, HDL-C and LDL-C in boys and girls ages 9-10 years. Eighteen children participated in an exercise training program and ten children served as control group. The exercise program included 60 minutes of aerobic activity, three times per week at an exercise intensity that elicited heart rates of 160-180 b·min
t (80-90 % of peak HR). TG was the only variable that was favorably altered after the 10-week exercise intervention. Although the authors mentioned the use of heart rate monitors, they also mentioned that heart rates were monitored by pulse counting and thus it was not clear how many subjects were using heart rate monitors at any one time. Additionally, the inclusion of both boys and girls in a relatively small sample size may result in an affect that independent of the exercise intervention.


Blessing and Williford 24 done an experimental study for 16 week training on Blood lipid and physiological responses in adolescents of the longest to date, their subjects were 25 males and females who ranged in age from 13-18 years. The 16-week training program involved 40 minutes of various aerobic activities at an intensity that was to approach 90% of previously determined peak work capacity. Intensity was measured by the subjects obtaining a radial pulse. The results showed that a positive alteration in TC, HDL-C, LDL-C, TC/HDL-C levels after the 16 weeks of exercise training. The inherent problem with this study was the inclusion of both males and females in the same study. Additionally, the age range of 13-18 years was too broad due to the differing maturational stages of this group.

Rowland et.al.,25 conducted a thirteen week study that included 34 boys and girls of ages ranged from 10 to 13 years. First, there was not a control group. Instead, the subjects acted as their own controls to try and minimize the genetic effects of trainability between subjects. However, this study design did not control the effect on growth and


maturation. Second, although heart rate monitor were used to measure exercise intensity, only seven subjects used the monitors during each exercise session. The result showed that exercises intensity was only collected on each subject for one out of three exercise sessions each week. A final source of error was again subject heterogeneity. As mentioned previously, the inclusion of adolescent boys and girls in the subject pool makes interpretation of blood lipid and lipoprotein changes difficult.

Stergioulas et al.,26 examined the effect exercise training had on HDL-C levels in 18 boys ages ranged 10 to 14 years. The subjects were chosen from a group of 1000 Greeks who participated in a survey that was conducted in 1993. HDL-C levels increased significantly after the eight-week training program. There were several inherent problems with this study. First, it is difficult to ascertain how exercise intensity was measured. They indicated that exercise was set at 75% of physical working capacity that was an exercise with heart rate of 170 b·min⁻¹. However, it is not clear whether a peak exercise test was completed prior to the exercise intervention or whether peak heart rate information was gathered from the Greek survey results of 1993. If exercise heart rate was estimated, than it was questionable that a heart rate of 170 b·min⁻¹

would be accurate for boys with an age ranged from 10 to 14 years. Second, the authors did not describe whether or not heart rate was monitored during the exercise sessions. A final source of error was subject heterogeneity. Although only boys participated in the study, their maturity level was not assessed. Assessment of maturity level was pertinent because there were most likely significant differences in the boys who ages ranged from 10-14 years and, as mentioned above, testosterone has been shown to adversely affect the blood lipid and lipoprotein profile of males.

Stergioulas and Filippou\textsuperscript{27} conducted a second study with 10-14 year old boys. In this study all subjects completed peak exercise tests for the determination peak HR. The subjects completed 4 training sessions per week at 80 % of their peak HR for 8 weeks. Significant, positive alterations were observed for all variables at the end of the eight weeks. However, it again needed to be pointed out that the probable maturity differences among the subjects made the data difficult to accurately interpret.

Stoedefalke et al., (2000)\textsuperscript{28} has the longest well controlled exercise training study to examine the effects of exercise training on post menarchial 13-14 year old girls. The twenty week study included twenty experimental subjects and eighteen control subjects. All subjects underwent peak exercise tests to determine maximal HR values. Subjects exercised three times per week for 20 minutes on either a treadmill or cycle ergometer. Exercise intensity was kept at 75-80\% of maximal HR as verified by HR monitors. No significant change in TC, HDL-D, LDL-C or TG was observed in either group.

Welsman et. al.,\textsuperscript{29} examined the effect two separate modes of aerobic training had on TC levels in 35 girls' aged from 9-10 years. The exercise intervention lasted eight weeks and exercise intensity was set at approximately 80 \% of peak HR. All subjects underwent peak exercise tests to determine peak HR values. No changes in TC or HDL-C were observed in either group. Subjects exercising on the cycle ergometers with heart rate monitors so that exercise intensity could be accurately measured. Subjects who participated in the aerobic dance program underwent a pilot study to determine which routines would consistently


elicit heart rates above 150 b·min⁻¹. Additionally, if the subjects in the aerobic dance group experienced a decline in sub-maximal HR than the dance routines may not have been rigorous enough to elicit HR levels of 150 b·min⁻¹ in the latter weeks of the study.

Tolfrey et al.,³⁰ conducted a very well controlled study with 48 prepubertal boys and girls of which twenty eight of the subjects completed an exercise training intervention. They controlled for exercise intensity by using HR monitors and through constant encouragement, they were able to have all subjects maintain an exercise intensity of 79% of peak HR. The subjects pedaled on cycle ergometer three times per week for 12 weeks. The results showed that there was no difference over time for TG and TC between the two groups. However, the exercise group experienced an increase in HDL-C and a decrease in LDL-C levels. Changes in the blood lipid profile were independent of alterations in peak VO₂. In fact, the control group started out with a higher peak VO₂ and maintained the greater peak VO₂ until the end of the study suggesting that it was the exercise training which directly effected blood lipid profiles and not peak VO₂. This was the first study that had adequately controlled for exercise intensity and, although it probably

unrealistic to expect children to continue to exercise at a constant intensity, doing the same mode of exercise outside of an experimental setting, the study did advance our knowledge of the effects a highly structured exercise training program has on blood lipids and lipoproteins in pre-pubertal children. The major design flaw was the inclusion of both boys and girls in the study. Additionally, as mentioned above, few studies have lasted longer than 12 weeks and it would have been beneficial to observe whether a longer training period resulted in more dramatic differences.

Tolfrey et al.,\textsuperscript{31} conducted a second training study with 34 subjects, ranged 10-11 year old boys and girls. All subjects exercised three times per week at 80 \% of peak HR. Again all subjects wore HR monitors for the 12-week exercise-training program. Unlike other studies, the study was unique in that exercise duration was individualized to match energy expenditure targets. Two groups were established. A LOW group that expended 100 kcal·kg\textsuperscript{-1} and the MOD group that expended 140 kcal·kg\textsuperscript{-1}. The exercise training program elicited no change in TC, HDL-C or LDL-C irrespective of exercise duration and energy expenditure. The authors suggest that the exercise volume may have been insufficient to elicit a change.

Williford and Blessing\textsuperscript{32} study was to examine exercise training effects in black, male adolescents. Twelve boys completed a 15 week, 5 day per week exercise training program. The exercise sessions took place for 30 minutes during a regularly scheduled physical education class. The subjects jogged at 70-90\% of their pre-determined peak heart rates. It was not clear how HR was monitored. Unique to this study was the inclusion of a weight-training program that took place two times per week. The 15-week exercise-training program resulted in significant increases in HDL-C and significant decreases in LDL-C. No change in TC occurred. The authors point out that further research was needed regarding the effects of ethnicity and the effects of exercise training on blood lipids and lipoproteins.

Borecki et al.,\textsuperscript{33} assessed major gene effects for baseline HDL-C, LDL-C, TG, and their training responses (post-training minus baseline) in 527 individuals from 99 White families and 326 individuals from 113 Black families in the HERITAGE family study. The baseline phenotypes were adjusted for the effects of age and BMI, and the training response

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phenotypes were adjusted for the effects of age, BMI, and their respective baseline values, within each of the sex-by-generation-by-race groups, prior to genetic analyses. In Whites, we found that LDL-C at baseline and HDL-C training response were under influence of major recessive genes and multifactor (polygenic and familial environmental) effects. Interactions of these major genes with sex, age, and BMI were tested, and found to be no significant. In Blacks, we found that baseline HDL-C was influenced by a major dominant gene without a multifactorial component. This major gene effect accounted for 45% of the variance, and exhibited no significant genotype-specific interactions with age, sex, and BMI. Evidence of major genes for the remaining phenotypes at baseline and in response to endurance training were not found in both races, though some were influenced by major effects that did not follow Mendelian expectations or were with ambiguous transmission from parents to offspring. In summary, major gene effects that influence baseline plasma HDL-C and LDL-C levels as well as changes in HDL-C levels in response to regular exercise were detected in the current study.
Mahmoud\textsuperscript{34} examined the effect of prolonged submaximal exercise followed by a self-paced maximal performance test on cholesterol (T-Chol), triglycerides (TG), and high-density lipoprotein cholesterol (HDLC). Nine trained male athletes cycled at 70\% of maximal oxygen consumption for 60 min, followed by a self paced maximal ride for 10 min, venous blood samples were obtained at rest, at 30 and 60 min during submaximal exercise, and immediately after the performance test. Lactic acid, haematocrit (Hct), haemoglobin (Hb), T-Chol and TG were measured in the blood, while plasma was assayed for HDL-C. Plasma volume changes in response to exercise were calculated from Hct and Hb values and all lipid measurements were corrected accordingly. In order to ascertain the repeatability of lipid responses to exercise, all subjects were re-tested under identical testing conditions and experimental protocols. When data obtained during the two exercise trials were analysed by two-way ANOVA no significant differences between tests were observed at 0.05 level. Consequently the data obtained during the two testing trials were pooled and analysed by one-way ANOVA. Blood lactic acid increased non-significantly during the prolonged submaximal test, but rose markedly

following the performance ride. Lipid variables ascertained at rest were within the normal range for healthy subjects. ANOVA showed that blood T-Chol and TG were unchanged (P > 0.05), whereas HDL-C rose significantly (P < 0.05) in response to exercise. Post hoc analyses indicated that the latter change was due to a significant rise in HDL-C after the performance ride. It was concluded that apparent favorable changes in lipid profile variables occur in response to prolonged sub maximal exercise followed by maximal effort, and these changes showed a good level of agreement over the two testing occasions.

Ring and Serge³⁵ analysed regular endurance exercise has favorable effects on cardiovascular risk factors. However, the impact of an exercise induced change in aerobic fitness on blood lipids often inconsistent. The purpose of this study was to investigate the effect of nine consecutive months of training on aerobic fitness and blood lipids in untrained adults. Thirty subjects 35-55 years of age (wt: 73.1 ±13.6 kg, height 171.1 ±9.0 cm, %body fat 24.6 ±6.3%, 14 males and 16 females) were randomly assigned to an exercise (EG) (N =20) and control (CG) (N =10) group. All subjects completed an incremental treadmill test, anthropometric measurements, and venous blood sample collection.

before and after the 9 months of exercise. Participants in the exercise group were supervised and adjusted for improvements in running performance, whereas no change was administered for the control group. One-way and multivariate ANOVA was conducted to determine significant differences in means for time and group in selected variables [body mass, % body fat, BMI; VO$_{2peak}$, km/h at 2.0 (v-LA2) and 4.0 (v-LA4) mmol l$^{-1}$ blood lactate (LA) concentration, km/h of the last load (v-max); TC, LDL-C, HDL-C, TG, Apo B, Apo A-1, and Lp (a)]. Correlation coefficients and multivariate regression analysis was used to determine the association between aerobic fitness and blood lipids. The exercise group improved significantly (P < 0.0001) in VO$_{2peak}$, v-LA2, v-LA4, v-max and exhibited a significant decrease in Apo B (P < 0.04) compared to the control group (NS). In nine months period, EG achieved 24% increase in VO$_{2peak}$ and 18% reduction in Apo B, denoting the impact of cardiovascular fitness on cardiovascular risk.

Boudou et al.,$^{36}$ investigated the effect of an exercise training program on lipid profile in correlation with DHEA level and body weight and body composition in type 2 diabetic men. Longitudinal, controlled clinical intervention study with exercise training consisting of an 8 week

supervised program of aerobic exercise (75% VO$_2$ peak, 45 min), twice a week and intermittent exercise, once a week, on a bicycle ergometer. Sixteen men (age 45.4±7.2), HbA1c 8.15±1.7%, body mass index (BMI) 29.6±4.6 kg/m$^2$) were randomly divided into two groups: trained group (n=8) and control group (n=8). Lipid, apo - and lipoprotein and DHEA concentrations. Cross - sectional areas of subcutaneous and visceral adipose tissue and mid-thigh muscle by magnetic resonance imaging. Training decreased visceral (153.25±38.55 vs 84.20±21.30 cm$^2$, P<0.001), subcutaneous (241.55±49.55 vs 198.00±39.99 cm$^2$, P<0.001) adipose tissue area and triglyceride levels (2.59±1.90 vs 1.79±1.08 nmol/l, P<0.05) and increased mid-thigh muscle cross-sectional area (148.30±36.10 versus 184.35±35.85 cm$^2$, P<0.001), and DHEA levels (11.00±3.10 versus 14.25±4.10 nmol/l, P<0.05) with no modification in body weight. Changes in triglycerides were negatively correlated with changes in DHEA (r=-0.81, P=0.03). This correlation was independent of changes in abdominal fat distribution. Training decreases abdominal fat depots, improves muscular mass and affects favorably triglyceride and DHEA levels. Changes in triglycerides and DHEA were inversely related.

Hager et.al.,$^{37}$ examined the association between aerobic fitness and serum cholesterol and the effects of controlling for gender, body

composition, abdominal fat, and dietary saturated fat in 262 children. The 1-mile run was used to estimate fitness. Skinfold were used in assessing body fat. Fit children had lower total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels and higher high-density lipoprotein cholesterol levels than unfit children, except after adjustment for body fat and/or abdominal fat. Unfit children appear to be at an increased risk of unhealthy levels of serum cholesterol due primarily to increased levels of body fat.

Khanna et al.,\textsuperscript{38} studied this study was based on a cross-sectional sample comparison of 313 subjects of 8-1 years. All subjects of this study used to participate actively in some or the other physical activity. Cycle ergometer was used to evaluate cardio-pulmonary responses. Each subject are given a graded protocol exercise starting with an initial work of 1 W/Kg of body weight and thereafter every two minutes work load was increased by 0.5 w/kg till exhaustion. Oxygen consumption, carbon-di-oxide production, ventilation heart rate and oxygen pulse was recorded after every 30 seconds on a computerized ergoneumotest during exercise. and recovery O\textsubscript{2} was computed from the recovery responses of O\textsubscript{2} consumption. It has been concluded that

VO\textsubscript{2}/min and HR at 2 W/Kg of work load can best predict maximum aerobic capacity and oxygen debt. Recovery VO\textsubscript{2} value at 2\textsuperscript{nd} min can predict VO\textsubscript{2} max and O\textsubscript{2} debt VCO\textsubscript{2} /min, max and O\textsubscript{2} pulse have highest. Whereas BE has lowest coefficient of determination with VO\textsubscript{2} max.

Ashok & Rupiner\textsuperscript{39} studied to examine the distribution of Subcutaneous fat in young adult physically active males (N=50) and females (N=50) aged from 18-24 years, before and after a 90 days conditioning programme consisting of exercises targeted to improve flexibility, Strength and Cardio respiratory endurance. The data was significantly analyzed by using the SPSS X Software. The ANOVA and Scheffe Post hoc tests were used to derive the result. The result shows that the distribution pattern of subcutaneous fat in the form Skinfold thickness in males was sub scapular (maximal) followed by calf, triceps suprailiac, biceps (minimal). The subcutaneous Skinfold thickness from the observed body sites significantly decreased (except Sub scapular in females) with the progression of a conditioning programme but it could not change the preconditioning distribution pattern of subcutaneous fat in both males & females. Whereas the Body fat Percentage significantly decreased (before 23.87 ± 3.20 & after 20.86 ± 2.41) and LBM%
significantly increased (before 76.00 ± 3.20 after 79.14 ± 2.80) only in females after conditioning programme. These findings indicate that a conditioning programme on the one hand lowers the total body fat by mobilizing and using the subcutaneous fat and on the other hand increase lean body mass (LBM) both in males & females.

Ravinderan et.al.,\textsuperscript{40} studied to assess the changes in blood glucose level before and after the aerobic exercise with two types of recovery periods 20 min and 60 min respectively. Ten men student were randomly selected as subjects from 50 students of department of physical Education Annamalai University. Their age ranged 19-22 years. For aerobic Conditioning, inclination of treadmill set at 5.5percent and speed was 10 km/hr\textsuperscript{1} for 15 minutes on completion of the aerobic exercise, post blood samples (ante-cubital vein were collected from Group I & Group II with a recovery of 20 minutes & 60 minutes respectively. The result shows that t ratio for the difference between pre and post test for 20 minutes test on blood glucose level was decreased after aerobic exercise at different condition of recovery period, the longer recovery after aerobic activity impact on re-synthesis of glucose.

Isabel et al., studied to analyse the role played by aerobic exercise training in the plasma lipoprotein profile, prebeta 1-HDL concentration, and in the in vitro HDL₃ ability to remove cholesterol from macrophages and inhibit LDL oxidation in type 2 diabetes mellitus (DM) patients and control subjects, in the fasting and postprandial states. Healthy controls (HTC, N = 11; 1 M/10 F) and subjects with type 2 diabetes mellitus (DMT, N = 11; 3M/8F) were engaged in a 4-month aerobic training program, and compared with a group of sedentary subjects with type 2 diabetes mellitus (DMS, N = 10; 4 M/6 F). All groups were submitted to an oral fat load test to analyze all parameters, both at the beginning of the investigation protocol (basal) and at the end of the study period (final). Exercising did not modify body weight, BMI, plasma concentrations of total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides (TG), glucose, insulin, or HOMA-IR, but it reduced the waist circumference. The HDL₃ composition did not change, and its ability to remove cell cholesterol was unaltered by aerobic training. In DMT but not in HTC, aerobic training improved 15% the HDL₃ protective effect against LDL maximal oxidation rate in the fasting state, and reduced 24% the plasma prebeta 1-HDL concentration in the postprandial state, suggesting an enhanced protective effect against LDL oxidation.

prebeta 1-HDL conversion into larger, more mature HDL particles. In this regard, regular aerobic exercise enriched HDL₂ with TG in the fasting and postprandial states in HTC and in the fasting phase in DMT. Our results show that aerobic exercise training in diabetes mellitus improves the HDL efficiency against LDL oxidation and favors HDL maturation. These findings were independent of changes in insulin resistance and of the rise of plasma HDL cholesterol concentration.

Woolf-May et al.,42 studied the effect of two different 18-week walking programmes on aerobic fitness, selected blood lipids and factor XIIa. Forty-nine previously sedentary or low active individuals aged 40-71 years were allocated to three groups. The long walking group participated in an 18-week walking Programme which consisted of walks lasting 20-40 min; the repetitive short walking group completed walks of between 10 and 15 min, up to three times a day, with no less than 120 min between each walk; and the control group maintained their low level of activity. Both walking programme began at a prescribed 60 min/week, which increased steadily up to 200 min/week by week 12. During the study, the long walking group walked for an estimated 2514 min (139 min/week), expending an estimated 67.5 MJ

(3.72 MJ week⁻¹) at an estimated 73% of their age-predicted maximum heart rate and 68% of their estimated VO₂max. The repetitive short walking group walked for an estimated 2476 min (135 min. week⁻¹), expending an estimated 58.5 MJ (3.17 MJ week⁻¹) at an estimated 71% of their age-predicted maximum heart rate and 65% of their estimated VO₂max. The results showed a statistically significant reduction in heart rate during a standardized step test (pre- vs. post-intervention) in both walking groups, indicating an improvement in aerobic fitness, although the control group showed a higher average heart rate during the post-intervention test, indicating reduced fitness. When compared with the male subjects pre-intervention, the females possessed more favorable levels of high-density lipoprotein (HDL) cholesterol (P < 0.001), apolipoprotein (apo) Al (P < 0.001) and ratios of total cholesterol: HDL cholesterol (P < 0.02) and low-density lipoprotein (LDL) cholesterol: HDL cholesterol (P < 0.02). Compared with the controls post-intervention, the walking groups showed no statistically significant changes in total cholesterol, LDL cholesterol, HDL cholesterol, apo Al, apo All, apo B, or the ratios of total cholesterol: HDL cholesterol, LDL cholesterol: HDL cholesterol, apo Al : apo B or apo Al : apo All (P > 0.05). Relative to the walking groups, factor XIIa increased in the control group (P < 0.05). We conclude that, although both walking programme appeared to improve aerobic fitness, there was no evidence of improvements in the
blood lipids or associated apolipoproteins of the walking groups. Further analysis indicated that this apparent lack of change may have been related to the subjects' relatively good pre-intervention blood lipid profiles, which restricted the potential for change. The implications of the observed changes in the coagulation/fibrinolytic factors remained unclear.

Prasad et.al.,\textsuperscript{43} studied the Impact of Pranayama and Yoga on Lipid Profile In Normal Healthy Volunteers. The present study was conducted on normal healthy volunteers, 41 men and 23 women, to evaluate the impact of Pranayama and Yoga asana on blood lipid profiles and free fatty acids, in two stages. In stage-I, Pranayama was taught for 30 days and in stage-II, yogic practices were added to Pranayama for another 60 days. A significant reduction was observed in triglycerides, free fatty acids and VLDL-cholesterol in men and free fatty acids alone were reduced in women at the end of stage-I. A significant elevation of HDL-cholesterol was seen only in the men at the end of stage-I. At the end of stage-II, free fatty acids increased in both men and women, and women demonstrated a significant fall in serum cholesterol, triglycerides, LDL-and VLDL-cholesterol. The results indicated

that HDL-cholesterol was elevated in men with Pranayama, while triglycerides and LDL-cholesterol decreased in women after yoga asana. The results of the present study indicated that Pranayama and yoga asana can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia etc.

Reza et.al., study was to investigate the effects of aerobic exercises on serum paraoxonase-1 (PON1) activity, arylesterase (ARE) activity, and lipoprotein profile. Forty-four non-active healthy men volunteered to participate in this research. They were randomly assigned into three groups: vigorous aerobic exercise group (VAE-group, n=15), moderate aerobic exercise group (MAE-group, n=17) and control group (n=12). Duration of training was 8 weeks, 3 sessions per week and each session lasted 30-45 minutes. VAE-group and MAE-group carried out exercises at 80-85 and 60-65 percent of maximal reserve heart rate. Dependent variables were measured in the three phases of the study, including pre-test, mid-test and post-test. Results did not show any significant changes in PON1 activity, ARE activity, low density lipoprotein cholesterol (LDL-c), or total cholesterol (TC) concentration after aerobic exercises. However, high density lipoprotein cholesterol (HDL-c), HDL-
c/Total cholesterol ratios and maximal oxygen uptake (VO2max) significantly increased (P<0.05) and body mass index (BMI) conversely decreased (P<0.05) due to vigorous aerobic exercises. The lack of significant interaction between PON1/ARE activity and aerobic exercises in an Iranian group (with AA phenotype) along with low PON1 activity of our subjects probably confirm the concept of racial variability of PON1 activity.

Herrera et.al.,45 study was to examine the association of somatotype with blood pressure during ageing. The Heath-Carter anthropometric somatotype and both systolic (SBP) and diastolic (DBP) blood pressures were recorded. The sample included 809 healthy institutionalized elders (370 males and 439 females) from geriatric units in Caracas, Venezuela. Ages ranged from 60 to 102 years. Product-moment correlation coefficients between somatotype components and both blood pressure readings were calculated. Principal component analysis and homogeneity analysis by means of alternative least squares tests were also performed. Results showed that Females were more endomorphic and mesomorphic than males. Males were more ectomorphic than females. SBP showed a downward tendency with

age in males, while in females the tendency was for the SBP to increase. Correlations among variables were from low to moderate and ranged from -0.37 to +0.34 in males, and from -0.18 to +0.32 in females. Correlations tended to be stronger in the younger age group and differences between sexes were found. A negative tendency in the correlation between ectomorphy and both SBP and DBP was found, except for the oldest age group, for which the correlation was positive. Endomorphy and mesomorphy showed a stable correlation pattern with blood pressure in males, while in females this pattern was more irregular and less consistent. Conclusion: Individuals with high levels of SBP and DBP had mean somatotypes, which were similar to those of other male groups characterized by myocardial infarct, coronary heart disease and the risk of hypertension, indicating that these somatotypes may be associated with cardiovascular risk factors. The results indicated that individuals who present a cardiovascular risk profile are more endomorphic and mesomorphic and less ectomorphic than those with a lower cardiovascular risk profile.

Katzmarzyk et al.\(^{46}\) investigated the relationships among subcutaneous fatness, subcutaneous adipose tissue (SAT) distribution, endomorphy, and mesomorphy in the Québec Family Study. They found that individuals with high levels of SBP and DBP had mean somatotypes, which were similar to those of other male groups characterized by myocardial infarct, coronary heart disease and the risk of hypertension, indicating that these somatotypes may be associated with cardiovascular risk factors. The results indicated that individuals who present a cardiovascular risk profile are more endomorphic and mesomorphic and less ectomorphic than those with a lower cardiovascular risk profile.

somatotype and risk factors for coronary heart disease (CHD). The sample included 1410 (715 male and 695 female) youths and adults from the Québec Family Study. Six skinfold and the dimensions necessary for the derivation of the Heath-Carter anthropometric somatotype (endomorphy, mesomorphy, ectomorphy) were measured. The six skinfolds were summed to provide an index of subcutaneous adiposity (SUM). In addition, the trunk-to-extremity skinfold ratio, adjusted for SUM using regression procedures (TER), and the first principal component (PC1) of skinfold residuals (also adjusted for SUM) were used to indicate SAT distribution, independent of the overall level of fatness. Risk factors for CHD included systolic and diastolic blood pressures, and fasting glycaemia, triglycerides (TGs), plasma cholesterol, high and low density lipoprotein (HDL-C and LDL-C) cholesterol, and the HDL-C/total cholesterol (CHOL) ratio. In general, SUM was positively correlated with endomorphy and mesomorphy, and negatively correlated with ectomorphy. On the other hand, SAT distribution was not associated with somatotype, except in females where TER and PC1 were negatively correlated with mesomorphy. The result of forward stepwise regression analyses to predict CHD risk factors, indicated that a significant proportion of the variance in the risk factors could be accounted for by SUM, SAT distribution and somatotype (up to 16%). SUM was the best predictor, entering the regressions first (most important) in six of 15
significant regressions in males and 14 of 16 significant regressions in females. Somatotype components enter as predictors 10 times in males, and six times in females. Similarly, TER and PC1 enter as predictors nine times in males and five times in females. It was concluded that 15 Somatotype was related to SUM, while somatotype and SAT distribution are largely independent of one another. Furthermore, SUM, somatotype and SAT distribution were significant predictors of biological risk factors for CHD.

Hoshizaki & Bell\textsuperscript{47} studied Seventeen measures of joint flexibility were obtained on 190 volunteer subjects, 124 women and 66 men. Using a Leighton flexometer and a Universal goniometer seventeen measures of flexibility were taken. A principle axes method of factor analysis with oblique rotation revealed four significant factors. The first factor had 14 significant factor loadings ($r>0.30$) with Factor II having 13, Factor III, 11 and Factor IV, 16. Each factor included one very high coefficient; Factor I had trunk lateral flexion (0.96), Factor II, shoulder flexion-extension (0.91), Factor III, trunk flexion-extension and Factor IV, hip flexion (0.94). These variables also had high coefficients in the other three factors which were reflected by high communality values; trunk lateral flexion ($h = 0.92$), hip flexion ($h = 0.88$) trunk flexion-extension ($h = 0.88$) and

shoulder flexion-extension ($h = 0.83$). Analysis of the data indicated four factors representing an underlying structure for body flexibility. Within the four factors, four variables contributed a high percentage of the variance, suggesting total body flexibility may be represented using these four measures.

Alysia et al. studied to compare cardiovascular fitness between obese and nonobese children. Based on body mass index, 118 were classified as obese (boys [OB] = 62, girls [OG] = 56), while 421 were nonobese (boys [NOB] = 196, girls [NOG] = 225). Cardiovascular fitness was determined by a 1-mile [1.6 km] run/walk (MRW) and estimated peak oxygen uptake (VO2peak) and analyzed using two-way analyses of variance (Gender x Obese/Nonobese). MRW times were significantly faster ($p < .05$) for the NOB (10 min 34 s) compared to the OB (13 min 8 s) and the NOG (13 min 15 s.) compared to the OG (14 min 44 s.). Predicted VO2peak values (mL.kg$^{-1}$.min$^{-1}$) were significantly higher ($p < .05$) for the NOB (48.29) compared to the OB (41.56) and the NOG (45.99) compared to the OG (42.13). MRW was compared between obese and nonobese participants on the President’s Challenge (2005), the National Children and Youth Fitness Study, and FITNESSGRAM® HFZ

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standards. The nonobese boys and girls scored higher on all three, exhibiting better cardiovascular fitness as compared to obese counterparts.

Photiou, et al., conducted general socioeconomic conditions as well as the physical environment have undergone remarkable changes in Hungary during the past 30 years. Unfortunately, these positive processes have resulted in a reduction of habitual physical activity along with unfavorable changes in dietary habits. Therefore, the purpose of the present study was to compare some selected morphological and functional parameters of 7-14-year-old Hungarian schoolboys living in the middle of the 1970s and at the beginning of the new millennium. It was hypothesized that there would be significant differences in morphological and functional characteristics of the Hungarian schoolboy populations, because they were assessed 30 years apart. Means of height, body mass, body mass index (BMI), the sum of five skinfold tests, percentage of body fat, and two running performance times (400 m and 1,200 m) of the boys (N = 3,672) studied in 1975 were compared to those of the boys (N = 3,758) in 2005. Data were analyzed using two-tailed independent samples t tests (p < .05). We observed significant secular changes in body mass and height. In

addition, boys in 2005 had significantly more subcutaneous fat compared to 1975. The running times for the two distances were significantly poorer at the time of the second investigation. The remarkable and unfavorable changes in body composition and cardiorespiratory performance were attributed to the continuously decreasing intensity of habitual physical exercise and a lifestyle that had become more sedentary (watching TV, playing computer games, etc.). Radical interventions are necessary to reduce these risks associated with the high prevalence of cardiovascular disease in Hungary, and the challenge to resolve the problem requires combined efforts at the educational, societal, corporate, and government levels.

Robert Buresh et al., study was to determine the relationships between: (a) measures of body size/composition and heat production/storage, and (b) heat production/storage and heart rate (HR) drift during running at 95% of the velocity that elicited lactate threshold, which was determined for 20 healthy recreational male runners. Subsequently, changes in skin and tympanic temperatures associated with a vigorous 20-min run, HR, and VO2 data were recorded. It was found that heat production was significantly correlated

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with body mass ($r = .687$), lean mass ($r = .749$), and body surface area (BSA, $r = .699$). Heat storage was significantly correlated with body mass ($r = .519$), fat mass ($r = .464$), and BSA ($r = .498$). The percentage of produced heat stored was significantly correlated with body mass ($r = .427$), fat mass ($r = .455$), and BSA ($r = .414$). Regression analysis showed that the sum of body mass, percentage of body fat, BSA, lean mass, and fat mass accounted for 30% of the variability in heat storage. It was also found that HR drift was significantly correlated with heat storage ($r = .383$), percentage of produced heat stored ($r = .433$), and core temperature change ($r = .450$). It was concluded that heavier runners experienced greater heat production, heat storage, and core temperature increases than lighter runners during vigorous running.

Haus et al.,$^{51}$ studied the effect of aerobic exercise on skeletal muscle myofibrillar proteolysis in humans. Relatively little was known about the dynamics of the skeletal muscle protein pool following aerobic exercise. Myofibrillar protein synthesis has recently been shown to be substantially elevated for 3 days after a strenuous 60 min bout of one-legged aerobic exercise, and this increase was surprisingly equal to or greater than what has been shown numerous times following

resistance exercise over the same time course. Because net protein accretion was the sum of protein synthesis and degradation, we sought to directly measure skeletal muscle myofibrillar proteolysis in five healthy young males in response to an identical strenuous 60 min aerobic exercise bout and at the same time points (rest, 6, and 24 h post-exercise and 48 and 72 h post-exercise in a subset of subjects). We measured skeletal muscle myofibrillar proteolysis by monitoring the release of the natural tracer 3-methylhistidine (3MH) from the vastus lateralis muscle into the interstitial space via microdialysis. Skeletal muscle interstitial 3MH concentration was no different (P>0.05) from rest (5.16±0.38 nmol/mL) after 6 (5.37±0.55 nmol/mL), 24 (5.40±0.26 nmol/mL), 48 (5.50±0.74 nmol/mL), or 72 h (4.73±0.28 nmol/mL). These results suggested that proteolysis of the myofibrillar fraction of skeletal muscle was relatively refractory to an intense aerobic exercise stimulus for up to 3 days, despite the large increase in synthesis of this muscle fraction following the same exercise stimulus. The apparent net myofibrillar protein accretion in the hours and days after exercise may occur in order to offset the large elevation in mixed muscle proteolysis that has been shown during similar bouts of intense one-legged aerobic exercise.
The study conducted by García-López et al. aimed to investigate the effects of a 21-week period of progressive strength or endurance training on peripheral blood mononuclear cells (PBMC) antioxidant enzyme gene expression and activity in healthy middle-aged untrained men. Strength (n=11) and endurance (n=12) training were performed twice a week, including resistance exercises to activate all the main muscle groups or cycle-ergometer pedaling, respectively. mRNA levels of catalase, glutathione peroxidase, mitochondrial superoxide dismutase, and cytosolic superoxide dismutase were increased after 21 weeks of strength training, while endurance training induced significant changes only in MnSOD and GPx mRNA levels. CuZnSOD protein content was significantly increased only in strength-trained subjects. The program of strength or endurance exercise training had no significant effects on the activity of any of the antioxidant enzymes. In conclusion, in a middle-aged population, 21 weeks of strength or endurance training was a sufficient stimulus to up-regulate mRNA levels of PBMC antioxidant enzymes, the strength training being a more optimal stimulus. However, the discrepancies between enzyme protein and mRNA levels suggest that the present systematic strength or endurance training.

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training period had no beneficial effects on enzymatic antioxidant defense mechanisms in previously untrained middle-aged men.

Prasad et al\(^{53}\) presented a study on normal healthy volunteers, 41 men and 23 women, to evaluate the impact of Pranayama and Yoga asanas on blood lipid profiles and free fatty acids, in two stages. In stage-I, Pranayama was taught for 30 days and in stage-II, yogic practices were added to Pranayama for another 60 days. A significant reduction was observed in triglycerides, free fatty acids and VLDL-cholesterol in men and free fatty acids alone were reduced in women at the end of stage-I. A significant elevation of HDL-cholesterol was seen only in the men at the end of stage-I. At the end of stage-II, free fatty acids increased in both men and women, and women demonstrated a significant fall in serum cholesterol, triglycerides, LDL-and VLDL-cholesterol. The results indicated that HDL-cholesterol was elevated in men with Pranayamam, while triglycerides and LDL-cholesterol decreased in women after yoga asanas. The results of the study indicate that Pranayama and yoga asanas can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia etc.

Henry J. Montoye studied on a modification of the Harvard Step Test was administered to approximately 4700 males and females, age 10-69 in Tecumseh, Michigan. Heart rate response to this standardized exercise test is an estimate of capacity for muscular work. A blood sample was drawn one hour after a glucose challenge on the same day the exercise test was given. Four skinfolds were measured as an index of body fatness. It was the purpose of this analysis to study the relationship of glucose tolerance to heart rate response to exercise. All analyses were done in age and sex-specific sub-groups. The correlation coefficients were low but positive in all but one sub-group and half of the coefficients are statistically significant. This suggests that poor fitness for work (high heart rate in response to exercise) was related, albeit weakly, to lowered glucose tolerance. However, there was a positive relationship between body fatness on the one hand and serum glucose and heart rate response to exercise on the other. When the effect of body fatness was eliminated the relationship of heart rate response to exercise and glucose tolerance remained about the same; low but statistically significant in some age groups.

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Sanchez-Munoz study were to describe the anthropometric characteristics, body composition and somatotype of elite male and female junior tennis players, to compare the anthropometric data, body composition and somatotype of the first 12 elite junior tennis players on the ranking with the lower ranked players, and to establish an anthropometric profile chart for elite junior tennis players. A total of 123 subjects (57 males and 66 females) elite junior tennis players participated in this study. The athletes were divided into two groups, the first 12 and the lower ranked players, according to gender. A total of 17 anthropometric variables were recorded of each subject. There were no significant differences in height and weight between the first 12 and the lower ranked boys, while the first 12 girls were significantly taller than the lower ranked girls. Significant differences were found for humeral and femoral breadths between the first 12 and the lower ranked girls. The mean (SD) somatotype of elite male junior tennis players could be defined as ectomesomorphic (2.4 (0.7), 5.2 (0.8), 2.9 (0.7)) and the mean (SD) somatotype of elite female junior tennis players evaluated could be defined as endomesomorphic (3.8 (0.9), 4.6 (1.0), 2.4 (1.0)). No significant differences were found in somatotype components between the first 12 and the lower ranked players of both genders. The

conclusion, when comparing the first 12 and the lower ranked elite junior tennis players of both genders, no significant differences were observed in any measured item for the boys. By contrast, significant differences were observed in height and humeral and femoral breadths between the first 12 and the lower ranked girls, whereby the first 12 were taller and had wider humeral and femoral breadths than the lower ranked players. These differences could influence the playing style of junior female players.

Bandyopadhyay\textsuperscript{56} studied on 50 sedentary males and 128 sports persons (volleyball=82, soccer=46) of 20-24 years of age were selected from West Bengal, India, to evaluate and compare their anthropometry and body composition. Skinfolds, girth measurements, body fat percentage (\%fat), and endomorphy were significantly higher among sedentary individuals, but lean body mass (LBM) and mesomorphy were significantly (p<0.001) higher among the sports persons. Soccer and volleyball players were found to be ectomorphic mesomorph, whereas sedentary subjects were endomorphic mesomorph. The soccer and volleyball players had higher \%fat with lower body height and body mass than their overseas counterparts. \%fat exhibited a significant correlation with body mass index (BMI) and thus prediction equations for

%fat from BMI were computed in each group. The present data will operate as a reference standard for the anthropometry and body composition of Indian soccer and volleyball players and the prediction norms for %fat will help to provide a first-hand impression of body composition in the studied population.

Malousaris et al.,\textsuperscript{57} purpose of this study was to describe the morphological characteristics of competitive female volleyball players. For this purpose, body weight and height, breadths and girths as well as skinfold thickness at various body sites were assessed in 163 elite female volleyball players (age: 23.8\textpm{}4.7 years, years of playing: 11.5\textpm{}4.2, hours of training per week: 11.9\textpm{}2.9, means\textpm{}S.D). Seventy-nine of these players were from the A1 division and the rest from the A2 division of the Greek National League. Two-way ANOVA was used to compare the differences in these characteristics between competition level and playing position. Body height ranged from 161cm to 194cm, and the mean value (177.1\textpm{}6.5cm) was not inferior to that of international players of similar calibre. Adiposity of these players (sum of 5 skinfolds: 51.8\textpm{}10.2mm, percent body fat: 23.4\textpm{}2.8) was higher than that reported in other studies in which, however, different methodology was used. Volleyball athletes of this study were mainly balanced.

endomorphs (3.4-2.7-2.9). The A1 division players were taller and slightly leaner with greater fat-free mass than their A2 counterparts. Significant differences were found among athletes of different playing positions which are interpreted by their varying roles and physical demands during a volleyball game. The volleyball players who play as opposites were the only subgroup of players differing between divisions; the A2 opposites had more body fat than A1 opposites. These data could be added in the international literature related to the anthropometric characteristics of competitive female volleyball players.

Bale P et al.,58 study was to investigate the differences in somatotype, % fat, and strength in relation to body mass of two groups of American football players. One hundred and forty-three football players (85 high schools and 58 colleges) were classified into five weight groups (< 73 kg, 73-82 kg, 83-91 kg, 91-100 kg, > 100 kg). Body composition was estimated from skinfold, and somatotype was determined using the Heath-Carter method. Strength was measured from one-repetition maximum (1-RM) lifts in the bench press and deadlift. Most of the somatotypes were dominant mesomorphs for the high school player and endo-mesomorphs for the college player. The weight groups in both the high school and college footballer showed

significant differences in % fat, somatotype, and strength measures between the lower and higher weight categories. Weight was a greater factor dictating strength in either lift in the high school player than in the college player. A higher mesomorphic component was a more important factor determining strength in the college player while a lower ectomorphic component contributed more in the high school player. The proportion of the variance accounted for by regression equations for the bench press and deadlift was 17% to 41% in the high school player and 35% to 61% in the college player. Although football requires a large individual at certain positions, the question remains concerning overall size versus muscularity to achieve a superior performance level.

Gualdi-Russo and Graziani\textsuperscript{59} studied on Somatotype of 1593 young Italian sport participants (717 males and 876 females) were described and analyzed. The average somatotype for sport participants was 2.7-4.7-2.7 for males and 3.6-3.7-2.8 for females. The predominance of mesomorphy on the other two components was found in all sport-groups examined. This was particularly evident in males for gymnasts and rowers and in females for martial arts competitors. As for sexual dimorphism, females were endo-mesomorphs, while males were balanced mesomorphs. Somatotype show statistically significant changes with the

level of performance in some sport-groups with an increase in the mesomorphic component (in ballgames and martial arts) and in the endomorphic component (in swimming). Comparisons with other sport-groups from literature were greatly limited by several genetic and environmental factors.

Susanne et.al., study was to investigate the correspondence of physique structures estimated by the Heath-Carter anthropometric somatotyping method and a factor analysis based on the same set of 10 variables used by Heath-Carter. The investigation was carried out on a group of 200 healthy young adults of 20 years of age who were students of physical education. The mean somatotype was 2.7-4.6-3.0 for the males and 3.3-3.4-3.1 for the females. The 73% of the total variance in males and 75% in females were represented by three factors. They were identified as muscular, fatness and skeletal factors in the males, and in the females as muscular-trunk fatness, skeletal and limb fatness factors. A PCA gives different results depending on the measurements used for the calculation. The same set of variables as for the somatotyping method was used intentionally to extract the PCA factors and to evaluate the possible correspondence between these factors and the Heath-Carter components. On the basis of the correlation between the

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factors and the somatotype components, one can conclude that there was: (1) a high correspondence between endomorphy and fatness factors in both sexes; (2) that mesomorphy correlated positively with the muscular factor in males and negatively with the skeletal factor in both sexes; and (3) that ectomorphy was highly positively correlated with the skeletal factor and negatively with the other two factors in both sexes. Factors and somatotype components do not correspond exactly which leads to the following conclusions: (1) The three somatotype components cannot be identified as orthogonal factors in a factorial analysis based on the same measurements as for the somatotype, e.g. the ectomorphy component was not an independent factor in males or in females; (2) The muscle measurements and bone width used to estimate mesomorphy in somatotyping scored in two independent factors; and (3) The factor structure of the 10 measurements was sex dependent.

Hayward JS\textsuperscript{61} studied the hyperthermic response to exercise in a warm (30 degrees C), humid (80% relative humidity) environment was obtained for 27 men who exhibited a wide range of body physique in terms of the mesomorphy component of somatotype. Increase in tympanic temperature (Tty) was significantly dependent on

mesomorphy rating (X) according to the regression equation $Y_{ty} = -0.390 + 0.088X$. Increase in rectal temperature ($Y_{re}$) was also significantly dependent on mesomorphy rating according to the equation $Y_{re} = -0.100 + 0.066X$. The hyperthermic response was significantly correlated with other measures of physique, including ectomorphy, surface area/weight ratio, and body weight, but was not correlated with fatness or fitness. The results support the generalization that during exercise in warm, humid environment individual differences in heat strain can be highly dependent on physique, especially if fitness and fatness are similar. In this context, mesomorphy appears to provide the optimum description of physique variation. Individuals with a mesomorphy rating greater than 7 warrant designation as being at high risk for heat intolerance during exercise in environments that significantly impair the rate of body heat loss.

Peeters et al.\textsuperscript{62} studied the genetic and environmental determination of variation in Heath-Carter somatotype (ST) components (endomorphy, mesomorphy and ectomorphy). Multivariate path analysis on twin data for Eight hundred and three members of 424 adult Flemish twin pairs (18–34 years of age). The results indicated the significance of

sex differences and the significance of the co-variation between the three somatotype components. After age-regression, variation of the population in ST components and their covariation was explained by additive genetic sources of variance (A) shared (familial) environment (C) and unique environment (E). In men, additive genetic sources of variance explain 28.0% (CI 8.7–50.8%), 86.3% (71.6–90.2%) and 66.5% (37.4–85.1%) for endomorphy, mesomorphy and ectomorphy, respectively. For women, corresponding values were 32.3% (8.9–55.6%), 82.0% (67.7–87.7%) and 70.1% (48.9–81.8%). For all components in men and women, more than 70% of the total variation was explained by sources of variance shared between the three components, emphasising the importance of analysing the ST in a multivariate way. The findings suggested that the high heritabilities for mesomorphy and ectomorphy reported in earlier twin studies in adolescence were maintained in adulthood. For endomorphy, which represents a relative measure of subcutaneous adipose tissue, however, the results suggest heritability may be considerably lower than most values reported in earlier studies on adolescent twins. The heritability was also lower than values reported for, for example, body mass index (BMI), which next to the weight of organs and adipose tissue also includes muscle and bone tissue. Considering the differences in heritability between musculoskeletal robustness (mesomorphy) and subcutaneous adipose
tissue (endomorphy) it may be questioned whether studying the genetics of BMI will eventually lead to a better understanding of the genetics of fatness, obesity and overweight.

Porcari et al. studied the effects of self-administered neuromuscular electrical stimulation (NMES) on changes in strength, endurance, selected anthropometric measures, and subject's perceived shape and satisfaction of the abdominal wall. Twenty-four adults (experimental group) stimulated their abdominals 5 days per week (20-40 minutes per session) for 8 weeks and refrained from engaging in any additional exercise during the study. A control group (N=16) refrained from exercising the abdominals or engaging in any other exercise training during the study. Subjects were tested at the beginning, mid-point, and end of the study. Isometric strength of the abdominal muscles was tested using an isokinetic dynamometer, endurance was measured using the ACSM curl-up test, abdominal circumference was measured using a steel tape measure, and body shape and satisfaction were assessed via questionnaire. The stimulation group had a 58% increase in abdominal strength, whereas the control group did not change. The stimulation group also had a 100% increase

in abdominal endurance versus a 28% increase in the control group. Waist circumference decreased by of 3.5 cm in the stimulation group compared to no significant change in the control group. All 24 subjects in the stimulation group felt that their midsections were more “toned” and “firmed” and 13/24 (54%) felt that their posture had improved as a result of the stimulation. None of the control group subjects reported changes in these parameters. There were no significant differences in body weight, BMI, or skinfold thickness over the course of the study in either group. NMES, as used in the current study, resulted in significant improvements in the muscular strength and endurance of the abdominal region, as well as subject’s perceived shape and satisfaction of the midsection.

Lilam F. Oliveira studied on Incline Dumbbell Curl (IDC) and Dumbbell Preacher Curl (DPC) were variations of the standard Dumbbell Biceps Curl (DBC), generally applied to optimize biceps brachii contribution for elbow flexion by fixing shoulder at a specific angle. The aim of this study was to identify changes in the neuromuscular activity of biceps brachii long head for IDC, DPC and DBC exercises, by taking into account the changes in load moment arm and muscle length elicited

by each dumbbell curl protocol. A single cycle (concentric-eccentric) of DBC, IDC and DPC, was applied to 22 subjects using a submaximal load of 40% estimated from an isometric MVC test. The neuromuscular activity of biceps brachii long head was compared by further partitioning each contraction into three phases, according to individual elbow joint range of motion. Although all protocols elicited a considerable level of activation of the biceps brachii muscle (at least 50% of maximum RMS), the contribution of this muscle for elbow flexion/extension varied among exercises. The submaximal elbow flexion (concentric) elicited neuromuscular activity up to 95% of the maximum RMS value during the final phase of IDC and DBC and 80% for DPC at the beginning of the movement. All exercises showed significant less muscle activity for the elbow extension (eccentric). The Incline Dumbbell Curl and the classical Dumbbell Biceps Curl resulted in similar patterns of biceps brachii activation for the whole range of motion, whereas Dumbbell Preacher Curl elicited high muscle activation only for a short range of elbow joint angle.

Kerstin Stoedefalke65 aimed describe the effects of exercise training in children and adolescents on the following blood lipids and lipoproteins: total cholesterol (TC), high density lipoprotein cholesterol

(HDL-C), low density lipoprotein cholesterol (LDL-C), and triglycerides (TG). Only studies that described mode, frequency, duration and intensity of the exercise were included in the review. The results of the studies reviewed were equivocal. Clearly the effects of exercise training on the blood lipid and lipoprotein levels of normolipidemic children and adolescents were equivocal. Of the 14 studies reviewed, six observed a positive alteration in the blood lipid and lipoprotein profile, four of the studies observed no alteration in the blood lipid and lipoprotein profile and one study observed a negative effect on HDL-C but an overall improvement in the lipid and lipoprotein profile due to the decrease in the TC/HDL ratio. It appeared that methodological problems presented in the majority of the exercise training studies limited the ability to make conclusive, evidence based statement regarding the effect exercise training has on blood lipid levels in normolipidemic children. Most of the research design flaws can be linked to one or more of the following: small numbers of subjects in each study, low or no representation of girls, inclusion of both boys and girls in the subject pool, inclusion of boys and girls at different maturational stages in the subject pool, exercise training regimes that do not adequately control for exercise intensity, exercise training regimes that do not last longer than 8 weeks and exercise training studies that do not have an adequate exercise volume to elicit a change. Ideally, future research should focus on longitudinal
studies which examine the effects of exercise training from the primary school years through adulthood.

Michael and Jason study was to examine the relationships between measures of isometric force (PF), RFD, jump performance and strength in collegiate football athletes. The subjects in this study were twenty-two men [(mean ± SD): age 18.4 ± 0.7 years; height 1.88 ± 0.07 m; mass 107.6 ± 22.9 kg] who were Division I college football players. They were tested for PF using the isometric mid thigh pull exercise. Explosive strength was measured as RFD from the isometric force-time curve. The one repetition maximum (1RM) for the squat, bench press and power clean exercises were determined as measures of dynamic strength. The two repetition maximum (2RM) for the split jerk was also determined. Vertical jump height and broad jump was measured to provide an indication of explosive muscular power. There were strong to very strong correlations between measures of PF and 1RM. The correlations were very strong between the power clean 1RM and squat 1RM. There were very strong correlations between 2RM split jerk and clean 1RM, squat 1RM, bench 1RM and PF. There were no significant correlations with RFD. The isometric mid thigh pull test does correlate well with 1RM testing in college football players. RFD does not appear to correlate as well with

other measures. The isometric mid thigh pull provides an efficient method for assessing isometric strength in athletes. This measure also provides a strong indication of dynamic performance in this population.

Bayios et al.\textsuperscript{67} aims of this study were to determine the anthropometric profile, body composition and somatotype of elite Greek female basketball, volleyball and handball players, to compare the mean scores among sports and to detect possible differences in relation to competition level. A total of 518 female athletes, all members of the Greek first National League (A1 and A2 division) in B, V and H sport teams participated in the present study. Twelve anthropometric measures required for the calculation of body composition indexes and somatotype components were obtained according to the established literature. Result shows that the athletes were the tallest (P<0.001) among the three groups of athletes, had the lowest values of body fat (P<0.001) and their somatotype was characterized as balanced endomorph (3.4-2.7-2.9). B athletes were taller and leaner than H players, with a somatotype characterized as mesomorph-endomorph (3.7-3.2-2.4). H athletes were the shortest of all (P<0.01), had the highest percentage of body fat (P<0.001) and their somatotype was balanced endomorph.

mesomorph-endomorph (4.2-4.7-1.8). In comparison with their A2 counterparts the A1 division players were taller (P<0.001) and heavier (P<0.01), but at the same time leaner (P<0.001), and exhibited higher homogeneity in somatotype characteristics (P<0.05). It was concluded that the Anthropometric, body composition and somatotype variables of Greek female elite team ball players varied among sports; selection criteria, hours of training and sport-specific physiological demands during the game could explain the observed differences. More data are certainly needed to define the anthropometric profile of B, V and H female athletes internationally.

Bale\textsuperscript{68} studied on the relationship of Physique and body composition to strength in a group of physical education students, for the purpose fifty-three specialist women physical education students were measured anthropometrically and from these measurements somatotype and body composition were estimated. Leg, back and grip strength dynamometers were used to measure strength indices. Arm strength was calculated from each subject's pull-ups and push-ups and lung capacity was measured using a spirometer. The somatotype ratings and percent fat measurements indicate that the P.E. students are generally more muscular and less fat for their age than non-P.E. students.

There was a strong relationship between percent fat and the endomorphy rating and a moderate relationship between lean body weight and mesomorphy. The moderate relationship of the strength variables with the muscular rating, whether expressed as mesomorphy or lean body weight, suggests that the higher a subject's muscular component the greater their dynamic strength.

Abbas and Mohsen, studied on comparative and correlational study of the Body image in active and inactive Adults and with body composition and somatotype. The purpose of the study was to examine the effect of regular participating in physical activities on body image and its relationship with body composition and somatotype. One hundred and twenty men and women and their ages ranges from 25 to 65 were randomly selected and then divided into two namely active and inactive groups through the median split technique based on the physical activity index score. Physical self description questionnaire which considered of body fat, global physical and appearance subscales were used 2x2MANCOVA (gender x group) with covariates of body fat and body Mass Index was used to analyses the data. The result show significant interaction for gender and group in body image

subscales. Also, the result revealed inverse significant relationship between body image and body fat, BMI, endomorphy and mesomorphy and direct relationship with ectomorphy. In conclusion, one’s attitude toward his/ her body stem from his/ her physical ability and size. In addition, active men have more positive body image than women.

Fabunmi and Gbiri studied on the ability to maintain either static or dynamic balance has been found to be influenced by many factors such as height and weight in the elderly. The relationship between other anthropometric variables and balance performance among elderly Nigerians has not been widely studied. The aim of this study was to investigate the relationship between these other anthropometric variables and balance performance among old individuals aged >60 years in Ibadan, Nigeria. The study used the ex-post facto design and involved two hundred and three apparently healthy (103 males and 100 females) elderly participants with ages between 60 years and 74 years, selected using multiple step-wise sampling techniques from churches, mosques and market place within Ibadan. They were without history of neurological problem, postural hypotension, orthopedic conditions or injury to the back and/or upper and lower extremities within the past.

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one year. Selected anthropometric variables were measured, Sharpened Romberg Test (SRT) and Functional Reach Test (FRT) was used to assess static balance and dynamic balance respectively. All data were summarized using range, mean and standard deviation. Pearson's product moment correlation coefficient was used to determine the relationship between the physical characteristics, anthropometric variables and performance on each of the two balance tests. The results showed that there were low but significant positive correlations between performance on FRT and each of height, weight, trunk length, foot length, shoulder girth and hip girth. There was low significant and positive correlation between SRT with eyes closed and arm length, foot length and shoulder girth and there was low but significant positive correlation between SRT with eyes opened and shoulder girth and foot length. Anthropometric variables affect balance performances in apparently healthy elderly.

Amit Bandyopadhyay studied on Anthropometry and Body Composition in Soccer and Volleyball Players in West Bengal 50 sedentary males and 128 sportspersons (volleyball-82, soccer-46) of 20-24 years were selected from West Bengal, India, to evaluate and compare their anthropometry and body composition. Skinfolds, girth

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measurements, body fat percentage (%fat), and endomorphy were significantly higher among sedentary individuals, but lean body mass and mesomorphy were significantly higher among the sportspersons. Soccer and volleyball players were found to be ectomorphic mesomorph, whereas sedentary subjects were endomorphic mesomorph. The soccer and volleyball players had higher %fat with lower body, height and body mass than their overseas counterparts. %fat exhibited a significant correlation with body mass index and thus prediction equations for %fat from BMI were computed in each group. The present data will serve as a reference standard for the anthropometry and body composition of Indian soccer and volleyball players and the prediction norms for percent fat will help to provide a first-hand impression of body composition in the studied population.

Luiz Guilherme et al. objective was to analyse the relationship of maximal aerobic power and the muscular strength (maximal isotonic strength and vertical jump explosive power) with the running economy (RE) in endurance athletes. Twenty-six male runners performed in different days the following tests: a) incremental test to determine the maximal oxygen uptake (VO2max) and the intensity corresponding to the VO2max. b) constant-velocity treadmill run to determine RE; c) 1-RM

test in the leg press and; d) maximal vertical jump test (VJ). VO2max was significantly correlated with RE. However, the IVO2max the maximal isotonic strength and the VJ were not significantly correlated with RE. One concludes that the maximal aerobic power can explain in part the inter-individual RE variability in endurance athletes. However, maximal isotonic strength and explosive strength seem not to be associated with RE values observed in this group of athletes.

Madan mohan et.al. studied on the effects of yoga training on cardiovascular response to exercise and the time course of recovery after the exercise. Cardiovascular response to exercise was determined by Harvard step test using a platform of 45 cm height. The subjects were asked to step up and down the platform at a rate of 30/min for a total duration of 5 min or until fatigue, whichever was earlier. Heart rate (HR) and blood pressure response to exercise were measured in supine position before exercise and at 1, 2, 3, 4, 5, 7 and 10 minutes after the exercise. Rate-pressure product \[ \text{RPP} = \left( \text{HR} \times \text{SP} \right)/100 \] and double product \( \text{DoP} = \text{HR} \times \text{MP} \), which are indices of work done by the heart were also calculated. Exercise produced a significant increase in HR, systolic pressure, RPP & DoP and a significant decrease in diastolic pressure. After two months of yoga training, exercise induced changes

In these parameters were significantly reduced. It was concluded that after yoga training a given level of exercise leads to a milder cardiovascular response, suggesting better exercise tolerance.

Jyotsana R Bharshankar et al. conducted a study to examine the effect of yoga on cardiovascular function in subjects above 40 yrs of age. Pulse rate, systolic and diastolic blood pressure and Valsalva ratio were studied in 50 control subjects (not doing any type of physical exercise) and 50 study subjects who had been practicing yoga for 5 years. From the study it was observed that significant reduction in the pulse rate occurs in subjects practicing yoga. The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant. The systolic and diastolic blood pressure showed significant positive correlation with age in the study group as well as in the control group. The significance of difference between correlation coefficient of both the groups was also tested with the use of Z transformation and the difference was significant (Zsystolic = 4.041 and Zdiastolic = 2.901). Valsalva ratio was also found to be significantly higher in yoga practitioners than in controls (P<0.001). Our results indicate that yoga reduced the age related deterioration in cardiovascular functions.

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Stefan J et al. examined cross sectional the physical activity patterns associated with low, moderate, and high levels of cardiorespiratory fitness. Physical activity was assessed by questionnaire in a clinic population of 13,444 men and 3972 women 20 to 87 years of age. Estimated energy expenditure (kcal.wk⁻¹) and volume (min.wk⁻¹) of reported activities were calculated among individuals at low, moderate, and high fitness levels (assessed by maximal exercise tests). The result shows that average leisure time energy expenditures of 525 to 1650 kcal.wk⁻¹ for men and 420 to 1260 kcal.wk⁻¹ for women were associated with moderate to high levels of fitness. These levels of energy expenditure can be achieved with a brisk walk of approximately 30 minutes on most days of the week. In fact, men in the moderate and high fitness categories walked between 130 and 138 min.wk⁻¹, and women in these categories walked between 148 and 167 min.wk⁻¹. It concluded that most individuals should be able to achieve these physical activity goals and thus attain a cardiorespiratory fitness level sufficient to result in substantial health benefits.

Vaithianathan\textsuperscript{76} studied the effects prior to and after training on selected physical and physiological variables. For this purpose 70 physically fit and untrained boys were randomly assigned to one of the two groups: Group I (experimental group) performed circuit training five days a week for a period of 12 weeks; Group II (control group) were restricted to participate in any of the training programme. Prior to and at the end of training period all subjects were tested for muscular strength, muscular endurance, cardio-respiratory endurance, blood pressure, vital capacity and respiratory rate. The results of the study indicated that circuit training improved the efficiency significantly in physical fitness variables such as muscular strength, muscular endurance and cardio-respiratory endurance and also physiological variables such as blood pressure, vital capacity and respiratory rate.

Shakthignanavel\textsuperscript{77} studied the effect of continuous running yogic pranayama and combination of continuous running and yogic pranayama exercises on cardio-respiratory endurance, selected


physiological and psychological variables. Sixty male students were selected from one hundred eighty from the age group of fourteen to eighteen years from schools of Puducherry. Four groups were randomly divided as Group I to IV. The respective training on Continuous running group, Pranayama group, Continuous and Pranayama group and Control group were given. The control group did not undergo any training. The experimental variables such as Forced Expiratory volume in the First second and peak expiratory flow rate, respiratory pressure such as Maximum inspiratory pressure maximum expiratory pressure and 40 mmHg test were measured, Rate pressure product, Cardiorespiratory endurance by 12 minutes run/walk test were conducted. The Psychological variables such as mental health Self confidence State anxiety were also tested. The Analysis of covariance was used for significance. It was concluded that there were significant difference found in all the three experimental group in Peak expiratory flow rate, maximum inspiratory pressure and 40 mmHg, for continuous running and combination of continuous running and Pranayama improved cardiorespiratory endurance, Self confidence level and state anxiety, combined continuous running and Pranayama improved Mental health, continuous running improved Forced expiratory volume, Pranayama practices improved maximum expiratory pressure and there was no significant difference found in all experimental group for Forced
Vital capacity, systolic, Diastolic, Mean pressure, pulse pressure and rate pressure.