ISSN 0973-2020

Journal of Exercise Science and Physiotherapy (JESP)

(An official Journal of Exercise Fitness & Health Alliance, EFHA)

Volume 1, No. 1 & 2, 2005

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An official Publication of
Exercise Fitness and Health Alliance
www.efha-in.org

JOURNAL OF EXERCISE SCIENCE AND PHYSIOTHERAPY

Volume 1, No. 1&2, 2005

Editor-in-Chief: Prof. Dr. S.K. Verma

It is my great pleasure in bringing to you the first issue of **Journal of Exercise Science and Physiotherapy** ***(JESP)***. *JESP* is the official journal of the ***Exercise Fitness and Health Alliance*** (**EFHA**). A necessity of starting this journal was realised by the researchers/professionals who are working in the area of exercise sciences for the last many years. *JESP* is an international peer review journal aimed to cover the latest advances in clinical practice and research. Topics include all aspects of exercise sciences, such as the management of sports injury, exercise physiology, sports psychology, physical education, physiotherapy and the epidemiology of exercise and health. By virtue of open exposure of the journal to almost all aspects of exercise and sports related research, *JESP* is destined to serve the interest of readers that includes sports physicians, primary care physicians, exercise scientists, physical educationists, physiotherapists, trainers, medical advisors to sporting organisations, kinesiologists, orthopaedic consultants/surgeons, osteopaths, consultants in emergency medicine, paediatricians, growth development specialists, cardiologists, occupational therapists, chiropodists and podiatrists, pain specialists, behavioural psychologists, dieticians and obesity specialists, exercise immunologists, rheumatologists, rehabilitation specialists and public health specialists.

Each issue includes original research papers, short communications, case studies, book reviews and review articles. The present issue of *JESP* contains original research contributions from leading researchers working in the area of exercise physiology, health related fitness, training, physiotherapists, obesity and nutrition. In addition to this, the recent issue of *JESP* also includes short communications and case reports from eminent health professionals. Need of the application of Information technology in sports management is a fine idea brought forward by young researchers in their paper included in this issue. Over and above the research reports, the journal also presents the review reports on the two wide selling books (A Manual of Biological Anthropology and Exercise Prescription for Diabetics) written by eminent Indian colleagues.

In the end I hope my fellow colleagues who are actively serving the arena of exercise science, physical education, medical sciences and physiotherapy would like to contribute their research findings/case reports for publication in the *JESP* for the benefit of readers. Suggestions for further improvement are welcome. I convey my thanks to all the members of EFHA and editorial team for their help in bringing out this issue of *JESP*.

S.K. Verma

The Kinetics of Cardiopulmonary Dynamics during Recovery Following Maximal Exercise

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Abstract

The study was carried on 193 elite male sports person consisting of (a) Anaerobic group (n =43), (b) Mixed group (n=100): This group was further divided into two sub - groups i) Non-Combative (n=60) ii) Combative (n =40), (c) Aerobic group (n =50). Graded cardiopulmonary exercise testing was carried out till exhaustion and the selected cardiopulmonary transients were recorded every 15 seconds by a portable computerised metabolic analyzer for the entire duration of test and recovery. The results revealed that the long distance athletes (aerobic group) had significantly different recovery patterns so far as the oxygen uptake during recovery was concerned, and they were also found to posses the highest VO_2 max were able to recover much quicker than those who didn't ($P<0.01$). Further, the cardiopulmonary dynamics during recovery was found to be influenced by training. The study concluded that a strong emphasis needs to be given to adequately develop the aerobic component in games and sports where recovery is important, even in anaerobic sports.

Key Words: **VO_2 max, HR_{max}, VE_{max}, VCO_2, Anaerobic threshold**

Introduction:

The return of the muscle homeostasis to its pre-exercise state following exercise is known as recovery *(Tomlin and Wenger, 2001).* The process of recovery from exercise is perhaps just as important as exercise itself and the energy process at work during recovery from exercise are just as crucial as those at work during exercise.

A strong relationship between aerobic fitness and recovery from high intensity intermittent exercise has already been established *(Tomlin and Wenger, 2001);* although such a relationship following a graded maximal exercise is yet to be demonstrated. Further, it is also conjectured that a high level of aerobic fitness is a prerequisite even for superior performance in anaerobic sports *(Aziz et al, 2000)*, since phosphocreatine resynthesis has been found to be dependent on the availability of oxygen during recovery *(Harris et al, 1976).* It is therefore reasonable to assume that an individual with a higher VO_2 max will posses a greater capacity to deliver oxygen to the working muscle, which in turn will lead to a greater and quicker rephosphorylation of CP stores during recovery periods *(Balsom et al, 1994). Dawson et al, 1993*, also reported significant correlation between VO_2 max and anaerobic performance.

If an enhanced oxygen uptake does indeed facilitate recovery, it is pertinent and reasonable to hypothesize that the recovery patterns of the various cardiopulmonary transients will vary in athletes, depending on the volume of aerobic training a

particular group of athletes might undertake.

Thus the purpose of our study was to decipher the dynamics of pattern of recovery as an indicator of specificity of events and to find out the possible differences in kinetics of cardiopulmonary adjustments during recovery and to correlate it with the functional status of sports persons.

Materials and Methods:

Subjects: The study was conducted on 193 volunteers, all elite sports persons, consisting of a minimum of 40 in each of the four groups mentioned below, in which the athletes have been categorized. The volunteers were taken from elite male sports persons belonging to various National camps that were held in the Sports Authority of India, Netaji Subhas National Institute of Sports, Patiala. All volunteers were adults, within the age range of 18 to 26 years. The volunteers were divided into three groups, based on their game/event, and the energy system that predominantly caters to their metabolic needs, as under:

***Anaerobic group** (n=43):* This included volunteers of events of athletics (n=33) [belonging to sprints (n=12), and jumps (n=21)], and weight lifting (n=10).

Mixed group (n=100): This group was further subdivided into two sub-groups:

(i) *Mixed Group Non-Combative* (n=60), including volunteers of events of middle distance running (800 m and 1500 m; n=21), Table tennis (n=9), Volleyball (n=14) and Rowing (n=16), and,

(ii) *Mixed Group Combative* (n=40**)**, including volunteers of events of combat events/contact sports, consisting of Kabaddi (n=12), Judo (n=14), and Boxing (n=14).

Aerobic group (n=50): This included volunteers of events of long distance running (3000 m and above: n=50).

Each volunteer was first subjected to a physical examination that included measurement and / or recording of the following:

Date of Birth (from which the decimal age was calculated)

Stature (height in cm)

Weight (in kg)

Body Surface Area (BSA: in sq.m; *Dubois, 1916*)

Subsequent to the above, each volunteer was explained in detail as to what he was required to do and the efficacy of carrying out the CPET. Only those volunteers participated in the study who were willing, and prior verbal consent was obtained from each of them. Thereafter, the volunteers were subjected to CPET to assess their following physiological measures:

VO_2 (oxygen consumption: L/min and ml/kg/min)

VCO_2 (carbon dioxide production: L/min and ml/kg/min)

VE (pulmonary ventilation: L/min)

HR (heart rate: beats/min)

TV (tidal volume: ml)

f_R (frequency of respiration: No. of expirations/min**)**

O_2 Pulse (oxygen consumption / heart rate: ml)

Methods:

Exercise tests were performed on an electronically operated motor driven treadmill (LE 6000: Erich Jaeger, Germany), using a test protocol consisting of administration of a graded running. The initial speed was prefixed at 8 km/h and this was increased every two minutes at the rate

of 2 km/h, till exhaustion *(Leger and Boucher, 1980)*, consequent to which, the volunteers were asked to walk briskly at a recovery speed of 6 km/h. The peak treadmill running speed or the maximal velocity attained, that could be maintained for a whole minute during the test was taken as the 'velocity at VO_2 max' or vVO_2 max. If an athlete failed to sustain 60 seconds at his peak speed, the velocity of the immediately preceding completed work stage (treadmill speed) was recorded as his velocity at the VO_2 max or the vVO_2 max *(Noakes et al, 1990).* The tests were carried out in an air conditioned room with temperature and humidity levels controlled at 23° $\pm$ 2° C and 55 $\pm$ 5% respectively. The tests were carried out at least 3h after last meal and after a minimum of 12h of limited exertion.

All measurements were carried out breath-by-breath, using the computerized metabolic analyzer, "Oxycon Champion", (Erich Jaeger, Germany). The heart rate (HR) and ECG were continuously monitored during the period of test and recovery. The volunteers breathed through a small dead space (35 ml), low resistance mouthpiece and TripleV volume transducer. Respired gases were withdrawn automatically from the mouthpiece and passed on to the CO_2 and O_2 analyzers for breath-by- breath display and recording of the various physiological variables. Temperature and pressure sensors of the instrument automatically read the ambient temperature and atmospheric pressure, and data about existing relative humidity was fed to it. All gas volumes were automatically corrected for, and expressed in STPD, and V_E was expressed as V_E BTPS.

The CO_2 and O_2 analyzers, as well as the volume transducer were calibrated before each test using a precision gas mixture (5% CO_2; balance N_2), and a 2 litre calibration pump (both Erich Jaeger, Germany).

A test was considered maximal only if a change in load did not produce a corresponding significant change in HR and VO_2 ($\pm$ 4 bpm and 100 ml respectively), and if the HR values are within 15% of the age - predicted HRmax *(Bruce et al., 1974; Jones et al., 1985).* The RQ was greater than 1.13 also *(Inbar et al., 1994)*. The Anaerobic Threshold (AT) point was determined from the deviation point of the V_E-$V0_2$ linearity *(Beaver et al., 1985),* and confirmed from plots of VCO_2 vs. VO_2 (modified V-slope technique, Sue et al., 1988). The VO_2, measured at the anaerobic threshold (AT) level was taken as the AT-VO_2. Similarly, the other cardiopulmonary transients measured at the maximum of exercise, for example, VE, HR, etc. were suffixed with the word 'max', like V_E max and HRmax, and their values obtained at the anaerobic threshold level were prefixed with AT, like, AT-V_E and AT-HR.

The breath-by-breath data of the aforementioned cardiopulmonary transients were converted to 10 second averaged data, by the analysis software, and all 10 sec data of the cardiopulmonary transients beyond their maximal effort, during the first 5 minutes of recovery was computed for comparisons.

Statistical Analysis:

The means and standard deviations of the physical characteristics of decimal age, height, weight and body surface area were calculated by the statistical packages of the Microsoft Office (MS 6.0) / MS Excel. The 10 second averaged breath-by-breath data of HR, VE, VO_2 and VCO_2 responses for each athlete during the entire 5 minutes of recovery were tabulated, based on the discipline/event of the athlete.

Individual regression equations for the slope of responses were then drawn for each athlete, for each of the cardiopulmonary transient. The coefficient of regression (r) values thus obtained were tabulated and one way single factor ANOVA was applied to study if and whether the slopes are significantly different. In all cases where the differences were found to be significant ('F' value higher than the 'critical F'); Duncan's Multiple Range (Post-Hoc) Tests were carried out to elucidate the degree of significance between the groups.

Results and Discussion:

Table 1: Comparison of means (±SD) of physical profiles and exercise duration of athletes of Anaerobic, Mixed Non-Combat, Combat and Aerobic Group

Event	(n)	Dec. Age (yrs)	Height (cm)	Weight (kg)	BSA (sqm)	Total Exercise Duration (minutes)	AT-Time (minutes)	Supra-AT Time (minutes)
Anaerobic Group (Total)	43	21.4 (2.66)	174.2 (7.73)	69.2 (13.17)	1.83 (0.17)	11.2 (2.46) [11:12.0]	6.9 (1.94) [6:54.0]	4.2 (1.33) [4:12.0]
Mixed Non-Combat Group (Total)	60	21.6 (2.86)	177.6 (10.49)	66.6 (9.91)	1.83 (0.18)	12.56 (2.88) [12:33.6]	8.08 (2.41) [8:4.8]	4.5 (1.48) [4:29.4]
Mixed Combat Group (Total)	40	22.0 (2.71)	172.1 (6.83)	68.1 (9.62)	1.80 (0.15)	10.12 (1.96) [10:07.2]	7.20 (1.75) [7:12.0]	2.92 (0.85) [2:55.2]
Aerobic Group (Total)	50	20.7 (2.97)	169.3 (5.53)	56.6 (7.92)	1.65 (0.13)	16.7 (3.58) [16:42.0]	10.9 (2.24) [10:54.0]	5.8 (2.47) [5:48.0]
Grand Total	193	21.1 (2.87)	173.5 (8.62)	64.9 (11.31)	1.78 (0.18)	12.84 (3.74) [12:50.4]	8.36 (2.65) [8:21.6]	4.43 (1.94) [4:25.8]

Table 1 compared the means (±SD) of the physical profile and the exercise duration of all the four different groups of athletes, the anaerobic group, the mixed non-combat group, the mixed combat group and the aerobic (long distance) group. Table 1 revealed that the differences in ages between the groups of athletes were not significant. The anaerobic group was found to be significantly taller than the aerobic group ($p<0.01$). The mixed non-combat group was significantly taller than the mixed combat group ($p<0.01$) and the aerobic group ($P<0.01$). The mixed combat group was also found to be significantly taller than the aerobic group ($p<0.05$). Table 1 also revealed that the anaerobic and aerobic groups differed significantly ($p<0.01$), in their weights. The aerobic group was also significantly lighter than both the mixed non-combat and combat groups ($p<0.01$). The BSA of the aerobic group was significantly lesser than the anaerobic, mixed non-combat and the mixed combat groups ($p<0.01$). It is already an established fact that the distance runners are usually the shortest and the lightest, which is exhibited in our study also. The total exercise time of the aerobic group was found to be significantly higher than the anaerobic, mixed non-combat and the mixed combat groups ($p<0.01$). The anaerobic group exercised for a

significantly ($p<0.05$) longer period than the mixed combat group and significantly shorter than the mixed non-combat group ($p<0.05$) and the aerobic group ($p<0.01$). The exercise duration of the mixed non-combat group was also significantly higher than the mixed combat group ($p<0.05$). The time to reach the anaerobic threshold level, or the AT-Time was significantly longer for the aerobic group than the three other groups ($p<0.01$). The AT-Time of the anaerobic group was also significantly lesser than the mixed non-combat group ($p<0.01$). The mixed non-combat group had significantly longer AT-Time than the mixed combat group ($p<0.05$). The time spent beyond the anaerobic threshold level, or the Supra-AT Time for the aerobic group athletes was higher than all the other three groups ($p<0.01$). Whereas there were no significant differences observed between the anaerobic and the mixed non-combat group, the anaerobic group's AT-Time was significantly longer than the mixed combat group ($p<0.01$). The results indicate that the mixed combat group are not able to sustain a high degree of anaerobiosis, as a group and as well as, there exists very little differences between the anaerobic and mixed non-combat group athletes, in physical perspectives. The results also reveals that the aerobic group athletes displays not only the longest duration of exercise, corresponding to a mean vVO_2 max of 22 km/hr, but they are also able to tolerate the highest degree of anaerobiosis, since that are able to sustain for the longest duration at the supra-threshold level of exercise. This indicates that aerobic training possibly can influence the duration of exercise that can be tolerated at the supra-threshold level.

Table 2: Comparison of means (±SD) of some selected cardiopulmonary transients of athletes of Anaerobic, Mixed Non-Combat, Combat and Aerobic Group.

Event	(n)	HR max (bpm)	AT-HR (bpm)	VO_2 max (ml/kg/min)	AT-VO_2 (ml/kg/min)	AT-VO_2 max%	V_E max (L/min)	AT-V_E (L/min)
Anaerobic Group (Total)	43	183 (8.59)	155 (9.83)	54.8 (10.52)	42.2 (10.81)	74.3 (11.06)	129.8 (27.60)	72.2 (19.67)
Mixed Non-Combat Group (Total)	60	181 (1.48)	160 (7.98)	59.8 (12.35)	45.9 (12.76)	77.2 (9.90)	135.0 (22.19)	81.04 (18.88)
Mixed Combat Group (Total)	40	180 (7.18)	159 (7.16)	54.8 (10.74)	44.5 (11.16)	80.7 (8.59)	131.0 (20.28)	87.3 (20.71)
Aerobic Group (Total)	50	180 (5.97)	156 (6.51)	74.9 (10.02)	64.8 (9.01)	83.0 (5.16)	132.4 (20.77)	82.9 (13.80)
Grand Total	193	181 (8.19)	158 (8.16)	61.1 (13.88)	49.1 (14.63)	78.8 (9.45)	132.3 (22.71)	80.8 (18.88)

Table 2 compared the cardiopulmonary responses of all the four groups. The Table illustrates that the maximum heart rate was not found to be significantly different amongst the groups. The AT-HR values of the aerobic group was not found to be significantly different from the anaerobic group, but was different from the mixed non-combat and mixed combat groups at $p<0.01$ and $p<0.05$, respectively. The anaerobic group AT-HR was also found to be significantly different from the mixed

non-combat and mixed combat groups at $p<0.01$ and $p<0.05$, respectively. The VO_2 max and AT-VO_2 values of the aerobic group were found to be significantly higher than those of the other three groups ($p<0.01$).

Differences between the VO_2 max values of the mixed non-combat and the mixed combat groups were also significant at $p<0.05$. The other AT-VO_2 values were not found to be significantly different. The fractional utilization of VO_2 max at the AT level, or AT-VO_2max% of the aerobic and the mixed combat group was found to be significantly different at $p<0.05$. The AT-VO_2max% values of the anaerobic group was significantly different from the mixed combat group at $p<0.01$. Values of the other groups were not significantly different from each other.

The V_E max was not found to be significantly different between the groups. The AT-V_E values of the anaerobic group was however significantly different with the values of the aerobic group ($p<0.01$), mixed non-combat ($p<0.05$) and mixed combat ($p<0.01$) groups.

Comparison of Kinetics of VO_2 responses

The slopes of the kinetics of VO_2 during recovery demonstrated that the aerobic group had oxygen uptake slopes that were significantly different from all the three other groups. The VO_2 consumption patterns of the aerobic (long distance athletes) group had the steepest slope, distinctly and significantly different from those of the three other groups. Since this group of athletes was also found to be endowed with the highest oxygen uptake capacity (Table 1), it would be pertinent to suggest that endurance training and/or a higher VO_2 max does result in superior recovery. It has already been established that individuals with high maximal aerobic capacity exhibit increased concentrations of aerobic enzymes, increased mitochondrial number, size and surface area and increased myoglobin all contributing to improved oxygen extraction by muscle. In conjecture with enhanced ATP/CP stores and elevated myokinase and creatine kinase concentration in trained athletes, results in supplying more energy through the phosphagen system and aerobic system, thus decreasing reliance on anaerobic glycolysis, which too, could influence the VO_2 recovery patterns.

Comparison of Kinetics of HR responses

It is reported by many investigators that the magnitude of work done determines the rate of decrease of heart rate during recovery and the recovery heart rate at the beginning of recovery is strongly influenced by the heart rate during work and VO_2 max but the influence of these parameters on recovery heart rate decreases as the recovery progress.

In our study it was shown that the kinetics of Heart rate responses of the different groups during recovery were not found to be significantly different from each other. Similarity of HR dynamics during recovery possibly cannot be entrained and that training possibly is not able to modify the HR response pattern or its slope.

Comparison of Kinetics of V_E responses

The kinetics of pulmonary dynamics during recovery was not found to be significantly different between the groups also. The existence of non-significant differences between the various groups suggests that the underlying control mechanisms of the V_E response dynamics function in a similar manner in athletes irrespective of the type of training, during recovery, varying only barely and marginally, in the case of aerobic group

athletes. Ventilation has been found to increase monoexponentially, with a time constant which is about 10% slower than that of VCO_2 *(Casaburi et al, 1989; Whipp et al, 1982).* It has been suggested that there may be a control link between V_E and VCO_2 (*Wasserman et al, 1977 and Whipp, 1981).*

Comparison of Kinetics of VCO_2 responses

The dynamics of VO_2 responses during recovery revealed that the slope response of the anaerobic group was significantly different from the aerobic group and the mixed non-combat groups. The kinetics of VCO_2 recovery responses of the mixed combat group did not differ significantly from any of the other groups.

The comparison of the VCO_2 responses revealed the general trend wherein the aerobic group consistently displayed response kinetics distinctly different from the three other groups. The VCO_2 kinetics, unlike VO_2 , appears not to be controlled but rather reflect the time course with which CO_2 is produced metabolically and stored in tissues. The difference in VO_2 and VCO_2 response is therefore presumably a reflection of the amount of intramuscular storage *(Whipp and Ward, 1990).*

However the present study indicates that the slope response of VCO_2 responses during recovery may be guided by the degree of anaerobiosis or CO_2 production during the exercise, and may not be related to the initial storage, as observed by (*Whipp and Ward, 1990).*

Table 3: Comparison of oxygen consumption (VO_2) during the recovery in different groups of athletes

ANOVA: Single Factor:

Summary

ANOVA

	Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Recovery VO_2	Between Groups	0.01599	3	0.00533	4.943567	0.00251	2.652392
	Within Groups	0.20379	189	0.00108			
	Total	0.21978	192				
Recovery Heart rate	Between Groups	1.856729	3	0.61891	0.602585	0.614089	2.652648
	Within Groups	193.0931	188	1.027091			
	Total	194.9498	191				
Recovery Ventilation	Between Groups	1.022662	3	0.340887	0.201804	0.895049	2.652392
	Within Groups	319.2594	189	1.689203			
	Total	320.2821	192				
Recovery VCO_2	Between Groups	0.007146	3	0.002382	2.772614	0.042791	2.652392
	Within Groups	0.162375	189	0.000859			
	Total	0.169521	192				

Conclusions:

The study entitled, 'The Kinetics of Cardiopulmonary Dynamics During Recovery following Maximum Exercise in selected groups of elite Indian Athletes', is one of the first of its kind in our endeavour for the enhancement of knowledge and understanding of the complex cardiopulmonary physiology of athletes during recovery.

This study elucidated the actual kinetics of the dynamics of the change in the metabolic transients during recovery, in the elite athletes of India, which can be used as pointers for the evolution of credible training programmes, in the pursuit of enhancement of, and excellence in performance. The major findings and conclusions are enumerated below:

The kinetics of VO_2 during recovery showed that the aerobic group had O_2 uptake slopes which were significantly different from the three other groups. The results indicated that the factors controlling or influencing the oxygen uptake possibly cannot be entrained by physical activity at least so far as the rate of uptake is concerned, although, the aerobic groups in this study quantitatively consumed the highest amount of Oxygen, significantly so, from the other groups, yet its kinetics or rate of uptake was similar to those of the other groups. The fact that the aerobic group had significantly different recovery responses strongly suggests that the oxygen uptake kinetics during recovery is guided predominantly by the oxygen debt (or the excess post exercise oxygen consumption) contracted during the exercise, or the degree of anaerobiosis tolerated. Clearly, since the aerobic group tolerated the greatest anaerobiosis, they exhibited the highest and quickest oxygen uptake. The positive effects of aerobic training therefore, cannot be ruled out in enhancing the VO_2 kinetics during recovery in the aerobic group athletes.

Since increases in VO_2 max and aerobic capacity results from endurance training, aerobic capacity measures have proven useful in predicting success in distance running events *(Costill, 1973 and Tanaka, 1984)*. Aerobic group has a different recovery pattern because with aerobic training concentrations of aerobic enzymes increases, mitochondrial number, size and surface area and myoglobin content increases all contributing to improved oxygen extraction by muscle *(Saltin, 1980 and Holloszy, 1984).* Aerobic training also results in increased muscle blood flow, which is accomplished through elevated cardiac output, increased capillarisation of muscle tissue and an improved ability to vasodilate. Oxygen delivery in the endurance trained athlete is further improved by increases in blood volume and total hemoglobin volume. Together these enhancements results in an increased rate of VO_2 during high intensity exercise and decreased time to reach peak VO_2 during exercise. Moreover, the enhanced ATP/PCr stores and elevated myokinase and creatine concentration, results in an ability to supply more energy through the phosphagen and aerobic systems, thus decreasing the reliance on anaerobic glycolysis. With reduced anaerobic glycolysis during exercise, less energy is required during the recovery period to rid the muscle of H^+ and lactate, potentially hastening the recovery process.

Other training effect seen in aerobically trained individuals may improve temperature regulation during and after exercise (Baum et al, 1976). Thus it appears that the metabolic and circulatory adaptations associated with high levels of aerobic power should facilitate faster recovery from high intensity exercise.

Comparisons of the kinetics of the HR responses during CPET revealed that there were no differences in the kinetics of the HR responses of all the four different groups during recovery, strongly suggesting that the control mechanisms of such dynamics may not be entrained by training. The kinetics of pulmonary dynamics during recovery was not found to be significantly different between the groups.

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Health Related Physical Fitness of Boys Aged 8 to 18 Years

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Abstract

Keeping in view the lack of information about health related physical fitness of young boys, the present investigation was carried out on 797 male children and youth belonging to Punjab and falling in the age range of 8 to 18 years. Four components of health related physical fitness namely cardiovascular endurance, muscular strength/endurance, flexibility and body composition were assessed using standard techniques. The results in general indicate a trend of improvement in cardio respiratory fitness of the boys belonging to the present study with increase in age. However when comparison is made with Prudential fitness gram standards Results indicate poor level of Vo_2 max in boys of the present study, the results of muscular strength and endurance, an important health related component of fitness indicate variations in its development with respect to different body regions in boys of the present study from age 8 to 18 years. The muscles related to the upper body region like triceps, deltoid, pectorals major etc. are observed to develop relatively better in their strength endurance ability than the muscles belonging to abdominal, hip and leg regions. It is believed that disproportionate development of muscular strength endurance in boys of the present study may be due to their habitual life style and a craze for some selected muscular strengthening exercises, like use of dumbbells, lifting weights etc. in order to develop their body for an attractive physical appearance. Average percent body fat of these boys at all age level is observed to fall in the health fitness zone. However the percent body fat of boys of the present study after the age of 14 years and onwards exhibit a sharp rise, which continues up to 17 years of age.

Key Words: **% Body fat, Flexibility, Cardiovascular endurance, VO_2 max**

Introduction:

Keeping in view the fact that childhood physical fitness has important health consequences during adulthood (*Sallis et al., 1992*) a large number of studies on physical fitness have been reported from different countries of the world. Data on the physical fitness of children from Denmark (*Knuttgen, 1961*), England (*Campbell & Pohndof, 1961*), South Africa (*Sloan, 1966*), Belgium (*Hebbelinck and Borms, 1969*), Israel (*Ruskin, 1978*) and Japan (*Ishiko, 1978*) are available in the literature. All these reports made the health planners realise the importance of the contribution of Health Education and Physical Fitness in the development of total fitness. The practice of physical testing in children started thereafter in various countries.

The interest in studies on physical fitness in India is of comparatively recent origin. The emphasis of researchers in India has remained mainly on the reporting of physical growth and development patterns among different populations inhabiting the country, as is evident from a large number of publications reported in the literature in the last fifty years *(Fabich & Hamburger, 1941; Dawer, 1946; Currimbhoy1963), Vijayraghavan et al (1971); Khanduja et al., 1967; Neumann et al., 1969; Sidhu, 1969; Singh and Meenakshi, 1969; Bhandari et al., 1972; ICMR, 1972 & 1989; Lall, 1972; Mehta and Merchant, 1972; Bhatnagar, 1975; Kansal, 1981; Verma, 1983; Verma, 1988; Kumar and Bhalla, 1988; Chatterjee and Mandal, 1994; Joshi, 1996; Nischint, 1998; Kumar, 2001 and Ajita, 2001*.

No planned attempt seems to have been made to study the health related fitness in India. The present investigation therefore has been conducted with an aim to report the health related physical fitness of boys ranging in age from 8-18 years.

Materials and Methods:

The study has been conducted on a cross sectional sample of 797 male children and youth falling in the age range of 8 to 18 years. The subjects for the study were chosen on random basis from various educational institutes situated in the Patiala district of Punjab state and divided into eleven age groups on the basis of their age.

Table 1: Tests and Equipments Used For Assessing Various Components of Health Related Physical Fitness

Component		Test executed
Cardiovascular Endurance		2.4 km run time
Muscular Strength/ Endurance	**Upper Body**	Pull ups
	Abdominal	Sit Ups
	Lower Body	Bench Jumps
Muscular Flexibility		Modified Sit and Reach Test
Body skin folds-% Body Fat		Skin folds from biceps, triceps, sub scapular & suprailiac sites (Harpenden Calliper)

Various components of health related fitness were measured using standard techniques (Table 1).

Results and Discussion:

(i) Cardiovascular Endurance (Table 2 & Figure. 1):

Performance in 2.4 km run is considered to be a good indicator of cardiovascular endurance fitness, an important component of health related physical fitness. The mean values of 2.4 km run time along with its SD have been enlisted in Table 2.

It is observed that the performance of boys in this parameter exhibit a general trend of improvement from age 8 to 18 years, with the exception at the ages 9, 13 and 18 years. On an average, a boy at the age of 17 years complete the 2.4 km distance by taking about 19.4% lesser time as compared to the boy of age 10 years. Another important observation regarding this test indicates rapid improvement in performance in this test of cardio respiratory endurance from age 9 to 12 years (16.7%), hereafter from age 13 onwards, the improvement continues in this component of health related physical fitness but at a slower rate. The results in general indicate a trend of improvement in cardio respiratory fitness of the boys belonging to the present study with increase in age.

As per the fitness classification given by *Hoeger and Hoeger (1990)* based on performance of boys in 2.4 km run, boys of the present study from age 8 to 10 years are observed to possess fair level of fitness but after the age of 10 years the fitness of the present group of boys deteriorates and they are observed to belong to the average category. Vo_2 max/kg body weight has been calculated from the 2.4 km run timings of boys based on the conversion table given by *Cooper (1968).* The average value thus calculated for the different age groups on boys of the present study has been compared in Figure. 1 with the Prudential Fitness Gram Standards for HFZ on American boys given by Cooper institute for Aerobic Research, Dallas, Texas *(Nieman, 1995).* Results indicate poor level of Vo_2 max in boys of the present study as compared to the Prudential fitness

gram standards. According to Cooper institute for aerobics, cardio respiratory endurance is the ability to continue or persist in strenuous tasks involving large muscle groups for extended period of time. It is the ability of circulatory and respiratory systems to adjust to and recover from the effect of whole body exercise or work. According to *Ross (1985),* low levels of cardio respiratory endurance are consistently linked with increased risk of heart diseases etc. in the later part of life.

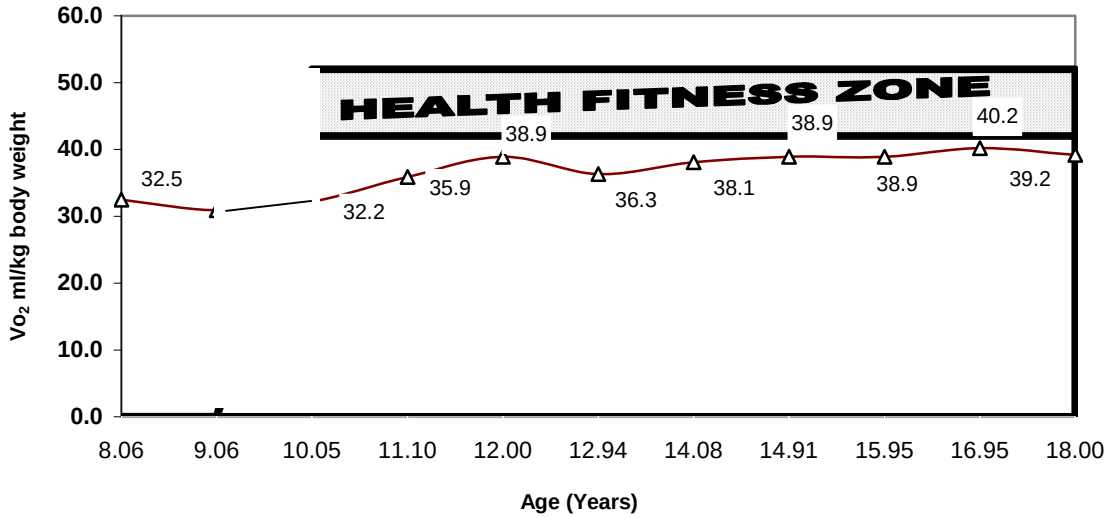

Figure 1: Age changes in Cardio vascular Endurance as indicated by predicted Vo_2max in Boys of the present study and their fitness status with respect to the Health Fitness Zone

Low levels of cardio respiratory fitness among Punjabi boys have also been reported by *Verma (1988)* in comparison to the boys belonging to Western countries. The results of the present study conducted after 14 years again point to the same trend. The results of the study indicate that despite increased health fitness awareness among the people, the health fitness scenario among the growing population is discouraging, may be due to the extra emphasis laid by the parents on the study of their children leading to neglect of physical activity. This indeed is alarming because childhood health fitness status is reported linked with the adult health fitness status.

(ii) Muscular Strength / Endurance (Table 2 & Figures 2-4):

For all our essential basic activities both muscular strength/endurance are required. This has been measured and results related to this are presented and discussed as follows:

(a) Upper body strength/endurance
(b) Abdominal strength/endurance
(c) Lower body strength/endurance.

Upper Body Strength/Endurance (Table 2 and Figures. 2):

The mean values of upper body muscular strength/endurance as measured by pull up test in boys from age 8 to 18 years are given in Table 2. A general trend of increase in this component of health related physical fitness is observed from age 12 to 18 years. Before this age, the boys do show a general increase in pull up

scores from age 8 to 12 years, but the magnitude of increase in this parameter is observed to be of smaller magnitude than that observed between 13 to 18 years.

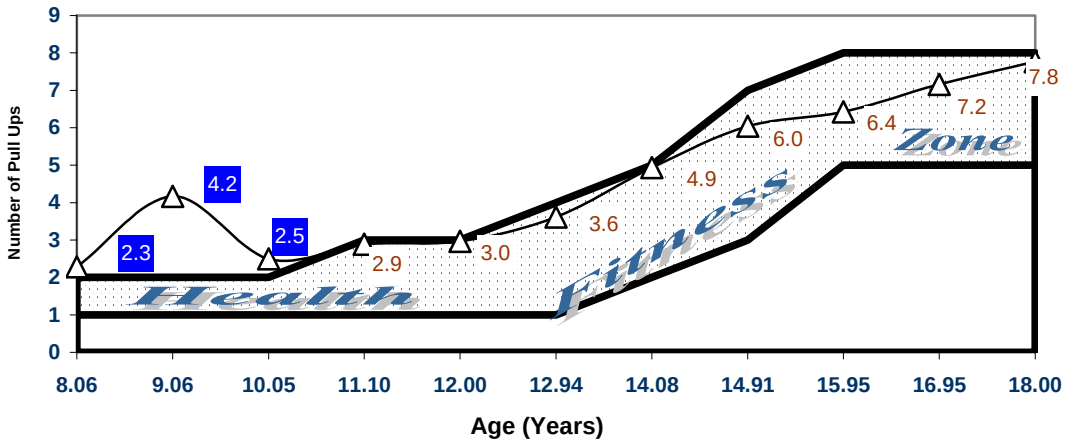

Figure 2: Age changes in upper body strength/endurance as measured by pull up test in Boys of the present study and their fitness status

Pull up test measures the strength /endurance of arms and shoulders muscles. Percentage gain in the strength/endurance of muscles of arms and shoulders from age 8 to 12 years has been found to be about 59% as compared to a gain of 115% recorded in these muscles from 13 to 18 years of age among Punjabi boys. Increased gain in the muscular strength endurance of arms and shoulders from age 13 to 18 years can be ascribed to the occurrence of adolescent spurt in Punjabi boys during this phase of growth. Comparison of the muscular strength/endurance scores of Punjabi boys with the norms reported by *Ross et al, (1985 & 1987)* on American boys of similar ages, reveals comparable values. As per norms reported by them, Punjabi boys are found to possess average strength endurance values at different age levels between 10 to 18 years. At the age of 8 and 9 years, the Punjabi boys are found to exhibit better upper body strength /endurance than their American counterparts (Figure. 2).

Abdominal Muscular Strength /Endurance (Table 2 Figure. 3):

This has been assessed by sit up and bent leg Curl up tests. The results indicate a general trend of increase in sit up score, though at varying rates from age 8 to 14 years. After the age of 14 years, a gradual decrease in sit up-score is seen with increase in age.

Gakhar & Malik (1999) also reported a similar trend of increase in sit up scores with increase in age in Jat school children of Delhi. The boys of the present study however are observed to demonstrate better scoring in this test than their age peers studied by the above authors.

Sit-ups measure the strength/endurance of abdominal group of muscles, which include rectus abdominalis and obliques. The results indicate increase in the abdominal strength/endurance of these muscles with increase in age in boys of the present study. Comparison of sit up

scores of boys of the present study from age 15 years onwards with the normative data reported on American boys by *Ross et. al, (1985 & 1987)* reveal poor status of the former as compared to the later.

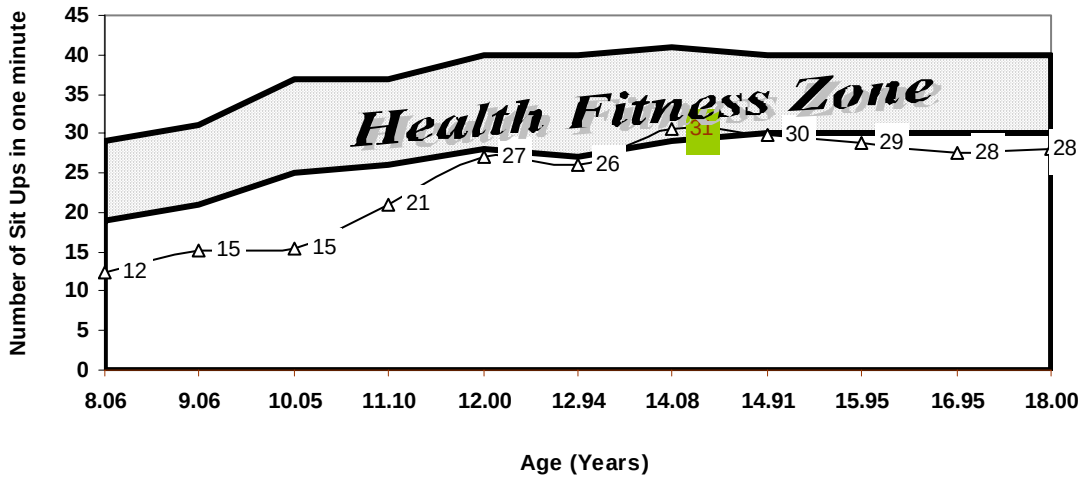

Figure 3: Age changes in abdominal strength/endurance as measured by sit up test in Punjabi Boys and their fitness status with respect to the Health Fitness Zone

Muscular strength/endurance are considered to be crucial for everyone's physical well-being and therefore is considered an important component of health related physical fitness. It becomes although more important if the strength under consideration relates to the abdominal region. Flabby muscles of the abdomen having low tone invite deposition of fat in the abdominal adipose area along with protrusion of belly that can lead to the development of biomechanical problems related to posture and can affect the spinal nerves. The poor abdominal muscular strength/endurance exhibited by boys of the present study, point to the negative life style being lead by them. In order to have a healthy adult population, it is felt that there is a need to create awareness among the general public about the importance of the health related fitness among the youth of Punjab.

Lower Body Muscular Strength /Endurance (Table 2 & Figure. 4):

Bench jumps test has been administered for assessing the muscular strength /endurance of the lower body of the boys of the present study.

The execution of this test involves the use of major muscles namely glutei, quadriceps, gastronomies and soleus. Mean values of this parameter exhibit a general pattern of increase from age 8 to 15 years, where after, the mean values are found to decrease slowly but continuously up to the age of 18 years. The boys belonging to 15-year age group show maximum value of mean bench-jump score. Comparison of average bench scores with the bench jump scores in American boys reported by *Hoeger & Hoeger (1990)* reveal poor lower body muscular strength/endurance in boys of the present study at all age levels (Figure. 4).

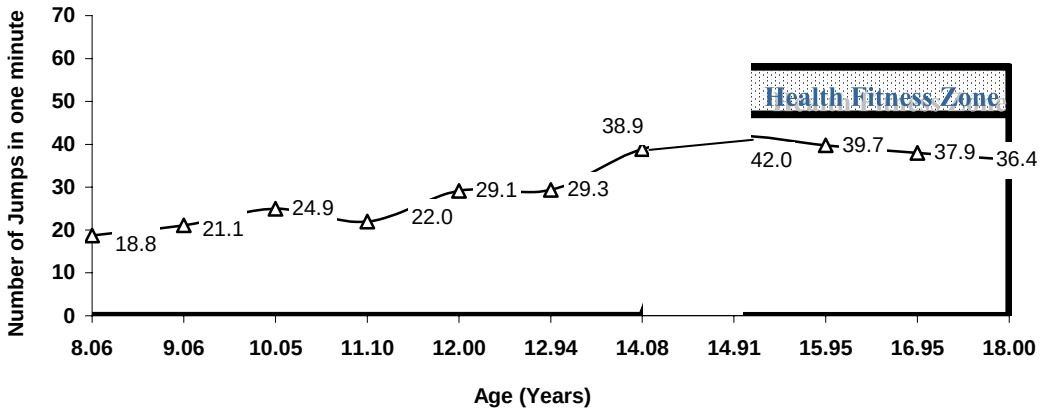

Figure 4: Age changes in Lower Body Muscular strength/endurance as measured by Bench Jump test in Boys of the present study and their fitness status with respect to the Health Fitness Zone

In nutshell the results of muscular strength/endurance, an important health related component of fitness indicate variations in its development with respect to different body regions in boys of the present study from age 8 to 18 years. The muscles related to the upper body region like triceps, deltoid, pectorals major etc. are observed to develop relatively better in their strength endurance ability than the muscles belonging to abdominal, hip and leg regions. This disproportionate development of major regions of the body needs an explanation and analysis. It is believed that disproportionate development of muscular strength/endurance in boys of the present study may be due to their habitual life style and a craze for some selected muscular strengthening exercises, like use of dumbbells, lifting weights etc. in order to develop their body for an attractive physical appearance. In addition to this, demands of their daily rural activities involve the use of upper body system mainly arms for fodder to be cut by machine, lifting of objects, milking the cattle and so on. These factors may be contributing to the better development of muscular strength and endurance of upper body in Punjabi boys. Mechanisation in cities of Punjab has already made an impact on the life style of the people. Sedentariness is the outcome of modernisation and mechanisation that has led to the reduction in daily physical activities involving walking, jogging etc. This might have lead to the poor muscular strength/endurance development in the abdominal and lower body regions. The results of the present study need to be taken seriously in view of the fact that poor development of muscular strength and endurance is known to be associated with a number of health related problems, the most important of which is low back pain and another related to the postural problems. *(Deyo, 1991, Plowman, 1992, Biering et al., 1994).*

(iii) Flexibility (Table 2 & Figure. 5):

Flexibility is another very important component of health related physical fitness and is defined as the functional capacity of joint to move through full range of movement. Muscles, ligaments and tendons contribute largely to the amount of movement possible at a joint. The age changes in flexibility in boys of the

present study have been studied by the Modified Sit and Reach test. At the age of 8 years, a mean value of 3.8 inches is observed and with increase in age a slow and continuous decline in this parameter is witnessed up to the age of 11 years. Thereafter, a general trend of increase in modified sit and reach scores are observed leading to a maximum average value of 5.4 inches exhibited by 18-year-old boys. Comparison of the boys of the present study with the normative data on youth in the Canadian Fitness Survey (*Stephens & Craig, 1988)* yields very valuable information. The boys of the present study are found to possess poor levels of flexibility as compared to the Canadian norms (Figure. 5).

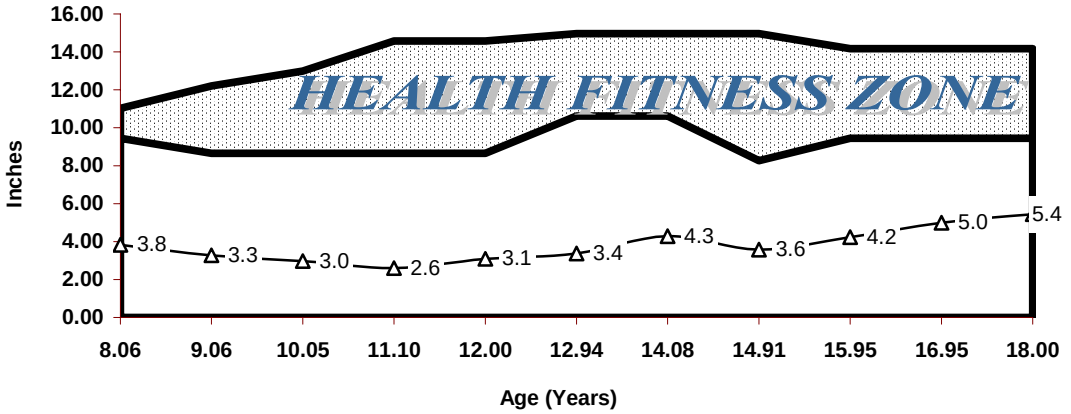

Figure 5: Age changes in Flexibility as measured by Modified Sit and Reach Test in Boys of the present study and their fitness status with respect to the Health Fitness Zone

According to *Heyward (1991)* flexibility is the capacity of a joint to move freely through its full range of motion. The limitation to joint flexibility is tightness of soft tissue structure like joint capsules, muscle tendons and ligaments. The more muscle can stretch the better becomes the flexibility of a joint. Good flexibility is important for joint health and prevention of injuries. In addition leg back and hip muscles must be strong and flexible to prevent problems like low back pain. The decrease in flexibility around 14 to 15 years of age is believed to be due to the adolescent changes taking place in the body especially the increased muscular development and associated structures during this phase of growth. As this phase passes off the adolescent processes lead to the stabilization of muscles and associated structures like tendons, ligaments etc, that lead to once again in the gain in the flexibility during the rest of the period of growth. Physiologically speaking, the maturation of proprioceptive neuron and muscular facilitation also matures after the adolescent, thus leading to increases in flexibility in the latter part of the growth. The lower level of the flexibility in boys of the present study in comparison to their American age peers reflects on their habitual life style. Decrease in physical exercise levels in the society, in general is considered the most plausible explanation for this. Almost a complete neglect of physical education curriculum, which used to be an important and integral part of our educational system in the past, may be responsible for this state.

(iv) Percent Body Fat (Table 2 & Figure. 6):

Body composition is another very important component of health related physical fitness. People whose body composition is optimal tend to be healthier. Possession of excess body fat is known to be linked with the risk of running chronic diseases like blood pressure, diabetes, hypertension etc. *Sourenson and Sonne (1988), Mossberg (1989) and Serdula et al. (1993)* reported that fatty children become fat adults in their later part of life.

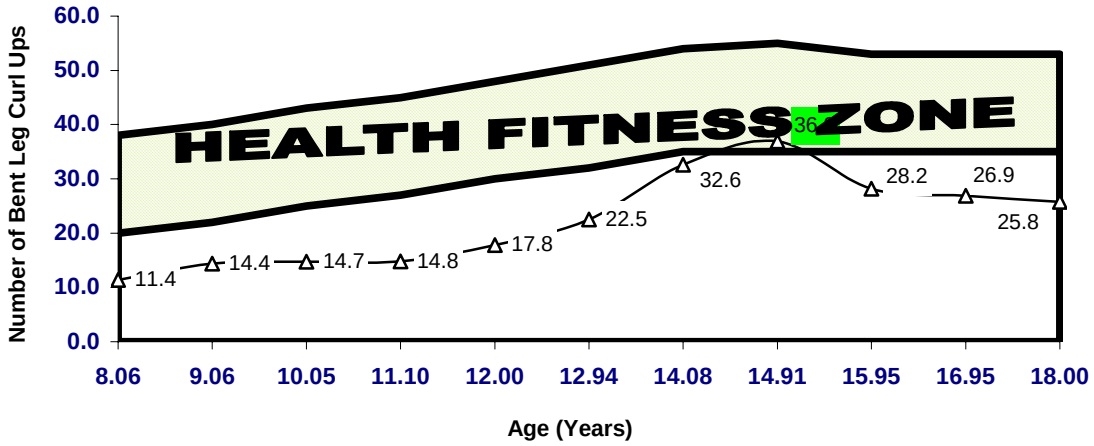

Figure 6: Age changes in percent body fat as predicted from skin folds in Punjabi Boys and their fitness status with respect to the Health Fitness Zone

Keeping in view the importance of percent body fat during childhood, body fat assessment has been carried out in boys of the present study from 8 to 18 years of age. Mean values of percent body fat exhibited by these boys at different age levels, is given in Table 2 and also illustrated in the form of distance curve in Figure. 6. On an average, 8 year old boys possess 12.0% body fat that increase to 14.3% at the age of 11 years, where after a gradual decrease occurs till 14 years of age. After this age up to the age of 17 years, the boys exhibit a sharp rise in percentage body fat and touch the highest mean of 17.5%.

Baseline data on the health related fitness level pertaining to body composition of school aged American children were made available with the release of First National Children and Youth Fitness Studies (NCYFS-I) in 1985 and subsequently by the President Council of Physical Fitness and Sports School population fitness survey in 1987. NCYFS-II also published data related to health related fitness on US children *(Pate and Ross, 1987; Ross et al., 1987; Ross and Pate, 1987).*

Comparison of percent body fat possessed by boys of the present study at different age levels with the similar data reported on American children has been made. The results reveal that on an average, these boys fall in the health fitness zone limits (given by Cooper Aerobic Research Institute), which has been reported to be between 10 to 25% in the above mentioned studies. Average percent body fat of these boys at all age level is observed to fall in the health fitness zone. However the

percent body fat of boys of the present study after the age of 14 years and onwards exhibit a sharp rise, which continues up to 17 years of age. As far as the age trends in percent body fat are concerned our results agree with *Kansal (1981) and Giri (1990).* At the age of 17 years maximum average value of percent body fat (17.5%) is seen in the present study. In the opinion of the investigator these observations may have a negative effect on the health and well being of boys of the present study.

A comparison of percent body fat of boys belonging to the present study with a similar data reported by *Kansal (1981) and Giri (1990)* also reveal greater percent body fat possessed by the former. This means that boys of the present study have become fatter since 1990. Probably the negative life style coupled with increased energy intake seems to be the reason for this type of trend in the present study. The trend of increase in fatness in the boys of the present study is a signal for the health planners and if remedial measures are not planned in time, the consequences of this will be bad not only to the population concerned but also to the state. The observation needs to be taken seriously because increased body fat is known to be associated with a wide variety of health problems.

Table 2: Mean values of various components of health related fitness

Mean Age (Years)		8.06	9.06	10.05	11.10	12.00	12.94	14.08	14.91	15.95	16.95	18.00
	N	75	65	78	80	79	70	65	70	70	75	70
2.4 KM Runtime [min]	Mean	15.25	16.01	15.33	13.94	12.70	13.47	13.10	12.81	12.80	12.35	12.49
	SD	3.19	3.10	2.96	2.11	1.63	2.76	2.25	2.39	2.20	1.76	1..98
Pull Up Score	Mean	2.3	4.2	2.5	2.9	3.0	3.6	4.9	6.0	6.4	7.2	7.8
	SD	1.13	1.91	1.19	1.33	1.43	1.71	2.30	2.76	3.04	3.39	3.53
Sit Up Score	Mean	12.5	15.2	15.4	21.1	27.1	26.0	30.6	29.8	28.7	27.7	28.0
	SD	6.2	6.6	7.1	10.2	9.2	12.6	11.0	10.4	8.5	7.3	8.7
Bench Jumps	Mean	18.8	21.1	24.9	22.0	29.1	29.3	38.9	42.0	39.7	37.9	36.4
	SD	8.2	9.1	11.6	7.7	10.0	14.8	10.5	14.2	14.6	15.7	15.0
Sit & Reach (inches)	Mean	3.8	3.3	3.0	2.6	3.1	3.4	4.3	3.6	4.2	5.0	5.4
	SD	1.79	1.62	1.33	1.20	1.49	1.66	1.70	1.65	1.61	1.71	2.40
Percent Body fat	Mean	12.0	13.6	14.2	14.3	13.9	13.6	13.3	15.4	17.0	17.5	14.5
	SD	3.16	3.99	5.27	4.82	5.44	4.30	4.36	4.19	4.50	4.57	4.49

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Effect of Different Types of Exercise Programmes on Daily Dietary Intake of Nutrients in Females

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Abstract

The present investigation studied the effect of different types of exercise programmes (aerobic, strength, mixed i.e. combination of aerobic & strength) on daily dietary intake of nutrients in 120 females ranging in age from 20-40 years. The subjects were divided into four groups' viz. aerobic, strength, mixed and control depending upon the type of exercise programme administered to them. Exercise programme was administered for six weeks and five days a week as per the details given in the paper. Information related to the dietary content of food ingested by the subjects was obtained from daily dietary records of the subjects. Subjects were instructed to identify every food and drink and the amount ingested over a period of 45 days (three days before the starting of exercise programme till the end of six weeks period of study). From this information average daily dietary intake of nutrients was calculated using Dine Healthy Software. The results indicate that with the progression of the exercise programme, the aerobic group demonstrated a significant reduction in the daily dietary energy intake, while in the remaining groups this was not the case. Effect of different exercise programmes on the daily dietary intakes of nutrients vary with the nature of exercise schedule and is discussed at length in the research report.

Key Words: C**arbohydrates, Fats, Proteins, Body Mass Index**

Introduction:

Some people believe that exercise generates an increase in hunger and a drive to eat while others say that physical activity can suppress appetite. From the literature reviewed, regarding the impact of physical activity on the dietary intake, it is gathered that physical activity influences food intake varying from either no change to suppression of appetite *(Thompson et al, 1988; Kissileff et al, 1990; Lawton et al, 1993; King et al, 1994; King et al, 1996; Imbeault, 1997 and King et al, 1997)*. Overall, the body of evidence points to a rather weak pairing between energy intake and physical activity induced energy expenditure *(King et al, 1997; Blundell & King, 1998 and King, 1998)*. Literature is silent as far as the effect of different types of exercise programmes on intake of energy and nutrients in the daily diet is concerned.

The investigation was undertaken to study the effect of different types of exercise programmes on daily dietary intake of nutrients in females.

Materials and Methods:

The study was conducted on 120 females ranging in age from 20 to 40 years. These subjects were grouped into the following categories on random basis and each group comprised of 30 subjects who lasted till the end of the study.

Group I: Aerobic (These subjects were given six weeks of aerobic exercise programme)

Group II: Control (These subjects acted as control and were not subjected to any exercise programme)

Group III: Mixed (These subjects were given six weeks of aerobic plus strengthening exercise programme)

Group IV: Strength (These subjects underwent six weeks of strengthening exercise programme.

Information related to the dietary content was obtained from dietary records of the subjects. Subjects were instructed to identify every food and drink and the amount ingested over a period of 45 days (three days before the starting of exercise programme till the end of six weeks period of study). From this information average daily dietary intake of nutrients was calculated using Dine Healthy Software.

Following three types of exercise programmes were administered to the various groups of females.

Sr. No	Name of the Programme	Group
I	Aerobic Exercise Programme	Aerobic
II	Strength Exercise Programme	Strength
III	Mixed Exercise Programme (Aerobic Plus Strength)	Mixed

The details of the exercise programmes are given below:

A. Aerobic Exercise Protocol:

Based on the principles of aerobic exercise prescription, the aerobic exercise protocol was prepared and included the following important components.

Warm Up (10 minutes)
Mode of Exercise (Brisk Walking)
Exercise Period (30 minutes/session, 5 days/week for 6 weeks)
Cool Down (slow walking plus static stretching exercises for 8-10 minutes)

Following is the list of warm up exercises, which closely resembles the actions central to the training programme. Standing Spinal Twist, Low Back Press, Side Bends, Crossed Leg, Seated Straight Leg, Legs Spread, Legs Spread progression, Side Stretch, Double Knee to the Shoulders, Abdominal Stretch, Inverted Hurdler.

B. Strengthening Exercise Programme

Following strengthening exercise programme was designed for administration to a group of females in the present study. The exercise programme consisted of the following components as is typical of any strength exercise programme.

Warm up:

Same exercises as given under the sub heading of warm up in the aerobic exercise protocol were given for warm up.

Stretching Exercises: - Shoulder Stretch- Anterior & Posterior, Back Extensions Lying & Cross Over Stretch Lying, Back Stretch- Upper One Arm Rows, Push Ups Wide, Neck Stretch Chin-Shoulder, Lying Oblique & Vertical Leg Crunches, Quadriceps Stretch Lying and Toe Drag

Strengthening Exercises: - Back Extensions Standing, Fly Dumbbells, Shrug Dumbbells, Abdominal Oblique Twists, Step Ups

Cool Down:

Exercises given under the subheading of cool down in the aerobic exercise protocol were used after the strengthening/stretching exercises for cool down.

The focus of strength training programme was to develop muscular strength endurance and to achieve this, high repetition, low resistance principle was followed. While administering strengthening exercises to the subjects, a mixture of stretching and strengthening exercises were used in the protocol. Each exercise was repeated 8-12 times and carried in sets of 2-4 with interval of about 40 seconds. Where stretching was involved,

the subject in general was instructed to hold the stretch for 10 or more seconds.

C. Mixed Exercise Protocol

This exercise protocol comprised of both aerobic as well as strengthening exercises. The details of these protocols have already been given above. The aerobic and the strengthening exercises were used alternately during the six weeks period. By alternating, it is meant that on one-day aerobic exercise programme was given and the following session was devoted to the strength building exercises. Frequency of exercise programme was kept five days/week. The subjects performed warm up and cool down exercises in the same manner as described for other exercise programmes.

Statistical Analysis:

SPSS version 10.0 was used for the statistical analysis of the data collected on females of the present study. Usual statistical derivatives like mean and standard deviation were obtained for the various dietary variables before, during and after the exercise programmes for the different groups.

To test the impact of different types of exercise programmes on the dietary intake, paired't' test was applied.

Results and Discussion:

Each one of the exercise programme administered to the females has been divided into four phases as follows:

Pre Programme Phase	Exercise Phase		
	Phase I	Phase II	Phase III
Three days before the start of the exercise programme	First 14 Days (1-14)	Next 14 Days (15-28)	Next 14 Days (29-42)

The average values of daily energy intake alongwith the nutrients in the daily diet during the different phases of exercise programmes have been computed right from pre programme phase to phase III of the exercise programme (Table 1). The notable changes in the daily dietary intake of nutrients because of the administration of exercise programme have been analysed with respect to both the type of exercise regimen and the phase of the programme.

i) Changes in Daily Energy Intake in Females Subjected To Different Types of Exercise Programmes

On an average, the energy intake is observed to significantly increase in females undergoing aerobic, strength and aerobic plus strength exercise programmes as well as in the control group from the pre exercise programme phase to phase I of the exercise schedule. In general, the increase in the energy intake ranges from 102 to 121 Cal among the various groups. The average daily dietary intake of energy is observed to record a continuous increase from phases I to II of the exercise programme in the three experimental groups, but this is not the case with the control group in which opposite is observed (Figure 1).

With the progression of the exercise programme, the aerobic group demonstrates a significant reduction in the daily dietary energy intake, while in the remaining groups the mean values relating to phases II and III of the exercise programme are not observed to be statistically different from each other (Table 2).

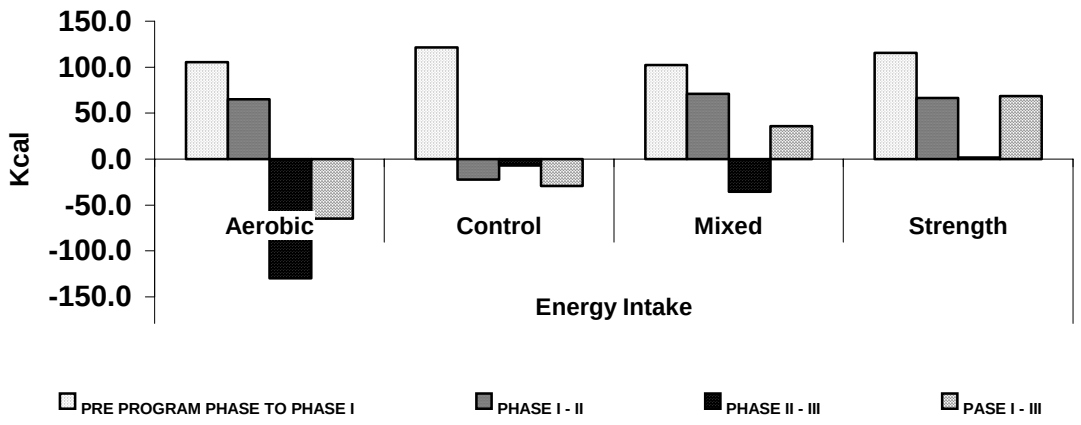

Figure 1: Comparison of mean changes in dietary intake of energy in different groups from one phase of exercise programme to another

It is apparent that different types of physical exercise regimens administered to the females produced varied types of changes in the daily dietary intake of nutrient energy. For example, aerobic exercise regimen caused a significant drop in the intake of dietary energy during the course of the programme. On the other hand, the group of females who underwent programme of strength building exercise and another group that was administered a mixture of strength and aerobic exercises for six weeks duration, though demonstrated a significant increase in the intake of dietary energy at some or the other stage of the programme but failed to record a significant reduction in energy intake at any stage of the study. In the literature, the body of evidence points to a rather week coupling between energy intake and physical activity induced energy expenditure *(King et al, 1997; King, 1998 and Blundell & King, 1998)*. The failure of some investigators to report a linkage between energy intake and physical activity may be the fact that the energy intake might not had been tracked in their studies for sufficiently long period of time after increasing the physical activity. *Edholm et al (1955)* put forth his view that although there is no relationship between energy expenditure and energy intake on the same day but there may be a positive relationship between energy expenditure on one day and energy intake two days later. This led *Edholm et al (1977)* to comment that 'We do not eat for today but for the day before yesterday'. In the present investigation, the energy intake has been tracked for sufficiently long period; therefore, any impact of physical activity on the energy intake is likely to surface out prominently. Decrease in energy intake noticed during the exercise programme especially in the females subjected to aerobic exercise regimen, point to suppression of appetite. A number of investigators have also reported exercise-induced anorexia shortly after the period of vigorous or intense workout *(Thomson et al, 1988; King et al, 1994; King et al, 1996 and Westertrep et al, 1997). Westertrep et al (1997)* also reported that this suppression of appetite is more marked in persons undergoing aerobic training. The observations of the present study are in concurrence with Westertrep as

significant decrease in energy intake has been recorded in females who underwent a programme of aerobic exercises for six weeks. This may be one of the possible causes of greater weight loss potential associated with the aerobic type of exercises. This sight gets strength from the results of the present study also because the females who participated in the aerobic exercise regimen as well lost maximum body weight after the conclusion of the study.

ii) Changes in the Daily Dietary Intake of Nutrients in Females Subjected to Different Types of Exercise Programmes

Assessment of the mean intake of carbohydrates in females who were administered aerobic exercise programme reveal a continuous trend of increase in the average amount ingested by the females with the progression of the exercise programme.

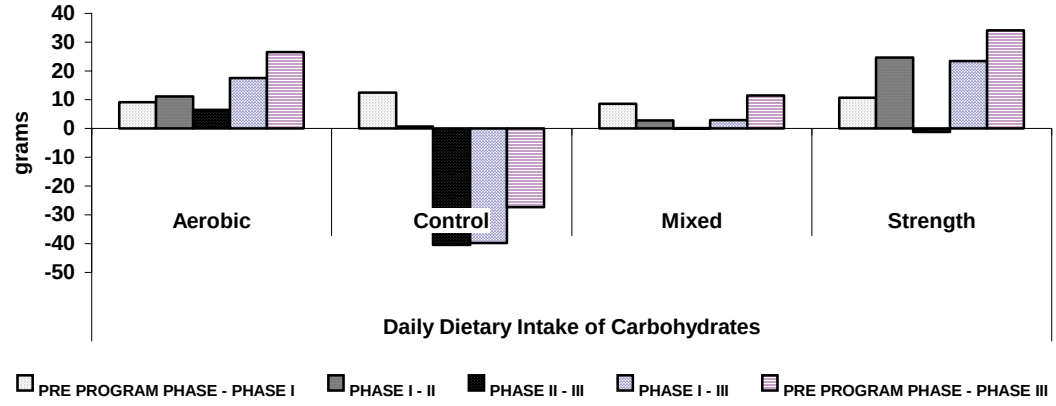

Figure 2: Comparison of mean changes in dietary intake of carbohydrates in different groups from one phase of exercise programme to another

Figures 2 & 3 compare the mean changes in dietary intake of carbohydrates in different groups from one phase of the exercise programme to another. It can be observed from the Figures that only in the aerobic group a continuous increase in the intake of carbohydrates is seen with the progression of exercise phase while in the strength and mixed groups a similar trend is observed except for a decrease in the intake of carbohydrates from phase II to phase III. Control group on the other hand demonstrated an initial increase in this nutrient from pre exercise programme state to phase I of the programme thereafter it recorded a continuous decrease with the progression of the exercise programme. In nutshell, the females who were subjected to different exercise programmes demonstrated a net increase in the carbohydrate intake during exercise as compared to their pre exercise programme stage. Control group on the other hand demonstrated the opposite. High carbohydrate diet is probably the most essential for physically active individual.

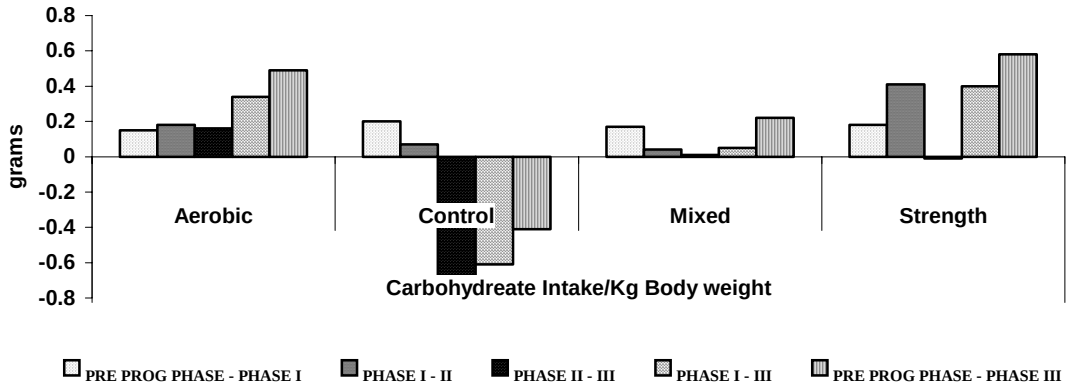

Figure 3: Comparison of mean changes in dietary intake of carbohydrate/kg body weight in different groups from one phase of exercise programme to another

Body carbohydrate stores are extremely important because they are the primary fuel source for the working muscles. It is well known that when muscle glycogen level drops too low, the ability to do exercise falls. *Christensen and Hansen (1939)* first demonstrated the effect of exercise intensity on the fuel used by the muscle during exercise. They reported that as the exercise intensity increased the relative contribution of carbohydrates as muscular fuel also increased. *Ivy (1991)* and *Nieman et al (1987)* in their studies revealed that ability to do hard muscular exercise such as aerobics and strength is closely linked to muscle glycogen level. In the present investigation although no dietary control on the subjects was exercised and the subjects were permitted to eat ad libido, still the increase in carbohydrate intake in the exercise groups occurred by itself, which is indicative of the natural adjustment in the dietary ingestion of nutrients to cope up with the needs of exercise.

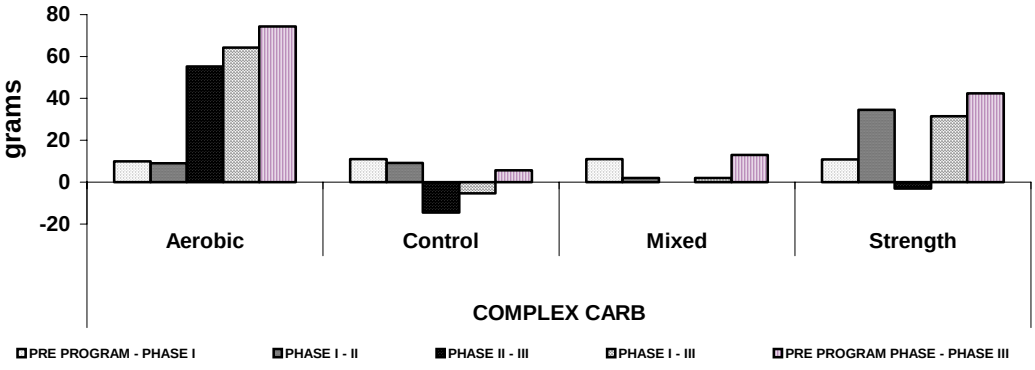

Figure 4: Comparison of mean changes in dietary intake of complex carbohydrates in different groups from one phase of exercise programme to another

It is interesting to observe that intake of complex carbohydrates in the daily diet by the females belonging to the aerobic group demonstrate a continuous significant increase from one phase to another during the progress of the aerobic exercise programme. A similar analysis for the other groups reveals only a slight change in the dietary intake of complex carbohydrates (Figure 4).

Another important component of carbohydrates is added sugar. The mean comparison of changes in the dietary uptake of this component is depicted in Figure 5. It is evident from the figure that in different exercise groups, changes of only very small magnitude are noticed in the subjects from one phase to another during the exercise programme. It is only in the control group that the added sugar intake exhibited a decrease of greater magnitude during the different phases of the study in comparison to the exercise groups.

Mean intake of fibres in the diet by females belonging to different groups is depicted in table 2. In general, changes in dietary intake of fibre are observed in females subjected to different types of exercise programmes from one phase to another (Figure 4). Aerobic and strength group of females demonstrate a greater magnitude of increase in the average ingestion of fibers in their daily diet as compared to the control and mixed group of females. Statistically speaking the average change in the dietary intake of fibers from pre programme phase of exercise to phase I in different groups is significant.

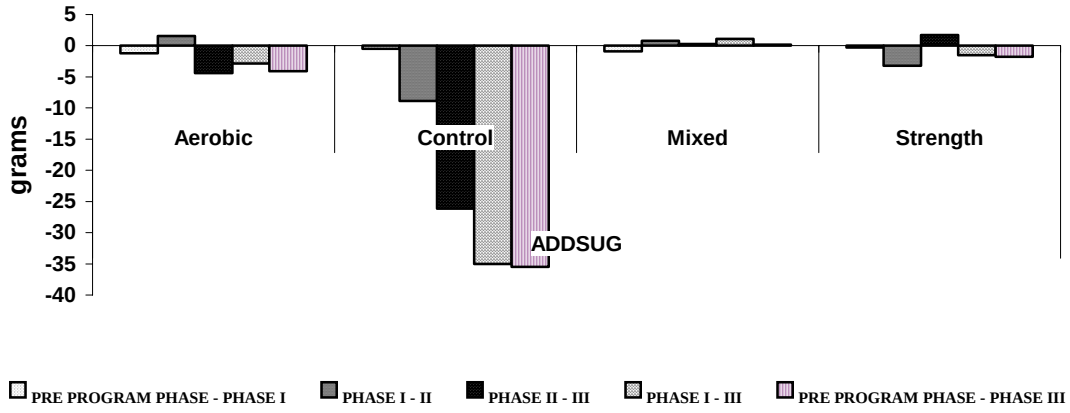

Figure 5: Comparison of mean changes in dietary intake of added sugar in different groups from one phase of exercise programme to another

Dietary fiber, commonly known as "Bulk" or "Roughage" consists of carbohydrate plant substances that are difficult or impossible for the humans to digest. Instead, fiber passes all the way through the intestinal tract and provides bulkiness for faeces in the large intestine, some types of fibers are broken down by bacteria into acids and gases which explicate why consuming a great deal of fiber can lead to intestinal gas. Nutritionists categorize dietary fibers as soluble or insoluble. Soluble fibers slow the body's assimilation of glucose and bind cholesterol

containing compounds in the intestine, lowering blood cholesterol level and lessen the risk of cardiovascular diseases. On the other hand, insoluble fibers unite water, making the faeces bulkier and softer, so they pass more rapidly and effortlessly through the intestine. As per the recommendations of Dine Healthy System, an intake of 20 to 35gms/day of dietary fibers in the diet is considered good. The three experimental groups of the study comprising of females belonging to the aerobic, strength and mixed groups consume the dietary fiber much in excess of the recommended range of 20 to 35gms, but females belonging to the control group take dietary fibers as per the recommendation of the Dine Healthy System even at the pre exercise programme phase. The administration of exercise programme has further caused a rise in the intake of fibers in the experimental groups. There is no doubt that diet high in dietary fiber can help to prevent a variety of health problems including Constipation, Haemorrhoids and Diverticulitis. In addition to this, some studies have associated high level of insoluble fiber in the diet with lower incidence of colon and rectal cancers. These subjects are therefore protected from the risk of running the above said diseases. The exercise groups, comprising of females who participated in the exercise programmes, are observed to consume too much fiber even before the start of the study and exercise further increased their intake of fibers. These females may be exposed to some medical problems such as large stools along with malabsorption of important minerals. It is therefore felt that for the fiber intake, as in all aspects of nutrition, balance and moderation as the key principle should be kept in mind while participating in exercise programmes of long durations

In general, the results of the study related to carbohydrate intake, indicate that various exercise programmes produce varying long-term effects on the intake of carbohydrates in the daily diet, but out of these exercise regimens, that involving aerobic exercises result in improving the quality of diet more than the other programmes.

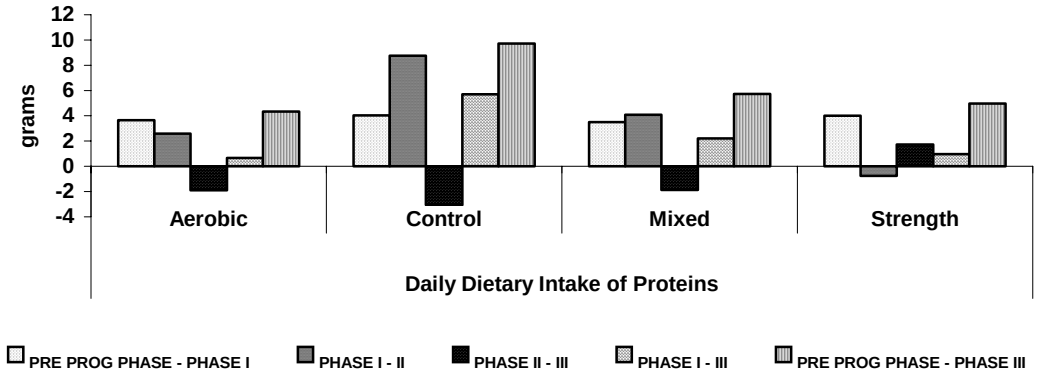

Figure 6: Comparison of mean changes in dietary intake of proteins in different groups from one phase of exercise programme to another

Mean values of total daily dietary intake of proteins by the females belonging to the different groups are presented in table 1. Before the start of the exercise

programme aerobic, mixed and strength group of females were found to consume greater amounts of proteins as compared to the control group. The administration of different types of exercise programmes resulted in varying degree of changes in the protein intake by the females during the different phases of exercise protocols (Figs 6 & 7). Statistical valuation of the changes in the intake of daily dietary proteins from one phase to another phase of exercise programme among the different groups is presented in tables 2 to 5. All the groups have demonstrated a significant increase in the intake of proteins through diet from pre programme phase to phase I of the exercise protocol.

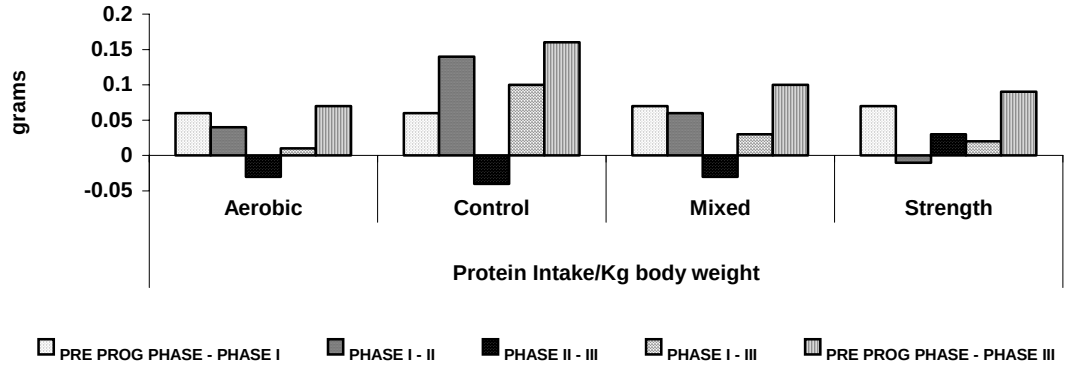

Figure 7: Comparison of mean changes in dietary intake of protein/kg body weight in different groups from one phase of exercise programme to another

The importance of proteins for athletes has continued to be debated over years. *Clark et al (1998)* reported that the primary fuel for muscular contractions was derived from muscle proteins and further suggested that large quantities of meat should be taken to replenish the supply. The studies conducted by *Lemon (1987)* and *Lamont et al (1990)* failed to confirm the above-mentioned results and gave the concept that changes in protein metabolism during exercise are non existing or minimal at best. However, studies using modern technology have concluded that proteins are a much more important fuel source during exercise than was previously thought *(Nair et al, 1987; Tarnopolsky et al, 1988 and Lemon et al, 1992).* The value of proteins to those persons who exercise is due to the fact that exercise cause significant muscle damage *(Evans, 1991),* increase in amino acid oxidation *(Dohm, 1985; Lemon, 1987; and Phillips et al, 1993)* and increase in gluconeogenesis *(Dohm, 1985 and Nair et al, 1987).* From the evidence available from these studies, it is understandable that the proteins should be available in the exercising individual's body in appropriate amounts to deal with the wear and tear caused by the work out. In the light of the reasons cited above, an increase in the protein intake of the females seems quite justified.

Fats constitute the most concentrated energy rich nutrient of the diet. It is known to play an important role during a work out especially if it is of long duration. Table 1 compares the mean values of daily dietary

intake of fats as well as the components of fat in the diet during the different phases of the exercise programmes.

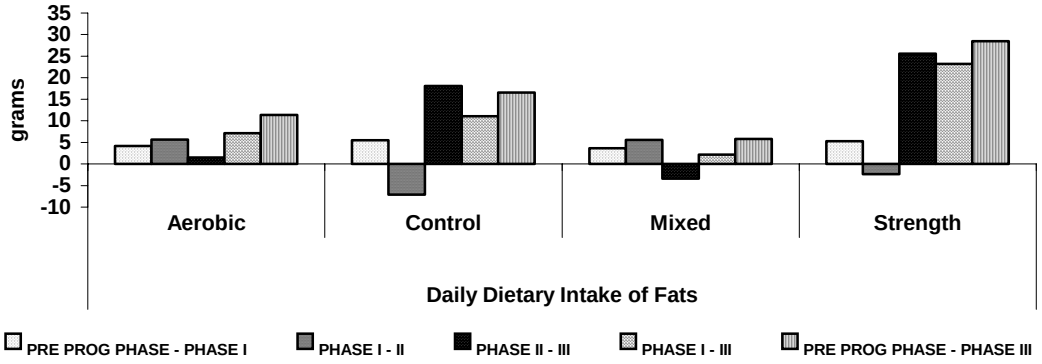

Figure 8: Comparison of mean changes in dietary intake of fats in different groups from one phase of exercise programme to another

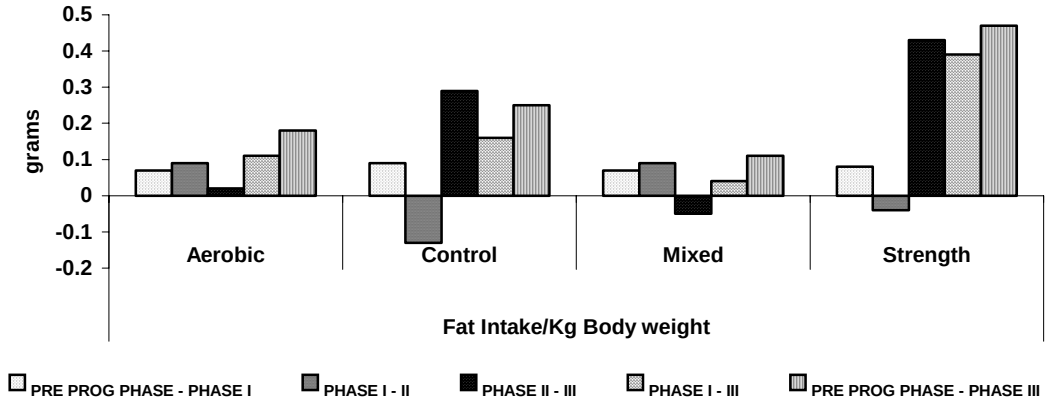

Figure 9: Comparison of mean changes in dietary intake of fat/kg body weight in different groups from one phase of exercise programme to another

Average consumption of total fats in the daily diet by the females in general; exhibits a trend of increase with the progression of the exercise programme. In case of aerobic group fat intake continue to increase from one phase to another while control and the strength groups demonstrate a slight decrease in the fat intake from phase I to phase II of the programme (Figure 8).

Consumption of total fats when expressed in relation to the body weight of the subjects also demonstrates a similar picture as seen in case of total fats (Figure 9)

Comparison of mean changes the dietary intake of saturated fats in different groups also reveals almost a similar picture as seen in case of total fats (Figure 10). Mean intakes of unsaturated fats consumed in the daily diet by the females of different groups during the course of the study are depicted in Table 1 and illustrated with the help of Figures 11& 12.

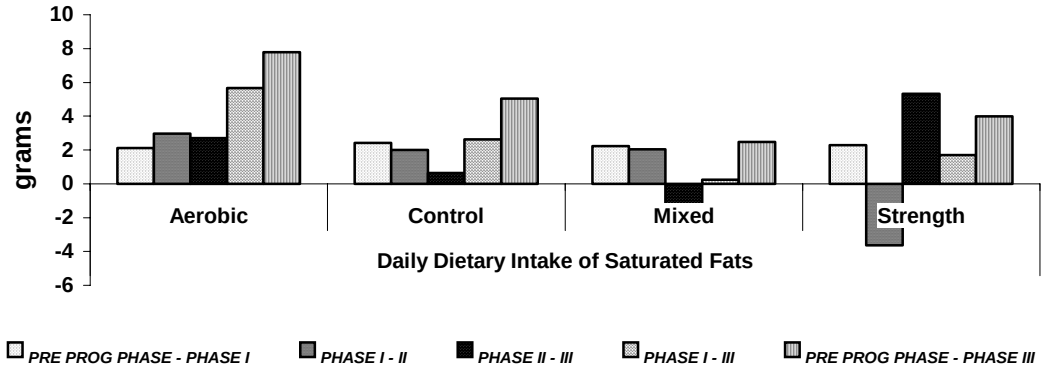

Figure 10: Comparison of mean changes in dietary intake of saturated fats in different groups from one phase of exercise programme to another

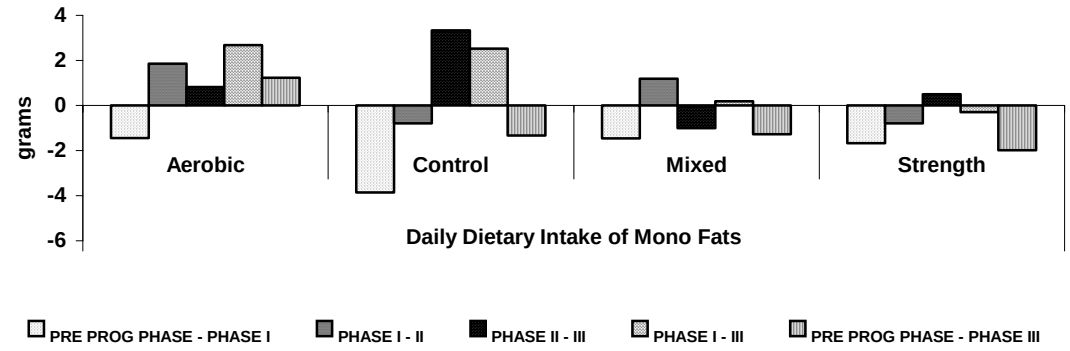

Figure 11: Comparison of mean changes in dietary intake of mono fats in different groups from one phase of exercise programme to another

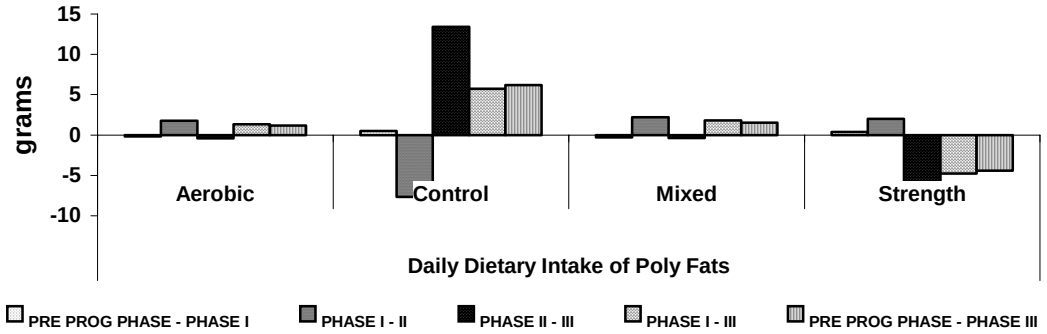

Figure 12: Comparison of mean changes in dietary intake of poly fats in different groups from one phase of exercise programme to another

Aerobic group in general demonstrate a pattern of increase in the daily dietary consumption of mono and polyunsaturated fats, a trend similar to that seen for saturated fats. Strength group on the other hand exhibit a trend of decrease in the daily dietary intake of mono and poly groups of unsaturated fats with the progress of the programme, a trend opposite to that observed in case of saturated fats in this group.

Statistical evaluation has revealed the existence of significant differences in the mean changes recorded for both saturated and unsaturated fat intakes in the daily diet by different groups of females from one phase of the programme to another (Tables 2 – 5).Fats no doubt are known to be the most concentrated source of energy and are linked with a number of important functions in the body, but health experts are of the view that excessive consumption of fats especially if their energy contribution exceeds the upper limit of 30-35%, can lead to a number of health problems, most important of which is arteriosclerosis.

In the present investigation, the dietary analysis has very clearly revealed an increase in the intake of saturated fats with the progression of exercise regimen in all the groups. The polyunsaturated fats on the other hand have shown only a slight increase in females who were subjected to aerobic and mixed type of exercise protocol, while in case of strength group on the contrary a decrease was recorded with the progression of the exercise regimen. From the view point of quality of diet, the changes in the consumption of fats and its components do not seem to be positive in nature because high fat consumption especially of the saturated fats are reported by many investigators to lead to weight gain and also increase the risk of developing diseases like high blood pressure, coronary heart disease, diabetes and even cancer etc *(Doll & Peto, 1981; Margetts & Nelson, 1991; Powels & Ruth, 1994 and Lucas, 1998).*

In the present investigation, the subjects were allowed to eat at liberty and no dietary restrictions were imposed on them during the course of the study. It is observed from the results related to fat intake that a variety of physical workouts as administered through different exercise programmes to the females, failed to check the excessive consumption of saturated fats in their daily diets. Therefore, it is believed that there is a need of interventions in the form of dietary constraints in those adopting for any physical exercise programme with a specific aim of reducing body weight as well as for deriving the necessary health related fitness benefits linked with the exercise.

Many research studies have revealed that athletes have no guarantee of protection from heart diseases unless they follow prudent habits of exercise and diet and further stress that even during training a high-saturated fatty diet can raise serum cholesterol to alarmingly high levels indicating thereby that exercise is not powerful enough to fully negate bad nutritional habits. These investigators advocate that even during any physical exercise programme, wise dietary practices should be followed *(Lukaski, 1984; Miller et al, 1984 and Vukovich et al 1993).*

Table 1: Comparison of mean values of daily dietary intake of nutrients in females of various groups during different stages of exercise programme

Variable	Group	N	Pre Programme Phase		First Phase		Second Phase		Third Phase	
			Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Energy Intake [Cal]	Aerobic	30	2210.33	275.55	2315.92	267.21	2380.99	301.91	2251.32	287.64
	Control	30	2152.33	426.68	2273.70	414.99	2251.50	394.52	2244.50	359.62
	Mixed	30	2322.27	219.06	2424.56	216.05	2495.68	243.14	2460.32	256.18
	Strength	30	2211.55	398.69	2327.10	386.64	2393.73	447.83	2395.50	416.86
Body Weight [Kg]	Aerobic	30	63.92	7.50	63.88	7.44	62.17	7.13	61.60	6.88
	Control	30	63.05	6.09	63.08	5.98	63.13	5.80	62.95	5.97
	Mixed	30	59.90	3.72	59.68	3.77	58.58	3.52	57.80	3.32
	Strength	30	61.98	4.13	61.92	4.09	61.63	4.05	61.58	4.19
Total Carbohydrate [gm]	Aerobic	30	290.54	32.17	299.60	28.29	310.68	39.44	317.12	118.19
	Control	30	292.79	102.54	305.27	99.76	305.90	102.96	265.47	82.80
	Mixed	30	345.41	34.22	353.95	32.60	356.74	40.47	356.88	35.64
	Strength	30	288.88	87.26	299.57	84.90	324.23	97.72	323.03	113.40
Complex Carbohydrate [gm]	Aerobic	30	247.34	29.64	257.34	27.82	266.42	33.19	321.62	182.73
	Control	30	219.12	99.71	230.07	100.37	239.23	90.79	224.77	85.40
	Mixed	30	318.51	35.09	329.52	34.27	331.44	42.49	331.44	36.80
	Strength	30	242.53	93.76	253.43	94.31	288.00	93.42	284.93	113.25
Added Sugar [gm]	Aerobic	30	46.29	14.95	45.07	14.15	46.61	17.29	42.21	13.76
	Control	30	75.90	67.16	75.43	63.95	66.57	71.69	40.43	31.06
	Mixed	30	25.39	12.83	24.47	12.36	25.26	13.12	25.55	13.33
	Strength	30	39.78	36.69	39.50	35.00	36.27	39.14	38.00	36.29
Dietary Fibre	Aerobic	30	43.22	8.00	44.20	7.75	53.48	41.63	52.09	35.52
	Control	30	35.07	26.31	36.41	26.56	38.00	26.43	35.83	26.78
	Mixed	30	54.59	7.75	55.38	7.40	57.99	8.98	56.84	7.85
	Strength	30	41.34	22.70	42.36	22.57	51.15	28.84	46.02	28.40
Total Protein [gm]	Aerobic	30	74.03	10.28	77.68	9.99	80.26	7.79	78.35	9.59
	Control	30	64.28	19.81	68.30	20.56	77.07	22.73	74.00	19.95
	Mixed	30	78.68	9.95	82.18	9.91	86.26	9.35	84.39	9.59
	Strength	30	73.13	20.59	77.13	20.70	76.37	19.30	78.10	17.97
Total Fats [gm]	Aerobic	30	85.51	14.86	89.69	14.72	95.32	20.78	96.83	26.26
	Control	30	88.69	26.45	94.20	27.31	87.10	29.46	105.23	30.38
	Mixed	30	81.95	12.10	85.58	12.16	91.13	14.37	87.75	15.43
	Strength	30	94.05	27.90	99.33	28.53	96.93	22.18	122.53	142.21
Mono Saturated FAT	Aerobic	30	25.40	3.50	23.95	3.67	25.81	6.99	26.63	9.80
	Control	30	28.73	12.14	24.87	7.88	24.07	8.40	27.40	6.52
	Mixed	30	24.15	3.33	22.69	3.67	23.88	3.57	22.88	4.12
	Strength	30	26.81	9.46	25.13	6.63	24.33	5.51	24.83	6.20
Poly unsaturated FAT [gm]	Aerobic	30	28.88	5.87	28.71	5.26	30.47	9.26	30.05	8.69
	Control	30	29.92	17.76	30.40	17.29	22.73	9.29	36.13	24.04
	Mixed	30	21.10	4.69	20.79	4.43	23.00	8.37	22.61	6.85
	Strength	30	33.80	25.10	34.17	24.79	36.17	21.01	29.40	17.53
Cholesterol	Aerobic	30	173.11	79.50	171.76	76.29	188.74	80.96	168.50	66.09
	Control	30	135.50	83.67	139.47	86.46	167.23	95.11	160.67	106.78
	Mixed	30	163.39	30.03	161.06	27.99	168.55	33.91	161.25	31.01
	Strength	30	149.66	93.03	150.70	91.98	122.80	67.17	157.40	84.87

Table 2: Effects of aerobic exercise programme on daily dietary nutrient intake as evaluated by paired't' test in females

Variable	Pre Prog to Phase I	Phase I to II	Phase II to Phase III	Phase I to Phase III
Body Weight	-0.57	8.13*	5.19*	11.33*
Daily Energy Intake	23.53*	-1.27	2.01*	1.40
Proteins	18.10*	-1.27	0.99	-0.35
Fats	19.02*	-1.64	-0.27	-1.54
Saturated Fats	23.22*	-2.04*	-0.95	-1.82
Mono Fats	-6.66*	-1.61	-0.44	-1.57
Poly Fats	-0.96	-0.92	0.19	-0.75
Total Carbohydrates	7.40*	-1.44	-0.29	-0.78
Complex Carbohydrates	11.15*	-1.37	-1.63	-2.00*
Added Sugar	-2.69*	-0.47	1.23	1.02
Dietary Fibers	4.39*	-1.17	0.15	-1.27

Table 3: Mean differences in daily dietary nutrient intake as evaluated by paired't' test in the control females

Variable	Pre Prog to Phase I	Phase I to II	Phase II to Phase III	Phase I to Phase III
Body Weight	1.98*	0.42	-0.65	2.48*
Daily Energy Intake	1.14	23.33*	1.05	0.30
Proteins	-1.58	11.75*	-2.22*	0.73
Fats	-1.72	12.25*	1.24	-3.01*
Saturated Fats	-0.71	9.76*	-0.56	-0.18
Mono Fats	-1.55	-3.02*	0.54	-2.22*
Poly Fats	-1.22	1.64	2.13*	-3.11*
Carbohydrates	2.74*	9.40*	-0.04	2.41*
Complex Carbohydrates	0.31	12.54*	-0.59	1.32
Added Sugar	2.75*	-0.43	0.66	1.96
Dietary Fibers	0.11	4.71*	-0.40	0.67

Table 4: Effects of mixed exercise programme on daily dietary nutrient intake as evaluated by paired 't' test in females

Variable	Pre Prog to Phase I	Phase I to II	Phase II to Phase III	Phase I to Phase III
Body Weight	-3.79*	15.83*	10.50*	15.50*
Daily Energy Intake	32.73*	-3.76*	1.23	-1.75
Proteins	27.62*	-2.96*	1.15	-2.38
Fats	28.19*	-2.52*	1.25	-1.13
Saturated Fats	39.38*	-1.98	1.31	-0.25
Mono Fats	-3.90*	-1.89	1.23	-0.29
Poly Fats	-3.79*	-1.25	0.21	-1.72
Total Carbohydrates	8.69*	-0.49	-0.02	-0.58
Complex Carbohydrates	15.06*	-0.31	0.00	-0.36
Added Sugar	-4.21*	-0.41	-0.13	-0.41
Dietary Fibers	5.04*	-1.95	0.63	-1.15

Table 5: Effects of strength exercise programme on daily dietary nutrient intake as evaluated by paired't' test in females

Variable	Pre Prog to Phase I	Phase I to II	Phase II to Phase III	Phase I to Phase III
Body Weight	-0.85	15.83*	10.50*	15.50*
Daily Energy Intake	25.15*	-3.76*	1.23	-1.75
Proteins	17.10*	0.20	-0.23	-0.23
Fats	13.44*	-2.52*	1.25	-1.13
Saturated Fats	11.87*	-1.98	1.31	-0.25
Mono Fats	-1.66	-1.89	1.23	-0.29
Poly Fats	1.05	-0.48	1.71	0.91
Carbohydrates	8.60*	-1.63	0.09	-1.31
Complex Carbohydrates	12.14*	-1.97	0.21	-1.41
Added Sugar	-0.49	0.33	-0.18	0.15
Dietary Fibers	5.55*	-1.62	1.14	-0.61

* $p < 0.05$

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Quadriceps Strength of Patients of Osteoarthritis Knee: Relationships to Pain and Disability

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Abstract

The study was conducted on two hundred patients ranging in age from 40 to 70 years with established osteoarthritis knee to examine the association of quadriceps strength with pain and disability of knee osteoarthritis. In addition the relationships between various components of health related fitness, pain, effusion and disability were also examined in the present study. Quadriceps strength seems to be an independent contributor to the severity of osteoarthritis knee; the findings illustrate the need of improving the muscle function in these patients. No association between knee pain and disability indicates that functional limitations in patients with osteoarthritis should be explored separately from the evaluation of symptoms.

Key Words: **Isotonic, Isometric, Lean Body Mass, % Fat**

Introduction:

Osteoarthritis has the distinction of being the oldest and most prevalent chronic joint disease known to humanity. Worldwide it touches the lives close to one billion people *(Gordon, 1993).* This is particularly apparent at the knee joint, one of the commonest sites to be affected. Despite major efforts in the past, little is known about the risk factors associated with pain and disability of osteoarthritis knee compared to other diseases with major public health impact. Recent attention has focused on Quadriceps mechanism. Quadriceps strengthening exercises are widely recommended for osteoarthritis knee based on longitudinal studies showing decreased muscle strength in patients of osteoarthritis knee in comparison to their healthy counterparts. *(Tan et al., 1995; and Wessel, 1996).* Studies of elderly, generally healthy subjects, have reported relationships between muscle strength and functional status *(Hyatt et al., 1990).* Such associations, however, have not yet been examined in patients of osteoarthritis knee.

The aim of the study was to examine the association of quadriceps strength with pain and disability of knee osteoarthritis. In addition the relationships between various components of health related fitness, pain, effusion and disability were also examined in the present study.

Materials and Methods:

Subjects: Two hundred patients with established osteoarthritis knee ranging in age from 40 to 70 years from physiotherapy O.P.D., Lyallpur Khalsa College, Guru Nanak Mission Hospital, Mangat Hospital and Oberoi Hospital of Jalandhar City (Punjab, India) were recruited for the study.

Clinical Health Status:

Pain, tenderness, effusion were recorded depending upon the severity and graded as per criteria laid by *Livesly et al. (1991).*

Body Composition:

The Skinfold caliper was used to measure the thickness of skinfolds at biceps, triceps, subscapular and suprailiac sites. For the purpose of calculation of percent body fat the four skin fold values were added to get the total skin fold value. The body density there after was calculated by using the *Durnin and Womersley (1974)* formula appropriate to the age and sex category of the subject. After the calculation of body density, percent body fat was calculated by using the formula devised by Siri (1961).

Muscle Strength Measurements:

Isotonic strength of quadriceps was recorded by 10 R.M. method and isometric muscle strength was recorded by using Back-Leg-Chest Dynamometer.

Range Of Motion:

Universal goniometer was used to measure R.O.M. of Knee joint. Both knee movements i.e. flexion and extension were measured in prone lying.

Cardiovascular Fitness:

Crompton test was used to record cardiovascular fitness.

Functional Status:

Patients were categorized into class I, II, III and IV according to the 1991 revised criteria given by American College of Rheumatology.

Statistical Analysis:

Pearson chi-square test was used to reveal the existence of association between disability as judged from the functional status of the patient and the variables of health related fitness status as well as clinical health status. The ensuing significant associations were further explored with paired samples correlation to establish the form of these relationships. Consequently multiple regression analyses were used to examine the predictability of one variable from several variables.

Results:

Pearson chi-square test was used to find out the association between disability in osteoarthritis knee and physical characteristics, various clinical parameters, the components of health related fitness and the radiographic changes. The results are being displayed in table 1.

It was observed that the calculated value of $\chi 2$ was less than the table value for the parameters of pain ($\chi 2$=6.081), effusion ($\chi 2$=7.754) and body mass index ($\chi 2$=7.151). This indicated that disability of the patients of osteoarthritis knee as judged from their functional status was not associated with pain, effusion and body mass index. On the other hand the significant value of χ^2 ($p<0.05$) for all other parameters has demonstrated a strong link of functional status with age, body weight, % body fat, lean body mass, isotonic strength of quadriceps, isometric strength of leg muscles, range of knee extension, cardiovascular fitness, the stage of osteoarthritis as judged from radiological changes and the level of physical activity determined by exercise habit of the patients of osteoarthritis of knee.

Table 1: Pearson chi-square applied between functional status and various subject characteristics in 200 patients with osteoarthritis knee

Variable	$\chi 2$	d.f.	N	Sig.
Functional Status & Age	18.76**	4	200	0.001
Functional Status & Pain	6.08	8	200	0.638
Functional Status & Effusion	7.75	6	200	0.257

Functional Status & Body Weight	22.14**	4	200	0.000
Functional Status & Body Mass Index	7.15	4	200	0.000
Functional Status & % Fat	35.67**	4	200	0.000
Functional Status & Lean Body Mass	20.32**	4	200	0.000
Functional Status & Isotonic Muscle Strength	119.9**	10	200	0.000
Functional Status & Isometric Muscle Strength	149.56**	8	200	0.000
Functional Status & Range of Knee Extension	35.19*	18	200	0.009
Functional Status & Cardiovascular Fitness	115.4**	4	200	0.000
Functional Status & Radiological Changes	23.04**	4	200	0.000
Functional Status & Exercise Habit	20.01**	4	200	0.000

*p<0.05

The results of Pearson chi-square test only indicated whether the different subject characteristics were or were not significantly related with functional status of the patients of osteoarthritis knee, without reference to any assumptions concerning the form of relationship. Consequently the test of statistics named paired samples correlation was applied to appraise a measure of the degree or form of the relationship of functional status with age, body weight, % body fat, lean body mass, isotonic strength of quadriceps, isometric strength of leg muscles, range of knee extension, cardiovascular fitness, the stage of osteoarthritis as judged from radiological changes and the level of physical activity determined by exercise habit of the patients of osteoarthritis of knee. However correlation analysis was not used to assess the linear association of functional status with pain, effusion and body mass index because the administration of Pearson chi-square test had already established that functional status of the patients of osteoarthritis knee was not associated with pain, effusion and body mass index.

Table 2: Correlation analysis between functional status and various subject characteristics in 200 patients with osteoarthritis knee

Variable	Correlation	N	Sig.
Functional Status & Age	0.23**	200	0.001
Functional Status & Body Weight	-0.24***	200	0.000
Functional Status & % Fat	0.39***	200	0.000
Functional Status & Lean Body Mass	-0.29***	200	0.000
Functional Status & Isotonic Muscle Strength	-0.65***	200	0.000
Functional Status & Isometric Muscle Strength	-0.62***	200	0.000
Knee Extension	0.11*	200	0.139
Functional Status & Cardiovascular Fitness	0.69***	200	0.000
Functional Status & Radiological Changes	0.32***	200	0.000
Functional Status & Exercise Habit	0.35***	200	0.000

*p<0.05

Table 2 shows the several significant linear correlations. In the total group of 200 patients of osteoarthritis knee, the functional status correlated positively with age ($r = 0.226$; $p<0.001$), % body fat ($r = 0.389$; $p<0.000$), knee extension ($r = 0.105$), cardiovascular fitness ($r = 0.692$; $p<0.000$), radiological changes ($r = 0.320$; $p<0.000$) and exercise habit ($r = 0.354$;

p<0.000). On the other hand functional status was found to be correlated negatively with body weight(r = -0.238; p<0.000), lean body mass(r = -0.289; p<0.000), isotonic strength of quadriceps (r = -0.658; p<0.000) and isometric muscle strength of leg muscles (r = -0.620; p<0.000).

The results of correlation analysis have established the close relationship of functional status with age, body weight, % body fat, lean body mass, isotonic and isometric strengths of leg muscles, knee extension, cardiovascular fitness, radiological changes and exercise habit of patients of osteoarthritis knee. Hence multiple regression analyses were used to examine the predictability of one variable from several variables associated with disability of osteoarthritis knee.

Table 3: Partial correlation coefficients derived from multiple regression analyses in 200 patients with osteoarthritis knee.

	Dependent Variables	
Independent Variables	**Functional Status**	**Radiological Changes**
Age	0.037	0.629*
Body Weight	0.128	0.128
Body Mass Index	-0.119	0.143
Isotonic Strength	-0.440*	-.364*
Isometric Strength	-0.332*	0.169
Knee Extension	0.352*	0.11
CV Fitness	0.475*	0.008
%Fat	0.172	-0.027
Lean Body Mass	-0.004	-0.154
Exercise Habit	-0.046	0.1705

Table 3 shows the results of multiple regression analyses with functional status and radiological changes as the dependent variables and age, weight, BMI, isotonic strength of quadriceps, isometric strength of leg muscles, cardiovascular fitness, %Fat, lean body mass and exercise habit as independent variables. Isotonic strength of quadriceps was the most important determinant of functional status and stage of osteoarthritis as judged from radiological changes.

Table 4: Partial correlation coefficients derived from multiple regression analyses in 200 patients with osteoarthritis knee.

	Dependent Variables	
Independent Variables	**Pain**	**Effusion**
Age	0.829	-0.029
Body Weight	0.029	-0.124
Body Mass Index	0.0396	0.1286
Isotonic Strength	-0.136	0.0658
Isometric Strength	-0.0283	0.082
Cardio-vascular Fitness	-0.114	0.0397
%Fat	-0.0594	0.0803
Lean Body Mass	0.0626	0.135
Exercise Habit	0.1493	-0.0571
Knee Extension	0.015	-0.0103

Table 4 shows the results of multiple regression analyses with pain and effusion as the dependent variables and age, body weight, body mass index, isotonic muscle strength, isometric muscle strength, cardiovascular fitness, %Fat, lean body mass and exercise habit as independent variables. None of the variables was correlated either with pain or with effusion. Thus, quadriceps strength was found not to be associated with pain.

Table 5: Partial correlation coefficients derived from multiple regression analyses in 200 patients with osteoarthritis knee.

Independent Variables	**Dependent Variables**	
	Pain	Effusion
Functional Status	-0.016	-0.104
Radiological Changes	-0.321	-0.039

Table 5 presents the results of multiple regression analyses with functional status and radiological changes as dependent variables while pain and effusion as the independent variables. The results confirmed that clinical health status was not associated either with functional status or radiological changes.

Discussion:

The present study could not establish any direct linkage between pain and disability. The findings does not hold good with usual assumption that pain is a primary factor in limiting function of the patients of osteoarthritis of knee. In addition, pain was also found not to be associated with any of the parameters of health related fitness. This suggests that a patient with knee osteoarthritis may experience considerable pain with either good muscle strength or even with good cardiovascular fitness. These findings can be explained on the basis that pain is the subjective phenomenon and the perception of pain can be subjectively modified by past experiences and expectations *(Bishop, 1980).* A poor relationship between pain and radiological changes has repeatedly been reported in patients of osteoarthritis *(Downie, 1993; Haslett et al. 2000; Braunwald et al., 2001; O'Sullivan and Schmitz, 2001).* Many individuals with advanced osteoarthritis have no symptoms. Pain arises in structures possessing nerve endings and may result from micro-fractures in subchondral bone, increased venous pressure in subchondral bone and osteophytes, capsular thickening and subluxation. With cartilage damage alone, there is no pain, since articular cartilage does not contain nerve endings. This might be the reason why the disease may be obvious radiologically long before symptoms appear. However the reverse is also true, and pain may be severe despite minimal clinical and radiological findings. In fact it has been reported that some patients may magnify the pain they experience (Melvin et al., 1989). According to *Downie (1993),* usually there are increasing complaints over a number of years but occasionally the history can be short, a matter of few months only, despite extensive radiological disease. Thus, the findings illustrate the need to explore functional limitations in patients with osteoarthritis separately from the evaluation of symptoms. In 2001, O'Sullivan and Schmitz also reported that a clinical examination, predicted on the assumption that pain is a primary factor in limiting function, could lead to the hasty conclusion that the patient's functional status is normal if pain is absent.

Decreased muscle strength has repeatedly been reported in arthritis patients *(Tiselius, 1969; Hsich et al., 1987; Ekdahl et al., 1989; Ekdahl and Broman, 1992; Philbin et al., 1995; Tan et al., 1995; Wessel at el., 1996; Joshi and Kotwal, 2000 and Braunwald, 2001).* The present study has also recorded the similar findings.

The studies of healthy subjects have reported relationships between muscle strength and functional status *(Hyatt et al., 1990),* chair rising ability *(Bassey et al., 1992)* and walking and stair climbing speed *(Bassey et al., 1988; Bendall et al. 1989 and Bassey et al., 1992).* Furthermore, an association between muscle strength and the risk of recurrent falls *(Whipple et al., 1987 and Lord et al., 1994)* and fractures *(Nguyen et al., 1993; Lord et al., 1994 and Cummings et al., 1995)* has been demonstrated. Obviously, muscle strength and endurance translates into good functional capacity and lessened disability. That is one of the reasons why muscle

strength is linearly and negatively correlated with disability in patients with osteoarthritis knee.

Another important factor contributing to disability is altered stereognostic control of opposing muscle groups surrounding knee joint, which is a major weight bearing joint. Normally strong periarticular muscles of knee joint are capable of withstanding the impact of loading. However this mechanism is reduced in case of reduced muscular strength and endurance in patients with osteoarthritis knee. In 1986, Radin reported that altered stereognostic control of loading force attenuation is an important regulator, as it can be modified in many patients by conservative physical therapy and gait control. These factors should be taken into consideration while managing the patients of osteoarthritis knee.

The primary concept involved at the knee is that of increased stress and the response of the musuloskeletal system to this stress *(Goldberg et al., 1992).* An understanding of this concept is imperative in understanding of the severity of osteoarthritis knee and its relationship with quadriceps strength. For example, unhealthy body composition produces increased articular surface stress, which is normally predominantly absorbed or attenuated by strong quadriceps. This is well in line with the finding of *Yang and co-workers (1989).* The present finding illustrates the need of improving muscle function in the management of osteoarthritis knee.

The present study has investigated the obesity, as a risk factor of disability of osteoarthritis knee, in terms of body weight, body mass index and body composition. A positive correlation between % body fat and functional status indicates that as the amount of % fat increases the functional status of patients with osteoarthritis knee moves from class I to class IV meaning % body fat is directly proportionate to the level of disability. On the other hand a negative relationship between lean body mass and functional status was observed meaning a decrease in lean body mass is closely associated with an increase in disability as judged from functional status. It is important to mention here that carrying too much fat in comparison to lean tissue is the main characteristic of unhealthy body composition or obesity. Thus we may conclude that an unhealthy body composition is closely related with an increase in the level of disability in cases of osteoarthritis of knee. The findings indicate that exercise rehabilitation programme of osteoarthritis knee should include a healthy body composition programme that helps a person lose weight and look thinner by targeting fat and preserving muscle.

It is important to emphasize that the present investigation could not demonstrate any direct linkage between body weight and the disability associated with the osteoarthritis knee. On the contrary, we observed a lower level of disability in patients with increased body weight. This observation needs to be interpreted in the light of body composition of the subjects. It is revealed in the results of the present study that healthy body composition probably is more important than the body weight alone in influencing the disability in patients of osteoarthritis knee. That is why body composition analysis, i.e., assessment of the percent of fat vs. lean body mass of an individual should be incorporated while evaluating the patients of osteoarthritis knee.

Conclusions:

1) Quadriceps strength seems to be an independent contributor to the severity of osteoarthritis knee; the findings illustrate the need of improving the muscle function in these patients.

2) No association between knee pain and disability indicates that functional limitations in patients with osteoarthritis should be explored separately from the evaluation of symptoms.

3) Healthy body composition probably is more important than the body weight alone in influencing the disease process of osteoarthritis knee.

4) In addition, treatment programme of osteoarthritis knee should have the potential to improve their cardiovascular fitness, flexibility and body composition.

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Effect of Six-Weeks of Plyometric Circuit Training on the Jumping Performance of Female College Players

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Abstract

Effect of six weeks of two types of plyometric circuit training programmes on jumping performance of female college level players and athletes were compared. Circuit Training Programme-I used depth jumping in combination with hopping and hurdling while Circuit Training Programme-II comprised only of depth jumping from boxes varying in heights from 15-45cms. The results show that gains in jumping abilities as a result of CTP-II are much higher than the gains accruing as a result of CTP-I. The amount of gain in abilities is not uniform. The gain varies from ability to ability. CTP-II has proved more effective in improving the jumping abilities of the subjects because it is more saturated with depth jumping exercises.

Key Words: **Vertical Jump, Depth Jumping, Standing Broad Jump, Spike Jump**

Introduction:

The improvement in jumping records in various international competitions (Asian and Olympic) in the past thirty years has witnessed a dramatic change in the positive direction. This has attracted the attention of various physical educationists and sports scientists to analyse the causes for this boom. As the performance in jumping events is largely determined by ones muscular strength and also to a number of other related strength factors the training of athletes therefore, is mainly directed to improve the strength ability of the athletes. Old traditional techniques include the weight training and run jumps. These training techniques are no doubt very effective methods used world over for the training of athletes, but with the recent advent of plyometrics (depth jumps) which is based on the principle of overload, an improvement of much greater magnitude in the jumping performance has been reported by the research as is also reflected in the improvement in jumping records of athletes in the past 30-40 years. Depth jumping (Plyometric drills) produces explosive re-active movements since it trains the eccentric part of muscle contraction. The fundamental research in the area was conducted by Russians in the mid and late 1960s. This has unveiled a great potential in the plyometrics. The scientific basis of depth jumping according to *Miller and Power (1981)* is concentric (shortening) contraction. These depth jumping exercises are based on the principle of pre-stretching of the muscles in an amortisation phase to use the kinetic energy developed in this phase in the contraction. The mechanical energy gets stored within the muscle *(Marey and Demeny, 1885).* When two jumps in succession are performed, the second jump is always higher than the first one because of the mechanical energy stored during the falling power phase of the first jump. Many researchers have advocated depth jumping as training aid for improving the jump ability of sportsmen/women *(Verhoshansky, 1967; Lenz and Losch, 1979).* Recently *Walker and Kenneson (1986)* have ascribed

a catalytic role to plyometric exercises in improving the jumping ability.

Advanced countries which are dominating in the field of sports have been using these techniques (plyometrics) for the training of their athletes since the sixties. However, in India which has great genetic potential, very little effort has been made to make use of plyometrics method of training. Strong and consistent steps in this direction are the need of the time, but before it is actually applied on Indian athletes/sportsmen, there is a need to prepare a plyometric circuit suitable for Indian athletes. Unfortunately no scientifically prepared and tried Circuit Training Programme is available in our country.

The present study is aimed to develop a plyometric circuit training suitable for female college players. The investigator not only prepared a circuit training unit but also studied the effects of six- weeks of training on jumping performance of the subjects included in the sample.

Materials and Methods:

In all two hundred (N=200) female college level players and athletes preparing for different inter-college competitions were randomly selected for the purpose of the study. The subjects belonged to five games namely volleyball, basketball, hockey, kho-kho, and kabaddi, and five athletic events i.e. long jump, high jump, shot-put, discus throw and javelin throw. Twenty subjects were selected from each category for the study. The selected subjects were tested on various jumping ability tests which included (i) Standing broad jump (ii) Vertical jump (iii) Three successive double foot jump (iv) Three successive right foot jump (v) Three successive left foot jump (vi) Three meter spike jump

The subjects were put to progressive six-week plyometric circuit training with a frequency of three times in a week and tested again after the completion of experimental period on jumping ability test to find out whether or not their jumping abilities improved.

Investigators tried boxes of different heights ranging from 10cms to 36cms with different athletes for more than three months. Not only the different heights were tried but also the distances between their placements were tried. As a result of prolonged efforts, it was decided to have two parallel circuits with different exercises but with boxes of the height ranging between 15cms to 45cms only. After standardisation of the height of the boxes for depth jumping as well as the distance between the successive boxes and jogging distances in accordance with the capabilities of the subjects selected two sets of six-week Circuit Training Programmes were devised. These have been described in tables 1 & 2.

Table 1: Components of Circuit Training Programme-I

	Details of Activity
1	First 10 meters comprised of 3 hops on left foot followed by 3 hops on right foot.
2	Next 10 meters comprised jogging.
3	Double foot depth jumping on five boxes each of 25cm height (L=90cm × B=45cm) interspersed at a distance of 1.15 meters from each other.
4	Jogging for 10 meters.
5	Two legged hurdle jumping over five hurdles each of 42cms height and separated from each other by a distance of 1.30 meters.
6	Jogging for 10 meters.
7	Double foot depth jumping on five boxes each of 30cm height (L=90cm × B=45cm) and placed at a distance of 1.12 meters from each other.

8	Jogging for 10 meters.

Table 2: Components of Circuit Training Programme-II

	Details of Activity
1	First 10 meters included five depth jumping on boxes each of height 15cm (L=90cm × B=45cm) situated at equal distances of 1.20 meters from each other.
2	Next 10 meters comprised jogging only.
3	Depth jumping on five boxes each of 35cm height (L=90cm × B=45cm) interspersed at a distance of 1.10 meters from each other.
4	Jogging for 10 meters.
5	Double foot depth jumping of five boxes each of 25cm height (L=90cm × B=45cm) interspersed at a distance of 1.15 meters from each other.
6	Jogging for 10 meters.
7	Depth jumping on five boxes each of 45cm height (L=90cm × B=45cm) and placed at a distance of 1.10 meters from each other.
8	Jogging for 10 meters.

The duration of training was kept as six-weeks without break. The frequency was kept as thrice per week with a change in load after every two weeks.

In all 144 repetitions were made obligatory six- repetitions for the first two-weeks, eight repetitions for the third and the fourth weeks and ten repetitions for the last two weeks. For arriving at the finality, various combinations were tried and the best ones retained. The final repetitions as indicated above worked out to be as under:

Week I and II 2x3x6 =36 Repetitions

Week III and IV 2x3x8 =48 Repetitions

Week V and VI 2x3x10=60 Repetitions

Total Repetitions = 144

Each group of players/athletes was divided into two subgroups of 10. The subjects in each group were given one week conditioning exercises to bring them to athletic form. This orientation programme consisted of running, callisthenics, and usual body fitness exercises. Each group of subjects (N=10) was administered six-week circuit training Programme I and II as per description given above.

Jumping abilities of the subjects were measured both after the orientation programme and again after completing the Circuit Training for six-weeks.

Results and Discussion:

Effect of CTP-I and II on body weight of female players and athletes (Table 3 and 4).

Tables 3 & 4 enlist the mean values of body weight of the female players before and after the administration of six-weeks of Circuit Training Programme I and II respectively. Both the Circuit Training Programmes produced on an average a slight decrease (statistically insignificant) in body weight ranging between 0.3 to 1.4 kg in the players.

The mean value of body weight before the start of CTP-I has been observed to be 53.9 Kg. which is found to be statistically not different from the mean value of body weight recorded (52.4 Kg) in the female subjects before the start of CTP-II. The Circuit Training Programme-I which lasted for six-weeks reduced an average decrease in body weight of the order of 0.8 Kg which in percentage term works out to be 1.5. A similar picture of decrease in body weight of the same magnitude is demonstrated by the subjects who underwent six-weeks of circuit training–II programme. The results therefore very clearly reflect changes in the body weight of the subject undergoing the above mentioned exercises programme. The circuit training probably affected the body composition of the subjects in a positive manner by stimulating the energy metabolic processes towards loss of excess

body fat and building up of the muscle component of the athletes and players. This type of trend is generally observed in almost all type of athletes and players undergoing conditioning programme. The net effect is in the redistribution of body fat in the different sites of the body depending upon the body segments recruited for muscular action. As body composition has not been studied in the present endeavour, it is difficult to comment on the changes in body composition and the distribution of fat in the various regions of the body as a result of Circuit Training Programme. But based on the findings from some other studies *(Adams, 1984; Brown et al., 1986 and Gehri et al., 1998)* it can be safely said that the slight reduction in body weight in the subjects of the present study is in agreement with the above studies and can be considered as a normal positive training response.

Table 3: Effect of CTP-I on body weight (kgs) of female players

	Before CTP-I				After CTP-I					
Games & Events	**Mean**	**SD**	**SEM**	**CV**	**Mean**	**SD**	**SEM**	**CV**	**Mean Diff.**	**'t'**
Volleyball	53.8	7.55	2.39	14.0	52.4	7.60	2.40	14.5	1.4	0.43
Basketball	57.7	6.22	1.97	10.8	56.6	5.94	1.88	10.5	1.1	0.40
Hockey	52.4	5.95	1.88	11.4	51.5	5.90	1.87	11.5	0.9	0.36
Kho-kho	49.5	6.82	2.16	13.8	49.1	6.89	2.18	14.0	0.4	0.13
Kabaddi	53.5	8.02	2.54	15.0	52.5	7.67	2.43	14.6	1.0	0.29
Long Jump	51.6	4.84	1.53	9.4	51.1	4.65	1.47	9.1	0.5	0.24
High Jump	48.2	4.42	1.40	9.2	47.9	4.38	1.39	9.2	0.3	0.15
Shot put	57.4	6.28	1.98	10.9	57.2	6.49	2.05	11.4	0.2	0.09
Discus Throw	62.7	8.68	2.75	13.8	61.4	8.42	2.66	13.7	1.3	0.34
Javelin Throw	52.4	3.78	1.19	7.2	51.3	3.76	1.19	7.3	1.1	0.65

Table 4: Effect of CTP-II on body weight (kgs) of female players

	Before CTP-II				After CTP-II					
Games & Events	**Mean**	**SD**	**SEM**	**CV**	**Mean**	**SD**	**SEM**	**CV**	**Mean Diff.**	**'t'**
Volleyball	49.6	4.86	1.54	9.8	48.5	4.55	1.44	9.4	1.1	0.52
Basketball	52.2	6.54	2.07	12.5	51.4	6.14	1.94	11.9	0.8	0.28
Hockey	53.0	2.54	0.8	4.8	52.2	2.29	0.72	4.4	0.8	0.79
Kho-kho	50.8	4.92	1.56	9.7	49.5	5.08	1.61	10.3	1.3	0.58
Kabaddi	55.5	4.48	1.42	8.1	54.5	4.35	1.38	8.0	1.0	0.51
Long Jump	49.8	4.57	1.44	9.2	49.3	4.56	1.44	9.3	0.5	0.27
High Jump	51.2	3.91	1.24	7.6	50.8	3.80	1.20	7.5	0.5	0.26
Shot put	54.5	3.34	1.06	6.1	54.0	3.39	1.07	6.3	0.5	0.33
Discus Throw	57.7	5.27	1.67	9.1	56.4	4.95	1.57	8.8	1.3	0.57
Javelin Throw	50.0	3.02	0.96	6.0	48.8	3.06	0.97	6.3	1.2	0.88

Effect of CTP-I and II on ability to jump

An analysis of the improvement in the various jumping ability measures after CTP-I and CTP-II programmes in the light of components of the training regimens has been discussed below:

Table 5: Training effects on Vertical Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		After CTP-I				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff.**	**%↑**	**'t'**
Volleyball	0.263	0.427	0.304	0.039	0.041	15.59	2.229*
Basketball	0.250	0.067	0.291	0.071	0.041	16.4	1.319
Hockey	0.234	0.043	0.294	0.041	0.060	25.64	3.168*
Kho-kho	0.227	0.046	0.274	0.044	0.047	20.70	2.317*
Kabaddi	0.237	0.048	0.287	0.053	0.050	21.1	2.197*
Long Jump	0.246	0.041	0.290	0.052	0.044	17.89	2.060
High Jump	0.219	0.025	0.281	0.023	0.062	28.31	5.665*
Shot put	0.223	0.065	0.301	0.086	0.078	34.98	2.287*
Discus Throw	0.226	0.057	0.281	0.055	0.055	24.34	2.202*
Javelin Throw	0.246	0.037	0.321	0.038	0.066	26.83	3.853*
All Combined	0.237	0.048	0.292	0.052	0.055	23.21	7.761*

Table 6: Training effects on Vertical Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		After CTP-II				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff.**	**%↑**	**'t'**
Volleyball	0.288	0.023	0.332	0.025	0.044	15.28	4.070*
Basketball	0.253	0.035	0.313	0.023	0.060	23.71	4.527*
Hockey	0.243	0.051	0.296	0.033	0.053	21.81	2.766*
Kho-kho	0.238	0.039	0.301	0.043	0.063	26.47	3.448*
Kabaddi	0.282	0.035	0.332	0.048	0.050	17.73	2.630*
Long Jump	0.253	0.047	0.314	0.049	0.061	24.11	2.822*
High Jump	0.258	0.057	0.310	0.054	0.052	20.16	2.097
Shot put	0.302	0.048	0.427	0.058	0.125	41.39	5.242*
Discus Throw	0.258	0.046	0.355	0.061	0.097	37.60	4.005*
Javelin Throw	0.227	0.026	0.301	0.031	0.074	32.60	5.789*
All Combined	0.260	0.046	0.328	0.056	0.068	26.15	9.377*

Table 7: Training effects on Three meter Spike Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		After CTP-I				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	2.406	0.079	2.463	0.589	0.057	2.36	1.829
Basketball	2.426	0.119	2.482	0.124	0.056	2.30	1.029

Hockey	2.340	0.084	2.418	0.066	0.078	3.33	2.313*
Kho-kho	2.285	0.057	2.352	0.048	0.067	2.93	2.842*
Kabaddi	2.373	0.123	2.447	0.097	0.074	3.11	1.499
Long Jump	2.340	0.057	2.407	0.057	0.067	2.86	2.617*
High Jump	2.326	0.079	2.401	0.056	0.075	3.22	2.453*
Shot put	2.365	0.107	2.501	0.144	0.136	5.75	2.399*
Discus Throw	2.432	0.048	2.509	0.050	0.077	3.16	3.496*
Javelin Throw	2.368	0.052	2.459	0.049	0.091	3.84	3.980*
All Combined	2.366	0.091	2.444	0.091	0.078	3.30	6.057*

Table 8: Training effects on Three meter Spike Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		**After CTP-II**				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	2.368	0.057	2.428	0.062	0.060	2.53	2.266*
Basketball	2.462	0.130	2.542	0.121	0.082	3.33	1.424
Hockey	2.352	0.084	2.430	0.082	0.078	3.31	2.095
Kho-kho	2.281	0.638	2.381	0.054	0.100	4.38	3.780*
Kabaddi	2.420	0.038	2.501	0.038	0.081	3.34	4.739*
Long Jump	2.268	0.081	2.363	0.074	0.095	4.18	2.738*
High Jump	2.404	0.105	2.498	0.092	0.094	3.91	2.129*
Shot put	2.340	0.064	2.523	0.066	0.183	7.82	6.272*
Discus Throw	2.320	0.115	2.489	0.075	0.169	7.28	3.872*
Javelin Throw	2.380	0.119	2.487	0.103	0.107	4.49	2.152*
All Combined	2.360	0.103	2.464	0.095	0.104	4.41	7.400*

(a) Improvement in the ability to jump as high as possible (Tables 5-8).

Tables 5-8 indicate the responses to two types of training programmes using either only depth jumping (CTP-II) or depth jumping in combination with hopping and hurdling (CTP-I) in improving ability to jump as high as possible assessed by vertical jumping and three meter spike jumping. Maximum benefits of CTP-I in vertical jumping ability and three meter spike jumping ability are shown by the subjects belonging to shot-put, Javelin, High jump and Hockey while as a result of Circuit Training Programme-II maximum improvement in vertical jumping and three meter spike jumping ability occurred in shot-putters, discus throwers, javelin throwers, kho-kho players, long jumpers and basketball players in that order. Both the training programmes i.e. CTP-I and CTP-II caused a substantive degree of improvement in the ability of both the game players and athletes to jump as high as possible. This is evident from the percentage of improvements witnessed in vertical jumping ability test which has been found to be about 19.9% and 21.0% after test CTP-I and CTP-II in case of game

players and 26.5% and 31. 2% after CTP-I and CTP-II respectively in case of athletic group. It is clearly indicated that athletes improve their vertical jumping ability more than the game players' inspite of the same type of Circuit Training Programme. The greater magnitude of improvement in vertical jump ability in case of athletes is difficult to be explained but it is thought that the potential traits possessed by them for athletic excellence may be responsible for the phenomenon. The training programme somehow or the other is able to stimulate the physiological mechanisms involved in jumping more effectively in case of athletes than the game players and make them high responders to Circuit Training Programme-II by virtue of its 100% depth jump nature and thus has been able to surpass Circuit Training Programme-I in showing greater improvements in the vertical jump ability. It may be because of the same reason of high ingredient of plyometrics in the training programme that the training responses of female athletes and players to CTP-I and CTP-II indicate a greater magnitude of training response in vertical jumping ability than other jumping ability measures.

Vertical jumping as a test is commonly used to measure lower body power. The primary muscle groups of the lower body which are involved in vertical jump include extensors of the hip, knee and ankle. *Robertson and Fleming (1987)* measured the contribution of each muscle groups in vertical jumping and reported 40% contribution of the hip extensors, 24.2% of knee extensors and about 36% of the ankle extensors towards vertical jumping. Based on the knowledge of the primary muscle groups of lower body involved in the vertical jump, a number of trainers have used training programmes consisting of a chain of exercises that involve extension of the hip and the knee such as the squat or extension of the hip, knee and ankle, such as clean for improving vertical jumping ability. Following this approach increases in vertical jumping have been reported following a weight training programme by *Gauffin et al (1988)* and *Adams et al (1992).* Adams et al further reported a significant increase in hip and thigh power following a seven-week programme of periodised parallel squats. In the present study the comparison of the training response of the subjects in their ability to jump vertically to two types of plyometric training programmes, indicate greater magnitude of improvement following a training programme which consisted only of depth jumping (CTP-II). The results of the present study are in agreement with several other studies which have reported that plyometric training resulted in a significant effect on increasing hip and thigh power specific to vertical jump *(Miller, 1982 and Brown et al, 1986).* It seems that the plyometric training bridge the gap between strength and speed and exploits the stretch -shortening cycle and thus increases the rate of force development and power output. In addition it seems that CTP-II programme comprising of just depth jumps is more effective as compared to CTP-I in enhancing neuro-muscular efficiency which in turn facilitates excellent transfer of power to other bio-mechanically similar movements that require a powerful thrust from the hips and thighs such as the vertical jump. The superiority of plyometric training seems to be established over power lifting as well, because in power lifting as the performance improves the power output actually decreases. *According to Gar Hammer (1993)* the power lifting although makes the athlete stronger and increases his ability to lift more weight, but the

movement speed substantially decreases, may be because of the lack of typical explosive movements in power lifting. As the plyometric training programmes adopted in the present study contains exercises to develop explosivity by employing depth jumping in case of CTP-II programme and depth jumping in combination with hurdling and hopping in CTP-I, it can be stated with confidence that these plyometric training programmes are more effective in improving the vertical jumping ability of the athletes as compared to the traditional methods employing power stresses of plyometric training. However, there is a need to conduct further studies to reveal the optimum degree of weight training and plyometrics to achieve best results.

(b) Improvement in the ability to jump forward (Tables 9-16)

lifting alone. Further the CTP-II programme has proved, beyond doubt, more effective than the CTP-I programme in improving vertical jump performance. Therefore, it is suggested that to build explosiveness in movement, the training programme should be a plyometric one as well as it must contain a grater component of depth jumping in it. Further it is thought that combination of weight training and plyometric can produce better results. This recommendation is made in the light of the need for an adequate strength base to reduce the chances of injuries from the high

The trends of improvements in the ability to jump forward as assessed by three successive double foot jump, three successive right foot jump, three successive left foot and standing broad jumps indicate maximum improvement in case of kho-kho and hockey players after the completion of CTP-I.

Table 9: Training effects on Standing Broad Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		After CTP-I				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	1.508	0.148	1.625	0.150	0.117	7.76	4.206*
Basketball	1.438	0.232	1.551	0.235	0.113	7.86	1.082
Hockey	1.509	0.222	1.641	0.233	0.132	8.75	1.297
Kho-kho	1.337	0.140	1.490	0.155	0.153	11.44	2.315*
Kabaddi	1.455	0.100	1.604	0.103	0.149	10.24	3.273*
Long Jump	1.373	0.220	1.466	0.213	0.093	6.77	0.960
High Jump	1.393	0.169	1.495	0.150	0.102	7.32	1.430
Shot put	1.441	0.238	1.558	0.222	0.117	8.12	1.138
Discus Throw	1.435	0.193	1.521	0.181	0.086	5.99	1.029
Javelin Throw	1.370	0.222	1.452	0.218	0.082	5.99	0.833
All Combined	1.426	0.191	1.540	0.192	0.114	7.99	4.206*

Table 10: Training effects on Standing Broad Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		After CTP-II				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**

Volleyball	1.484	0.120	1.631	0.137	0.147	9.90	2.555*
Basketball	1.445	0.110	1.610	0.107	0.165	11.42	3.409*
Hockey	1.589	0.161	1.745	0.166	0.156	9.82	2.138*
Kho-kho	1.333	0.251	1.519	0.263	0.186	14.00	1.617
Kabaddi	1.486	0.094	1.674	0.084	1.188	12.65	4.702*
Long Jump	1.558	0.279	1.659	0.289	0.101	6.48	0.794
High Jump	1.536	0.196	1.638	0.197	0.102	6.64	1.159
Shot put	1.622	0.171	1.759	0.166	0.137	8.45	1.817
Discus Throw	1.480	0.183	1.605	0.192	0.125	8.45	1.489
Javelin Throw	1.405	0.201	1.518	0.213	0.113	8.04	1.223
All Combined	1.494	0.194	1.636	0.197	0.142	9.50	5.134*

Table 11: Training effects on Three Successive Double Foot Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		**After CTP-I**				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.511	0.443	4.687	0.450	0.176	3.90	0.881
Basketball	4.311	0.670	4.471	0.667	0.160	3.71	0.535
Hockey	4.398	0.626	4.617	0.613	0.219	4.98	0.790
Kho-kho	3.984	0.497	4.159	0.517	0.175	4.39	0.771
Kabaddi	4.230	0.393	4.407	0.371	0.177	4.18	1.035
Long Jump	4.012	0.750	4.191	0.750	0.179	4.46	0.534
High Jump	4.087	0.581	4.255	0.569	0.168	4.11	0.654
Shot put	4.140	0.655	4.396	0.737	0.256	5.80	0.821
Discus Throw	4.113	0.706	4.239	0.707	0.126	3.06	0.399
Javelin Throw	4.288	0.496	4.444	0.494	0.156	3.64	0.705
All Combined	4.207	0.585	4.387	0.610	0.180	4.28	2.160*

Table 12: Training effects on Three Successive Double Foot Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		**After CTP-II**				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.564	0.727	4.754	0.784	0.190	4.16	0.562
Basketball	4.372	0.437	4.603	0.427	0.231	5.28	1.196
Hockey	4.589	0.524	4.808	0.530	0.219	4.77	0.929
Kho-kho	3.830	0.960	4.084	0.976	0.254	6.63	0.587
Kabaddi	4.418	0.386	4.642	0.366	0.224	5.07	1.331
Long Jump	4.412	0.411	4.617	0.393	0.205	4.65	1.140
High Jump	4.181	0.799	4.366	0.819	0.185	4.42	0.511
Shot put	4.719	0.693	4.951	0.704	0.232	4.92	0.743
Discus Throw	4.307	0.643	4.522	0.617	0.215	4.99	0.763

Javelin Throw	3.945	0.534	4.146	0.532	0.201	5.10	0.843
All Combined	4.334	0.660	4.549	0.666	0.215	4.96	2.293*

Table 13: Training effects on Three Successive Right Foot Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		**After CTP-I**				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.265	0.408	4.426	0.401	0.161	3.77	0.889
Basketball	4.230	0.734	4.410	0.733	0.180	4.25	0.548
Hockey	4.225	0.538	4.439	0.539	0.214	5.06	0.888
Kho-kho	3.934	0.557	4.140	0.576	0.206	5.23	0.813
Kabaddi	4.310	0.475	4.461	0.466	0.151	3.50	0.717
Long Jump	3.931	0.707	4.138	0.714	0.207	5.26	0.651
High Jump	4.289	0.656	4.466	0.66	0.177	4.12	0.602
Shot put	4.290	0.841	4.411	0.84	0.121	2.82	0.321
Discus Throw	4.193	0.785	4.358	0.790	0.165	3.93	0.462
Javelin Throw	4.141	0.419	4.318	0.399	0.177	4.27	0.966
All Combined	4.181	0.612	4.357	0.610	0.176	4.21	2.037

Table 14: Training effects on Three Successive Right Foot Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		**After CTP-II**				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.067	0.466	4.316	0.496	0.249	6.12	1.158
Basketball	4.241	0.595	4.462	0.586	0.221	5.21	0.833
Hockey	4.554	0.688	4.773	0.723	0.219	4.80	0.693
Kho-kho	3.957	1.215	4.201	1.213	0.244	6.16	0.449
Kabaddi	4.159	0.522	4.375	0.529	0.216	5.19	0.918
Long Jump	4.479	0.349	4.664	0.318	0.185	4.13	1.236
High Jump	4.285	0.633	4.456	0.627	0.171	3.99	0.607
Shot put	4.859	0.875	5.107	0.906	0.248	5.10	0.623
Discus Throw	4.151	0.838	4.301	0.866	0.150	3.61	0.393
Javelin Throw	3.989	0.794	4.221	0.848	0.232	5.81	0.632
All Combined	4.274	0.748	4.488	0.762	0.214	5.01	2.004

The important components of this circuit included hurdling, hopping in combination with some depth jumping also. The single leg hopping component was meant to train the subjects to jump forward as quickly as possible allowing shortest possible time for the feet to remain in contact with the ground. The other component i.e. depth jumping is recognised as most effective method for developing the reactive ability of the neuro-muscular system. The outcome of the Circuit Training Programme-I reveal maximum improvements in distance jumping in case

of kho-kho and hockey players and minimum improvement in shot put and discus throwers. The variations in the training responses may be due to the difference in the body weight of these players and athletes. Kho-kho and hockey players have lighter bodies than the throwers and it is thought that the training programme has caused similar improvements in the explosive power in the lower parts of the body of both Kho-Kho and Hockey players as well as shot-putters and discus throwers, but the gains in this faculty relative to their body weights is different, more in case of former than the latter. It may be due to these reasons that there are differences in the performance of the subjects in distance jumping.

Table 15: Training effects on Three Successive Left Foot Jump (mtrs.) as a result of six weeks CTP-I

	Before CTP-I		After CTP-I				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.392	0.368	4.577	0.352	0.185	4.21	1.148
Basketball	4.340	0.608	4.527	0.637	0.187	4.30	0.671
Hockey	4.341	0.545	4.520	0.549	0.179	4.12	0.732
Kho-kho	4.086	0.527	4.312	0.547	0.226	5.53	0.940
Kabaddi	3.927	0.476	4.123	0.506	0.196	4.99	0.892
Long Jump	4.110	0.647	4.286	0.637	0.176	4.28	0.613
High Jump	4.066	0.515	4.274	0.528	0.208	5.11	0.891
Shot put	3.938	0.624	4.100	0.657	0.162	4.11	0.565
Discus Throw	4.261	0.672	4.429	0.672	0.168	3.94	0.559
Javelin Throw	4.200	0.691	4.413	0.683	0.213	5.07	0.693
All Combined	4.166	0.568	4.356	0.577	0.191	4.58	2.346*

Table 16: Training effects on Three Successive Left Foot Jump (mtrs.) as a result of six weeks CTP-II

	Before CTP-II		After CTP-II				
Games & Events	**Mean**	**SD**	**Mean**	**SD**	**Mean Diff**	**%↑**	**'t'**
Volleyball	4.484	0.577	4.721	0.593	0.237	5.28	0.906
Basketball	4.270	0.480	4.536	0.514	0.266	6.22	1.197
Hockey	4.529	0.528	4.762	0.545	0.233	5.14	0.971
Kho-kho	3.781	0.991	4.057	1.004	0.276	7.29	0.619
Kabaddi	3.800	0.725	4.045	0.705	0.245	6.44	0.766
Long Jump	4.271	0.419	4.461	0.405	0.190	4.44	1.031
High Jump	3.880	1.171	4.066	1.191	0.186	4.79	0.352
Shot put	4.589	0.583	4.844	0.619	0.255	5.55	0.949
Discus Throw	4.389	0.683	4.615	0.685	0.226	5.14	0.739
Javelin Throw	3.929	0.760	4.143	0.759	0.214	5.44	0.630
All Combined	4.192	0.752	4.425	0.762	0.233	5.56	2.178*

In general, game players reap greater benefits of training in standing broad jump ability than the athletes. Though it is explained to some extent above, but another reason may be the fact that in some games like kho-kho and kabaddi, the game situation demands flying diving etc. which involves almost the same type of muscular action as is witnessed during the execution of standing broad jump and thus may be providing an additional stimulus for the development of forward jumping movement.

Generally speaking the CTP-II comprising only depth jumping programme has successfully produced a significant increase in almost all the jumping ability measures chosen in the present study. Such findings get the support from some previous studies *(Muthiah, 1980; Ikai et al, 1984 and Holcomb et al, 1996).* The improvements noticed can be attributed to the improvement in muscular force generation through the combined effect of voluntary contraction and involuntary contraction caused by the reflex action (myotatic). This reflex has been put to action repeatedly in the Circuit Training Programme while jumping from boxes of varying heights. Muscle spindles, the sense organ or the muscles, react to sudden stretch by sending appropriate signals to the spinal cord, which produces the stretch reflex resulting in muscular contraction to oppose this sudden stretch. The series and parallel elastic components of muscles also get stretched during the stretching phase of muscles and result in a combination of utilisation of this stored elastic energy and the force developed by the contractile machinery of the muscles. The net effect is a greater amount of work output from the stretched muscles. The six-weeks Circuit Training Programme-II has probably acted as per the above and has thus resulted in improvements in various jumping abilities included in the present study. As regards CTP-II training, the improvement in all the jumping tests concerning distance jumping, a general picture indicate a greater degree of improvement as compared to CTP-I. This may be ascribed to the fact that CTP-II programme comprised of only depth jumping. Pure depth jumping from boxes varying in heights from 15 to 45cms has therefore, proved more effective as compared to depth jumping used in combination with hopping and hurdling as in the case of CTP-I. The results are in agreement with the results reported by other researchers *(Miller, 1981; Hakkinen et al, 1985; Harvey, 1994 and Gehri et al, 1998).*

In plyometrics the most important muscular contraction is the eccentric contraction. The eccentric contraction also plays a great role in action like jumping, pushing and throwing etc. It has been established in many Soviet studies that the performance in executing a jump is not limited by the strength of the leg extensors and the spine extensors at the time of take off, but by the strength that these muscles show during their stretching. This implies that the force generated during the landing is significantly greater than during the push off stage. In other words strength needed most by the jumper is not for extension of the pushed off leg, but to prevent excessive flexion of the support leg in this stage. The Circuit Training Programmes employed in the present study not only successfully produced maximum eccentric contraction to develop maximal tension in the muscles but the continuation of the circuit for six-weeks duration conditioned the central nervous system to switch the eccentric contraction

to concentric contraction to produce the observed training effects.

Normally a volitional contraction takes approximately six to eight tenths of a second to achieve maximal contraction, however in sports the entire skill is accomplished in majority of the cases between one and two tenths of a second. Thus the key to get a maximally explosive push off is to have the muscles respond with maximal force in the shortest possible time. This is actually what the present Circuit Training Programmes employed in the present study are aiming at i.e. first causing a strong eccentric contraction followed by its conversion to a strong concentric contraction in the shortest possible span of time. Jumping from the high boxes, the legs (knees, hips and ankles) at the movement of landing bend and stretch the muscles of the respective joint.

The stretching of the muscles generates the stretching reflex also called the myotatic reflex. The speed and intensity of this reflex directly depends upon the magnitude and the quickness of the stretching produced on the muscles. The plyometric training schedules employed in the present investigation are thus acting on both the central nervous system and the muscular system in influencing the events involved in the switch over from the eccentric phase of contraction to the concentric phase. As the improvements in the ability to jump forward are witnessed to a higher degree after the CTP-II programme than after the CTP-I. It, therefore, seems that the former regimen is more effective in influencing the CNS and muscular events more effectively and accelerates the kinetics of switching over from eccentric to concentric modes of contraction. This physiological mechanism makes the Circuit Training Programme-II superior to Circuit Training Programme-I for developing the explosive muscular power in athletes and players.

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Dietary Profiles of 30 to 50 Year Females of Punjab

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Abstract

The results of the present study conducted on 400 females indicate that females especially after the middle age consume greater calories in their daily diets both total as well as in relation to their body weight and also exceed the recommended values. In addition to this the dietary composition reveals greater fat consumption as well as protein in their daily diets. The energy expenditure profiles point to positive energy balance in these group of females. All these factors are indicative of a negative life style lead by them and increase the risk of obesity and other related diseases. It is therefore felt necessary to sound the health planners regarding all these facts. Preventive measures in this regard are necessitated. These include the ingestion of healthful diets containing optimal amounts of various nutrients both major and minor as well as increase in the physical activity in their daily life.

Key Words: **Carbohydrates, Proteins, Fats, Fibres, Cholesterol, RDA**

Introduction:

Today as a result of applications of Science & Technology many significantly change in our food supply and thus food consumption have occurred. There are new varieties of edible plants, large-scale methods of agriculture and animal husbandry, rapid mean of transporting food over long distances and large scale processing and storage methods for preservation of food. The food we eat is grown and prepared away from home; with the result the agribusiness and food processing industry exert much control over the food supply. Effect of these changes in the nutritional status is visualized to be both positive and negative. Seasonal foods are available throughout the year and perishable items last longer. Nutritional quality definitely depends on all the factors *[Stafford, 1979 and Arnold & Roberts, 1982]*. In addition to this faster life in urban areas has forced the people to go for the fast food, thus leading to major nutritional drawback in their eating behavior, which include lack of variety, high calcium density, high sugar contents, high proportion of saturated fat, high sodium contents and preponderance of refined foods and lack of food sources of fibers.

In India a number of surveys conducted on diets consumption revealed that majority of population depends on cereal based diet. Because cereals being the cheapest source of calories contributed 70 – 80 percent of the total calories in diet *[Gopalan et al 1985 and Rao et al 1986]*. The consumption pattern in Andhra Pradesh was studied by *Pushpamma et al [1984]* who reported that the average intake of fruits and vegetables was below the recommended level because fruits were taken occasionally in that state.

Hira et al [1991] conducted a study on 160 farming families from 8 villages of Ludhiana district of age group 30 – 60 years. The results showed that the energy consumption was low in landless (no land) low-income group (0-5 acres) and middle-

income group (5-10 acres) but not in case of high-income group (above 10 acres). The protein intake was more than the RDA in all the groups. A number of other investigators have reported a linkage between the energy consumption and socioeconomic status of the subjects *[Hanumantha Rao, 1976; Aujla et al, 1983; Rao et al, 1986; Rao, 1987; Kang, 1990 and Nayga, 1994]*.

In general, it can be said from the above reviewed studies that deviations are reported in the daily dietary intake from the normally recommended dietary allowances in Indian females. There is a need to interpret these findings in the light of functional changes with age in females as well as changes in their lifestyle and the social environment. This is important for the middle-aged segment of females who are facing the ageing effects. The dietary survey studies thus assume significance especially when it is well known that physical activities and a good diet can reverse the process of ageing to a significant degree *[Evans and Rosenberg, 1991]*.

Keeping in view the above, the present investigation has been planned to study the dietary intake and energy expenditure profiles of middle-aged women belonging to 30-50 years age group with the following aims and objectives.

1. *To report daily dietary intake of nutrients by the females from age 30-50 years.*
2. *To study the daily energy expenditure profiles in women from 30-50 years of age.*

Materials and Methods:

The present study was conducted on 400 sedentary women ranging in age from 30 to 50 years of age and belonging to urban areas of main cities of Punjab like Ludhiana, Patiala and Amritsar, where the impact of mechanisation is likely to be very great on physical activity and nutritional habits of the population. To study the changes in the dietary profiles and energy expenditure profiles through middle age in the females, the subjects have been divided into four, 5 yearly age groups as under:

Age Group (Years)	No of subjects (N)	Age range (Years)	Mean Decimal Age (Years)
30-35	100	30.00 - 35.00	32.39
35-40	100	36.00 - 40.00	38.43
40-45	100	41-00 - 45.00	43.22
45-50	100	46.00 - 50.00	48.46

Three days consecutive dietary record of each subject was taken and fed into the computer for dietary analysis of food for composition of its nutrients with the help of Dine Healthy software.

Results & Discussion:

Daily Energy Intake:

Table 1: Mean values of daily energy intake and expenditure

		Energy Intake Cal	Energy Expenditure Cal
Group – I (30-35 Yr)	Mean ± S.D.	1911 ±182	2049 ±229
Group – II (35-40 Yr)	Mean ± S.D.	1943 ± 128	2067 ± 163
Group – III (40-45 Yr)	Mean ± S.D.	2057 ± 117	2005 ± 153
Group – IV (45-50 Yr)	Mean ± S.D.	2118 ± 111	1923 ± 189

Average daily energy intake has been observed to increase with increase in

age. Group – I (30 – 35 year) females on an average consume 1911 Cal in their daily diet that increase to 2118 Cal in the age Group – IV (45 - 50 year), thus demonstrate an increase of 10.8% (Table 1).

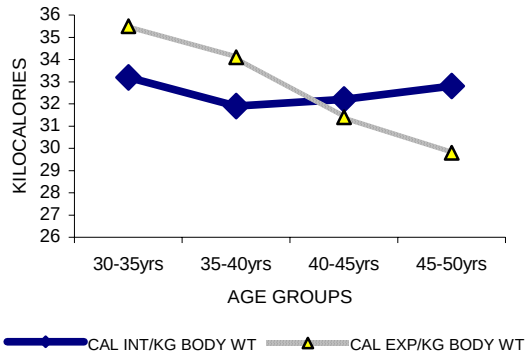

Figure 1: Average caloric intake and expenditure of females in relation to body weight in different age groups

In statistical terms, significant differences can be noticed in the daily energy intake among the various age groups (Table 8). On expressing the daily energy intake in relation to body weight of the females, a general trend of slow decrease is observed with increase in age (Figure 1). As per the NIN recommendations for Indian women, the daily energy intake by the females between 30 to 40 years has been found to be in agreement but beyond 40 years the present group of females exhibit 10 to 13% higher calorie intake in their daily diets. Mean daily energy intake values observed in the present study compares with the findings of some earlier investigators on Punjabi women. *[Ahluwalia, 1981; Puri et al, 1983; Kaur, 1992; Chadha,, 1996 & Mann et al, 1997].*

Daily Energy Expenditure:

Comparable mean values of daily energy expenditure are observed in the females belonging to the first two age groups. After the age of 40, the total daily energy expenditure is observed to decrease with increase in age in the present study. Statistically significant differences are recorded among the various age groups in this parameter (Table 8). After accounting for the increase in body weight by expressing the daily energy expenditure per kg body weight of the subjects, a gradual decrease in energy expenditure with the increase in age is observed (Figure 1). It is interesting to observe that females in the first two age groups spend more calories in relation to their body weight than what they consume. In the subsequent age groups i.e. 40 to 45 and 45 to 50 years, the opposite is found to be the case. This means that after the age of 40 years the females tend to have a positive energy balance which if maintained for a long period can lead to further weight gain in them.

Stamler [1993] reported that high daily energy intake is a major factor in the development of obesity in western societies. Many researchers have confirmed in their studies that if the daily diet contain high amount of dietary fat, tendency to gain weight develops more easily *[George et al, 1990; Kendall et al, 1991; Scotellaro et al, 1991; Sheppard et al, 1991; Tremblay et al, 1991; Thomas et al, 1992; Hill et al, 1992; Klesges et al, 1992; Tucker & Kano, 1992; Gazzaniga & Burns, 1993 & Lawton et al, 1993].* However they further report that when the intake of carbohydrates and fiber is high, it is easier to lose body weight.

Dietary Intake Profiles of Females Grouped By Age

The daily dietary intake of total fat by 30 – 35 year females is found to be 69.43gms and increase to 86.12gms/day in 45 to 50 year females. In terms of percentage, the increase calculates to 24%. An analysis of the breakup of total fat consumed in terms

of its saturated and unsaturated fat components, reveal that saturated fat component consumed by the females belonging to various age groups constitute 33 to 38% of the total fat. The rest of the fat consumed by the females is found to be in the form of Mono and Polyunsaturated fats. A similar analysis of the dietary intake of fat of the females belonging to the present study has been done for the animal and plant fat components. The results reveal that younger females (30 to 35 years age group) consume animal and plant fat almost in equal proportion but with increase in age, a general trend of increase in the consumption of fat derived from animal sources is demonstrated by the females (Figure 2).

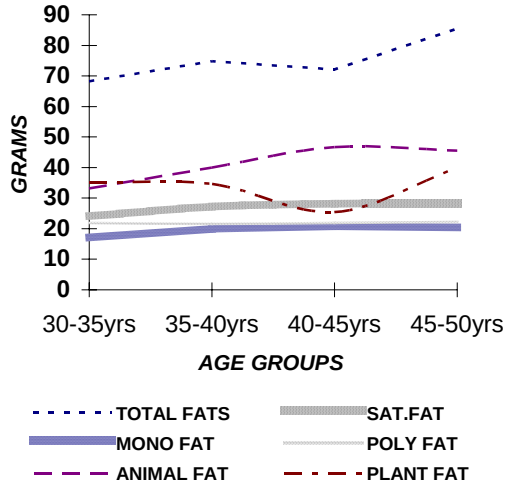

Figure 2: Average consumption of various components of fat by different age groups

Table 2: Daily dietary intake of fats among females belonging to different age groups

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	**Mean ± S.D.**	**Mean ± S.D.**	**Mean ± S.D.**
Tot Fats (gm)	69.43 ± 7.59	77.00 ±6.45	74.49 ±6.88	86.12 ±7.13
Saturated Fats	24.78 ± 4.22	28.12 ± 3.99	28.99 ± 4.11	28.67 ± 4.46
Monounsat Fats	17.47 ± 2.08	20.70 ± 2.66	21.18 ± 2.90	20.98 ± 2.89
Polyunsat Fats	21.96 ± 3.34	22.02 ± 2.67	22.56 ± 2.87	22.75 ± 2.72
Animal Fats	34.54 ± 6.48	41.05 ± 5.66	48.13 ± 6.90	45.59 ± 6.94
Plant Fats	34.89 ± 4.69	35.94 ± 5.19	26.35 ± 5.53	40.53 ± 5.08
Cholestrol (mg)	122.85 ±30.71	148.97 ±23.81	152.75 ±22.67	151.77 ±23.70

As far as the plant fat is concerned, its average remains the same for the 35 – 40 years age group and with further increase in the age, the consumption of this component of fat decrease in the 40 – 45 years age group, followed by an increase again to an average value 45.59gms/day in the last age group. In general, the consumption of animal fats by females from 30 to 35 years remains higher than the daily plant fat consumed by them. (Table 2 and Figure 2)

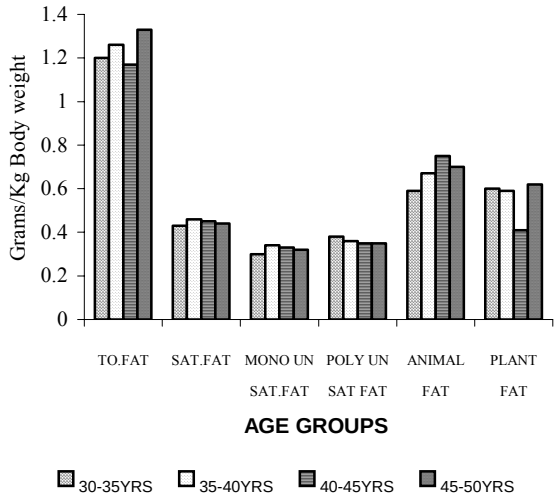

Figure 3: Comparison of consumption of total fat and its components among females

To account for the increase in body weight from age 30 to 50 years, the total fat consumed per day as well as the dietary

consumption of the various components of fat has been expressed in relation to the body weight of the subjects. (Figure. 3) In spite of the fact that the total fat and one of its components i.e. animal fat has been expressed in relation to the body weight of females, an increase in both is witnessed with increase in age. As far as the other components are concerned, their weight expressions reveal comparable average values in the different age groups.

Table 3: Percentage contribution of daily dietary intake of fats to total energy intake

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Tot Fats (gm)	32.80 ± 3.37	35.75 ± 2.98	32.57 ± 2.15	36.60 ± 2.27
Saturated Fats	11.64 ± 1.48	13.09 ± 2.13	12.69 ± 1.68	12.19 ± 1.79
Monounsat Fats	8.22 ± 0.84	9.61 ± 1.26	9.27 ± 1.22	8.92 ± 1.22
Polyunsat Fats	10.42 ± 1.97	10.21 ± 1.12	9.87 ± 1.19	9.68 ± 1.14
Animal Fats	16.21 ± 2.31	19.11 ± 3.15	21.07 ± 2.85	19.37 ± 2.74
Plant Fats	16.58 ± 2.91	16.63 ± 1.98	11.50 ± 2.22	17.25 ± 1.96

Fats are known to be the most concentrated source of energy and are responsible for various important functions in the body, which include insulation, cushioning and absorption of fat-soluble vitamins. The contribution by the total fat and its various components to the total energy has been calculated and average values along with the related statistical information are given in Table 3,9&10. The average contribution of total fat towards the total energy intake has been observed to increase with increase in age of females. Group - I females on an average are observed to derive 32.8% energy from total daily dietary fats. This value increases with age to the extent that females belonging to 45 to 50 years age group derive 36.6% energy from fats. The energy derived from the daily dietary consumption of saturated fats has been found to be 11.64%, 13.09%, 12.69% and 12.19% in groups I, II, III & IV respectively (Figure 4).

Health experts recommend that fat energy should not exceed 25 to 30% of the total Calories, with no more than 7 to 10% of that coming from saturated fat. The results pertaining to the present study indicate that on an average the females of the present study in all the age groups consume a far greater amount of fats in their diet (Figure 5).

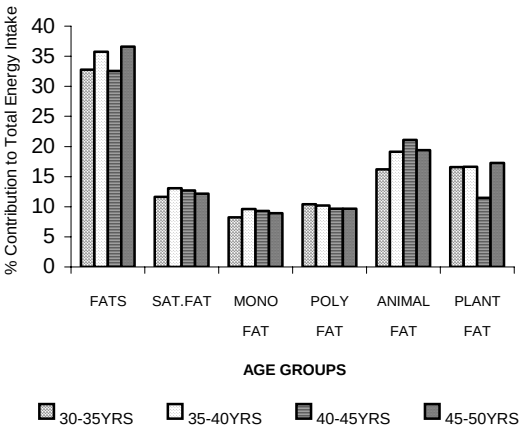

Figure 4: Percent contribution of total fat & its various components to total energy intake

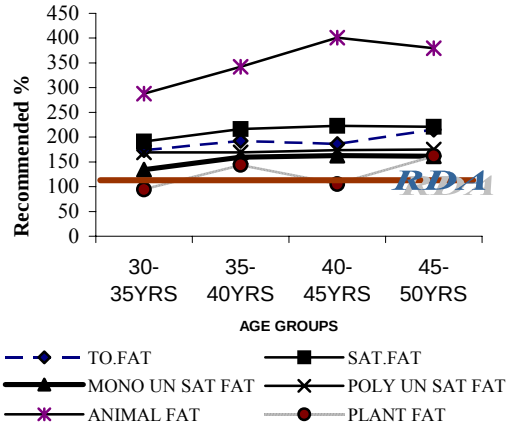

Figure 5: Dietary fat intake expressed as percent of RDA

High fat diet has been shown to be associated with weight gain *[Prewitt et al, 1991].* A clear trend of increase in fat intake by the females with increase in age makes them more vulnerable to weight gain. Moreover, the high quantity of fat in the diet is also reported to be linked with a number of diseases like High Blood Pressure, Coronary Heart Disease, Diabetes, and Cancer etc. Controlling the amount of saturated fats in the diet is the most important diet related action required to be taken to limit the levels of cholesterol. In blood, elevated levels of cholesterol are associated with increased risk of premature heart disease. As a preventive measure it is strongly suggested that these females should minimize their saturated fat intake. This is especially true for those who have high blood cholesterol levels i.e. more than 200mg/100ml of blood.

In the present investigation, the dietary intake of cholesterol among the various age groups of females has also been evaluated. The intake of dietary cholesterol has been found to range between 122.85mg to 152.75mg in the various age groups (Table 2). Health experts suggest daily dietary cholesterol consumption of less then 300mg/day. As per this guideline the females of the present study consume less cholesterol in their diets. *Sempos et al, [1993]* have reported 450mg/day dietary cholesterol in the U.S. population. Cholesterol is an essential metabolite and actively synthesized by human body in an amount equal to 800 to 1500mg daily. In contrast to many species, man absorbs cholesterol poorly; permitting the entry of only 10 to 50 percent of that in the diet According to *Giles et al [1993],* there is a curvilinear relationship between dietary cholesterol and serum cholesterol concentration in man. He further showed that the modification of diet with respect to the level of fat, kind of fat and amount of dietary cholesterol could cause the alteration in serum lipid and lipoprotein concentration in humans. According to him, a high intake of saturated fat is a major factor in elevating serum cholesterol and low-density lipoproteins (LDL) levels. He further demonstrated that a high intake of polyunsaturated fat is important in the lowering of serum cholesterol levels. *Connor et al [1978]* also hold the view that saturated fats, polyunsaturated fat and cholesterol in the diets can affect serum cholesterol concentrations.

American Heart Association (1988) has recommended that dietary lipids should be reduced to less than 30 percent of calories and that the ratio of polyunsaturated to saturated fat (P: S) be changed to a ratio of about 1.0 in order to achieve lower cholesterol levels in the population. The P: S ratio has been calculated in the different age groups of females in the present study to assess them as per the above guidelines. It is heartening to know that this ratio is quite close to the recommended value of 1.0. Females of the present study in general, consume polyunsaturated fats and saturated fats in the ratio of 0.78, which is very close to one and is much higher than the value of 0.4 reported on American population. There is still a scope of further improvement in the consumption of dietary fats so that the P: S ratio of 1.0 could be achieved on female population of Punjab, so as to keep them free from the risk of arteriosclerosis.

Daily Dietary Intake of Carbohydrates:

Average total carbohydrates consumed in the diet by group - I (30 - 35 years) are found to be 273.83gms and with increase in age of the subjects no trend of

either increase or decrease is witnessed (Table 4 & Figure 6). However when the total carbohydrates taken in the diet by the females belonging to various age groups are expressed in relation to their respective body weights, a general trend of decline is seen (Figure 7).

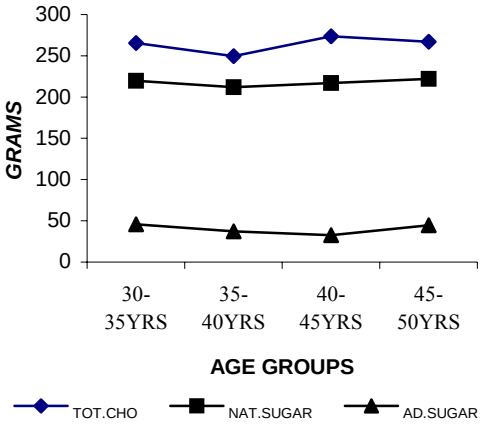

Figure 6: Average consumption of different components of carbohydrates

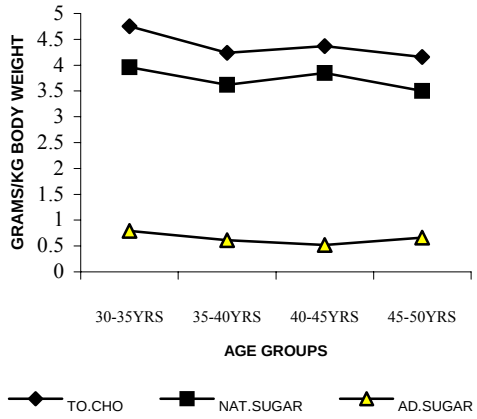

Figure. 7: Average consumption of different components of carbohydrates/kg body wt

Table 4: Mean values of daily dietary intake of carbohydrates

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Tot Carbohyd	273.83 ± 35.80	257.75 ±28.07	279.45 ±23.20	268.62 ± 0.81
Net Sugar	228.13 ± 32.60	220.29 ±26.15	245.96 ±21.70	225.81 ±20.12
Added Sugar	45.69 ± 13.38	37.46 ±10.73	33.48 ±12.38	42.81 ±10.58
Dietary Fibre	31.98 ± 6.17	36.69 ± 4.99	37.98 ± 5.20	67.01 ± 7.81

Table 5: Percentage contribution of dietary carbohydrates to total energy intake

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Total Carbohyd	57.25 ± 4.74	52.93 ± 3.78	54.32 ± 3.05	50.57 ± 2.52
Net Sugar	47.61 ± 4.04	45.22 ± 4.00	47.80 ± 2.96	42.65 ± 2.61
Added Sugar	9.64 ± 2.81	7.70 ± 2.17	6.51 ± 2.47	8.12 ± 2.05

Group - I females, on an average, are found to derive approximately 57% of their energy from carbohydrates while a similar contribution in case 35 - 40, 40 - 45 and 45 - 50 year age groups calculated to 52%, 54% and 50% respectively (Table 5 & Figure 8).

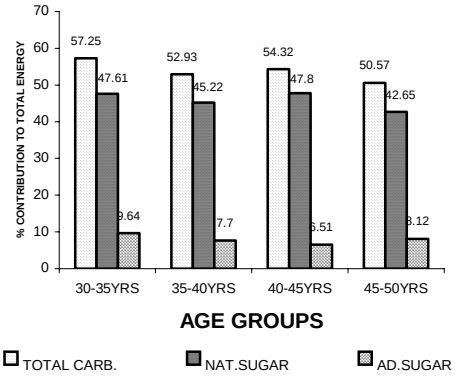

Figure 8: Percent contribution of carbohydrates and its components to total energy intake

The consumption of various components of carbohydrates taken in the

diet by females of the present study has also been analyzed. In general, females consume in their daily diet higher amounts of natural sugar as compared to the added sugar (Figure 8 & Table 11, 12). Group – I subjects consumed natural sugar and added sugars in the ratio of 5:1 and this ratio increases in group – II and group – III subjects to 5.9:1 and 7.4:1 respectively. In the group - IV subjects, the ratio declines to 5.3:1 in the females. Natural sugar consumption in general, is found to be comparable among different age groups. In terms of RDA (Recommended Dietary Allowances) for carbohydrates as per American Guidelines (Dine Healthy System) the consumption of total carbohydrates has been found to be normal. Natural sugar consumption on the other hand is found to fall short of RDA as per Dine Healthy System in all the age groups except 40 to 45 years age group Figure 9). The consumption of natural sugar however is found to far exceed the recommended values in all the age groups.

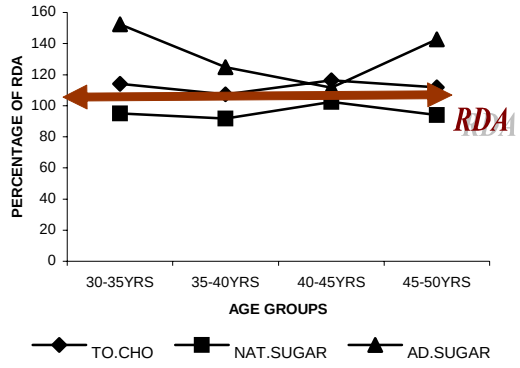

Figure. 9: Dietary intake of carbohydrates expressed as percent of RDA

As far as the added sugar consumption is concerned, less than 10 % of the caloric intake is due to the added sugar in the diet, which is with in the normal range of up to 10 % recommended *[Lank, 2000]*. This is a healthy trend observed in the dietary analysis pertaining to the present study, as sugar provides nothing but empty calories and tend to crowd other nutrients out of the diet. More so, it promotes tooth decay and can contribute to weight gain.

Dietary fiber consumption in the group – I subjects, is found to be 32gms, which increases to 36.7 and 38gms/day in-group – II and group – III subjects respectively. In the last group i.e. 45 to 50 years, the daily dietary fiber consumption is found to increase tremendously to exhibit a mean value of 67gms, which is almost 76% more than the females belonging to group – III. Expression of daily dietary fiber consumption in relation to the body weight of the subjects, in the various age groups, demonstrate the same pattern as given above (Figure 10).

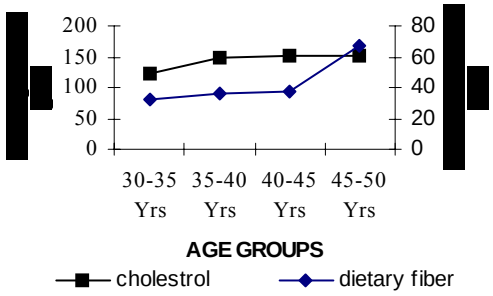

Figure 10: Average consumption of dietary fibres and cholesterol by females of different age groups

Figure 11: Comparison of dietary fibre and cholesterol intake by females grouped age

Dietary fiber, commonly known as "Bulk" or "Roughage" consists of carbohydrate plant substances that are difficult or impossible for the humans to digest. Instead, fiber passes through the intestinal tract and provides bulk for feces in the large intestine, some types of fibers are broken down by bacteria into acids and gases which explain why consuming too much fiber can lead to intestinal gas. Nutritionists classify dietary fibers as soluble or insoluble. Soluble fibers slow the body's absorption of glucose and bind cholesterol containing compounds in the intestine, lowering blood cholesterol level and reduce the risk of cardiovascular diseases. On the other hand insoluble fibers bind water, making the feces bulkier and softer, so they pass more quickly and easily through the intestine.

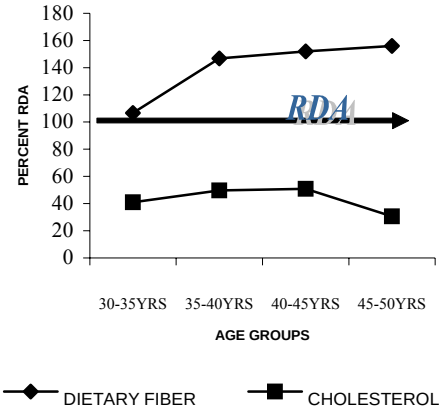

Figure 12: Dietary intake of fibre and cholesterol expressed as percent RDA

As per the recommendations of Dine Healthy System, an intake of 20 to 35gms/day of dietary fibers in the diet is considered good. The first three age groups of the study comprising of females from age 30 to 45 years consume the dietary fiber within the range of 20 to 35gms, but females belonging to the last age group takes dietary fibers much in excess of the recommendation of the Dine Healthy System. There is no doubt that diet high in dietary fiber can help to prevent a variety of health problems including Constipation, Hemorrhoids and Diverticulitis. In addition to this some studies have linked high level of insoluble fiber in the diet with lower incidence of colon and rectal cancers. These subjects are therefore protected from the risk of running the above said diseases. The last group, comprising of females falling between the age range of 45 to 50 years, are observed to consume too much fiber (67gm/day) and thus are exposed to some medical problems such as large stools along with malabsorption of important minerals. It is therefore felt that for the fiber intake, as in all aspects of nutrition, balance and moderation as the key principle should be kept in mind.

Daily Dietary Intake of Protein:

Mean values of daily total dietary protein taken by females belonging to various age groups with their related statistical derivatives are presented in (Table 6, 13 &14).

Table 6: Dietary intake of Proteins

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Tot Prot	47.70 ± 12.76	54.64 ± 5.28	67.27 ± 8.77	67.01 ± 7.81
Animal Protein	25.85 ± 6.38	24.29 ± 3.45	30.18 ± 8.95	30.28 ± 7.43
Plant Protein	21.85 ± 6.38	30.34 ± 3.78	37.09 ± 5.76	36.73 ± 5.26

On an average, 30 to 35 year age group females consumed 47.7gms of protein per day in their daily diet. The daily consumption of protein show a trend of increase with increase in age, so much so that 40 to 45 year old females consumed about 42% more protein in their daily diets

than the 30 – 35 year age group females (Figure 13).

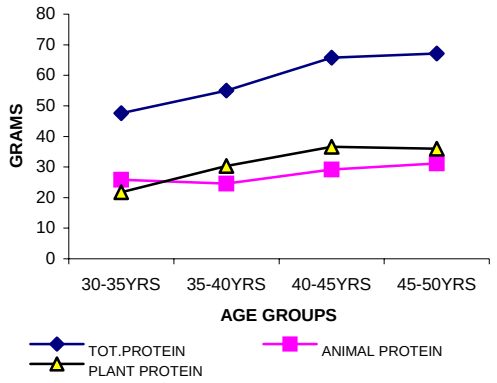

Figure 13: Average consumption of proteins in different age groups

This may be linked to the increase in body weight of these subjects with increase in age as has been reported earlier in the results. On accounting for the changes in body weight witnessed with increase in age, the daily protein consumption per kg of body weight reveal again a trend of general increase in protein consumption (Figure 14).

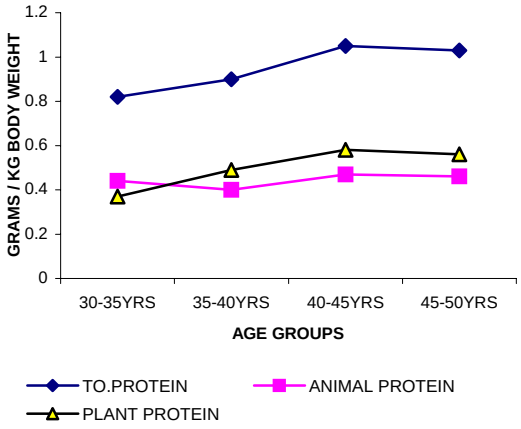

Figure 14: Comparison of protein consumption in females grouped by age

The contribution of proteins to the total energy intake reveals a mixed trend. Group I subjects are observed to contribute 9.9 % to the total energy intake which increases to 11.3 % and 13.1 % for group – II and group –III subjects respectively. In group – IV i.e. females falling in the range of 45 to 50 years, the contribution of protein energy is observed to fall slightly to 12.6 percent (Figure 15).

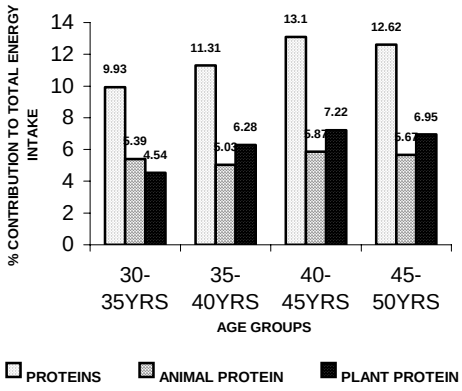

Figure 15: Percent contribution of proteins and its components to total energy intake

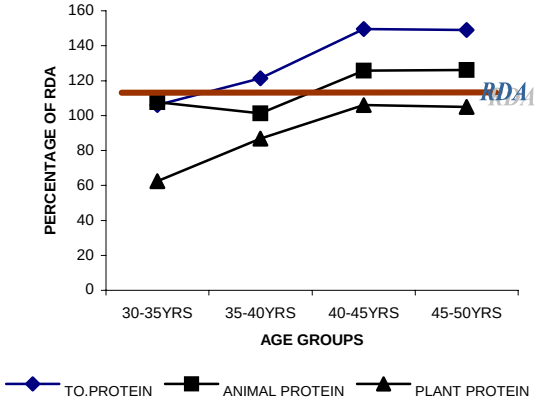

Figure 16: Dietary intake of proteins expressed as percent of RDA

Table 7: Percentage contribution of proteins towards total dietary energy intake

	(30-35 Yr)	(35-40 Yr)	(40-45 Yr)	(45-50 Yr)
	Mean ±S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Tot Prot	9.93 ± 2.34	11.31 ± 1.48	13.10 ± 1.75	12.62 ± 1.41

Animal Protein	5.39 ± 1.16	5.03 ± 0.85	5.87 ± 1.77	5.67 ± 1.33
Plant Protein	4.5 4± 1.18	6.28 ± 0.93	7.22 ± 1.13	6.95 ± 1.02

Protein is contained in the food from both animal and plant sources. Hence humans determine their supply of amino acids from these two sources. However, the human body cannot synthesize all amino acids and those amino acids that cannot be manufactured in the body are called essential amino acids and therefore must be present in diet consumed by the humans. It should be kept in mind that all 20 amino acids are necessary and must be present simultaneously for optimal maintenance of body growth and functions. In general, the protein we ingest from animal products is superior to those found in plants. The reason for the superiority of animal proteins over the plant proteins is (i) it contain all the essential amino acids, (ii) it contain all the essential amino acids in the proper proportion. Hence having the proper amount of animal protein in diet is the good way to ensure to receiving balance amount of amino acids and excellent sources include milk, cheese, meat and eggs. On the other hand proteins usually exist in smaller concentration in plant and may be lower in several of essential amino acids. Consequently most plant foods individually are unable to meet our nutritional needs. It is interesting to observe that amount of animal protein consumed by 30 to 35 year females is found to be higher as compared to the consumption of plant protein by them. In subsequent age groups, opposite trend is found i.e. females go for higher intake of plant proteins than the animal proteins in their daily diets. In relation to the body weight, the females belonging to the four age groups, exhibit the same trend as is observed for the total amount of both animal and plant proteins. Most probable reason for the shift from higher animal protein consumption to higher plant protein consumption with the increase in age may be ascribed to the social and cultural factors prevailing in the Indian society. It is thought that so far the subjects belonging to the present study continue to consume plant food in proper combination that can provide a balanced supply of amino acids there is no need to worry on this account. An example of good combination of plant food that represents a complete protein is that of grain products and beans such as rice and bean. This balanced intake is extremely important for those practicing strict vegetarian habits.

After protein is digested in the body, the amino acids are generally utilized to form body tissues and other protein substances, such as enzyme and carbose. There is a word of caution for the subjects of the present study that any excess protein, which is consumed in the diet, may be converted to glucose or fatty acids and protein waste product may be excreted as urea. Fortunately, the amount of protein found in the first two age groups meets with the recommended dietary allowances given by Dine Healthy System. However group – III and group – IV females i.e. those falling in the age range of 40 to 50 years are observed to exceed the recommended dietary allowances (RDA) by almost 50% (Figure16). The excess protein consumption by them may be getting accumulated in the form of fat and this is actually what has been seen in these subjects who are found to possess a very high percentage of fat in their body. A simultaneous high consumption of animal protein along with substantial amount of saturated fat and cholesterol may thus pose severe health problems. Some people argue that excess protein even has direct catabolic

effect on bones due to increased endogenous acid production and they point to increase urine calcium levels, especially after animal protein consumption These females need to be advised to reduce the intake of fat while maintaining adequate protein intake. To cite an example, a glass of whole milk and glass of skimmed milk both have about 8 gm of protein but whole milk has 8 gm of fat compared to only 1 gm or less of fat in the skim milk. Thus drinking a glass of skimmed milk instead of whole milk help to reduce fat intake by 7gms and save about 60 calories.

Table 8: Comparison of Mean Daily Total energy intake and Daily Total Energy Expenditure among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Caloric Intake, Cal	1.41	6.75*	9.70*	6.59*	10.32*	3.73*
Total Energy Expenditure, Cal	0.64	1.58	4.22*	2.75*	5.75*	3.36*

* Stands for statistically significant 't' values at 0.05

TABLE 9: Comparison of mean values of daily dietary intake of fats among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Fats (gm)	7.50*	4.93*	16.02*	2.65*	9.48*	11.73*
Saturated Fats	5.74*	7.13*	6.31*	1.51	0.91	0.52
Monounsaturated Fat	9.62*	75.85*	9.91*	13.08*	0.70	12.84*
Polyunsaturated Fat	0.20	1.43	1.89	1.39	1.92	0.47
Animal Fat	7.55*	14.30*	11.64*	7.93*	5.06*	2.60*
Plant Fat	1.49	11.68*	8.00*	12.63*	6.31*	18.87*
Cholestrol (mg)	6.56*	7.65*	7.28*	1.14	0.83	0.29

* Stands for statistically significant 't' values at 0.05

Table 10: Statistical Comparison of %age contribution of daily dietary intake of fats to total energy intake among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Fats (gm)	6.54*	0.55	9.34*	8.61*	2.26*	12.84*
Saturated Fats	5.58*	4.65*	2.34*	1.49	3.25*	2.03*
Mono Fat	9.16*	7.07*	4.71*	195	3.92*	2.00*
Poly Fat	0.92	2.34*	3.24*	2.01*	3.29*	1.19
Animal Fat	7.41*	13.22*	8.80*	4.59*	0.61	4.28*
Plant Fat	0.13	13.86*	1.81	17.17*	2.11*	19.21*

* Stands for statistically significant 't' values at 0.05

Table 11: Statistical comparison of daily dietary intake of Carbohydrates among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Carb (gm)	3.55*	1.31	1.25	5.95*	3.11*	3.47*
Nat Sugar	1.85	4.51*	0.59	7.49*	1.65	6.80*
Added Sugar	4.80*	6.72*	1.69	2.42*	3.54*	5.71*
Dietary Fiber	5.99*	7.46*	9.42*	1.79	3.54*	1.51

* Stands for statistically significant 't' values at 0.05

Table 12: Statistical comparison of %age contribution of daily dietary intake of carbohydrates to total energy intake among females belonging to different groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Carbohydrate (gm)	7.12*	5.20*	12.11*	2.85*	4.82*	9.00*
Nat Sugar	4.19*	0.38	10.36*	5.17*	5.43*	13.10*
Added Sugar	5.43*	8.35*	4.42*	3.62*	1.30	4.91*

* Stands for statistically significant 't' values at 0.05

Table 13: Statistical comparison of mean values of daily dietary intake of Proteins among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Protein (gm)	5.02*	12.63*	12.90*	12.32*	13.11*	0.21
Animal Protein	2.14*	3.93*	4.52*	6.13*	7.30*	0.09
Plant Protein	11.45*	17.72*	17.97*	9.78*	9.84*	0.46

* Stands for statistically significant 't' values at 0.05

Table 14: Statistical comparison of %age contribution of daily dietary intake of proteins to total energy intake among females belonging to different age groups

Parameters	Groups I & II	Groups I & III	Groups I & IV	Groups II & III	Groups II & IV	Groups III & IV
Total Protein (gm)	4.95*	10.79*	9.85*	7.77*	6.47*	1.86
Animal Protein	2.48*	2.27*	1.80	4.27***	4.16***	0.66
Plant Protein	11.50*	16.34*	15.40*	6.41*	4.82*	1.81

* Stands for statistically significant 't' values at 0.05

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Fat Distribution after a Conditioning Programme in Males & Females

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Abstract

The purpose of this study was to examine the distribution of subcutaneous fat in young adult physically active males (N=50) and females (N=50) aged 18-24 years, before and after a 90 day's conditioning programme-consisting of exercises targeted to improve flexibility, strength, and cardiorespiratory endurance. The results show that the distribution pattern of subcutaneous fat in the form of skinfold thickness in males is subscapular (maximal) followed by calf, triceps, suprailiac, biceps (minimal) and in females suprailiac (maximal) followed by triceps, subscapular, calf and biceps (minimal). The subcutaneous skinfold thickness from the observed body sites significantly decreased (except subscapular in females) with the progression of a conditioning programme but it could not change the preconditioning distribution pattern of subcutaneous fat in both males and females. Whereas the body Fat% significantly decreased (before 23.87±3.20 & after 20.86±2.41) and the LBM% significantly increased (before 76.00±3.20 & after 79.14±2.80) only in females after a 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 increases the total lean body mass [LBM] both in males and females.

Key Words: **LBM, Subcutaneous Fat, Skinfolds, Bioelectrical Impedance**

Introduction:

Conditioning programme related changes in body composition are of increasing interest because they hold important implications for nutritional status, functional capacity, and risk for chronic diseases. Typically, there is an increase in body weight from ages 20 to 50 yr, followed by a modest decline after age 70 yrs *(Borkan et al., 1983 and Silver et al., 1993)*. Fat free body mass (or Lean Body Mass [LBM]) has been reported to decline by 25 to 30% between ages 30 and 70 yr *(Fleg and Lakatta, 1988; Flynn et al., 1989; Grimby and Saltin, 1983; Smith & Serfass, 1981)* in conjunction with an increase in fat mass. Decreases in work capacity *(Shock, 1962)* and muscular strength *(Flynn et al., 1989; Grimby and Saltin, 1983; Smith and Serfass, 1981)* with aging, associated with these changes in body composition, could affect the ability to perform daily activities such as walking *(Bassey et al., 1992)* and lifting *(Jette and Branch, 1981)*. Ultimately, these could result in decreased mobility and a decline in the health and physical performance capabilities of an individual.

The accumulation of body fat with aging tends to be distributed in a typical pattern for males *(Schwartz et al., 1990)* a large part of the increase occurs at the central sites, in the Omentum, and in the organs in which fat replaces parenchyma *(Kenney, 1985)*. Subcutaneous fat tends to be lost peripherally from the limbs but

increases in the trunk *(Despres et al., 1990 and Kohrt et al., 1992).* There is evidence that increases in fat mass especially the central depots, may be associated with greater risk for chronic diseases and metabolic disorders such as hypercholesterolemia, insulin resistance, atherosclerosis, hypertension, and diabetes *(Despres et al., 1990).*

Previous studies *(Schwartz et al., 1990 and Kohrt et al., 1992)* have compared body composition parameters in young groups versus an older group. One problem with this research design is that it does not allow for examination of patterns or trends over the whole age range in both males and females. It is of interest, therefore, first to see the patterns in subcutaneous fat distribution with adequate representation of subjects from young age 18-24 years of both males and females before the start of a conditioning programme, secondly to observe whether the conditioning programme brought any change in the distribution pattern of subcutaneous fat and thirdly, to investigate the magnitude of change in the total body Fat% and LBM% at the end of the conditioning programme in both males and females.

Materials and Methods:

Subjects: Fifty males and fifty females apparently healthy, from 18 to 24 yr of age volunteered as subjects. The subjects were physically active but not involved in any specific physical training programme.

Method*:* The body weight and subcutaneous skinfolds from selected sites (biceps, triceps, subscapular, suprailiac and calf) was measured before and after the completion of first and second mesocycle of the conditioning programme using standard techniques given by *Tanner et al (1981).* Body composition was determined with the help of bioelectrical impedance analysis with a RJL system BIA-106 spectrum analyzer using the standardized protocol described in the user reference manual (RJL systems, Detroit, MI, 1987).

Design of the Conditioning Programme

The conditioning programme lasted for 90 days and comprised of two mesocycles, of 45 days each. The first mesocycle consisted of exercises targeted to improve static flexibility and cardio-respiratory endurance while the second mesocycle included those exercises, which could improve dynamic flexibility, muscular strength and endurance. The exercise regimen was administrated to the subjects in the morning, five days a week and the duration of each session was kept about 45 minutes.

Testing Protocol

The body weight, selected skinfold thickness, Fat% and LBM% were recorded at the following stages: -

Pre-Test [PT] - before the start of a conditioning programme.

Post-Test I [PT-I] - after the completion of first mesocycle (45days).

Post-Test II [PT-II] - after the completion of second mesocycle (90days).

Effort was made, wherever possible for keeping the timing of the day of measurement of pre and post conditioning tests same for each subject.

Statistical Analysis:

The data was statistically analyzed by using the SPSS X software. Means are expressed as mean ± standard deviation (SD). The ANOVA and Scheffe Post hoc tests were used to derive the results. A significant level of 0.05 was applied in all statistical analysis.

Results:

Among the measured body sites for skinfold thickness in the males during pre test, the thickest followed by the thinnest pads of subcutaneous fat were found in the sub scapular (9.10mm) then followed by calf (8.91mm), triceps (7.06mm), suprailiac (5.51mm) and the biceps (4.94mm) regions, and in case of females, these were found in the suprailiac (16.83mm), triceps (14.46mm), subscapular (13.53mm), calf (12.78mm) and the biceps (5.86mm) regions respectively during the pre conditioning (Table 1). In terms of percentage, maximum subcutaneous fat mobilization was noticed from the calf region (34.56%) followed by subscapular (31.97%), biceps (26.51%), triceps (25.07%), suprailiac (22.50%) in males and in case of females the triceps (11.27%) was followed by subscapular (11.08%), suprailiac (10.33%), calf (10.01%) and biceps (8.36%) at the end of a second mesocycle that is after 90 days.

It is also found that the subcutaneous skinfold thickness value on various body sites is more in females than in males before as well as after the conditioning programme but when percentage of maximum subcutaneous fat mobilization was compared between the pre test and post-test II then the magnitude of mobilization was more in males than in females.

Table 1 Descriptive Statistics of Subjects - Mean (standard deviation)

Variable (s)	Pre Test		Post Test-I		Post Test-II	
	Male	Female	Male	Female	Male	Female
Biceps Skin fold (mm)	4.94 ± 0.05	5.86 ± 0.82	3.8 ± 0.47	5.78 ± 0.71	3.63 ± 0.44	5.37 ± 0.66
Triceps Skin fold (mm)	7.06 ± 1.57	14.46 ± 2.64	6.13 ± 1.12	14.12 ± 2.58	5.29 ± 0.91	12.83 ± 2.62
Sub Scapular Skin fold (mm)	9.10 ± 2.29	13.53 ± 3.43	7.86 ± 1.66	13.26 ± 3.37	6.19 ± 1.32	12.03 ± 3.53
Suprailiac Skin fold (mm)	5.51 ± 1.68	16.83 ± 3.32	4.87 ± 1.09	16.50 ± 3.26	4.27 ± 0.74	15.09 ± 3.17
Calf Skin fold (mm)	8.91 ± 2.95	12.78 ± 1.56	7.53 ± 2.08	12.47 ± 1.56	5.83 ± 1.30	11.50 ± 1.74
Body weight (Kg)	62.31 ± 6.53	50.72 ± 3.60	60.23 ± 6.75	48.89 ± 3.69	61.27 ± 6.61	50.05 ± 3.48
LBM%	80.16 ± 5.50	76.13 ± 3.20	81.51 ± 5.65	77.62 ± 2.89	82.3 ± 5.44	79.14 ± 2.80
FAT%	19.83 ± 5.50	23.87 ± 3.20	18.48 ± 5.63	22.37 ± 2.89	17.7 ± 5.36	20.86 ± 2.41

After the completion of first mesocycle, there was a decrease in the mean value of total body weight both in males (from 62.31 Kg to 60.23 kg) and females (50.72 Kg to 48.89 Kg) (Table 1). But at the end of second mesocycle the total body weight was found to increase (from 60.23 Kg [during post test I] to 61.27 in males and from 48.89 Kg [during post test I] to 50.05 Kg in females). In spite of this increase in the mean value of total body weight, it was still lower than the pre test value. On the other hand, LBM % increased after the completion of first mesocycle (from 80.16% to 81.51% in males and 76.13% to 77.62% in females) and this trend of increase was persisted till the end of second mesocycle (from 81.51% to

82.3% in males and 77.62% to 79.14% in females)

In terms of percentage, after the end of the conditioning programme total body weight & Fat% decreased by 1.66% & 2.13% and LBM % increased by 1.14% in males and in case of females body weight and body Fat% decreased by 1.32% & 3.01% and LBM% increased by 3.01% but in spite of this decrease in the total body weight, the contribution of LBM % increased & that of Fat% decreased with the progression of a conditioning programme & the net effect was a gain in the total body weight at the end of second mesocycle.

Table 2 Analysis of Variance of Skin folds, Fat%, LBM% and Body Weight

Variable (s)		Sum of Squares		F	
		Male	Female	Male	Female
Biceps	Between Groups	6.81	6.93	7.41*	6.38*
	Within Groups	67.55	79.76		
Triceps	Between Groups	78.21	74.39	25.580*	5.42*
	Within Groups	224.72	1007.11		
Subscapular	Between Groups	213.54	63.80	32.75*	2.68
	Within Groups	479.25	1748.67		
Suprailiac	Between Groups	38.21	85.68	12.52*	4.04*
	Within Groups	224.20	1557.66		
Calf	Between Groups	237.46	44.67	24.06*	8.42*
	Within Groups	725.19	389.75		
Body weight	Between Groups	108.36	85.32	1.23	3.29*
	Within Groups	6475.23	1902.13		
LBM%	Between Groups	116.94	244.69	1.90	15.01*
	Within Groups	4509.29	1198.03		
FAT%	Between Groups	115.84	226.20	1.91	13.84*
	Within Groups	4453.74	1200.82		

*The mean difference is significant at the .05 level.

Table 2 shows one-way analysis of variance of skinfold thickness, Fat%, LBM %, and total body weight of males and females. It was found that a difference in the mean of body weight, Fat% & LBM% in males after the conditioning programme between pre test and post-test groups but these differences were not statistical significant. But the differences in the mean of five skinfold thickness (biceps, triceps, subscapular, suprailiac & calf) in males after the conditioning programme between various groups was statistically significant.

In case of females, there were statistically significant differences in the mean of skinfold thickness (except subscapular), Fat%, LBM %, and total body weight after the conditioning programme between pre test and post-test groups.

Table 3 Scheffe Post -hoc multiple comparisons of Skin folds, Fat%, LBM% and Body Weight

Variable (s)	Pre Test vs. Post Test-I		Pre Test vs. Post Test-II		Post Test-I vs. Post Test-II	
	Male	Female	Male	Female	Male	Female
Biceps	0.34*	0.07	0.51*	0.49*	0.16	0.41*
Triceps	0.92*	0.33	1.76*	1.63*	0.84*	1.29*
Subscapular	1.240*	0.27	2.91*	1.50	1.67*	1.22
Suprailiac	0.642*	0.33	1.23*	1.74*	0.59	1.41
Calf	1.372*	0.31	3.07*	1.28*	1.70*	0.96*
Body weight	2.082	1.82*	1.04	0.67	-1.04	-1.15
LBM%	-1.352	1.61*	-2.13	3.12*	-0.78	1.51*
FAT%	1.392	1.49*	2.11	3.00*	0.72	1.51*

* The mean difference is significant at the .05 level

Post hoc comparisons of females (Table3) indicate that the differences in biceps occurred between the pre test & post test II and post test I & post test II group. The same was true for triceps and calf, while in case of suprailiac the difference occurred only between pre test & post test II. In addition to this, the difference in body weight occurred between the pre test & post test I group. The differences in Fat% and LBM% occurred between pre test & post test I, pre test & post test II, and post test I & post test II group.

Post hoc comparison of males (Table 3) indicates that significant difference in the bicep skin fold thickness occurred only between the pre-test & post-test I and pre-test & post-test II .The same was true for suprailiac site, while in the case of triceps, subscapular, and calf sites significant difference occurred between all the groups i.e. the pre-test & post-test I; pre-test & post-test II and post-test I & post-test II.

Discussion:

Reduction of fat from the trunk and extremity regions observed both in males and females in the present investigation agrees with the findings of many other researchers, who have also reported mobilisation of fat from the trunk and extremity areas as a result of aerobic exercise paradigm. Preferential loss of fat from the abdominal and trunk subcutaneous regions over the extremity regions especially the lower extremity, has been reported by *Hayer et al., (1988)* and *Kohrt et al., (1992),* who also observed 10% greater fat loss from the trunk subcutaneous region than the peripheral fat in men who participated in aerobic training. A number of other investigators have also reported a greater loss of trunk and abdominal subcutaneous fat after aerobic training *(Despres et al., 1991; Schwartz et al., 1991 and Kohrt et al., 1992).* According to them, increase in lipoprotein lipase activity may be responsible for fat mobilisation during aerobic exercise programme.

The greater impact of second mesocycle of a conditioning programme both in males and females in decreasing the thickness of skinfolds of the trunk and extremity region over the first mesocycle may be ascribed to the specific type of direct exercises of the trunk group of muscles (stretching and strengthening exercises) included in the exercise paradigm.

In the present study in males the differences in the body weight, LBM% and Fat% after a conditioning programme was not statistical significance, the reason for this may be a decrease in the total body weight after first mesocycle & after second mesocycle it was observed to increase but still the value of total body weight was lower as compared to pre-test value. This fluctuation in the total body weight during the conditioning programme may be due to the changes in the daily dietary intake and increased energy expenditure imposed through planned exercise programme administered to the subjects. Moreover, the mean values of total body weight & Fat% of the male subjects in this study were in the acceptable range before the start of a conditioning programme as per the norms of *Lohman (1992),* but as soon as these subjects started participating in the conditioning programme, their energy expenditure increased along with wear and tear of the muscles, and the body tried to adjust metabolic balance of fats and proteins. In this process stress may be increased on both fats and proteins metabolism. Thus may cause a slight decrease in both fat and LBM contents. This may be further explained on the findings of many investigators who have reported different responses in muscle protein metabolism depending upon the type of exercise for example muscle protein synthesis has been shown to be stimulated by resistance exercise as long as the intensity of exercise is enough to challenge the muscles *(Chesley et al, 1992; Farrell et al; 1999; Phillips et al, 1999 and Tipton & Wolfe, 2001).* Resistance exercise causes increase in muscle protein breakdown but not as much as protein synthesis *(Biolo, 1995 and Phillips et al, 1999).* The relationship between these two parameters (rate of muscle protein synthesis and muscle protein breakdown) represents the metabolic basis of muscle growth. Keeping in view the physiological principles of strength training, this change seems to be in accordance as the second phase of training comprised of exercises, which were targeted to improve dynamic flexibility, muscular strength and endurance. Stressing of muscles as is followed in the present study might have lead to hypertrophy of the muscles after the completion of a conditioning programme both in males and females by adding mass to it.

In summary, the results show that the distribution pattern of subcutaneous fat in the form of skinfold thickness in males is subscapular (maximal) followed calf, triceps, suprailiac, biceps (minimal) and in females' suprailiac (maximal) followed by triceps, subscapular, calf and biceps (minimal). The conditioning programme could not change the preconditioning distribution pattern of subcutaneous fat in both males and females. However a three months conditioning programme significantly lowers the subcutaneous skinfold thickness of various body sites (except subscapular region in females) in both males and females while Fat% significantly decreased and LBM% significantly increased in females only It is therefore logically correct to state that adoption of exercise programmes as a part of daily routine offer the greatest advantage to humans (for both physical active & sedentary) in improving the body composition and thus can help in countering the development of a number of diseases such as diabetes, hypertension and disturbed lipid profiles that increase the risk of cardiovascular diseases and therefore offer the best in terms of health benefits.

Acknowledgements: The author of this paper would like to express his appreciation to the subjects for participation

in the study and to Ms. Seema, a research student for her assistance during the data collection process in this study.

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SHORT COMMUNICATION-I

Ability to Relax Through Mental Training in Various Categories of Athletes

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Abstract

Ability to relax through mental training was investigated on 30 male subjects (age range 18 to 30 years). The subjects were divided into three groups (Aerobic, Anaerobic & Mixed), based on their game/event, and the energy system that primarily caters to their metabolic requirements. It was found that aerobic group of subjects exhibited greater ability than all other groups to relax with the progression of mental training programme as indicated by the appearance of significant reduction in minute Heart Rate at all corresponding stages of the sessions from the start to the end of mental training programme (MTP).

Key Words: **Heart Rate, Biofeedback, Psycho relaxation, Imagery**

Introduction:

The poor performance of Indian athlete is a matter of great concern to the coaches in general and sport scientists in particular. Inspite of the best training programmes, the Indian athletes fail to give their best in the International competition. One of the important analysis of performance of the athletes yield poor psychological preparation to display their best during the competition. A number of investigators have reported positive effect of mind training and biofeedback on the sports performance of athletes *(Hirota & Hirai, 1990, Feltz and Riessinger, 1990; Blumenstein et al., 1993; Couture et al., 1994 and Bakker et al., 1996).* These studies indicate that the use of imagery training with biofeedback offers the best potential to combat this situation. The literature is silent on the response of athletes to visual imagery in athletes undergoing different types of training. The present study has been planned from this angle and employs the imagery training along with biofeedback control on different groups of athletes. The results of the study are expected to file great utility in the Psychological training of the athletes for high level competitions.

Materials and Methods:

The study was conducted on 30 male subjects (age range 18 to 30 years) of Diploma course run by NIS Patiala. The volunteers were separated into three groups, based on their game/event, and the energy system that primarily caters to their metabolic requirements, as under:
Aerobic: N=3, Anaerobic N=9, Mixed N=18

These subjects were given the Heart Rate biofeedback during the mental training sessions. Mental training sessions were given once in a day to all the subjects for fifteen days and it comprised of following two parts:-

Psycho regulation training with music: First three sessions each lasting for 30 minutes were devoted to psycho regulation training with music. Important features of this session included head to toe relaxation, 1 to 10 count down, followed by light relaxing music for five minutes and then 10 to 1 back count down. Music cassettes known to produce relaxation effects in the body like " M*usic for Meditation*" by Van Raj Bhatia, " *Here*" and "*Now*" by Hariprasad Chaurasia on flute, by Hariprasad Chaurasia were used according to the taste of the subjects for the psycho regulation session.

Imagery Sessions: Remaining twelve sessions were devoted to imagery and consisted of the following:

(a) Each session was of thirty minutes duration. (b) First ten minutes of the session were devoted to simple psycho regulation followed by five minutes of warming up exercises in imagination. (c) Final fifteen minutes of the session comprised of imagery session concerning the game or event of the player/athlete. The steps of simple psycho regulation were similar for all the subjects whereas sports specific warm up exercises and the competition were given to the subjects for visual imagination.

For the measurement of Heart Rate the IR transducer was applied on the index finger of the left hand of the subject to display Pulse Rate per minute on LCD panel meter. Subject was asked to glow the maximum number of green colour bars through his mental power by following commands. More the number of glowing green bars the subject could light depicted higher level of relaxation achieved by him. Glowing of red bars showed higher level of tension. Balance was kept controlled at minimum position i.e. on anti-clockwise direction and feedback gain control at maximum position. Pulse rate observed before and during the progression of different mental training sessions in the subjects was recorded.

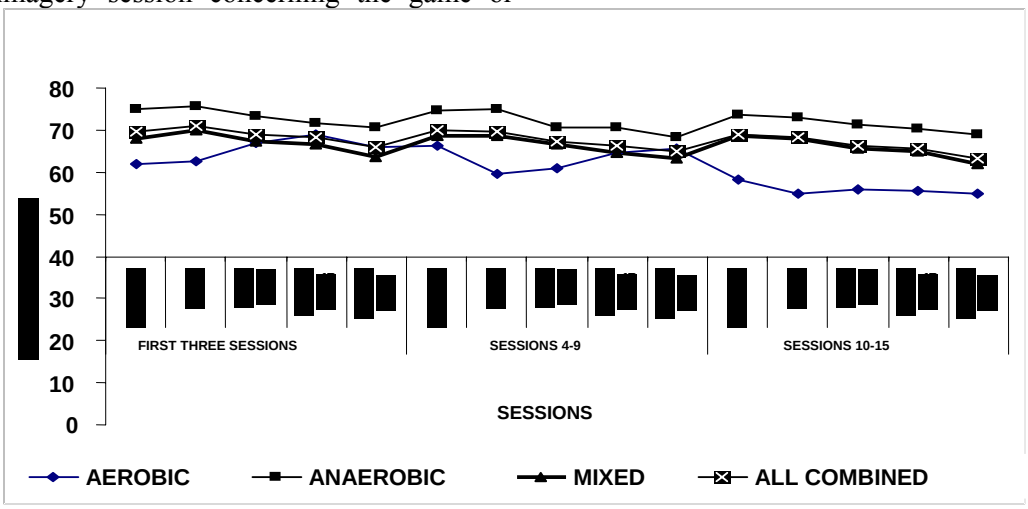

Figure 1: Pulse Rate Behaviour during Imagery Sessions among Different Groups of Athletes

Results and Discussion:

Comparison of autonomic (ANS) expressions in the nature of Heart Rate

among various activity groups (Table 1) during relaxation and imagery sessions of mental training programme reveal that aerobic group of subjects in general display lower mean values at all stages of the session as compared to all the other activity groups. This holds true for the general relaxation sessions, first set of imagery and second set of imagery sessions (Table 2). Lefevers (1971), Goldstein et al. (1977) and Becker et al. (1997) also found reduction in HR during relaxation sessions. Heart Rate values at all the stages of the session (HR balance, HR Initial, HR middle-I, HR middle-II, HR-final) are observed to be significantly lower in the aerobic group than all other activity groups at corresponding stages of the session.

A similar comparison of anaerobic group with the mixed and total reveal significantly higher mean values in the anaerobic group than the mixed and the total during the psycho relaxation and both the set of imagery sessions. Comparison of mixed with the total group (Table 3&4), on the other hand reveal lack of significant differences at all stages of the mental training programme. The above results indicate the following:

- Greater parasympathetic dominance in aerobic group of the subjects' right at the start of the mental training programme as evidenced by significantly lower Heart Rate in them as compared to the others activity groups.
- Greater ability of the aerobic group of subjects than all other groups to relax with the progression of mental training programme as is indicated by the appearance of significant reduction in HR at all corresponding stages of the sessions from the start to the end of mental training programme (MTP).

Table 1: Mean , Standard Deviation, Coefficient of variance of Heart Rate in general relaxation, first set and last set of Imagery sessions in different categories of players.

Sessions		AEROBIC					ANAEROBIC				
		Balance	Initial	Mid I	Mid II	Final	Balance	Initial	Mid I	Mid II	Final
1-3 Psycho relaxation	MEAN	62.00	62.56	66.78	69.00	65.89	74.86	75.52	73.18	71.51	70.56
	SD	8.35	7.19	13.99	15.37	9.85	9.18	7.35	7.73	7.75	7.05
	C.V.	13.46	11.49	20.95	22.27	14.95	12.26	9.74	10.57	10.84	9.99
4-9 Imagery	MEAN	66.22	59.67	61.00	64.44	65.50	74.50	74.93	70.67	70.60	68.16
	SD	8.78	8.62	8.35	17.26	13.45	10.13	14.77	8.98	8.55	8.98
	C.V.	13.25	14.44	13.68	26.79	20.54	13.59	19.72	12.71	12.11	13.17
10-15 Imagery	MEAN	58.11	54.84	56.00	55.50	54.95	73.62	72.99	71.22	70.29	68.82
	SD	6.39	5.81	4.30	3.88	5.43	9.66	9.35	8.95	9.06	13.88
	C.V.	10.99	10.60	7.68	6.99	9.89	13.12	12.81	12.57	12.89	20.16

Table 2: Mean , Standard Deviation, Coefficient of variance of Heart Rate in general relaxation, first set and last set of Imagery sessions in different categories of players

Sessions	MIXED					ALL COMBINED				
	Balance	Initial	Mid I	Mid II	Final	Balance	Initial	Mid I	Mid II	Final

1-3 Psycho relaxation	MEAN	68.07	69.93	67.37	66.46	63.56	69.50	70.87	69.05	68.23	65.89
	SD	10.53	9.42	9.17	8.74	9.15	10.69	9.41	9.77	9.63	9.20
	C.V.	15.46	13.47	13.62	13.15	14.39	15.38	13.27	14.14	14.11	13.97
4-9 Imagery	MEAN	68.50	68.69	66.45	64.65	63.31	70.07	69.66	67.17	66.41	64.99
	SD	11.14	9.89	9.53	10.30	10.55	11.04	12.25	9.67	11.08	10.67
	C.V.	16.26	14.39	14.34	15.94	16.67	15.76	17.59	14.39	16.69	16.41
10-15 Imagery	MEAN	68.67	68.09	65.62	64.84	62.07	69.09	68.23	66.33	65.53	63.38
	SD	8.31	7.46	8.39	7.32	8.30	9.59	9.37	9.29	8.70	10.92
	C.V.	12.10	10.96	12.79	11.28	13.37	13.89	13.74	14.00	13.27	17.22

Table 3: Statistical Comparisons

	AEROBIC				ANAEROBIC			
Sessions	**Balance/ Initial**	**Balance/ Middle-I**	**Balance/ Middle-II**	**Balance/ Final**	**Balance/ Initial**	**Balance/ Middle-I**	**Balance/ Middle-II**	**Balance/ Final**
1-3	0.14	0.83	1.13	0.86	0.28	0.71	1.41	1.90
4-9	2.19*	1.78	0.37	0.18	0.17	2.08*	2.16*	3.43**
10-15	1.57	1.12	1.44	1.56	0.34	1.33	1.85	2.08*

Table 4: Statistical Comparisons

	AEROBIC				ANAEROBIC			
Sessions	**Balance/ Initial**	**Balance/ Middle-I**	**Balance/ Middle-II**	**Balance/ Final**	**Balance/ Initial**	**Balance/ Middle-I**	**Balance/ Middle-II**	**Balance/ Final**
1-3	0.97	0.37	0.87	2.38*	0.92	0.29	0.84	2.42*
4-9	0.12	1.45	2.64**	3.52**	0.33	2.66**	3.13**	4.44**
10-15	0.54	2.68**	3.60**	5.83**	0.87	2.77**	3.69**	5.27**

*** Statistically significant at 5% level **statistically significant at 1% level**

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Short Communication-2

Occurrence of Bioccipital Tendonitis/ Rotator Cuff Tendonitis in the Subjects involved in Bench- Press Activities in Gymnasium

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Abstract

The study was conducted to register the occurrence of Bioccipital/ Rotator Cuff Tendonitis in the subjects involved in Bench Press Activity in gymnasium**.** Fifty male subjects (age group 20-30 years), having shoulder pain for at least three weeks, were selected randomly and were interviewed for the present history of shoulder pain, from various gymnasia. The subjects were interviewed through a questionnaire and assessed using standard orthopedic examination techniques. The value of Z (3.68) >3 showed a definite relationship between subjects doing Bench Press activity in gymnasium and occurrence of Bioccipital / Rotator Cuff tendonitis. This study gave preliminary data on the incidence of tendonitis in subjects who train with weights. Occurrence of these shoulder injuries can be prevented by a proper knowledge of the technique, supervision and knowledge about the mass of poundage lifted.

Key Words: **Hawkin's Test, isometric abduction, isometric external rotation, injury**

Introduction:

It is commonly seen that people going to gymnasium are more impressed by the amount they can bench as compared to they can dead lift or squat. So the use of gymnasium equipment is becoming increasingly popular both at home and in leisure centers and in gymnasia. But, people are unaware of the various risk factors involved or even the proper technique of lifting. Therefore at last they sustain some form of injury.

Shoulder injuries are the most common injuries, which occur among weight lifters and power lifters[1]. Among body builders and power lifters, the upper extremity, particularly the shoulder and elbow joint, showed the highest injury rate. More than 40% of all injuries occur in this area. The low back region and the knee were other sites of elevated injury occurrences[2].

The objective of this study was to register the occurrence of Bioccipital/ Rotator Cuff Tendonitis in the subjects involved in Bench Press Activity in gymnasium.

Materials and Methods:

Fifty subjects (age group 20-30 years), having shoulder pain for at least three weeks, were selected randomly and were interviewed for the present history of shoulder pain, from various gymnasia. These subjects were regular to gymnasia for more than 3 months and were specifically involved in Bench Press Activity for upper limb training. Those subjects who were involved major in other lifts such as lateral

pulleys, inclined Bench Press were excluded.

These subjects were doing 3 sets of 15 repetitions each twice weekly and hetereogenosity was noted in the amount of poundage lifted. The subjects were interviewed through a questionnaire, which included training programme, types of lifts, locations, type and history of injury. All were clinically examined using standard examination techniques.

Special test battery: Orthopedic examination consisted of special tests like Speed's test, Yergason's test[3], Empty can test, Lift off test, Neer's impingement test (1983), Hawkins Kennedy test (1980), Apprehension test, Relocation test, Sulcus sign test with arm at zero degree of abduction *(Neer, 1983)*, painful arc, isometric contraction of rotator cuff muscles.

For interpretation of clinical findings, following criteria was laid down:

1) History of Bench Press activity related shoulder pain.
2) Positive test from special tests.
3) Presence of any one of the following:

- Tenderness at greater tuberosity.
- Painful arc.
- Painful active contraction of any rotator cuff muscle.

Similar criteria were also used by *Sinha and Sandhu (2002)* in their study on Male Indian Overhead Athletes and by *Mujohara et al (1998)* on the quadriplegic rugby wheelchair players.

Simple percentile method was used to calculate the percentage of subjects afflicted with tendonitis.

Z-test of proportions was used to test the statistical significance of occurrence of Rotator Cuff/ Bioccipital tendonitis in these subjects.

$$Z = (p-P)/\sqrt{PQ/n}$$

Table 1: Clinical Evaluation Findings of Bioccipital and Rotator Cuff Tendonitis

Clinical Findings	Bioccipital Tendonitis n=10	Rotator Cuff Tendonitis n=28
Positive Speed's test	6	-
Positive Neer's test	-	13
Positive Hawkin's test	-	26
Tenderness over Greater Tuberosity	1	18
Tenderness over Bioccipital Groove	8	2
Positive lift off test	-	3
Positive empty can test	-	4
Painful arc	2	11
Painful isometric abduction	-	16
Painful isometric external rotation	-	5
Positive Yergason's test	4	-

Results:

Overall 76% (n=38) subjects in this study were found afflicted with Rotator Cuff / Bioccipital tendonitis as per the criteria laid down (Table 1). The value of Z (3.68) is significant i.e. the proportion of persons with the tendonitis can be said to be highly significant. Among the subjects positive for tendonitis, 26.3% (n = 10) were positive for Bioccipital tendonitis and 73.68% (n = 28) were positive for Rotator Cuff tendonitis. Among those positive for rotator cuff tendonitis, nearly 93% of them had positive Hawkins' Kennedy test, 46%

had positive Neer's impingement test, 39% had painful arc and 57% had painful isometric abduction.

Discussion/Conclusion:

The results of this study showed a definite relationship between subjects doing Bench Press activity in gymnasium and occurrence of Bioccipital / Rotator Cuff tendonitis, which are in accordance with the findings of *Goertzen et al (1989)* who found 40% shoulder injury rate among body builders.

Madsen and McLaughlin (1984) also identified three kinematic factors relevant to injury risk in the bench press, namely-speed of bar, path of bar and sequence of bar movements. Neviaser emphasized unfavorable position of rotator cuff during lifting as one of the factor leading to shoulder injury. Similarly *Herbert's et al (1984)* found excessive strain in the supraspinatus and infraspinatus with excessive load during elevation. But *Raske et al (2002)* found no correlation between shoulder injuries and any specific exercise[1]. During bench Press activity, the weight lifters desire to achieve higher limits of performance coupled with the rotator cuffs' unfavorable position during lifting often leads to shoulder injury. The rotator cuff is placed in a compromised position during the lift.

Herberts et al (1984) in their study emphasised on the biomechanical studies confirming the view that the shoulder muscles are heavily loaded when the arm is elevated. Excessive hand tool mass increases the strain markedly in some muscles, particularly the supraspinatus and infraspinatus. So if there are flaws in the technique, it can severely open the acromial

Injury prevention is the main job of team therapist. This requires knowledge of process and can result a severe amount of strain at the shoulder joints. Apart from faulty technique, lack of guidance and supervision is one of the major factors leading to injury. Another main factor that can contribute is excessive amount of poundage lifted. People, for the purpose of figure making and bodybuilding often go for a higher mass of poundage and at last sustain some form of injury.

Although no data exists in literature to confirm these findings, it is possible that the use of weight machines rather than free weights may decrease the incidence of injuries. However, weight-training coaches generally agree that the major lifts using free weights allow the development of coordinated strength and power in multiple muscle groups more effectively than do weight machines. If people use proper technique under good supervision, they can probably decrease injuries caused by the major lifts; proper coaching is not readily available in the gymnasium. So a small sample size of only male subjects, heterogenosity in the amount of poundage lifted and diagnosis on the basis of clinical findings are some of the limitations of this study.

This study gave preliminary data on the incidence of tendonitis in subjects who train with weights. Prospective research is needed to provide more accurate injury risks and more specific data concerning the causes of injury. Injury incidence depends on the quality, content, and intensity of the training programme. Thus evaluation of subjects in other gymnasia, and subjects involved in other activities, will give a more complete picture of the risks of this activity.

the incidence and causes of injury in a given activity. These data are not available

for musculoskeletal injuries caused by weight training, which is now widely used a conditioning method by many. Available injury data concern only selected populations. In addition to better information concerning injury rates, a better understanding is needed of the specific risk factors for injury. Occurrence of these shoulder injuries can be prevented by a proper knowledge of the technique, supervision and knowledge about the mass of poundage lifted. As the popularity of strength training grows, there will be ample opportunity to continue to catalog the injury patterns associated with this activity.

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Short Communication-3

Assessment of Overweight and Obesity among Urban Adult Males of Amritsar (Punjab)

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Abstract

In the present study, an attempt has been made to report the prevalence of overweight and obesity in 1,000 adult urban males of Amritsar city of Punjab. For the assessment of overweight and obesity, height and weight measurements were taken on each subject. The prevalence rate of overweight and obesity was calculated according to the latest WHO critical limits of body mass index (BMI). The observations revealed that the prevalence of overweight and obesity in the present sample was 29.8% and 21.7%, respectively.

Key Words: **Body Mass Index, Obese, Underweight**

Introduction:

According to World Health Organization (1998), one of the greatest public health challenges in the first-half of the 21st century is preventing the epidemic of obesity. Obesity is now so common that it is replacing the mere traditional public health concerns, including under nutrition and infectious diseases, and has proved to be one of the most significant contributors to ill-health. An increasing dichotomy can be seen in many developing countries whose populations are facing the serious problems of hunger and under nutrition as well as overweight and obesity (*Shetty, 2003*). For example, although the majority of Indian citizens are undernourished, a growing sector of urban population and high-income groups are becoming overweight and obese. Punjab is an economically advanced and physically robust state of India. Urban upper middle class of Punjab has achieved a socio-economic status similar to that of the developed countries, especially with respect to living conditions and nutritional intake. The socio-economic development has created changes in dietary intake, food consumption patterns and physical activity levels. All these factors have contributed to the problem of overweight and obesity. Therefore, in the present study, an attempt has been made to report the prevalence of overweight and obesity in urban adult males of Amritsar.

Materials and Methods:

This study was approved by the Ethical Committee of Guru Nanak Dev University, Amritsar (Punjab). The consent for participation was obtained from each subject. The aims and importance of the study were explained to each subject.

In this cross-sectional study, the data from 1,000 adult males of age 30-50

years were collected during the year 2003-2004. All subjects were of Punjabi origin and belonged to upper middle class with income ranging from Rs. 10,000 to Rs. 20,000 per month. The majority of data were collected from residential colonies occupied by well-to-do officers, professors, doctors and businessmen of Amritsar city of Punjab. The information regarding age, education, occupation, income and health status was collected through the pre-tested interview schedule from each individual. For the assessment of obesity, height and weight measurements were taken on each subject using standard protocol (*Weiner, J.S. & Lourie, 1981*). The protocol and clinical definition of obesity is based on body mass index (BMI). Therefore, the value of BMI was calculated for each subject. The suggested critical limits of BMI by *WHO/IOTF (2000)* were utilized for the assessment of obesity as given below

Classification	BMI (kg/m^2)
Underweight	< 18.5
Normal range	18.5-22.9
Overweight	23.0-24.9
Obese-I	25.0-29.9
Obese-II	≥ 30.0

Results:

Table 1: Classification of urban middle class males of Amritsar according to body mass index (BMI)

BMI	N	%age prevalence	Nutritional status
< 18.5	34	3.4	Undernourished
18.5-22.9	451	45.1	Normal
23.0-24.9	298	29.8	Overweight
25.0-29.9	148	14.8	Obese-I
≥ 30.0	69	6.9	Obese-II

Table 1 presents the distribution of all subjects according to BMI classification. Out of 1,000 adult males, only 34 males (3.4%) were underweight and 451 (45.1%) were normal while 298 (29.8%) were overweight, but 148 (14.8%) were in obesity grade I and 69 (6.9%) were in obesity grade II. Thus, the overall prevalence of overweight and obesity in this sample was 29.8% and 21.7%, respectively.

Discussion:

Table 2: Prevalence of overweight and obesity among adult males in India

Study group	BMI	Prevalence rate (%)	Investigator
Delhi urban males	> 25	21.30	(5)
Population of Hyderabad	> 25	23.90	(6)
Urban Delhi	> 25	29.20	(7)
Andhra Pradesh urban males	≥ 25	38.18	(8)
Kashmiri population	≥ 25	7.00	(9)
Urban slums of Delhi	> 25	13.30	(10)
Punjabi urban males	≥ 23	51.50	Present study

It is apparent from the present study that more than half (51.5%) of the adult males belonging to middle class in Amritsar city are currently overweight and obese (Table 1). A comparative picture of the prevalence of overweight and obesity in various populations (Table 2) no doubt suffers from the limitations of periodic dissimilarity of field work methodology and criterion used in defining obesity, but there is higher prevalence of overweight and obesity in Punjabi adult males as compared to other populations of India (*Gopinath et al, 1994, Visweswara et al, 1995, NFI, 1999, Venkatramana and*

Reddy, 1999, Zargar et al, 2000, Mishra et, 2001). A report from urban India (*Gopalan, 2001*) also suggests that the prevalence of obesity varies with socio-economic status with those in upper strata having higher prevalence rate than those in lower socio-economic groups.

The prevalence of obesity in urban middle class males of Punjab is no doubt less than that has been reported for industrialized western countries (*WHO, 1998*), but developing countries, like India, can ill-afford to bear the financial cost of obesity and its consequences. The prevention and control of this problem must, therefore, claim priority attention. Hence appropriate precautionary measures to prevent further progression of the problem into epidemic must be taken right at this stage. Because, if the present trends of overweight/obesity continue, the situation can get worse even within a decade and overweight could emerge as a single most important public health problem in adults of Punjab.

Acknowledgement: The financial aid to the first author provided by University Grants Commission, New Delhi for the major research project (No. F 3-8/2003/SR dated 30/03/2003) is gratefully acknowledged

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Short Communication-4

Application of Information Technology in Sports Management – A Challenge

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Key Words: **WAN, URLs, MIS, E-Commerce, Digital Divide**

Poor performance of Indian athletes in various international level competitions is a matter of great worry for the people of the country in general and sports planners in particular. Government of India is making every effort to look into the reasons of miserable performance of our athletes. Even extensive scientific explorations have been undertaken to bring into limelight the factors of poor sports performance. More than two decades have passed by when Sports Authority of India was established and an organised effort was undertaken to look into the reasons of debacle of Indian sports and even this has yielded no fruitful results. Sports administration and planning is often blamed for the sports disaster.

There is a need to plan and explore all the possibilities to address the problem. It is very pertinent that one of the important spheres to be explored is sports administration with the use of technological revolutions. This article will try to provide a general idea of how information technology (called IT) can result in positive change in the nature of management practices in sport. Following four approaches are suggested:

1. Application of "technological revolution" to the administration of sport.
2. Application of Internet and World Wide Web in specific management functions such as training and marketing.
3. Application of e-commerce to make participation in sports more available through lower priced equipment and lastly
4. The digital divide: and underlying condition that keeps some from participating fully in the benefits in the IT revolution.

Application of "Technological Revolution" To the Administration of Sport

The close of the last millennium has witnessed a basic change that is moving the world from the age of industry to the age of information. The currency in this new society that is being formed is information and the medium of exchange is called IT (and sometimes computer technology - CT). IT is simply the tools and methods used for the identification, organisation and manipulation of facts that we call data. IT has become the engine that

is driving all sectors of today's economy be it industry, government, education or indeed sports.

The most vital piece of apparatus that lies at the heart of the whole IT process is the computer. The computer and the software that it runs is a vital component in the new societal paradigm and it is a key to success for the modern sports manager. It is this piece of equipment that allows the sports administrator to maximise the return on limited resources whether this is people, facilities and equipment or finances. In turn, it is also possibly the single most important tool to the sports administrator to extend the reach of sport and recreational programming to as many probable participants as possible. Just as money has been the currency and a source of power in the old paradigm, information is the currency and a source of power in the new paradigm. No where is the old saying "that knowledge is power" more true than in a society where information or data is the force that drives the new economy. The secret to managing knowledge and information is in the development and maintenance of computer databases. A database is nothing more than an organised collection of common records that can be searched, accessed and modified. Database software is very widespread as most standard office computer software packages will typically have a simple database programme in addition to word processing, spreadsheet and presentation applications. There is, however, a far more powerful and useful kind of database for sport managers than the one that comes in the standard software suite: the relational database. A relational database is a data management system that stores information in a series of tables consisting of rows and columns of data. When the operator conducts a search, a relational database allows the individual to match data from one table with data from a second to produce a third table or a report.

An illustrative instance is that of an individual charged with overseeing a complex sports competition, the details of which have been entered into a relational database. The time for a scheduled event can be pulled from one table, a roster that has the names of qualified referees who can officiate the event from another table, their availability from a third table resulting in a report that lists all of the personnel who can undertake the officiating task at the appointed place at the appointed time. This task which could take hours of manual manipulation from paper records can be done in a fraction of the time from digital records. Similar event management software can assist the sports manager with a numerous of other tasks associated with the competition ranging from facility scheduling, equipment set up and knock-down.

From the abovementioned the value of using IT tools can be readily realised for the organisation of a competition. These tools are even more important for the day-to-day operation of the sport organisation as can be seen by the kinds of sport programme information that can be contained within these databases.

First is athlete specific information such as team rosters that include biographic information including name, sex, age, contact information and even clothing sizes for team uniforms. The same database may also contain details on medical conditions, performance history, or other participation characteristics of the athletes. Another common use is the development of rosters of programme support personnel such as officials, timekeepers, drivers, or medical

staff. Aside from details such as their addresses, a database of this type might also contain information about availability and reliability. For example, do they actually show up when they volunteer?

Money is always an issue for today's sport management professional. Databases are particularly useful for tracking donors or potential donors whether and they contribute money or in-kind services. In addition to the expected biographic information will be other keys to successful fund raising such as the source of their motivation or affiliation and the frequency with which they give. Databases are also essential for other types of administrative information. Examples include accounting and business records, employee files, equipment inventories or facility maintenance records. The organisational marketing information system (MIS) is also typically a database programme in which is tracked information such as season ticket sales, gate receipts or merchandising sales. It is particularly useful if different software applications interface with each other seamlessly which is to say, "do the programmes talk to each other?" Can, for example, the data entered in the MIS resulting from ticket sales be imported directly to the accounting programme?

To be effective, databases can and should be regularly updated to record changes. Bear in mind that the passage of time presents a more comprehensive picture of most activities and the ability to record change and make sense of it is essential for long term survival. Further, there is nothing so constant as change, particularly in sports organisations, and a well thought out and maintained database is a great way to develop and maintain an "institutional memory"; a record of those changes and the impact they have had on the organisation.

As great as databases are for effective sport programme management, the real power of information technology comes when individual computers are tied together through the medium of a network. This is truly a case where there are synergies created as in 2 + 2 = 6. A computer network simply is the hardware and software required to connect two or more machines together so to allow the sharing of data and other resources. Larger enterprises use computer networks to link together their operatives in a common computing environment. All of the permeations and configurations available to the sports administrator are clearly beyond the scope of this presentation except to note that the most common configuration of these kinds of networks are of the client - server variety. This type of network is has a main server that houses most of the information and database files. The individual operatives access the server through their desktop terminals or workstations which are called clients.

Aside from sharing data, a network can share other resources as well. For example, a network can have any number of computers sharing a very good quality printer instead of a using a number of mediocre workstation printers. A powerful server can substantially increase computing speed and effectiveness throughout an organisation. So what are the key issues to be addressed when considering the acquisition and implementation of an organisational IT system?

First and foremost, once the decision is made to introduce IT systems to the organisation, the table of organisation and staffing patterns will need to change. The new IT system cannot simply be "layered on" to the existing structure; it must be imbedded into the organisational

processes. The adoption of an IT strategy and associated changes in procedures usually means extensive training for the staff.

The next consideration is that of hardware. What is the computer system configuration and computing capacity that the organisation will need? Capacity should not be underestimated as a relational database can consume huge amounts of memory. So do other strategies that enhance organisational effectiveness such as moving data files off the hard drives of individual work stations and onto a file server on a computer network.

Another crucial decision revolves around operating software. Standard vendor prepared software packages are usually developed on the basis of the lowest common denominator for a group of potential clients. It is not uncommon that only about 80% of an organisation's needs are met by an off-the-shelf product. So the sport administrator is left with the choice of writing their own software programmes or adapting organisational operating procedures to some degree around the software package. The former can be hugely time consuming, very expensive and the end result is not always assured. Generally, the more extensive the modification required for a software product, the more expensive the product becomes and the more difficult it will be to accommodate software upgrades from the vendor.

Application of the Internet

It is important to note that computer networks need not be limited to a single site or facility. Wide Area Networks (WANs) can link together sports administrators located throughout a country. For example, all of the regional offices of a national sports governing body such as the National Football Association can be linked together regardless of their geographic location. All of the operatives so linked can share administrative and programming information and communicate with each other cheaply and efficiently through the medium of e-mail.

The computer network with which the public is most familiar is the Internet and the World - Wide - Web, known simply as "the Web", is what most people think of when we say the "the Internet". While the Internet has been around for decades, the Web is a comparatively new innovation first introduced in the mid 1990s. It is a digital medium which presents information in text, audio and graphics in a simple hyper-text computer language understandable by a browser. This medium has simply exploded and today there are more than 20 million web addresses called Uniform Resource Locators (URLs), many with hundreds of individual pages on their sites. Thousands or applications for new URLs are received every week.

The ways that the Web has changed society are almost too numerous to mention. Suffice to say it has become an extremely important medium of communication, education and commerce and its importance in these areas will only continue to grow in the future. In terms of communication, for example, USA Today which is the closest thing a national newspaper in America gets more than three million visits per day. Some 60% of these visits are to its sports pages. In terms of education, the concept of "distributed learning" or "distance education" gains more adherents with every passing day. Through the U.S. Sports Academy, for example, one can do the entire course of study for an accredited Master of Sport

Science degree through the Web without leaving their home. The same possibilities exist at the undergraduate level through the International Sports Academy.

But most significant at this juncture is the marketing and commerce applications of the web. There are virtually no professional sports teams in the United States that do not have a Website and most are linked together through networks of Websites coordinated through the various league offices. Just how tight these linkages are is driven in part by agreements between the league teams on activities such as revenue sharing for media broadcasting rights and merchandise sales.

The Web is currently used by professional sports teams in ways that the developers of this technology never envisioned. For example, there are no English language radio broadcasts in Montreal for the Montreal Expos professional baseball team. Fans wanting hear the play-by-play in English can only do so by calling up the team's Website and listen to it coming across as an audio feed. Another example of how deeply the Internet has penetrated professional sports is how some pro hockey teams now require their players to have e-mail addresses as a means to interact with both the team administration and their fans.

These examples lie at the heart of how the Internet will affect sports in the future: through the changing of the way that the sports fan will consume the sport product. Where in its infancy sport marketing did not extend much beyond putting out a sign on the side walk saying "Game Today", now sports teams have well developed and extensive Websites to more effectively market to their customers. The trend in this regard is also clear. What will emerge is networks of teams and users bound together by a common interest and driven in part by advances in information technology.

These developments are not limited to the upper end of the sports hierarchy. Compared to the extremely high cost of traditional television broadcast, the comparatively low cost of "web casting" will bring to sports fans events that could never before be seen on traditional broadcast media. The web is not constrained by the limited availability of broadcast channels and high production costs. And while bandwidth is currently an issue for the web, this will resolve itself in the near future with the introduction of broadband technologies.

Application of E-Commerce

It is also proper to briefly examine how the web will change the sale and distribution of sporting goods which central to running sport programmes. The relative cost for sports equipment can be an issue for the profession, particularly in terms of trying to broaden the appeal of sport to the greatest number of participants. E-commerce through the Internet holds the potential for containing costs for sports equipment as illustrated by the following example.

In the traditional model of manufacture and distribution through a sporting goods store, it is not uncommon for a tennis racquet which cost $40 to manufacture to be marked up as much as 300 to 400% to as much as $160 as it moves through various wholesalers and retailers in the distribution chain to a tennis player. With an e-commerce arrangement whereby the manufacturer can reach the player directly without going through middlemen, the mark-up in distribution can be reduced to as little as 50% of the

traditional retail price resulting in a sale price to the end user of about $80. Very simply, the more middle men in a distribution chain, the greater the benefit derived to the end user from using e-commerce distribution.

E-commerce is well on its way to becoming a force in the world economy as it serves to remove barriers both natural and artificial. The barriers that will vanish include those of time and space as well as national borders both physical and ideological. That this will occur is underscored by the fact that this year e-commerce will employ more than 2 million people and create a turnover in excess of $500 billion. By next year, the turn over is expected to pass $1 trillion.

The Digital Divide

In closing it would be negligence on our part if attention is not paid to one of the important problems resulting from expensive technological tools. This is called "Digital Divide". For example in the U.S., approximately 60% of American adults are linked to the Internet and are on-line. These users are mainly from the upper and middle class and have the financial ability to purchase computers and Internet services. It is a matter of great concern that the very people who stand to benefit the most from economies to be realised through information technology as outlined earlier under e-commerce are the ones least able to afford it. It is the economically disadvantaged that are currently being left out of the IT revolution.

This Digital Divide also transcends national borders. While 60% of American adults are connected to the Internet, only about 5% of the global population can make that claim. Some areas, Africa and parts of India for example, are almost totally disconnected and can only be considered disadvantaged as a result. Herein lies the challenge for the future.

IT applications in sports management are noticeably changing the way that we do business. Thinking through how we can use this kind of equipment and these tools greatly enhances outcomes. The bottom line is that these IT tools are rapidly becoming a necessity for the sports administrator at whatever level in the sports hierarchy they are working.

CASE STUDY-1

Diabetic Foot Ulcer – A Case Study

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Key Words: NIDDM, VLDL, LDL, $HbA1_c$

Inroduction:

Diabetic foot is the most dreaded complication of diabetes mellitus. Diabetic neuropathy is most disabling as it leads to increased morbidity and decreased quality of life in patients with diabetes. Failure to recognize symptoms of autonomic neuropathy may lead to secondary complications in form of diabetic foot ulcers and cardiac arrhythmias. One of the most feared complications of this disease is loss of lower limb and is a challenge to surgeons. This is most dangerous in view of sudden cardio respiratory deaths during and after surgery in diabetics. This case history demonstrates the adverse effects of diabetes on feet, and the multidisciplinary team's contribution to successful treatment and healing of a complex foot lesion. A case of Diabetes mellitus involving both feet is discussed.

Case History

Seventy eight years old patient an old case of type 2 NIDDM on irregular medical treatment was admitted with history of diabetic feet bilateral. Patient also had foul smelling discharge from left foot and had auto amputation of 2nd to 4th toe left foot due to gangrene.

On examination patient was restless. General condition was poor. Pulse 110/ minute, temp 102^{o}F, BP 124/80 mm of Hg. Local examination of left foot revealed gangrene of heel, sole and auto amputation of 2nd, 3rd and 4th toe. Right foot had superficial ulcers over dorsum of 2nd and 3rd toe. Distal pulsations were present.

Patient was investigated and broad spectrum antibiotics started after wound debridement and dressing. Blood sugar levels varied between fasting 151mg% to 170 mg% and post prandial up to 223 mg%. Below knee amputation was done as it was not possible to save his left foot due to extensive gangrene of sole. Reshaping of stump was done at a later date as patient developed flap necrosis. Patient was advised aerobic exercises of upper limbs, diabetic diet and oral hypoglycemic agents and has improved.

Discussion:

Diabetes can cause damage to the nerve and vascular supply in the feet and legs. Patients with neuropathy have reduced or no sensation and, therefore, might be unaware of any trauma to their feet caused by ill-fitting footwear or an object in their shoes, such as a piece of glass, a stone or a drawing pin. Continued walking on an injured foot will damage it further and minor lesions can become more serious. A simple examination of the feet, feeling inside the shoes before wearing them and not walking barefoot can help to prevent

minor injuries. Many of the patients attending the diabetes clinic are older and some cannot see feel or reach their feet, which means that they are often unaware of any injuries. Diabetic foot ulcers should be treated to maintain health status, improve quality of life and reduce the number of amputations.

A recent study by American Diabetic Association (2004) has demonstrated a consistent beneficial effect of regular physical activity training on carbohydrate metabolism and insulin sensitivity, which can be maintained for at least 5 years. These studies used physical activity regimens at an intensity of 50–80% Vo_2max three to four times a week for 30–60 min a session. Improvements in HbA1c were generally 10–20% of baseline and were most marked in patients with mild type 2 diabetes and in those who are likely to be the most insulin resistant. Many patients with type 2 diabetes have impaired fibrinolytic activity associated with elevated levels of plasminogen activator inhibitor-1 (PAI-1), the major naturally occurring inhibitor of tissue plasminogen activator (t-PA). Studies have demonstrated an association of aerobic fitness and fibrinolysis. Regular physical activity has consistently been shown to be effective in reducing levels of triglyceride-rich VLDL. However, effects of regular physical activity on levels of LDL cholesterol have not been consistently documented. Effects of physical activity on reducing blood pressure levels have been demonstrated most consistently in hyperinsulinemic subjects. Of particular interest are studies suggesting a disproportionate effect of physical activity on loss of intra-abdominal fat, the presence of which has been associated most closely with metabolic abnormalities. "Care your feet as your face or you will bury your feet before your face"

Techniques to prevent and treat lower extremity amputation in patients with diabetes vary from simple foot inspection to complicated vascular and reconstructive surgery. Early identification of risk factors, careful and regular evaluation, and aggressive treatment in a multidisciplinary team approach prevent amputation in most cases of diabetic foot ulcer. This case history demonstrates the adverse effects of diabetes on feet. The patient had a dense neuropathy, which meant that he was unaware of the chicken bone embedded in his foot. He continued to put weight on the foot, which resulted in a minor foot injury developing into a serious health problem. Poor blood supply to his feet and legs hindered wound healing. In patients with diabetic foot problems, often a combination of factors cause the tissue to breakdown; in this case it was neuropathy, vascular disease and a minor foot lesion that became infected. All of the co-existing factors must be addressed when treating patients with diabetic foot ulcers.

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CASE STUDY-2

Spastic Triplegia – A Case Study

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Key Words: **MFDT, Knock Knee, Motor Development**

Ayushi had severe Spastic Triplegia with visual problem. She was very much delayed in gross motor and fine motor milestones. Her age was 2.3 years, when she came in for treatment.

According to MFDT (Munich Functional Developmental Diagnosis), her pre-treatment status was as following.

Gross Motor Functions:

1. Prone Development: She could lift head up to 45 degree, self-supported on both lower arms (hands tightly fisted) which kept her at the age of 4 months.
2. Sitting: While being pulled up to sit up to 45 degrees, she could raise her head but used to keep her legs tightly straight which kept her at the age of 4 months.
3. Standing: She had severe equines at the ankle, severe extension at the knee (knock knee) and flexion at the hip. In MFDT we could keep her at 4-5 months but with very abnormal appearance.

Hand Functions:

She could not stretch her hand towards the toy fully. Left upper limb was involved so elbow remained tightly flexed and hand fisted on left side which kept her at 5 months of age.

Perception:

As mentioned in diagnosis she had a squint and continuous eye-ball movement in her left eye. It was very difficult for her to focus. She used to try to turn her head towards a fallen object with minimum sound. This kept her at the age of 6 months.

Speech:

She was around 4 months on this scale.

Social Function:

She scored maximum on social function, i.e. around 11-12 months. She used to exhibit the efforts and give object to a familiar person on request.

With total observation we found that she was much more delayed on her motor development score then her mental development.

As she was young in age and her Mother was willing to co-operate fully, we started her treatment on a regular basis. Each session was of almost 40-45 minutes.

Line of Treatment:

Though Ayushi was 2 years + in her age, on account of her motor development, we started with Development Stimulation Programme i.e. mainly positioning her in correct posture with the help of pillows and Therapist's hand

support. Lots and lots of visual and auditory stimulations with Toys were added.

We made extensive use of Medicine Ball and balanced board for getting the right reactions from her.

As soon as she started using her hand for protection and positioning, we started keeping her in weight bearing positions. Lots of weight shifting exercises helped the child for starting with locomotion.

Along with the above said treatment strategies, she was given normal stretching exercises for maintaining the range of motions. Strengthening exercises for opposite group of muscles were done for keeping her ready for weight bearing positions.

Though now days the concept is changing, we still believe that good control over the spinal muscles and strong abdominal muscles are needed before we could make such a child stand. Hence, we gave her lots of exercises for spinal and abdominal muscles.

External Support:

Earlier she was given night splints for her ankles. And now they are being replaced by full (KFO) length support with fixed ankle for making her stand.

Results:

At the age of 2.9 years today Ayushi is on MFDT scale as below.

Motor Development:

- Crawling: She can sit from prone position by hip bending and trunk turning. She has started crawling on hands and knees with cross-coordination. So, she is at 10-11 months on the scale.
- Sitting: She can sit without support for 3-5 minutes. Sits up from supine by holding onto some furniture with very little support. She is at 10 months on the scale.

Fine Motor:

Her hand function is at around 10 months on scale. She picks up small objects with her thumb and index finger. She also tries to move toy car to and fro.

Perception:

She tries to touch eyes, nose etc details of any person who comes close to her with Index finger. Also pulls a toy car by string. This puts her at the age of 11-12 months.

Speech:

In this she has shown drastic change. She is at the age of 25-26 months. She can speak two words sentences in child language

Social:

She has started imitating household activities which puts her at the age of 16-17 months. In her posture she has improved very well. Her lordosis in sitting position has completely gone with strengthening of spinal muscles.

In ankle, tightness has reduced to a large extent. She can comfortably sit in squatting position. She can stand between parallel bars with her splints. Her left upper limb can fully stretch during an activity and she is able to use her fingers while holding an object.

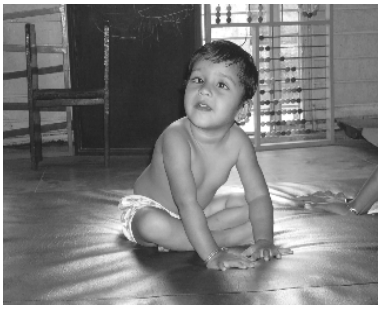
Overall Functional Improvement:

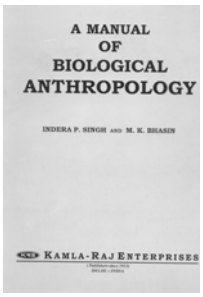
Functionally she has improved drastically compared to her condition when she had come to us for treatment.

- She can do crawling with co-ordination for small distances.
- She comes up in kneeling position with minimum support and can do kneel walking with some object / walker.
- She can sit without support for a while during her activities.
- While balancing and playing she uses both her upper limbs comfortably.

Future Plan:

- More work needs to be done to improve her sitting balance.
- She needs strengthening of hip extensors and hamstrings at knee joint to improve her legs positioning while standing.
- Long term goal is to make her walk with minimum support





A Manual of Biological Anthropology

By

Indera P. Singh & M.K.Bhasin

Pages: 538

Binding : Hard

Published By Kamla-Raj Enterprises, Delhi

This book entitled "*A **Manual of Biological Anthropology**"* provides professionals with the most current biological anthropology data, guidelines and procedures needed to not only to study microevolutionary adaptation process which determine the survival value of a population, but also help in deciding the pathogenic characters of a population. Based on this, practicable and tangible programmes for their alleviation can be prepared. All possible important aspects have been incorporated to bring up to date the first edition of the book to accommodate the rapidly growing scope of physical or biological anthropology.

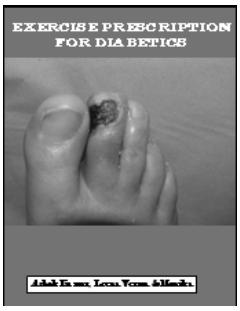
As stated in the preface, the manual is intended to be a comprehensive book for the use of students and research scholars of biological anthropology as well as allied disciplines. In my opinion it is meeting the aim very well. The manual provides a ready source for the students and research scholars to consult when professionals need to identify the necessary tools for addressing issues related to health and sports. To this end, the contributing authors have accomplished the purpose set forth in the preface.

People for whom the manual will be useful include graduate and post graduate students of anthropology and medical sciences, and current professionals employed in health sector as well as medical professionals practicing in clinical settings. Based on my educational experiences and involvement in the area of exercise, fitness and health, this practical manual should be made an integral part in preparing professionals for the health fitness and sports sector.

Features: The manual is a valuable source of guidelines, procedures, and illustrated anthropometric, dermatoglyphics, osteometry and somatometry techniques for anthropologists, physiologists and clinical facilities personnel who work with clients and patients. It does not contain superfluous information. Each chapter is written in a brief, clear, concise style and provides only the most pertinent information to prepare professionals to successfully complete their degree examinations. Extensive contemporary reference lists at the end of the book offer readers the opportunity to pursue a topic more deeply to develop a better understanding of the material covered. There are no shortcomings. Periodic reviews and updates of each chapter of the manual by eminent persons in the field during the preparation of the book have led to the clarity of writing and presenting style. In addition current and new trends in anthropometric techniques are appropriately dealt with in the manual to prepare professionals for conducting research.

This manual is going to be an invaluable companion to the any anthropologist. There are no other competitor manuals or textbooks, because the manual has been created specifically to address knowledge, skills, and activity objectives that must be mastered by any one who takes up the anthropology course. It is mandatory that a book like the resource manual undergo major revision processes at least every four years.

Reviewer: Prof. S.K. Verma, Ph.D., Department of Physiotherapy & Sports Science, Punjabi University Patiala (Punjab) India



Exercise Prescription For Diabetics

By

Ashok Kumar, Leena Verma & Monika

Pages: 182,

Price: Rs. 400/-

Binding: Soft

Published by P.K. Publications New Delhi

Description: The book covers all aspects of diabetes related complications and highlights the strengths as well as weaknesses of an exercise programmes for various diabetes related complications. In this book you will find a clear explanation of what diabetes mellitus is, diagnosis of diabetes mellitus, complications of diabetes, management of diabetes mellitus via medicines & exercises, essentials on tailoring an exercise programme to your capabilities, guidelines for safe exercises during complications of diabetes & in addition to this you will get more useful information like desired body weight with percent fat, commonly used drugs for diabetes mellitus, normal human blood serum values, & constituents of normal human urine.

Purpose: Diabetes like modern 'ailments' is essentially a byproduct of unhealthy lifestyle including bad food habits and physical inactivity. A severe case of diabetes can result in staggering medical complications especially the scourge of mankind i.e. Coronary Artery Disease (Heart Attacks).

One of the most terrible things about diabetes is its negative effect on quality of life. Even a moderate case of diabetes can devastate a person's ability to be productive & fully functional. Moreover it is a huge burden on national economy directly or indirectly. The authors have chosen very noble objective of writing the book entitled *"Exercise Prescription for Diabetics"*. The book is a guide not only for the diabetes patients who can keep good control over the disease by following the steps described in the book but also for the non diabetics to lead a healthy lifestyle and keep this disease away. Diabetes management has come a long way over the years. Today diabetes patients can be rehabilitated and given the tools, one of which is safe exercise, to exert more control over this problem than ever before. After reading 'Exercise Prescription for Diabetics' most of you will discover that you can partially-or almost fully- reverse many of the disabilities that diabetes has caused & thus, go back to a healthier lifestyle. Cheer up and get ready for exercise!

Audience: The book will be valuable for the diabetes patients and the graduate and post graduate students of physiotherapy and medical sciences and professionals working in health fitness sectors as well as medical professionals involved in clinical settings. This practical guide possesses the required qualities for its inclusion in the curriculum of health related courses.

Every section of the book is printed in a brief, understandable style.

Reviewer: Dr. N.K. Multani, M.S.P.T., Ph.D., Principal, College of Physiotherapy, Mullana, District Ambala [Haryana] India

Instructions to Contributors

Journal of Exercise Science and Physiotherapy (JESP) is a scientific journal, publishing research studies and review articles in the field of sports injuries, physiotherapy, exercise physiology, sports rehabilitation, diseases and exercise, sports psychology, nutrition, physical education, sports biomechanics, kinesiology and sports education.

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JESP is a non-commercial journal aims to present easy access to the scientific knowledge for health & sport conscious individuals. The purpose is to minimise the problems like the delays in publishing process of the articles by drawing advantage from electronic medium.

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DISCUSSION

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Journal Article, Article not in English:

Seker-Aygül, Z., Akova, B. and Gür, H. 2001. The relationship of stress and stress management factors with injury in soccer players. *Turkish Journal of Sports Medicine,* **36:** 71-80. (In Turkish: English abstract).

Journal Article in press:

Gür, H., Cakin, N., Akova, B., Okay, E. and Kücükoglu, S 2002. Concentric versus combined concentric- eccentric isokinetic training: Effects on functional capacity and symptoms in patients with osteoarthrosis of the knee. *Archives of Physical Medicine and Rehabilitation,* in press.

Journal Article in electronic format:

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Book:

Guyton, A.C. and Hall, J.E. 1996. *Textbook of medical physiology.* 9th edition. W. B. Saunders Company, London.

Chapter in edited book:

Wilson, C.H. 1984. Exercise for arthritis. In: *Therapeutic exercise.* Ed: Basmajian, J.V. 4 th edition. Baltimore: Williams and Wilkins. 529-545.

Thesis:

Özyener, F. 2000. *Effects of work intensity on dynamics of pulmonary gas exchange during exercise in humans.* Doctoral thesis, University of London, London. 79.

Thesis not in English:

Özer, Ö. 2001. *The effect of muscle exercise to oxygen kinetics in chronic smoker*s. Doctoral thesis, University of Uludag, Bursa. 1-54. (In Turkish: English abstract).

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