CHAPTER-II

REVIEW OF RELATED LITERATURE
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An attempt has been made by the scholar to locate literature related to the study. The relevant studies of specific importance are cited in this chapter.

N. Govindara July Gunaradopa and Bera\(^1\) conducted experiments on schools’ girl students in the age group of 11 to 13 years. These subjects are divided into two equal groups, experimental and controlled group.

An eight-week-yoga training was given daily in the morning session for a duration of one hour. This Yogic training consists of some asanas, Amulonviolma, Shavasan etc.

Final postures of each of the practices is maintained for 30 second and Shavasan is given in between each asana.

Prior to the end of 8 weeks of Yoga training, the pre-test and posttest were conducted on flexibility. French and Scott tests are cardio-respiratory endurance of 9 minutes run and walk test respectively.

Their results are that short termed Yoga practices could improve flexibility level whereas improvement in cardio-respiratory endurance was found significant among the girls at the age of puberty.

Dr. Ganguly and Dr. Bhole\(^2\) conducted on 20 college students and they (age 15 to 39 years) were the subjects for these studies.

Seven static flexibility items i.e. trunk extension, trunk flexion, toe touch, twist, touch lateral bending and static lateral flexibility were administered to the students.

The measurements were taken under two conditions i.e. during the phases of breath holding after deep inspiration and deep expiration.

Their conclusions were that flexibility was better after expiration while extension was better after inspiration.

The trunk and shoulder extension were more during breath holding after deep inspiration in comparison to breath holding after deep expiration, the former being highly significant.

Extent flexibility as studied through trunk flexion, toe touching, lateral bending with hand over the head and by the side of the body and twisting the spine along its vertical axis were found to be more during expiration condition in comparison to breath holding after deep inspiration, the result being significant except for the toe and twist & touch.

Biswa Satyajit Saha and Bera\(^3\) conducted on 20 male varsity


athletes and twenty male Yoga practitioners aged 18-25 years under university of Kalyani, West Bengal. They were selected as subjects for this study.

Personality was evaluated through means of P.F. Cattell’s Personality Test and level of flexibility (forward and backward, shoulder and wrist, trunk, neck and ankle) was measured by using standard methods.

1) Sit and Reach Method

2) Bridge Up Test

3) Shoulder and Wrist Elevation Test

4) Trunk and Neck Extension Test

5) Ankle Flexion Test

The study concluded that:

1. There was significant difference between yoga group and athletic group both in personality & flexibility.

2. Yoga group was introvert in nature whereas athletic group was extrovert.

3. Athletic group showed overall higher level of flexibility than yoga group.

4. Personality profiles are related with one’s level of flexibility.
Bera, Ganuly, jelly and Ghorote\(^4\) conducted the yogic exercise group consisting of 50 male school students, aged 10-13 and who were first time enrollers in yogic exercise classes at the Gurukul High School, Lonavala, India. Subjects in the controlled group were 38 male volunteers of the same age group of the said school. During the three-year study, 23 subjects were lost from the yogic exercise group and 13 from the controlled group, the final number of participants was 27 and 25 respectively. Dropouts from the study were due to illness (Ss = 7), injury (Ss = 5) leaving the school (Ss = 22), and loss of interest (Ss = 2). The morphological records show that there were no substantial pre-study differences between treatment groups with respect to age height and weight.

It appears that yogic exercise is an effective intervention with respect to age-related growth of school students for improving motor performance. The findings of this study indicate school students with active lifestyles tend to maintain considerably higher level of performance on the variables (Viz CV endurance, abdominal muscle strength/ endurance, body fat % flexibility and balance) than do sedentary ones. In addition the result of the current study suggests that it may never be too late for school students and education authorities to realize the benefit of yogic exercise participation and to significantly reverse certain motor performance decline.

Salendranath Nath Maithly and Subhas Chandra Samanta conducted 5 ninety (N = 90) fifth-grade girls from Calcutta District, West Bengal considered as the subject. These subjects were chosen randomly from three institutions in Central Calcutta District. All the subjects (N = 90) were equally divided into three equivalent groups on the basis of organ motor fitness score, and all were randomly divided in to group I, group II and controlled group.

Group I (experimental) was given the Calisthenics exercise and Group II (experimental) was given selective yogasanas for practice on alternate days for ten to thirty minute per session for twelve weeks.

After twelve weeks of treatment, each subject belonging to three groups were being tested again on Organ Motor Fitness Test and their scores were treated as post test scores for motor fitness.

Improvement of motor fitness as assessed on Organ Motor Fitness Test after twelve weeks of treatment justified the fact that both the programmers of calisthenics and yogasanas were effective in the development of motor fitness of fifth-grade girls.

Calisthenics - exercise programme was found superior to yogasanas programmes in improving performance in each individual

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test than of Organ Motor fitness Test, except Crossed Arm Curl Up
This Hypothesis formulated for this study holds true.

Amit Gupta, Jaspal Singh, Sandhu and Shyamal Koley² selected
95 random Footballers (59 male and 36 female) age 17-22 years
of Indira Gandhi Institute of Physical Education and Sports
Sciences Delhi. Another 50 non-athletes subjects were taken
randomly as a controlled group from the same area matching their
age, socio economic condition etc. with the Footballers.

There are three fitness tests used for the check of body fitness
of Footballers. They are as follows :

1) Sit Up Test
2) Board Jump Test
3) Shuttle Run

The above test are to measure the special mobility and flexibility,
Three measurements viz anterior spinal flexion, lateral spinal lateral
flexion and extension were taken after Macrae and Wight (1969)
standard statistical calculation were also made.

The results of the present study show highly significant
differences between male and female footballers with their controlled
counterparts with regard to mobility and flexibility. There is fact that

² Gupta Amit, Jaspal Singh, Sandhu and Shyamal Koley "A Study on the
Physical Fitness Spinal Mobility and Flexibility".
footballers have greater mobility and flexibility of spine due to the well structured programme of stretching exercise. All footballers were given static programmes in their warm up session too. Footballers keep the muscles more flexible than the controlled ones. The connective tissue around the joint shortens and loses elasticity when a shorter position of activity is there in the case of non-sports persons.

Nandi, Adikari and Bera\textsuperscript{7} conducted experiments on the "Effect of Aerobic Exercise Yogic Practice And the Combination of Both on Cardio-Respiratory Endurance".

Eighty school boys belonging to class IX to X standards of Rajagram S.B. Rada Institute of District Bankura, West Bengal, were selected on random basis as the subject for the study. The average age of the subject was 15 years ranging from 14 to 16 years. Out of the eighty subjects each twenty subjects were randomly selected, for three experimental groups (A.B.C.) and the remaining twenty were selected as the subjects of the controlled group.

The experimental groups have undergone three respective training Programmes of 30 minute's, duration for three days in a week for 12 weeks. The aerobic exercise group (Gr. A) had undergone only a few aerobic exercises; the yoga practice group had undertaken a

few yogic practices like asanas and pranayam and group C (combination of aerobic exercise and yogic practice group) had received a training of both the aerobic exercise and yogic practice mentioned earlier in a combined form. The controlled group did not participate in any of the above Programmes.

Cooper test (12-minute run and walk) was administered to measure the cardio-respiratory endurance before and after training. The analysis of co-variance (ANOVA) was used in order to find out the existence of significant differences. In any case of having significant differences the Schefe’s Post Hoc Test was used.

It may be concluded that aerobic exercises are effective in improving cardio-respiratory efficiency. Moreover, yoga if practised alone or in combination with aerobic exercise also plays a prominent role in improving cardio-respiratory fitness.

Bhola⁸ selected 25 male volleyball players to study the relationship of absolute leg, length, foot and agility for jumping ability in volleyball using Three-Strides Rhythm and found that the foot length, agility, dynamic power, as well as ankle flexibility had significant relationship with jumping ability using Three Strides Rhythm whereas absolute leg length and relative leg length did not correlate significantly.

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Prakash\textsuperscript{9} conducted a comparative study on 15 players each for a group of students undergoing special coaching in soccer and cricket were selected. Criteria measures were employed to measure, maximum expiratory pressures pulse rate, systoric blooc pressure, diastotic blood pressure, and speed (50 yard dash), shoulder girdle explosive strength (self ball throw), leg explosive strength (standing broad jump), muscular endurance (sit up), and flexibility (toe touch in long sit position). He concluded that well-conditioned collegiate soccer players were seen to have potential to develop cardiopulmonary fitness muscular endurance than as cricket players measured by Chin-Ups, and Explosive Leg test.

Richard\textsuperscript{10} studies the functional capacities of according to this study Shri Bishma Devendra's physical examination structure, Dynamometric test showed comparatively low heart rate upon cessation of the required exercise. The result of the respiratory ECg studies found that the yogenic techniques utilized in controlled breathing produced absence of low heart rate. Tests revealed unusual degree of flexibility without evidence of traumatic and pathologic changes. Richard conducted a study also on effectiveness of overload on accuracy of throwing. Thus it


\textsuperscript{10} Hopock Richard "Study on Effectiveness of Overload of the Accuracy on Throwing Football," Completed Research in Health, Physical Education and Recreation, 10(1968).
reflects that work load for longer duration gives better cardiovascular endurance and better adaptation on soccer game.

Singerseth and Haliski\textsuperscript{11} conducted a study, the specific purposes of which were (a) to compare the flexibility of 21 joint or areas of football players against some normal college students to measure the flexibility of linesmen and backfield men in the same joints and areas (a) to determine whether there is a difference in the flexibility of comparable right and left joint of the body. Data was obtained from 100 football players. Leighton had earlier collected similar data from 56 normal college students. A goniometer called Leighton flexometre was used in taking the flexibility measurements of ankle flexion and extension, knee flexion, leg abduction, hip flexion, and extension trunk hip flexion and extension, side trunk, hip flexion, wrist flexion and extension, arm flexion, elbow flexion, head rotation, head extension and flexion and shoulder flexion, and extension when right and left sight measurements of similar joints of football players were compared. Only the differences between right and left knee flexion and between right and left elbow flexion were large enough to be significant. There was no significant instance of difference in flexibility between the right and left joint on service course members.

Ferris\(^{12}\) obtained low, mostly insignificant, correlations between trunk flexibility measures of abdominal isometric and isotonic strength and endurance. For the most part, he found boys 6-13 years of age with high and low scores on motor ability items did not differ significantly on flexometre tests. Boys in the standing broad jump, 30 yard dash, and softball distance throw were found to be more flexible in trunk extension: those with the greatest distances in the softball throw had the greatest neck rotation & trunk lateral flexion flexibility.

Downic\(^{13}\) studied the age difference in the flexibility of boys from 6-14 years, utilising nineteen flexometer tests generally, Flexibility increased upto the age of twelve and then declined.

Chauhan\(^{14}\) conducted a study to compare the selected general-motor-ability components, i.e. speed, agility, flexibility, muscular endurance, balance, leg strength, arm and shoulder strength and coordination between women basketball and volleyball players. The numbers of subjects were 15 from each game, the data collected in all the tests were statistically compared by using “t” ratio at 05 level of

\(^{12}\) Black F. Ferris, “The Relationship Between Flexibility and Selected Measures of Abdominal Strength and Endurance” (Master’s Thesis University of Organ, 1966), P. 98.

\(^{13}\) Patricia O. Downic “A Study of the Relationship Between Flexibility, Measures and Chronological Ages of Six to Ten Years Old Boys” (Masters Thesis University of Organ, 1965).

significance. In the analysis, the women basketball players were comparatively superior to volleyball players in arm and shoulder strength. But there were no significant differences between the two groups in speed, agility, trunk flexion, abdominal endurance, balance, leg strength and hand-eye co-ordination.

The first group performed warming-up exercises. Passive range of joint motion was determined in hip flexion and the trunk flexion using a goniometer and a flexometer. They indicated that the warming-up session induced a significantly increased range in all lower extremity joints and trunk flexion (P<0.01 to p<0.001) of both groups.

Conclusion: flexibility improves as a result of muscle elongation during warming up or even through an incorporated pathetic stretching programme.

Saudler et al\textsuperscript{15} conducted a study focussing on age and physical activity as determinates of muscle strength. The study involved 620 women 25-73 years of age. The five muscle groups assessed were, grip, planter flexor, hip abductors, trunk flexors, and truck extensors. Pearson’s correlations yielded significant negative correlations of muscle strength with age and positive correlations with height as well as physical activity. In stepwise regression analysis,

age was the strongest predictor of strength of all muscle groups, with smaller contributions to the variance by physical activity. A sample population was divided by Anthropometrics variables and it was further subdivided based on fertile physical activity. The results of actorial analysis indicated that the main effects due to age and physical activities were significant. It was concluded that 1) moderate levels of physical activity tend to improve muscle strength even in older women, and 2) normative values of muscle strength could serve as an indicator of the adequacy of the habitual levels of physical activity.

Gurrary et al.\textsuperscript{16} conducted a study where pre-season health, strength and fitness evaluations were conducted on 40 professional baseline players to assess levels of conditioning and potential for injury. Screening identified many players with problems or potential problems. Body composition, muscular endurance, flexibility and aerobic capacity were the parameters of the test.

Scott\textsuperscript{17} conducted a study on the relationship of some selected flexibility and strength measures to time in 100 yards crawl stroke, male SHS swimmers (N=26) who bettered as equated to time of 56 seconds for the 100 yeards crawl stroke. They were tested for flexibility


\textsuperscript{17} Guilfoil J. Scoot, "The Relationship of Selected Flexibility and Strength Measures in time in 100-yard crawl stroke" \textit{Completed Research in Health, Physical Education and Recreation}, 9 Vol. 20.1978, P. 304.
of the ankle, knee, hip trunk and shoulder. Upon completion of these tests, the subjects were timed for a 100 yards kick, pull swim. It was concluded that certain flexibility measurers were significantly related to swimming time. However, it was determined that knowledge of certain strength and flexibility measures will not be used to predict 100 yards crawl stroke times.

Gloria Lee\textsuperscript{18} conducted a profile photograph of 92 undergraduate women, which were taken as a basis for measuring angular diviations of the head and neck, trunk and hips from a straight line. The deviations were submitted for an overall assessment of body alignment. The strength of the upper thoracic extensions, trunk extensors, hip flexors and extensors, and factorial and scapular adductors was measured, and five flexibilities were measured. The positive and significant linear correclations between strength of opposing muscle groups indicated that alignment depended on a balance in muscular strength. Standard score strength ratio for trunk extensor to flexor strength of 1:2:1 were associated with same angular deviation of the trunk. The relation of imbalance to deviation was generally higher with curvilinear correlations. Excess hip flexor strength was associated with the pelvic tilt and other misalignments were generally related to muscular imbalances.

Aver\textsuperscript{19} found out the relative effects of selected warm up exercise strength, agility, flexibility and power. The researcher had taken 90 college-going-male students as subjects. They were tested in five volleyball classes before and after ten weeks of activity, involving 4 or 8 minutes of isometric activity per class period. No significant difference occurred among treatment results except for dipping strength.

Tiva\textsuperscript{20} selected twenty-two women physical-education majors at the University of California, Los Angeles, who were tested for arm strength and flexibility. The weaker arm was trained three times a week for four weeks with specific isometric exercises. The strength of the trained arm increased and the range of motion in extension increased slightly but the correlations between strength and flexibility were not significant.

Mohan\textsuperscript{21} made a study to compare the physical fitness components i.e. speed, extend flexibility, explosive strength, gross body coordination and cardio-respiratory endurance of football and basket ball players. On the basis of analysis of data, the following conclusions were drawn. The basketball players were comparatively superior to the football players.

\textsuperscript{19} Hampton Harvil Aver, "The Relative Effects of Selected Warm Exercises on Strength, Agility, Flexibility and Power," \textit{Completed Research in Health Physical Education and Recreation}, Vol. 9, 1976, P. 56.

\textsuperscript{20} Barnea Tiva, Effect of Balanced Development on Flexibility, Flexibility of the Shoulder Gridle, M.S. in \textit{Physical Education (W. Massy)}.

\textsuperscript{21} Chander Shekhor Mohon, "Comparative Study Physical Fitness Components of Football and Basketball Players," (Published Master's Thesis, Jiwaji University, Gwalior, 1981)
Joseph\textsuperscript{22} conducted a study on the relationship of power, agility, flexibility and measurements of selected body segments to volleyball playing ability taking college male players as subjects. He concluded that power and arm strength are significantly related to playing ability. Agility and shoulder flexibility showed insignificant relationships to player ability in volleyball.

Devi\textsuperscript{23} conducted a study on twenty-four volleyball players to find out the relationship of selected strength and flexibility measures to playing ability on volleyball. She concluded in her study that arms strength, abdominal strength, leg strength and shoulder flexibility were significantly related to playing ability in volleyball. Grip strength did not correlate significantly to playing ability in volleyball. Wrist flexibility and ankle flexibility had insignificant relationship to playing ability in volleyball, and trunk flexibility showed negative but insignificant correlation to playing ability in volleyball.

Saudler et al.\textsuperscript{24} conducted a study focusing on age and physical activity as determinants of muscle strength. The study involved 620 women 25-73 years of age. The five muscle groups assessed were

\begin{itemize}
\item \textsuperscript{22} Joseph V.K. "Relationship Power, Agility, Flexibility and Measurement of Selection Body Segment to Volley Vall Ability," (Unpublished Master's Thesis Jiwaji University, 1983).
\item \textsuperscript{23} Kh. Sanatombi Devi, "Relationship of Selected Strength Flexibility measures to Playing Ability Volleyball," (Unpublished Master's Thesis, Jiwaji Univeristy)
\end{itemize}
grip, planter flexor, hip abductors, trunk flexor, and trunk extensors. Person correlations yielded significant negative correlations of muscle strength with age and positive correlation with height as well as physical activity. In stepwise regression analysis age was the strongest predictor of strength of all muscle groups, with smaller contributions to the variance by physical activity and anthropometrics variables. When the sample population divided by decades of age, was further subdivided by fertile Physical activity, results of factorial analysis indicated that the mass effects due to age and physical activity were significant. It was concluded that (1) moderate levels of physical activity tend to improve muscle strength even in older women, and (2) normative values of muscle strength could serve as an indicator of the adequacy of the habitual levels of physical activity.

International Fitness Association\textsuperscript{25} reported that many sports training for successfull competition has become virtually a year-round endeavor. To assist in better preparation, a competitor’s year may be divided into phases such as off-season and in-season indicating reduction of increased competition commitments, respectively. A number of studies have described the effects of seasons or periods of competition, training, detraining and reduced training on aspects of physical fitness. Depending on performance level, the type of sport and the fitness parameter in question, the swings in fitness variables

reported may be as high as 18% from one season to another. In elite competitors, anaerobic parameters, heart frequencies, subcutaneous fat, flexibility and hemoglobin levels remain relatively unchanged throughout the year. Aerobic metabolism and muscular strength may demonstrate noticeable changes and plasma hormonal levels normally follow genetics. It is still not known whether greater fitness gains attainable with longer off season training programmes can be successfully maintained over the duration of the competition season. However, the consensus would seem to be inadequate for fitness maintenance and improvements. This is perhaps supported by the general trends found in literature regarding muscular strength. While supervised off-season conditioning programmes may result in significant improvements for both recreational and competitive athletes, no such changes are normally observed after competition seasons. These findings may reflect, amongst other factors, a lack of optional training. Amongst other factors, a lack of optional training to bring about strength increases during in-season periods, In athletes at low competitive levels, training season may lead to considerable function of the cardio-respiratory system, coupled with occasional increases in muscular strength and decreases in body fat. Relatively low fitness levels at the beginning of training have been put forward as an explanation for these improvements. Seasons of training and
competition result in so significant changes is flexibility measurements. In novices and in athletes at low competitive level it may also be seen third in children and adolescents engaged in sports their fitness improvements are consistent with normal patterns of growth and development. No differences have been identified at different competition levels.

Kibler and others²⁶ have pointed out that the elite handball as well as a large number of active recreational players are in a sport that applies high repetitive loads that can create tension overload situations in certain key anatomic areas of the body and add to possible overload situations in other areas of the body. These results in patterns of inflexibility and weakness that can be demonstrated on handball specific musculo-skeletal exam, and that can be correlated with areas of increased injury occurrence. These players report conditioning programmes that are, for the most part, inadequate to confer total conditioning of all the muscular parameters important in playing handball. All of these factors, in addition to the frequency and type of playing, contribute to the occurrences of the overload injuries noted. These aspects need to be addressed in a preventative programme for injury reduction. We do not believe that major changes in the way that handball is played should be implemented until the effects of

proper preventative conditioning programme are evaluated. The ideal composition of the programme is in doubt; our studies allow us to recommend flexibility, strength and endurance training for all athletes playing handball at frequent intervals. This programme should be guided by the findings on the preparaticipation exam.

L. Tiken, K. Konsam, A.K. Joy and T. Inaobe\textsuperscript{27} conducted on sixty athletes who are undergoing training in SAI and NERC Imphal. They were randomly selected (30 boys from 61 and 31 girls from 54) for this study.

They were divided into two groups—boys and girls, their mean age 17.5 years for boys and 16.0 years for girls.

The aerobic exercise classes were given twice a week in the early morning.

For observing the influence of Yoga and aerobic exercise on physical fitness, six physical fitness items were selected and the test was conducted on the subjects.

The Selected physical fitness items are:

1) Vertical Jump (Explosive power)
2) Sit reach (Flexibility)
3) 50 yard dash (Speed)

4) Push ups (strength endurance)
5) Sit up (strength endurance)
6) Run–walk (endurance)

All these tests were taken thrice on both boys and girls according to the standard procedure.

Delores\textsuperscript{28} found out the effects of toe strength and flexibility on free running speed by testing women college students in toe strength, ankle strength, leg strength, toe flexibility, ankle flexibility and free running speed prior to and immediately following a four week’s exercise programme designed to increase the toe strength. There was significant gain in four of the strength tests and running speed, and a significant loss in leg strength, toe and ankle flexibility.

Ikeda\textsuperscript{29} conducted a series of tests during the last weeks of an eight weeks, badminton team including waist flexibility, shuttle run and various measures of kinesthesia, such as arms forward, wrist extension, wrist flexion, target finger spread, supination, pronation and grip pressure. They were administrated to 72 women students.


Their last scores were compared with the results of volleyball and a badminton tests. There was no significant relationship between wrist flexibility kinesthesia or agility and badminton playing ability.

Hutchine\textsuperscript{30} conducted a study in which the sample consisted of 92 undergraduate women who were individually photographed to assess their anterioposterior body alignment, the subjects were given seven tests of strength and five tests of flexibility. The findings showed that strength balance in the selected muscle groups is an important variable in anterioposterior posture. An analysis of linearity reveal that some of the variables of this study are linear while others are curvilinear indicating that exclusive use of linear statistics tends to under-estimate the nature of some of the relationships involved in anterioposterior posture. The findings further demonstrated neutralising effect of counterforce of one muscle group on another in order to maintain the balance of the body segments over the base of support.

Reid\textsuperscript{31} in his study examined the relationship of flexibility, strength and anthropometric measurements of lower limb to the skating speed of hockey players. 17 university hockey players were assessed for

\textsuperscript{30} Gloria Lee Hutchins, "Relationship of Selected Strength and Flexibility Variables to the Anterioposterior Posture of College Women", \textit{Research Quarterly}, 36, (October 1965) : 253.

leg and grip strength using Cable Tension Methods; lower limb flexibility by using Cable Leghton's flexmeter technique; anthropometry of the legs and skating speed under standing and flying start conditions with the without stick over two feet distance, 40 feet and 20 metre. The strength, flexibility and anthropometric measures were independent variables and the stating speed were of dependent variables. The data were analysed using Pearson Product Moment r and stepwise R. statistical methods (P. 05). The results indicated that flexibility was specific to each joint measured; there was a general strength factor and a general skating body type, Two of the skating speed tests encompassed many functions of the other six. Flexibility was related to strength and anthropometry; strength and anthropometry were related, and flexibility and anthropometry were not related to skating speed. the regression analyser accounted for all of the variance in each dependent variable but the variables entered were different in order and contributory at each analysis. Skating was indicated as being specific to the distance and condition under which it was performed.

Leuback and Mc Conville\(^32\) reported low correlations between flexibility and anthropometric measurements and between somatotype and flexibility. A high negative relationship was obtained between only fat and flexibility. Somatotype components were found to correlate in

the study. In a later study, the authors reported many significant correlations between strength and anthropometric measurements. The only somato type component found to correlate significantly with muscle strength was mesomorphy.

Johnson\textsuperscript{33} conducted a study on a group using the Whip and Wedge Type breast stroke kicks. They were tested for strength of high adducting flexibility, and power obtained from the kick. The differences between the groups were observed as regards strength and flexibility. The Whip kick yielded significantly higher power; strength was not a significant factor for power in either type of kicks. The results indicated that flexibility was a factor in determining the power in the Wedge kick and that it was not important for development of power in the Whip kick.

Gopal \textsuperscript{34} investigated two group of subjects: one had been trained in asanas for a period of six weeks, the second group had no previous training in Yoga. The latter regularly engaged in light exercise. During the performances both the groups performed sequence of 8 asanas and various EMG were obtained. In each of the asanas the non-experienced EMG was greater for the untrained subject than for the trained subjects.


Thus in both the above studies it was shown that the means of asanas involved less muscular work. It is clear that an easily recognised benefit of the practice of Yogic exercises is an increased flexibility.

V.H. Dhanaraj\textsuperscript{35} measured a number of physiological variable performances after training either in Yoga or in the 5 Bx physical fitness. The six weeks of training started with 15 minutes of selected asanas and two pranayamas. The six weeks of 5 Bx training consisted 5 Bx standard graded sequence of exercises. He found that after the daily practice of the Yoga routines, there were different increases as measured by the Shoulder and-Reach Test. Post detraining showed decreases in flexibility for Yoga group significantly.

R. Moses\textsuperscript{36} also considered changes in flexibility at ankle, the hip, and the trunk combined and the measurements were made before and after ten weeks by giving selected postures and breathing exercises in the experimental groups. Statistical analysis showed different increases in flexibility for the Yoga groups as compared with the controlled group for hip and trunk.

\textsuperscript{35} Dhanaraj V.H. "The effects of Yoga and the 5 Bx Fitness Plan on Selected Physiological Parameters," (Ph.D. Dissertation, University of Alberta, Edmonton, 1974).

T.R. Anantharaman\textsuperscript{37} conducted an experiment on forty boarding students. They were selected at random from among the boys of the local secondary school for the experiment. Their mean age, height and weight were 17 years, 158.17 cms., and 44.42 kg., respectively. They were clinically normal. They had a common programme and common food. On the basis the fitness Index points, the subject were divided into two matched groups of 20 each. One of the groups was randomly selected as the experimental group, and the other was treated as the controlled group. No subject engaged themselves in competitive sports or other systematic training programme. During the experimental period, which could have influenced the results. However, routine school activities were undergone by all the subjects.

The yogic training were perform with selected exercises. The Yogic exercises were progressively introduced to the experimental group in the first week and the remaining two weeks were devoted to the practice. The experimental period consisted of three weeks. The subjects performed the yogic exercises every day (Sunday excluded) and each session consisted of 30 minutes. After the experimental period was over, both the groups were tested again. Comparisons of all the data collected before and after the experimental periods by yogic training and de-training were made to study the effects. The experimental group was found to be statistically significant.

\textsuperscript{37} Anantharaman T.R. "Yogic Training and Physical Fitness" Seminar on Yoga Science and Man, P.P. 55-64.
O.P. Tiwari, say that Regular practice of ‘Shatkriyas’ helps in purification, ‘Asanas’ give strength, ‘Mudras’ give rise to steadiness and ‘pranayama’ develops lightness. These practices ensure nourishment to tissues through their beneficial influence on various systems of the body and thus help in preserving and promoting mental and physical health.

S.D. Vinod et al, conducted an experiment where after The initial medical check up all the participants (F=27, boy=14, girls=13, age : 15.63 yrs.) were tested for anxiety and personality variables. After practising Yogic exercise an improvement in over all personality was found. The result indicated that shavasana meditation produced emotional stability and physical relaxation significantly.

B.K.S. Iyengar say that even though the final aim of different exercise is the same i.e. development of an integrated personality, yoga approaches it subjectively. Yoga is a subject that has to be practised and experienced, and not merely discussed or argued about. Practice of yoga leads to physical well-being, i.e. flexibility etc and emotional stability and clarity.

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In Yoga Mimansa S.K. Ganguly and I.M.V. Bhole\textsuperscript{41} write that back
word bending (extension) was found to be more after inspiration while
forward bending was found to be more after expiration in a study on 32
college students. Likewise lateral bending was more in expired condition.

O.P. Tiwari\textsuperscript{42} the concept of health in Ayurveda has been
accepted by yoga. The practice of 'Asanas' gives (i) best organic
vigour to the whole body and (ii) good training to the spinal cord and
the brain (iii) health to the tissues, (iv) constant supply of nourishment
and endocrinal secration, (v) effective removal of the waste protects
and (vi) healthy functioning of the nervous system.

M.L. Gharote\textsuperscript{43} is of the opinion that asana is one of the ancient
yogic practices forming a base for all other practices and plays an
important role in every kind of yoga sadhana. It is one practice which
has attracted great attention of masse. There are various aspects of
this practice which could be studied. In this article, elaborate
discussions on the points of terminology, classification, number
characteristics, principles and a review of scientific, studies on asanas
have been presented.

\textsuperscript{41} Ganguly, S.K. and Bhole M.V., "Influence of Breathing on Flexibility," Yoga

\textsuperscript{42} Tiwari, O.P. "In A.B. Hiramani & Neelam Sharma (eds), Books," Health
and Youth in India, (Delhi, Agam Prakashan), PP. 117-127.

\textsuperscript{43} Gharote, M.L. "Asanas - A perspective," Yoga Mimansa, Vol. 24, No. PP.
17-38.
Neti Kriya, one of the exercises of Yoga, is taken to see its effect on its practitioners. This was done by De Vicent and Maiyo Pedrs.\textsuperscript{44} 188 patients (131 of spastic descending conditions of respiratory tract and 57 of bronchial asthma) were treated with Neti Kriya, over a period of eight years. 160 patients (85\%) showed general improvement in health, 170 patients (90\%) showed symptomatic improvement, 147 patients (78\%) showed reduction in medication while 66 patients (35\%) did not require medication during crises. 170 patients (95\%) reported pleasant feelings after performing Neti Kriya. 175 patients (93\%) showed better control in attack after learning this technique.

M.V. Bhole\textsuperscript{45} prepared an outline of instructions in yoga training cum-education divided in seven sessions. It was given for the patients of mild arterial hypertension and for the rehabilitation of patients after acute \textit{myocardial in function}? Guidelines for the practice of simple asanas, pranayamic breathing techniques, release of tensions leading to relaxation and instructions for recitation of Om with a view to work through vibrations have been included on the lines, from simple to difficult in progressive manner.


S.D. Vinod, R.S. Vinod, U. Khire discussed elaborately on the effects of practising Ashtanga Yoga. It deals with the effect of training in ashtanga yoga, on simple as well as disjunctive reaction time. pre- and post-training readings in milliseconds of simple Visual Reaction Time (SVRT) Disjunctive Visual Reaction (DVRT), Simple, Auditory Reaction (SART) and Disjunctive Auditory Reaction Time (DART) were recorded. The training programme continued for one month and comprised in-depth training of yogic philosophy, as propounded by Patanjali along with practical training in yogic postures, pranayama, meditation, prayer, chanting of Omkar, personal interviews, and group discussion. The sample was made up of 55 individuals, and was subdivided according to age (15 to 17 yrs. 18-20 yrs. and above 20 yrs.), sex and socio-economic status (upper, middle & upper-middle). The results indicate the comprehensive training in Ashtanga Yoga can significantly contribute towards increasing speed of processing of information and thus improve learning ability or general intelligence.

A.N. Khodeshar used 50 male Kabaddi players of age group 18-25 years of local Physical Education Training College. They were


divided into two groups equally that is experimental group and controlled group. The yogic training programme was given to experimental group for 6 weeks for 45 minutes daily except on Sunday. Both the groups were being involved in the common physical education programmes of the college in addition to the experimental stimulus. The results showed that the training based on some simple yogic exercises did have positive effect in increasing the cardiorespiratory endurance and efficiency. Post training values indicated improvement in *hanting* ability, vital capacity, breath-holding and the physical fitness index.

M.V. Rajapurkar\textsuperscript{48} wrote that ancient Indian Sages had already recorded definite observations on lateralization of nasal breathing and its applications on human physiology and psychology. This knowledge of the functions of the right hemisphere may give insight into how yogic knowledge was acquired. Yogic practices may develop and enhance right brain function and thus lead to a better understanding of the expression of institute Knowledge and reality.

J.P. Oak\textsuperscript{49} status that the development of stress depends on both, the external (malnutrition, lack of physical exercises, population, overwork etc) as internal (habits, desires, emotional set up etc)


environmental factors. Modern medicine provides only the tranquilizers and muscle relaxation drugs to mimise the stress temporarily. These drugs, however, show various side effects on the longer run eventhrough they are very effective to give immediate relief. Yoga on the contrary, is becoming more and more popular as a drugless therapy for such disorder eventhough the preliminary aim of yoga is not the therapy. The efficacy of the yoga treatment for asthma, diabetes, myocardial infraction, wild arterial hypertension, constipation, ulcer, hyperacidety, backache etc, has been proved research, training and treatment since 1924. It has been observed that, in-depth interview, application of various personality test, guidance and councelling, psychotheraphy are useful as associate means along with yogic treatment. Probably these methods help patients to have self-analysis and approach towards the root cause of their suffering by improving mental health. This wounderful combination of principles of yoga and psychology and its application are discussed with examples.

In an R.S. Bhogal,50 article underlines the gap between the conception of mentrospiritual life involved in the system of yoga and the understanding of behaviour through empirical approach involved in modern psychology. After giving an account of the psychological aspects of the various system of yoga and an

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exposition of modern psychology as it developed in the west the author compares them and discusses the ways in which a synthesis of the two can be brought about.

Utie. Schumann\textsuperscript{51} writes that regular practice of yoga gives a person an insight into his personality. It enables a man to observe his own behavioural customs in relations to his environments. In the science of Yoga we see an established system of exercise for self-experience as well as of techniques for self-studies. The field of yoga is based on psychology, phylosophy and religion. With reference to development of brain and channels of working of yoga techniques have been laid down in simple language.

V. V. Anantharaman,\textsuperscript{52} While strongly recommending the yogic exercises for maintaining a state of equilibrium between body and mind, V. V. Anantharaman pin pointedly describes important psychophysiological developments found in 20 subjects who underwent Hatha Yoga training.

M.L. Gharote \textsuperscript{53} conducted Yogic training of three weeks duration and brought about a significant improvement in the strength and endurance of the abdominal muscles of 12 females as judged through Sit-UpTest.


\textsuperscript{52} Anantharaman V.V., "Yoga as a Prophylactic Health Care" Yoga Mimamsa, Vol. 28, No. 1, P. 53-57, 1989.

M.L. Gharote, and S.K. Ganguly, conducted Nine week training in Yagic physical culture. It was helpful to improve general physical fitness level of 49 police cadets who were already conditioned to physical activities as against controlled group of 49 engaged only in school schedule as judged through (a) Flushman Basic Fitness Test, (b) Cureton’s Flexibility Test, (c) Skinfol and Harvard Steptest. The improvement was most significant as regards flexibility.

M.L. Gharote, conducted significant Seffect of 7.74 in fitness index in 17 males and 11.75 in 12 females. It was observed at the end of three weeks training in selected yogic exercises employing Fleishman Basic Fitness Test.

S.K. Ganguly and M.L. Gharote, claim that the purpose of this study was to see the effect of yogic training of the Regional Police Training School (RPTS), Khadala, from which 35 students were assigned to each of the experimental and controlled groups. Significant lowering of the sitting pulse rate was observed in the experimental group as compared to the controlled group. The cardiovascular endurance as judged by the Harvard Step Test improved significantly in the experimental group. Although mean increase in the Toe Touch Flexibility was observed in the experimental group, it did not reach the expected statistical significance.


T.K. Bera, M.V. Rajapurkar & S.K. Ganguly. The present experiment of evaluated the effects of a one-year yogic exercises training programme on body density and its selected substantiate variables. Fatfolds were taken from the triceps, subscapular, post-suprailiac, chin and midaxillary sites by a large caliper in 20 experimental and 20 controlled male subjects before and after one year progressive training regimen. Yogic exercise training consisted of 17 practices. ANCOVA revealed significant increase in body density and ideal body weight (P<0.01) for the experimental group as compared to the controlled group. However, significant gains in present body fate and absolute fat weight were observed in control group while compared with the experimental (P<0.01). The results demonstrate that the conventional yogic exercise does (1) preferentially reduce the present body fat and absolute fat weight, and significantly increases the ideal body weight and body density.

T.K. Bera & M.V. Rajapurkar undertook a study to evaluate if body type plays any role in better teaching, learning and performing Yogasanas. The subjects (SB) were teacher trainees in normal health, (N=40, age 25 to 40 years) of G.S. College of Yoga Cultural Synthesis,


Kaivalyadhama, Lonavala. Morphological confirmations were determined by utilising the Health Carter anthropometric somato type rating method. Yogasanas were evaluated by the dymentions as suggested by NCERT and scored on the basis of Liker’s 5 point scale. The results of a person’s product movement correlation showed that there was a significant correlation \( r = 0.75, P<0.01 \) between the somatotype scores and the mean performance scores of Yogasanas. The result of ANOVA revealed that - 1) the somato type groups (i.e., ecto-mesomorph meso-endomorph, endo-mesomorph, and balanced) could show similar and better performance in all the selected Yogasanas; 2) two Somatotype groups (i.e., ecto-endomorph and meso-endomorph) showed poor performance in the Yogasanas chosen for this study.

R.S. Vinod, S.D. Vinod & M. Rajguru,\(^{59}\) conducted a study from 1986 to 1988 on a sample fo 260 individuals (189 males and 71 females), average group of 18.9 yrs. who participated in a yoga training programme (18 Yogic postures, 2 pranayamic breathing, Shavasana meditation prayer and Omkar etc.) for 2 hours everybody for a total period of 1 month. The results revealed that positive approach towards life was considerably improved and a marked improvement in the qualities of the participants was noticed.

J.K. Bera and M.V. Rajapurkar\textsuperscript{60} conducted an experiment on male high school students, age 12-15 yrs. They participated for a study of yoga in relation to body composition, cardiovascular endurance and anaerobic power. The Ss were placed into two sub-sets viz, yoga group and controlled group. Body composition, cardio-vascular endurance and anaerobic power were measured using the standard method. The ANCOVA revealed significant improvement in ideal bodyweight, body density, cardiovascular endurance and anaerobic power and they were observed as a results of training. This study could not show significant change in body fat (mid axillary), skeletal diameters and most of the body circumferences. It was evident that some of the fat folks (triceps, subscapular, superailiac, umbilical, thigh and calf) and body circumferences (waist, umbilical and hip) were reduced significantly. The age ranges between 20 and 30 yrs. This method can be used to assess the effect, if any, of yogic practices (including streching and breathing exercises) on enxiety before, during and after a sport competition. In this context various yogic practices considered to be useful for the purpose are discussed and recommended.

Fieldman,\textsuperscript{61} conducted a study on 33 male college students doing the Toe-Touch Test to ascertain the relative contribution of


the back and hamstring muscles to hip joint flexibility. The subjects, performing six tests over a five week period, were photographed during each of their tests. Anthropometric measurements were taken prior to testing. It was possible to ascertain the curvature of the back, the angle of straight back flexibility and the angle of bent back flexibility. Hamstring muscles appeared to be one of the main factors contributing to hip joints flexion as measured in this study. There were not significant relationship to the angle of bent back flexibility.

M.L. Gharote\(^{62}\) has shown that greater improvement in physical index was observed after 3 weeks Yogic training programme. De-training effect on the individual test items of the Fleishman Battery showed that the scores of Shuttle-Run and Pull-up were markedly decreased. Scores on Leg-Lifts and Cable Jump did not show any direction; while scores of Extent Flexibility, Dynamic Flexibility, softball throw, balance, and 600 yards run showed increase indicating delayed effect.

M.M. Gore and M.L. Gharote,\(^{63}\) did an experiment on expect of Yogic Training on Peak Flow. It was found that flow rate increased significantly in 105 males and 30 females at the end of 3 weeks of training in Yogic physical culture indicating an improvement in the ventilatory efficiency.


A.M. Moorthy,⁶⁴ say that Yoga exercises are more beneficial than the non-yogic exercises to improve minimum muscular fitness of school children in the age group of 6 to 11 years. 6 weeks training in Yogic physical culture revealed a positive change amongst elementary school children of 6 to 11 years in passing the minimum muscular fitness test as well as the individual items of the same.

R.J. Sahu and M.V. Bhole,⁶⁵ gave the opinion that psychomotor performance involving speed and accuracy was seen in increases gradually from first week onward up till the end of the 3 weeks after high pitched omkar recitation in ten subjects undergoing training in Yogic physical culture.

Institute S.K. Ganguly,⁶⁶ found that daily one hour training yogic physical culture for three weeks as per N.F.C. Programme was found to improve cardio-vascular endurance significantly as measured by 20 Harvard Step Test.

Monjo Pedro de Vicente⁶⁷ came to know that improvement in emotional control and overcoming of the imblanced cardiac rhythm were observed in 15 subjects undergoing yogic training programme for 3 months with the help of 195 electrocardiograms.

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⁶⁷ Manjo Pedro de Vicente, "Emotion and Heart Rhythm As Influenced with Yoga".
R.J. Sahu and M.L. Gharote,⁶⁸ were of the opinion that speed accuracy and Co-ordination were found to increase significantly in 35 subjects of experimental group as compared to 35 subjects of controlled group at the end of 3 weeks’ training in Yogic Physical Culture as studied through Tweezer Dexterity Test.

S.D. Paranjape and M.V. Bhole,⁶⁹ the resting nerve-muscular activity was found to increase at the end of three months of training in yogic physical culture as the subjects were precising yoga techniques mostly as physical exercises. At the end of six months, the activity showed reduction as the students were corrected in their practices and more stress was laid on meditational aspect.

Swami Kuvalayananda,⁷⁰ a list of 10 yogic practices for the average man of health to be practised every morning and evening has been presented with the time duration of maintenance.

M.V. Bhole,⁷¹ the usefulness of yogic exercises in certain areas like (1) Basic personality traits, (2) Mental peace and tranquility (3) Prevention, treatment and rehabilitation after injuries etc., as a complimentary to sports training programme have been described scientifically.

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⁶⁸ Sahu R.J., & M.L. Gharote Effect of Yogic Training Programme on some Aspects of Psycho-Motor Performance.


Bhole, M.V.,72 the utility of games and sports and their inadequacy to meet some specific difficulties of elite society as compared with the potentially of yogic practices and their possible good effects on human organism have been described.

M.L. Gharote,73 non-conventional methods of training in sports such as Autogenic Training, Modified Autogenic Training, Sophrology, Bio-feed Back Training, Mind Development Programme are being used in the field of Sports to improve the performance levels. The approach is to cultivate mind in order to influence the body for better performance. As compared to these methods Yoga would have better influence as it is based on psycho-phsiological aspects of the human personality.

M.L. Gharote,74 the various aspects of Yoga such as prevention of the sports injuries and their cure, the promotion of basic fitness, specific sports skills, psychological factors and the maintenance of physical fitness during the participation period as well as in off season and for the promotion of sports are discussed in details.

M.L. Gharote,75 the different aspects, approaches, concepts, ideas and importance of Yoga and their inter-relationships for the development of human personality are discussed. An overall picture of Yoga viewed physically and mentally based on sound logical thinking is shown in this communication.

The areas of specialisation in Yoga such as Research, Treatment and Training and their various aspects, theoretical as well as practical are also discussed in details.

M.V. Bhole,76 Yoga techniques work on internal organs and through them on the autonomic nervous system which control our emotions, values etc. Other types of educational processes like games sports, etc develop ‘Kartru’ aspect or ‘Ahamkar’ while yoga education develops the ‘Drastu’ aspect of the individual which can make him realise higher principles behind our existence. Through yoga education one will remain straight and even, but without tension. It is mainly based on the inner experiences rather than mere teaching by a teacher or a preacher.

M.V. Bhole,77 most of the Yoga techniques work on internal organs and through them on autonomic nervous system and

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ultimately on our emotions, value systems and attitude to life as a whole. Yoga education emphasizes on observing the events which are happening initially and after practice for realizing higher principles behind our existence. One is expected to have an even, balanced and relaxed condition of the body, neck and head. By observing the movement of the abdomen and thorax and feeling the touch of air in and out of the nostrils on the finger, one can experience one’s own breathing. Yoga education can supply plenty of material to release tensions and make one experience peace and happiness.

Dickinson\textsuperscript{78} conducted a study on fifty male college students. Flexion and extension of wrist and ankle were measured with a tactograph goniometer, which was made of transparent plastic. The collected data was analysed by person product movement correlation. The reliabilities showed were all above 0.84. All inter-correlations failed to show a significant relationship between flexion and extension at the wrist and at the ankle. It has been concluded that in most cases, flexibility is not only specific to the joint but also to the individual movements of the joints.

Maccue\textsuperscript{79} observed that whosoever were more active, tended to be more flexible. One of the purposes of her study was to find out whether flexibility could be increased by exercise.


Thirty three subjects who were in the lower quartile on one or more of flexibility measures were put through a special daily exercise programme for three weeks. And it was concluded that significant increase in flexibility could be achieved through a suitable exercise programme. The t-ratio obtained was 5.71 which was far more than that required for significance at the 0.01 level.

Broer and Galles\textsuperscript{80} studied hundred college women to investigate the importance of the relationship of trunk plus arm length (reach) to leg length in the ability to perform the toe-touch test. Various anthropometric measurements, flexibility scores (Leighton's flexometer) and toe-touch scores were obtained. Results indicated that the relationship of reach length to length, leg length is not an important factor in the performance of the Toe-Touch Test for persons with average body builds, a longer trunk plus arm (reach) measurements in reaction to shorter legs give an advantage in the performance of this test.

Devries\textsuperscript{81} did evaluation of static stretching procedures for improvement of flexibility. In order to evaluate the static stretching procedure of Hatha Yoga for improvement of flexibility, fifty seven college male subjects were divided into two groups, one of which was trained

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through static stretching for seven thirty minute periods. The subjects were tested before and after the experimental period on Cureton’s Flexibility Tests involving trunk flexion, trunk extension and shoulder elevation. Both groups made statistical gains at the 0.01 level of confidence in all three measures, none of the difference in gains between groups were significant at the 0.05 level of confidence. The investigation reported the following conclusions:

1. Flexibility can be improved significantly both by static and ballistic method.

2. No evidence has been found to indicate significant difference in improvement of flexibility through the use of one method over the other.

Harris\textsuperscript{82} investigated the structure of certain measures of flexibility by the technique of Factor analysis. Two types of flexibility measures, single joint action and composite, were used. The data were analysed by several factor models to permit assessment of the extent to which the obtained structure of flexibility is independent of fractoring method.

\textsuperscript{82} Margareth Harris, “A Factor Analytic Study of Flexibility,” The Research Quarterly, 40:1, March, 1969, 2.
Landbach and McConville,\textsuperscript{83} obtained fourteen flexibility measurements, sixty three direct and derived anthropometric measurements on flexibility of somato type. The correlation between the flexibility measurements and anthropometric measurements were low and mostly insignificant. Body fat as measured by Skinfold Calipers, yielded fairly high significant negative correlations with the flexibility measurements. The correlation between the flexibility measurements and somato type was insignificant. Generally, high Correlation coefficients were obtained between the anthropometric measurements and somato type.