Chapter-II

REVIEW OF RELATED LITERATURE

A serious and scholarly attempt has been made by the research scholar to go through the literature related to this study. The specific importances of relevant studies are cited below:

Shaji\(^1\) conducted a study on performance variations in selected soccer skills on different ground conditions. The study was delimited to only three ground conditions, grassy ground, non grassy hard ground and muddy ground. The findings showed there were significant differences on selected soccer skills when performed on these different ground conditions. Further, it was observed that all the selected soccer skills were performed well on grassy ground as compared to non-grassy hard ground and muddy ground.

Grove and Gayle\(^2\) proceeded further and examined the physiological changes of eight college female players in age group of 16 to 18 year that engaged in 10 months training program. The

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repeated ANOVA test revealed the following facts: (1) Players percent of body fat decreased (2) Although the body weight didn’t vary much after a year, lean body mass significantly increased (3) Slightly increase in vital capacity but not bring significant change.

Balamani\(^3\) investigated the strength, endurance and flexibility variation resulting from a 3-set volleyball match played on different surfaces. The study was conducted on twelve male volleyball players of Lakshmibai National College of Physical Education, Gwalior, She came to the following conclusion:

1. Muscular endurance and cardio-vascular endurance showed significant increase after playing 3 sets volleyball matches on beaten earth surface and on sand court, whereas for strength and flexibility no significant variations were observed.

2. Volleyball matched (3 set) played on different surface resulted in significant variations in endurance ability and for strength and flexibility no significant differences were observed.

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\(^3\) B. Balamani, “Strenght Endurance and Flexibility Variations Resulting from a 3-Set Volleyball Match played on Different Surfaces” (Unpublished Dissertation of philosophy in Physical Education, Jiwaji University, 1995).
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Angyn, Mezey and Lelovics⁴ conducted a study to measure selected anthropometrical characteristics, motor abilities and cardio-respiratory functions of female players. The players were categorized into five groups (i) doing activities regularly, (ii) doing activities regularly on sand surface, (iii) doing activities regularly on natural surface, (iv) doing activities irregularly, (v) basketball players, all having training at least five times per week for 8 months. Better performance were obtained from the players predicted on sand surface than from the other groups. There was at slight improvement but not statistically significant difference were found between the groups in all anthropometric characteristics (weight, height, body fats), motor abilities and cardio-respiratory functions (resting blood pressure, heart rate, vital capacity and the ability to hold one’s breath). The result concluded that the sand group slightly better from the other group but it can’t brings significant changes in all selected variables because the duration of training was not sufficient to improve the variables of the players at the upper level of the normal range.

Ann⁵ has conducted a comparative study on the biomechanical and physiological response of suspended deep water running (SDWR) to hard surface running (HSR). Ten subjects were filmed at incremental speed (3-9 mph) 96m.min⁻¹-288m.min⁻¹ on the treadmill and at increase leg alteration (80-164 mph) in the pool. A cinematographical analysis was undertaken to compare faint angles of the two running modes. Twenty subjects performed a maximum oxygen uptake test on a treadmill and running suspended in deep water. Variables analyzed were oxygen uptake (V_o₂), heart rate (HR) Ventilation (VE) substrate utilization (R) and lactic acid production (LA). Significant differences in joint angles were found between HSR and SDWR. Greater maximum oxygen uptake and heart rate were found between HSR and SDWR. Significantly higher oxygen uptake and heart rate values were found between HSR at RPE 5-6 and REP 9-10 SDWR is significantly different biomechanical than HSR. One cannot work as hard during SDWR as compared to HSR and RPE training level for SDWR do not equate to HSR.

Impellizzeri, Castagna and Rampinini,⁶ conducted a study to determine the effects of 7 weeks of resistance training on sand surface, firm surface and hard surface on strength and sprint running performance in 20 female elite junior sprint runners in the age group of 18 to 20 ears. The athletes continued their sprint training throughout the study. Although the study showed that strength adaptations have been shown to occur rapidly in female athletes those practiced on sand surface, than training on firm surface, the present results suggest that sand surface, significantly changes on the strength and sprint running performance of female players.

Impellizzery, Castagna and Rampinini,⁷, the aim of this study was to compare the effects of aerobic training on sand versus a grass surface on muscle soreness, vertical jump, height and sprinting ability. Design was parallel two groups, randomized, longitudinal (pretest, post test) study. Methods used after random allocation, 18 soccer player completed 8 weeks of aerobic training on grass and 19 players on sand (sand group). Before and after training 10 and 20 m. sprint, squat jump,

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counter movement jump, and eccentric utilization ratio were determined. Muscle soreness was measured using the Vickers Likert Scale. The result of the study that both groups showing similar improvements but on the other hand, the sand group improved significantly more than players in the grass group. In contrast, players in the sand group experienced less muscle soreness than the grass group. Conclusion of the aerobic training on sand improved both jumping and sprinting ability and induced less muscle soreness. Grass surface seems to be superior in enhancing CMJ performance while the sand surface showed a trend in greater improvement in S.J. Therefore. Aerobic training on different training-induced effects on same neuromuscular factors related to the efficiency of the stretch shortening cycle.

Indira⁸ investigated the comparative effects of batting practice on cemented wicket matting wicket on reaction time and speed of movement and concluded that.

Cement wicket batting practice can contribute to left foot reaction time.

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2. Cement wicket batting practice can improve right foot reaction time.


4. Cemented wicket batting practice does not contribute to right and left-hand reception time.

5. Cemented wicket batting practice does not contribute to right and left foot speed of movement


7. Matting wicket batting practice does not improve right foot and left foot reaction time.

8. Matting wicket batting practice does not improve right hand and left hand reaction time

Malhotra et al.\textsuperscript{9} conducted a study on physiological stress of playing hockey on grassy and Astroturf fields. The study was conducted on 12 hockey trainers admitted to NSNIS, Patiala, for regular diploma course in coaching. They came to the following

conclusion, which exhibit the following difference between playing hockey on grassy and Astroturf fields.

1. Speed of running on Astroturf fields is higher than on the grassy field.

2. Turning of players on the Astroturf field is more difficult and time consuming than on the grassy field.

3. The ground resistance offered to the ball by the Astroturf is less and so the ball moves on it faster than on the grassy field.

4. Stress on the heart is more during the game played on the Astroturf than on grass field.

5. The increase in ventilation is more by about 22% during play on the Astroturf than on the grassy field.

6. The expenditure of energy on Astroturf field is greater than on the grassy field by about 18%.

Moffat\(^{10}\) states that environmental factors and field conditions affect the game of soccer to a large degree and the team that best adapts to them will increase its chance of winning. Bumpy fields can

adversely affect the playing quality of a soccer games particularly for teams with inferior ball handling. Their lack of skill will be exposed on a bumpy field. Soggy and muddy fields will slow the ball down. A wet, slippery field will assist ball kicks along the ground. Penalty takers must be aware of existing field conditions and weigh them carefully before taking their kicks. A kick in the air on a muddy field is better advised than a kick along the ground.

Muramatsu, Fududome and Kijima,\textsuperscript{11} the purpose of this study to investigate the relationship between ground conditions and strength development. Ground Conditions were subjectively rated as heavy, slippery, firm or hard. Regression analysis was conducted to examine the independent effects of the ground conditions, session type (training match), and the interaction between ground condition and strength development. The strength development slightly higher after training sessions and when ground conditions were heavy, there was a statistically significant interaction between ground condition and session type, with heavy ground conditions resulting in a slight strength development. In conclusion ground conditions influence strength development.

Muramatsu, Miyama and Arimoto\textsuperscript{12}, the purpose of this study was to comparatively investigate the effects of ground conditions on energy expenditures during training on sand versus firm surface. Eight female university volleyball players were recruited in this study and performed activity on sand and firm surface. The Oxygen requirement for activities was defined as the total oxygen uptake consecutively measured between the first set of exercises and the point that oxygen uptake recovers to the resting value, and the energy expenditure calculated. The conclusion that the sand surface required more energy to complete activities then firm surface.

Baver\textsuperscript{13} states that on wet, slippery and icy surfaces, it is best to use safe, short accurate passes to your term mates 'feet'. The man with the ball tries to wear down defenders by dribbling and feinting. Shorts from all positions including the second line of attack- are likely to succeed. When the ground is very muddy or covered in snow, an uncomplicated kick and rush game using a lot of space is often preferable.

Walter\textsuperscript{14} conducted a study of the effects of velocity, surface and angle of incidence an angle of rebound of tennis balls. 102 trials of tennis ball contacting three different surfaces at various angles of incidence and various velocities. It was concluded that angle of rebound of tennis ball is greater than its angle of incidence, that angle of rebound from a laykol surface, a tartan surface and hard wood gymnasium surface will not differ due to surface effects; deviation in angle of rebound from the angle of incidence increases from 20-30 degrees and than decreases as the angle of incidence increases, and tennis balls projected with a slow incidence velocity will rebound at a greater deviation angle then tennis ball projected at the same angle of incidence and a faster incidence velocity.

Uppal\textsuperscript{15} selected 80 untrained subjects and divided them equally into three experimental groups and one control group, to determine the effect of interval training and two continuous load methods, cardio respiratory and selected physiological parameters. One group was given interval training, the second Fartlek, and the third slow continuous running for a period of 10 weeks. The load was


\textsuperscript{15} Arun Kumar Uppal, "Comparative Effects of Two Duration Load Methods and Interval Running Methods on Cardiac Respiratory Endurance and Selected Physiological Variables" (Unpublished Doctoral Dissertation, Jiwaji University, Gwalior, 1980).
progressively increased. He found that all three groups had equal training effects on maximal oxygen uptake, vital capacity, leg strength, positive breath holding time and negative breath holding time. Slow continuous and Fartlek method indicated significant improvement in cardio respiratory endurance when compared to interval training. Slow continuous training and interval training were superior to Fartlek in reducing resting pulse rate. However, all these training methods did not show significant difference in diastolic blood pressure.

Olsen, Myklebust and Bhar,\textsuperscript{16} the purpose of this study was to compare the ACL injury rate between different floor types, wooden floor (generally having lower friction) and artificial floor (generally having higher friction). ACL injuries have been recorded prospectively from the three top divisions for men and women in Norwegian Team Handball during seven seasons. A total 174 ACL injuries have been recorded. The matches were divided into two groups: those played on wooden floors, and those played on artificial floor. A total of nine injuries occurred among men and 44 among women. Among men 4 injuries occurred on wooden floor, and five injuries occurred on

artificial floors. Among women, eight injuries occurred on wooden floor and 3 on artificial floor. These results indicate that the risk of ACL injury for women and men is higher on artificial floors than on wooden floors.

Parks\textsuperscript{17} undertook a study to determine the effects of ten weeks physical fitness programme on selected physiological and psychological variables of elderly people of 65 to 82 years. The subjects were 15 females. Pre and Post Measurements were obtained for psychological variables by the state trait Anxiety Inventory. The physiological variables measured were body composition, flexibility, heart rate and blood pressure. The subjects participated in the fitness programme half an hour in the morning on three days a week for 10 weeks. Each exercise session began with 10 minutes of warming up followed by 15 minutes of exercise of moderate intensity. The last five minutes were used as a cooling-off period. The ‘t’ test for correlated samples was employed to determine if a significant difference existed between pre and post test measures on the physiological and psychological variables. The following significant changes were found:

\textsuperscript{17} Charles James Parks, "The Effect of a Physical Fitness Programme on Body Composition, Flexibility, Heart Rate, Blood Pressure and Anxiety Level of Citizens", Dissertation Abstracts International \textit{41} (July, 1980) : 157-A.
1. The subjects decreased in percentage of body fat.

2. There was an increase in flexibility.

3. Three was a decrease in heart rate. However, there was no significant change in systolic and diastolic blood pressure and anxiety levels of the subjects.

Campbell\textsuperscript{18} conducted research on the relationship of selected measures of physical performance and structure to qualify of performance in college football. He tested 40 male members of the 1978 Springfield College Football squad. They were tested for height, weight 10, 20, 30 and 40 yard dash, vertical jump, agility, upper body strength and lateral movements. In addition, each player had a game performance score assessed by the grading of game film selected at random. No relationship was found between height, weight and performance.

Crist\textsuperscript{19} conducted a study to determine whether there was a significant difference between three day a week and five days a week


physical education programme. The 't' test was used to analyze the data. The results obtained indicated a significant difference in favour of these students who were involved in the five days a week physical education programme over those involved in the three-day a week programme.

Miller, Herniman, and Richard,\textsuperscript{20} the purpose of the study was to determine six weeks training on grassy versus sand surface improve on athlete's agility. Subjects were divided into three groups, a grassy group, sand group and a control group. The grassy surface group and sand surface group performed in a six week training program and control group did not perform any training techniques. All subjects participation in two agility tests: t-test and Illinois Agility Test. Univariate ANCOVA were conducted to analyze the change scores (post-pre) in the independent variables by group (training or control) with pre scores as covariates. The sand surface group had quicker post-test times compared to the grassy surface group and control group and grassy surface group found quicker post test time then control group. The aerobic training on sand surface group reduced time on the ground

\textsuperscript{20} G. Michael Miller, Jeremy J. Herniman, Mark D. Ricard "The Effects of A 6 Weeks Aerobic Training Programme on Sand Surface Versus Grassy Surface on Agility" (Published Project Report, Department of HPER, Western Michigan University, MI, USA, 1 Sep. 2006)
on the post-test compared to the other two groups. The results of this study shows that aerobic training on sand surface can be an effective technique to improve an athlete's agility.

Mathew\textsuperscript{21} studied the effect of soft playing surface for teaching defensive skills in volleyball. In order to find out the effect of soft playing surface, the scholar selected twelve outstanding volleyball players with ages ranging from 14 to 16 years and studying in Kendriya Vidyalaya, Trichy. The subjects were divided into homogenous groups on the basis of an initial test. The group was divided into as control and experimental group. The experimental group was put to practice on the soft ground for a period of six weeks. The control group practiced the same skill on the normal volleyball court. The data obtained through conducting final test and subjective assessment during actual game situation by the experts were put into statistical treatment. From the analysis data collected it is evident that suggested surface helps to improve the performance in drive and pass skill in volleyball.

Thomas\textsuperscript{22} conducted a study for the ten weeks on the effect of a programme of progressive resistance exercise on strength, muscle girth and body composition. Forty-Two college women participated in the study 20 serving as control group and 32 participated in progressive resistance exercises on the Universal gymnastic weight training apparatus. The results of the study revealed significant increase in strength within the experimental group on six of the eight strength tests. No significant increase in strength within the control group with the exception of the test for knee flexion and significant exercises for the experimental group over the control group in the elbow flexion. Knee extension and shoulder horizontal adduction strength test.

Mayers\textsuperscript{23} examined and compared the effect of training highly conditioned varsity soccer players on running circuits of 1.86 degree down hill and zero degree during a competitive season. The specific questions, with which this study was concerned, were the effects of downhill and level circuits on a varsity soccer player's maximum


running speed stride length stride frequency and leg strength. After a five week a training the study concluded that:

1. The down hill methods of training significantly improved the stride length of the varsity soccer players.

2. The down hill method of training can be effectively used as a supplementary sprint training method.

3. The downhill methods of training did not significantly increase running speed and stride frequency.

Diclemente\textsuperscript{24} state that in playing a wet ball on a wet field, the long passing game is more effective than the short passing game, since the wet ball is so much more difficult to handle. A ball on a wet field does not bounce but slides and comes off the ground much lower and faster than a bouncing ball on a dry field.

Vogel and Hansen\textsuperscript{25} indicate the heart rate response to exercise is higher than at sea level during low and moderate intensities of work. Just as the resting value is elevated, each level of sub maximal work


elicits correspondingly increased heart rate is lower than at sea level according to most accounts. It may be as much as 40 beats per minute, lower for some subjects exposed to acute hypoxia and it is achieved at lower workloads than at sea level.

Lane\textsuperscript{26} selected the AAHPER youth fitness test and the Humiston Motor Ability Test to determine the relationship between physical fitness and motor ability before and after a planned physical fitness programmer for high school girls. The test was administered to 69 girls of ninth grade (14 years). The group improved on both the tests and the correlation obtained between physical fitness and motor ability was higher after the planned fitness programme.

Lodziak\textsuperscript{27} states that the ball does not run smoothly on sticky, muddy patches. Thus, on muddy pitches the ball will have to be kicked with more force than is necessary on a dry pitch, in order to cover the same distance. Besides kicking with more force and determination, experience has shown that the longer pass is more effective than the shorter pass, partly because the longer pass requires a greater impetus and is less likely to stick in the mud, but mainly because muddy pitch

\textsuperscript{26} Georgia C. Lane "The Relationship between Physical Fitness and Motor Ability before and after a Physical Fitness Programme for High School Girls" \textit{Completed Research in Health Physical Education and Recreation} 8 (1966): 67.

\textsuperscript{27} Conrad Lodziak, \textit{Understanding Soccer Tactics} (London : Faber and Faber Ltd. 1966), P.162.
is often slippery. Slippery pitches provide difficulty to the defender beaten by a ball because the slipperiness impedes his turning speed. Pools of water on the pitch will cause the same difficulties as muddy patches and can be tackled in a similar fashion. Snow covered pitch posses some of the characteristics of a muddy pitch, but provide less difficulty because they tend to be crisp rather than sticky. Snow does, however slow the ball down, thus it is necessary to kick harder than is normal. Hard pitches can cause problems for players because each bump becomes accentivated and can therefore alter the path of the ball drastically. On such pitches it is advisable to play the ball along the surface.

King\textsuperscript{28} studies the effect of two training programmes on selected cardio-respiratory variables of college women. The physiological reactions measured were pulse rate, respiratory rate, respiration amplitude, minute volume of respiration and oxygen consumption. The respiratory variables were recorded simultaneously by a respirometer. The cardio-vascular reaction was measured by countering the pulse rate. All variables improved during the four weeks training period.

regardless of the training programme prescribed. Both training programmes were of sufficient duration and intensity to effect changes in post exercise scores.

Charles\textsuperscript{29} states that the season in Britain often begins in a heat wave, with the grounds hard and unyielding the come the rains and the mud, then come the fog and the freeze ups, which make the ground so hard that the animal loving British refuse to allow horses to race or even train on it, but expect footballers to play on it. Then there is the thaw, with more mud. And finally comes the spring and the hard grounds again. So the perfect British players would be able to withstand blistering heat and freezing cold, would be able to produce the delightful and accurate ball control so necessary on firm grounds and the dexterity and agility not to mention the nerve with are necessary on the frozen grounds.

Nagle and Irwin\textsuperscript{30} studied the effects of two types of weight training on cardio respiratory endurance and selected physiological factors. Sixty freshman students of the University of Florida, who volunteered to serve as subjects, were divided into three groups, two


experimental and one control. They were tested doing moderate and all out experience on a bicycle ergometer. Selected physiological responses and the cardio respiratory endurance times were measured. An eight week training programme followed during which the experimental group participated in weight training programmes and the control subjects participated archery or bait assisting. After training the tests were again administered. Though there was an indication of improved cardio-respiratory responses by the weight-training group, statistical treatment of the data revealed on significant difference among three groups in their responses to the exercise.

Keith\textsuperscript{31} took thirty untrained college males participated in a 10 week study comparing the effects of three different types of training on 800 meter run performances. All subjects were engaged in 20-30 minutes of endurance running three times a week. In addition to the endurance running, subjects participated in either hill training, sprint training, or weight training three days a week. The hill training consisted of repeated 30 second sprints up an 8% graded hill. Sprint training included distance ranging from 50 to 300 meters with 2-3

minutes recovery periods between sprints. The weight training included cleans, squats, calf-raises, leg-extension and leg curls. Each exercise was performed in 3 sets of 8-10 R.M.

Only the hill and sprint groups showed significant differences between pretest and post test 800 meter run performance. It was concluded that concurrent weight on endurance training is not an effective way to improve 800 meter run performance of untrained subjects.

Groups comparison revealed that both hill and sprint training resulted in significantly greater changes than weight training (p > .02).

Sprint training significantly improved leg flexion torque at slow and fast speeds. ANCOVA results, however failed to establish significant differences between training groups on the adjusted post test isokinetic strength measures.

Hill and sprint training resulted in nearly identical changes in the parameters tested. It was concluded that they are effective training methods for improving 800 meter run performances in untrained subjects. Endurance capacity, anaerobic capacity and percent body fat
were significant singular co-related to 800 meter run performance (p<.01).

Mazumder\textsuperscript{32} studied the changes in motor fitness component and playing ability resulting among soccer players at two stages of physical education and conditioning programme.

He concluded that: (i) during the first stage of physical education and conditioning programme speed, maximum leg strength, agility and playing ability were improved, (ii) during second stage only maximum leg strength and agility improved significantly, (iii) the break in between the stages of training diminishes.

Mendez\textsuperscript{33} investigated the relative effectiveness of two training programme i.e., progressive resistance exercise and sprint training in the improvement of sprinting velocity was determined. Two random groups of subjects (N= 31) were formed :- group I (N= 16) participated in a weight training programme using the universal real runner a pressive resistance exercise machine while group II (N=15) participated in sprint training programme. Subject were pre and post

\textsuperscript{32} Shyamal Mazumder, "Changes in Motor Fitness Components and Playing Ability Resulting Among Soccer Players at Two Stages of Physical Education and Conditioning Programme" (Published Master's thesis Jiwaji University 1986).

tested on the 60 yards dash, each time allowing one practice run by each student. The duration of the experiment was seven weeks, which included 20 periods of exercise. ANCOVA was used to determine significance of differences between the two groups (p.05). No significant differences were detected between the weight training and sprint training programmes. Both training programmes showed small but non-significant decreases in mean times for sprinting 60 yards.

Calloway\textsuperscript{34} conducted a study on coaches who lead athletes away from weight training either have limited knowledge of muscle development or will not take the time to understand strength and its relationship to sports.

The more powerful an athlete is the more successful, he or she will be in a given skill practicing sports is not enough. In order to gain extra power an athlete must work with an over load.

In order to have a successful weight lifting programme the single most important factor is the coach. He can have the most sophisticated weight equipments in the world but if he does not direct the programme from start to finish it will disintegrate.

\textsuperscript{34} Bill calloway "Weight conditioning for Athletes" \textit{Athletic Journal} 57 (October 1976) : 50.
Thomas\textsuperscript{35} conducted a study for ten weeks on the effects of a programme of progressive resistance exercise on strength, muscle girth and body composition. Fifty two college women participated in the study 20 serving as control group and 32 participated in progressive resistance exercises on the universal gym weight training apparatus. The result of the study revealed significant increases in strength within the experimental group on six of the eight strength tests, no significant increase in strength within the control group with the exception of the test for knee flexion, and significant increases for the experimental group over the control group in the elbow flexion, knee extension and shoulder horizontal adduction strength test.

Helixon\textsuperscript{36} studied the effect of a heavy resistance training programme upon running and jumping performance of first year high school trackmen. Twenty four subjects were randomly assigned either to an experimental group which engaged in weight training five days a week for six week or to a control group which engaged in no weight


training. Result showed no significant difference between the experimental and control group at the conclusion of the experiment.

Panny\textsuperscript{37} investigated the effects of resistance running on speed, strength, power, muscular endurance and agility. The training programme consisted of four forty minutes season per week for six weeks.

Result indicated that:

1. A training programme of resistance running alone or supplemented by weight training, iso-metric contraction and repetitive sprinting would significantly increase speed, leg strength, leg power, muscular endurance and agility.

2. Resistance running supplemented by isotonic leg exercises, isometric contraction and repetitive sprinting will not improve, standing broad jump ability as significantly as speed, leg strength, muscular endurance and agility.

3. Orthogonal comparison revealed upward trends in improvement of all variables during the six week training programme.

Kusintz\(^{38}\) conducted a study on the effects of progressive weight training upon running speed and circulo-respiratory endurance. The dependent variables of running speed and endurance were measured before and after a 12 week training period as follows: speed := 50 yard dash, endurance := McCloy endurance quotient and the 300 yards run and muscular strength := the McCloy strength index revision. The experimental group practiced progressive weight training and running while the control group practiced only running. The data were subjected to analysis of variance, two-way factorial analysis of variance and Pearson's products moment correlation. The conclusions were: progressive weight training and running are more effective than running only in developing running speed and endurance as measured by the 300 yards run: and individuals who began training with initial low strength do not make greater gains in the dependent variables than those with initial high strength.

Jaimitra\(^{39}\) took fifty four randomly selected male subjects to determine the effects of selected exercises on the physical fitness of secondary adults. The subjects were divided into two groups, one

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experimental group and other control. Experimental group was subjected to a training programme in selected exercises for six weeks. The study concluded that there were significant gains in mean of experimental group in abdominal and leg power and decreased in resting pulse rate.

In a study Buck\(^4\) compared two programmes of weight training in regard to their effects upon the development of muscular strength and endurance. Forty nine male college students were tested before and after seven weeks of weight training on eleven calisthenics and barbell exercises requiring muscular strength and endurance. Upper arm girth measurement was taken with elbow flexed forcefully. Subjects were assigned randomly to weight group (25) training with heavy weight and few repetitions and a Rap Group (24) using lifting weight and more repetitions. Both groups made substantial gains in each test. The weight group had greater average in seven of the twelve tests with three significant, beyond the 0.02 level of confidence. The Rap Group was significantly superior in none of the tests.

\(^4\) Besuard V. Buck, "A Comparison of Two Programmes of Weight Training in Regard to Their Effects Upon the Development of Muscular Strength and Endurance" *Completed Research in Health, Physical Education and Recreation* 5 (1963) : 89.
Brown⁴¹ conducted the study on the effect of circuit training on the physical fitness on grade 5 girls. Two classes were tested on the AAHPER fitness test before and after eight weeks of regular physical education classes. The experimental class, chosen by chance had a supplemental 10 minute circuit training programme before each class. Both classes showed significant gains in total score. The experimental group showed significant gain on all tests except the 50 yard dash. The control group showed significant gain on all tests except the pull-ups (modified) and 50 yards dash. The mean difference between groups was not significant, but the experimental class made greater gain except in the shuttle run. The supplemental circuit training produced generally better but not significantly better result than the regular programme.

Hooks⁴² has pointed out that weight training can improve strength and speed simultaneously. He suggested that weight training programme that over loads the muscle with enough weight to ensure strength gains, and at the same time, enables the muscle to contract.

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successfully with a burst of speed, will produce increased strength and speed.

Joe selected 40 junior high school boys participating in a weight training programme, two days a week for six months. Seventeen boys served as a control group. The test items consisted of the junior Amature Athletic Union physical fitness test, anthropometric measurements the California test for personality. The experimental group registered a significant difference at the .05 level of confidence, over the control group in anthropometric measurements and the five out of six physical fitness test items, while no significant improvement was found in personality test.

Whelton conducted a study on "effect of aerobic exercises on sand surface versus natural surface on blood pressure." He selected 2419 adults from 54 different studies of exercise; to see how much blood pressure decreases after regular exercise. Participants in the trials were divided into four groups. One group of physically active and physically inactive which practiced on sand surface and another group practiced on natural surface for at least 4 weeks, exercise that

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improves the body’s use of oxygen, such as jogging, running, & exercises were studied.

Researcher find that regular aerobic exercises decreased systolic blood pressure and diastolic blood pressure in people who were previously inactive, and better result found on sand surface rather then natural surface because sand gives the resistance effect, but who are physically active, for them short duration of training programmes not effect on blood pressure they need long duration of training programme.