CHAPTER-II

REVIEW OF RELATED LITERATURE
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The review of related literature are alight of spirit of something for better understanding of the problem and to interpret the results.

The search for reference material has been a time consuming but fruitful phase of the research program. A familiarity with the literature in any problem are helps the investigator to discover what is already known, what others have attempted to find out, what methods have been promising or disappoint and what problems remains to be solved John W. Best (1978).

The researcher had gone through the available literature related to this study. Review of literature was confined to the libraries of Annamalai University, I.N.I.C.P., Gwallor, Rayulaseema College of Physical Education, Proddatur and S.K. University, Anantapur, the latest literature related to the study by using internet facilities.

The purpose of this study was to find out the effect of two modes of circuit training schedule on long jumpers ability. In order to achieve this aim and to build up a background for the study related research done previously are briefly reviewed in this chapter.

Circuit Training

Employs a series of exercise stations consisting of combination of weight training, calisthenics and brief aerobic exercise, circuits might be designed to accomplish many difficult training goals and one moves rapidly from one station to the next and performs whatever exercise has to be done at the station within a specific time period. A typical circuit would consist of eight to twelve stations and the entire circuit would be repeated three times.
Ms. K.Bharathapriya (2012) The purpose of the study was to find out the effect of circuit training on strength endurance among college women. To achieve this purpose of the study thirty women students studying in the Department of Physical Education, Annamalai University were selected as subjects at random. Their age ranged between the 18 to 24 years. The selected subjects were divided in two equal groups fifteen each namely circuit training group and control group. Group I underwent circuit training for three days per week for twelve weeks, whereas Group II acted as the control group who maintained their daily routine activities and no special training was given to them. The following variables namely strength endurance was selected as criterion variable. The following variable named strength endurance was selected as criterion variable. The subjects of the groups were tested on strength endurance by using bend knee sit-ups at prior and immediately after the training period. The collected data were analyzed statistically through analysis of covariance (ANCOVA) to find out the significant differences.

M. Srinivas Reddy & Prof.Ramesh Reddy, (2012) The purpose of the study was to compare the Effect of Plyometric Training, Circuit Training and Combined Training on Flexibility, Speed among the secondary students.

Research used four different Training groups on selected fitness components to achieve the above purpose. It was decided to select the untrained school Boys of Ekashila High School Warangal in the age group of 14 -15 years those who have not participated intensively in games and sports or any special coaching programme. However they were allowed to attend the regular physical education classed in school. 40 students were selected randomly by lot from the total population of 300 subjects after eliminating physical handicapped students. Then they were divided into four equal groups randomly by lot as plyometric Training group, Circuit Training group, combined training group and control group and their performance were measured before and after 12-weeks of Training. In Plyometric Training eight exercises (four for Upper body and four for lower body body). In Plyometric Training eight exercises were used. The combined Training group subjects were asked to join with the plyometric Training group on Tuesday, Thursday, Saturday & Monday. Wednesday and Friday with Circuit Training group. The following component and test items were used.
1. Sit and Reach Test to measure Flexibility
2. 50mts Sprint to measure Speed

The control group did not participate in any training programme except their routine activities. The ‘t’ test and Anacova were used find out the Training effect and to compare the Training effect respectively.

Mr. K. Rajasekhar & Dr.P.Johnson (2012) The purpose of this study was to compare interval training programmes of different intensity on selected motor fitness components among school boys. For this purpose 45 male students Junior Colleges in Guntur District, aged 16 to 18 years took part in the study. Subjects were randomly assigned to three groups of 15 each. The analysis of data revealed that both the experimental treatments had significant impact on chosen motor fitness components, however there was significant difference in the level of effectiveness of intensive and extensive interval training on cardio respiratory endurance and speed.

M. Poornachandran & T.Lakshmanan (2012) To achieve the purpose of the study was find out the effects of aerobic, anaerobic and combined training on selected hematological and performance variables among school basketball players. Forty five school basketball players were selected from Kanchipuram District, Tamilnadu. Due to the six weeks aerobic, anaerobic and combined training, the hematological variables of RBC and hemoglobin, performance variables of dribbling and passing improved significantly at 0.005 level.

P. Packiaraj, T.Albert and D.Solomonraja (2012) The purpose of the study was to find out the effects of plyometric training and circuit training on motor ability components among college level women volleyball players. To achieve this purpose forty five college students were selected randomly as subject from St.Zevier College, palayankottai. Their age ranged between 18 to 25 years. They were divided into three equal groups. Experimental group I underwent plyometric training. Experimental group II underwent circuit training and control group was not exposed to any training. pre test were conducted to three groups in explosive power and muscular strength. Plyometric training and circuit training was given to the experimental group for a period of 6 weeks for 3 days in week. After 6 weeks of training the post test were taken from the subjects of three groups. Test was
conducted for explosive power and muscular strength at the end of each session and data were recorded. Analysis of Covariance (ANCOVA) was used to test significance. Wherever significant differences is found scheffé’s post hoc test was used. The result of the study reveals that the plyometric training showed greater improvement on explosive power that the circuit training. On muscular strength further the circuit training showed greater improvement on muscular strength than the plyometric training.

T. Ganesh babu & Dr.P.Gopinathan (2012) The purpose of the study was to find out the effects of SAQ training and circuit training on speed and agility among Tamilnadu physical Education and Sports University football players in order to achieve the purpose of the study forty five men intercollegiate football players were selected randomly and they were equally divided in to three groups of fifteen each as experimental group- I, experimental group- II and control group. The experimental groups and control group undergone normal routine football practices and in addition the experimental group- I underwent SAQ Training and experimental group-II underwent Circuit Training for one hour in the morning sessions. The control group was not given any special training. The period of training was eight weeks in a schedule of weekly three days for alternate days. The data were collected on the selected dependent variables at before and after the training period. Analysis of Covariance (ANCOVA) & scheffé’s post hoc test was used to analyze the data. To test the significance 0.005 level of confidence was fixed. Based on the results the study it was concluded that the SAQ training and circuit training was significantly improved the speed and agility among intercollegiate football players.

Goran sporiš & Luka Milanovic (2010) The purpose of this study was to determine the effects of agility training (training of acceleration, deceleration and quick change of the direction of movement) on athletic power performance. Eighty healthy male college students (age 19±1.1 years; body mass 77.2±7.1 kg; body height 180.1±7.1 cm; body fat percentage 10.8 ±1.6) participated in this study. The study was a randomized controlled trial. The subjects were assigned randomly to an experimental group (EG; n=40) and control group (CG; n=40). Statistically
significant differences were determined within the experimental group both in the
initial and in the final measurement (p<0.5), whereas significant differences were
found between the experimental and the control group in the final measurement
(p<0.5). Changes in muscle power were assessed through the jumping height, in a
counter movement jump (CMJ). The experimental group significantly (p<0.5)
 Improved in the jumping height in CMJ (43.17 vs 44.01 cm), counter- movement
jump from the left leg (CMJ(L)) (29.66 vs 30.12 cm) and counter-movement jump
from the right leg (CMJ(R)) (28.77 vs 29.11 cm). The values achieved by the subjects
from the experimental group ranged from low values for the standing long
jump (SLJ), to moderate values for the counter-movement jump (CMJ), to high
values for the 5m sprint (SP5). To enhance explosive explosive muscle power and
dynamic athletic performance complex agility training can be used. Therefore in
addition to the well known training methods such as resistance training and
plyometric training, strength and conditioning professionals may efficiently
incorporate agility training into an overall conditioning programme of athletes
striving to achieve a high level of explosive leg power and dynamic athletic
performance.

Zemkova E & Hamar D (2010) The study evaluates the effects of 6 week
combined agility-balance training on neuromuscular performance in basketball
players. Subjects divided into experimental (EG, n = 17) and control group (CG, n = 17
underwent a combined agility-balance training (in duration of 30 min) for a period of
6 weeks (4-5 sessions/week). Both groups performed reaction tasks similar to game-
ilike situations, however EG on wobble boards and CG on stable surface. Prior to and
after the training parameters of agility, balance, speed of step initiation, strength
differentiation accuracy, and explosive power of lower limbs were evaluated.
Postural stability was assessed under both static and dynamic conditions (wobble
board) with eyes open and eyes closed, respectively. The velocity of the centre of
pressure (COP) was registered at 100Hz by means of posturography system FITROS
way check based on dynamometric platform. Using FitRO. Reaction check simple
and multi-choice reaction times were measured. The same system was applied to
evaluate the agility performance including reaction and movement task. Speed of
step initiation was measured using FitRO Dyne Premium. Jumping abilities were
evaluated by means of FiTRO Jumper (10-seconds maximal jumps, Countermovement jump, Squat jump, Drop jump). Using the same system, the subject’s ability to match 50% of their maximal height of the jump was evaluated.

V.A. Shafeeq, Dr Abdussalam, Kanniyani, Hassan M.A, & shine Singh J.P (2010) The study was conducted to find out the effect of interval circuit training on selectee motor fitness variable and volleyball skill performance of male volleyball players. For the purpose of the study 30 male volleyball players, aged between 18 to 22 years, from the department of physical Education, Annamalai University, were selected as subjected as subjects. They were randomly divided into two groups, viz, experimental and control group, both consisted of 15 subject’s each. The motor fitness variables were explosive power, cardio-respiratory endurance and muscular strength. The volleyball skill performance of the subjects was assessed using Brady volley test and Russel Lange serving test prior to and after the experimentation. The experimental group underwent interval circuit training programme for three days per week for eight weeks. The experimental group underwent interval circuit training programme for three days per week for eight weeks. The data was statistically treated with ANCOVA (p - 0.05) and the results indicated that the interval circuit training significantly helped to improve the explosive power, cardio respiratory endurance and muscular strength (p - 0.05) and also volleyball skill performance such as volleying ability and serving ability.

Thomas, Kevin, French & Duncanhayes, Philip R (2009) Thomas, K,French,D, and Hayes, PR. The effect of two plyometric training techniques on muscular power and agility in youth soccer players. J Strength Cond Res 23(1):332-335, 2009- The aim of this study was to compare the effects of two plyometric training techniques on power and agility in youth soccer players. Twelve males from a semi professional football club’s academy (age =17.3± 0.4 years, stature = 177.9± 5.1cm, = 68.7± 5.6kg) were randomly assigned to 6 weeks of depth jump (DJ)or countermovement jump (CMJ) training twice weekly. Participants in the DJ group performed drop jumps with instructions to minimize ground-contact time while maximizing height. Participants in the CMJ group performed jumps from a standing start position with instructions to gain maximum jump height. Posttraining, both groups experienced improvements in vertical jump height (p<0.05) and agility time
and no change in sprint performance (p>0.05). There were no differences between the treatment groups (p>0.05). The study concludes that both DJ and CMJ plyometrics are worth while training activities for improving power and agility in youth soccer players.

Michael G. & Miller, (2009) The purpose of the study was to determine if six weeks of plyometric training can improve an athlete’s agility. Subjects were divided into two groups, a plyometric training and a control group. The plyometric training group performed in a six week plyometric training program and the control group did not perform any plyometric training techniques. All subjects participated in two agility tests: T-test and Illinoiais Agility Test, and a force plate test for ground reaction times both pre and post testing. Univariate ANCOVAs were conducted to analyze the change scores (post-pre) in the independent variables by group(training or control) with pre scores as covariates. The Univariate ANCOVA revealed a significant group effect F2.26- 25.42, p < 0.0000 for the T-test agility measure. For the Illinoiais Agility test, a significant group effect F2.26- 27.24, p < 0.000 was also found. The plyometric training group had quicker post test times compared to the control group for the agility tests. A significant group effect F2.26 7.81,p < 0.002 was found for the Force Plate test. The plyometric training group reduced time on the ground on the post test compared to the control group. The results of this study show that plyometric training can be an effective training technique to improve an athlete’s agility.

Avery D. Faigenbaum, (2007) The purpose of the study was to compare the effects of a six week training period of combined plyometric and resistance training (PRT, n=13) or resistance training alone (RT, n=14) on fitness performance in boys (12-15 yr). The RT group performed static stretching exercises followed by resistance training whereas the PRT group performed plyometric exercised followed by the same resistance training program. The training duration per session for both groups was 90min. At baseline and after training all participants were tested on the vertical jump, long jump, medicine ball toss, 9.1 m sprint, pro agility shuttle run and flexibility. The PRT group made significantly (p<0.05) greater improvements than RT in long jump (10.8 cm vs.2.2cm), medicine ball toss (39.1 cm vs.17.7cm) and pro agility shuttle run time (-0.23 sec vs. -0.02sec) following training. These findings
suggest that the addition of plyometric training to a resistance training program may be more beneficial than resistance training and static stretching for enhancing selected measures of upper and lower body power in boys.

Tricoli V & Lamas I. (2005) Among sports conditioning coaches, there is a considerable discussion regarding the efficiency of training methods that improve lower-body power. Heavy resistance combined with vertical jump (VJ) training is a well established training method; however there is a lack of information about T/S combination with Olympic weight lifting (WL) exercises. Therefore the purpose of this study was to compare the short-term effects of heavy resistance training combined with either the VJ or WL program. Thirty-two young men were assigned to 3 groups; WL =12, VL =12, and control=8. Theses 32 men participated in an 8-week training study. The WL training program consisted of 3x6RM high pull, 4x4RM power clean, and 4x4RM clean and jerk. The VJ training program consisted of 6x4 double-leg hurdle hops, 4x4 alternated single-leg hurdle hops, 4x4 single-leg hurdle hops, and 4x4 40cm drop jumps. Additionally, both groups performed 4x6RM half-quat exercises.

Kotzamaniids C & Chatzopoulos D. (2005) The purpose of this study was to investigate the effect of a combined heavy-resistance and running-speed training program performed in the same training session on strength, running velocity (RV), and vertical-jump performance (VJ) of soccer players. Thirty-five individuals were divided into 3 groups. The first group (n=12, COM group) performed a combined resistance and speed training program at the same training session, and the second one (n=11, STR group) performed the same resistance training without speed training. The third group was the control group (n=12, CON group). Three jump tests were used for the evaluation of vertical jump performance: squat jump, countermovement jump, and drop jump. The 30-m dash and 1 repetition maximum (IRM) tests were used for running speed and strength evaluation, respectively. After training, both experimental groups significantly improved their IRM of all tested exercises. Furthermore, the COM group performed significantly better than the STR of all tested exercises. Furthermore, the COM group performed significantly better
than the STR and the CON groups in the 30-m dash squat jump, and countermovement jump. It is concluded that the combined resistance and running-speed program provides better results than the conventional resistance training, regarding the power performance of soccer players.

**Toumi H & Best TM (2004)** The purpose of this study was to compare the effect of jump training as a complement to weight training on jump performance and muscle strategy during the squat and countermovement jump method. Twenty two male hand ball players, between the ages of 17 and 24 and in good health, were randomly divided into three groups. Two were trained groups; weight training (WTG) and jump training combined with weight training (CTG). And one was a control group (CG). Maximal isometric force and maximal concentric power were assessed by a supine leg press, squat jump (SJ), countermovement jump (CMJ), and surface EMG was used to determine change in muscle adaptation before and after the training period.

**Fayej & Falize (2004)** It is absolutely essential to acquire the basic technique high and long jumps in the initial stage of training when relevant global gestures are learned, as well as during future training for the improvement of such techniques. Our purpose is identifying a number of gestures which are not in keeping with element of the required techniques. It concerns execution mistakes, which we call "limiting criteria" because they are more or less likely to have an adverse effect on performance. In order to identify them, we used pictures, films and recording, by category of jump, 4 to 5 successive attempts of each one of 48 subjects selected for our study. The best attempt was viewed 5 times either in normal or slow motion, or picture by picture. For each criterium at eh end of the impulse, we compared the average of performances of students who did not make mistakes to those of the criterium concerned. Our results show that expect for two criteria, all the averages differences are significant to probabilities between either 0.05 and 0.01 or less than 0.001 this attests that some criteria have a less adverse effect than others, but that all criteria constitute hindrances to good performance. Therefore, the must be taken into account by anyone intervening in sports and or physical education who is a anxious of the output of his athletes or students.
Less A, Vanrenterghem & J, DeClercq D, (2004) This investigation was conducted to examine the various theories that have been purposed to explain the enhancement of jumping performance when using an arm swing compared to when no arm swing is used. Twenty adult males were asked to perform a series of maximum vertical jump while using an arm swing and again while holding their arm by the sides. Force, motion and electro graphical data were recorded during each performance. Participants jumped higher (0.080) in the arm swing compared to the no arm swing condition and was due to increased height (28%) AND (72%) of the center of mass at take-off, the increased height at take-off was due to the elevation of the arm segments. The increased velocity of take off stemmed from a complex series of events which allowed the arm to build up energy early it he jump and transfer it to the rest of the body during the later stages of the jump. This energy early in the jump and transfer it to the rest of the body during the later stages of the jump. This energy was used to (i) increase the kinetic and potential energy of the arms at take-off, (ii) store and release energy from the muscles and tendons around the ankles, knee and hip joint, and (iii) ‘pull’ on the body through an upward force acting on the trunk at the shoulder. It was concluded that none of the prevailing theories exclusively explains the enhanced performance in the arm swing jump, but rather the enhanced performance is based on several mechanisms operating together.

Liow DK & Hopkins WG. (2003) Athletes often use weight training to prepare for sprint events, but the effectiveness of different types of weight training for sprinting is unclear. We have therefore investigated the effect of slow and explosive weight training on kayak spring performance.

John Cronin & Peter McNair (2003) Eccentric strength training is thought to be important for improving functional performance. A form of training that may enhance the eccentric training stimulus is the attachment of a rubber bungy to the strength-training apparatus in such a way that the return velocity and, therefore, the force required to decelerate the load at the end of the eccentric phase are increased. To determine the effects of elastic bungy training, we performed two studies. In the first, we examined the electromyographic (EMG) and kinematic characteristics of three different squat techniques: traditional squat, non-bungy jump squat and bungy jump squat. In the second study, we examined whether jump squat training with and
without the attachment of a rubber bungy to an isoinertial supine squat machine affects muscle function, multidirectional agility, lunge ability and single leg jump performance. The EMG activity of the vastus lateralis and gastrocnemius muscles was recorded. An instrumented isoinertial supine squat machine was used to measure maximal strength and various force, velocity and power measures in both studies. Participants were randomly assigned to one of three groups: a control group and two weight-trained groups, one of which performed bungy squat jumps and one of which performed non-bungy squat jumps. The two experimental groups performed 10 weeks of ballistic weight training. The kinematic and EMG characteristics of the bungy and non-bungy squat techniques differed significantly from those of the traditional squat on all the variables measured. The only difference between the bungy squat and non bungy squat training was greater EMG activity during the later stages (970-100%) of the eccentric phase of the bungy squat condition. The 10 weeks of bungy squat and non-bungy squat jump weight training were found to be equally effective in producing improvements in a variety of concentric strength and power measures (10.6-19.8%). These improvement did not transfer to improved performance for the single leg jump and multidirectional agility. However, bungy weight training did lead to a significant improvement in lunge performance (21.5%) compared with the other groups.

Jensen RL & Ebben WP (2003) Complex training has been recommended as a method of incorporating plyometrics with strength training. Some research suggests. That plyometric performance is enhanced when performance 3-4 minutes after the strength training set, whereas other studies have failed to find any complex training advantage when plyometric are performed immediately, after the strength training portion of the complex. The purpose of this study was to determine if there is an ergogenic advantage associated with complex training and if there is an ergogenic advantage associated with complex training and if there is an optimal time for performing plyometrics after the strength training set. Subjects were 21 NCAA Division 1 athletes who performed countermovement vertical jump, a set of 5 repetitions maximum (5RM) squat, and 5 trails of countermovement vertical jump at interval of 10 seconds and 1,2,3 and 4 minutes after the squat, jump height and peak
ground reaction forces were acquired via a force platform. The pre-squat jump performance was compared with the post-squat jump. Repeated measures ANOVA determined difference \((p<0.05)\) between genders and that jump performance immediately following the squat exercise was hindered \((0.06)\), but no effect \((p>0.05)\) was found compared subsequent jumps \((0.72-0. 76m)\) to the pre-squat condition \((0.74m)\). When compared high to low strength individuals, there effect no effect on jump performance following the squat \((p>0.05)\). In conclusion, complex training does not appear to enhance jumping performance significantly; it decreases it when the jump is performed immediately followed the strength training set; however, a no significant trend toward improvement seemed to be present. Therefore to optimize jump performance it appears that athletes should not perform jumps immediately followed by resistance training. It may be possible that beyond 4 minutes of recovery performance could be enhanced; however, that was not within the scope of the study.

**Baker D (2003)** this study investigated the effect on upper body power output of manipulating resistances during contrast or complex power training. The power training strategy typically entails the athlete alternating sets of a heavy resistance in a health-oriented exercise with sets of a lighter resistance in a power oriented exercise. Sixteen rugby league players, who were experienced in power training and who performed complex training on regular basis, served as subject for this study and were divided equally into a control (con) or experimental (exp) group. Both groups were pre and post tested for power output while performing explosive bench press throws in a smith machine with a resistance of 50kg \((BT p50)\). The Exp group performed and intervention strategy of a 6 repetition set of bench presses with a resistance of 65% of 1 repetition maximum (IRM) between tests. At the pretest occasion, no differences were observed between the groups in power output; however in post testing a significant difference in power outputs was observed between the groups in the BT p50. The 4.5% increase in the power output recorded during the post testing BT p50 for the exp group was determined to be significantly different form all other scores \((p<0.05)\). These data indicate that the performance of
a set of heavy resistance strength training exercise between power training sets will acutely enhance power output in the second power training set. This effect has been previously theorized as possible due to some combination of acute neural or mechanical adaptations.

Blazevich AJ & Jenkins DG. (2002) The aim of this study was to determine effects of 7 weeks of high- and low-velocity resistance training on strength and spring running performance in nine male elite junior spring runners (age 19.0±1.4 years, best 100m times 10.89±0.21 s; mean±a). The athletes continued their sprint training throughout the study, but their resistance training programme was replaced by one in which the movement velocities of hip extension and flexion, knee extension and flexion and squat exercises varied according to the loads lifted (i.e 30-50% and 70-90% of 1-RM in the high- and low-velocity training groups, respectively). There were no between-group differences in hip flexion or extension torque produced at 1.05, 4.74 or 8.42 rad x s (-1), 20m acceleration or 20m ‘flying’ running times, or 1-RM squat lift strength either before or after training. This was despite significant improvements in 20m acceleration time (p<0.01), squat strength (p<0.05), isokinetic hip flexion torque at 4.74 rad x s (-1) and hip extension torque at 1.05 and 4.74 rad x s (-1) for the athletes as a whole over the training period. Although velocity-specific strength adaptations have been shown to occur rapidly in untrained and non-concurrently training individuals, the present results suggest a lack of velocity-specific performance changes in elite concurrently training sprint runners performing a combination of traditional and semi-specific resistance training exercises.

Jeffrey M & Mc Bride, (2002) The purpose of this investigation was to examine the effect of an 8-week training program with heavy-vs-light-load jump squats on various physical performance measures and electromyography (EMG). Twenty-six athletic men with varying levels of resistance training experience performed sessions of jump squats with either 30% (JS30,n59) or 80% (JS80,n 5 10) of their one repetition maximum in the squat (IRM) or served as a control (C, n 5 7). An agility test, 20m sprint, and jump squats with 30% (30J), 55% (55J), and 80%
(80J) of their IRM were performed before and after training. Peak force, peak velocity (PV), peak power (pp), jump height, and average EMG (concentric phase) were calculated for the jumps. There were significant increases in PP and PV in the 30J, 55J, and 80J for the JS30 group (p# 0.05). The JS30 groups also significantly increased in the IRM but ran significantly slower in the 20-m sprint. In the 30J the JS30 group’s percentage increase in EMG activity was significantly different from the C group. In the 80J the JS30 group’s percentage increase in EMG activity was significantly different from the C group. This investigation indicates that training with light-load jump squats results in increased movement velocity capabilities and that velocity-specific changes in muscle activity may play a key role in this adaptation.

Ashby & Hecgaard JH (2002). The role of arm motion on the performance of the standing long jump was investigated. Three males performed a series of jump with free (JEA) and with restricted (JRA) arm motion to determine if arm swing improves jumping distance. The subjects jumped off a force platform and the motion of the body segments were recorded with a four-camera, passive-capture systems. Jumping performance was defined as the horizontal displacement of the toe between the initial and landing (TD) position. The subjects jumped 21.2% further on average with arm movement (2.09±0.03m) than without ) 1.72±0.03m). Seventy-one percent of the increase in performance in JFA was attributable to a 12.7% increase in the take-off (TO) velocity of the center of gravity (CG). Increases in the horizontal position of the toe with respect to the CG at TD accounted for the remaining 29% of the improvement in jumping distance. The added balance and control proved by the arms throughout the jumping motion contributed to performance improvement in JFA. The subjects were able to remedy excessive forward motion about the CG by swinging the arm backward during the flight phase. Without the freedom to swing the arms during flight, the subjects had to eliminate any excessive forward rotation while still in contact with the ground. This tendency in JRA was manifest in the premature decline in the vertical ground reaction force (VGRF) and the development of a counter productive backward moment about the CG just before to.
Izquierdo M, Hakkinen, Gonzalez-Badillo JJ, Ibanez J & Gorostiaga EM (2002) Maximum concentric one repetition maximum half-squat (IRM (HS)) bench-press (IRM (BP), power – load curves during concentric actions with load ranging form 30% to 100% of IRM (HS) and IRM (B) were examined in 70 male subjects divided into five groups: Weightlifting (WL, n=11), handball players (HP, n=19), amateur road cyclists (RC, n=18), middle – distance runners (MDR, n=10) and age-matched control subjects (C, n=12). The IRMS(HS) values in WL, HP and RC were 50%, 29% and 28% greater respectively, (p<0.001-0.01) than those recorded for MDR and C the half-squat (from 30% to 100%) in WL and HP (p<0.01 at 45% and 60% with) were higher (0.05-0.001) than those in MDR, RC and C average power output at the load of 30% of IRM(HS) in RC was higher (p<0.05) than that recorded in MDR and C. Maximal power output was produced at the load of 60% for HP, MDR and C, at the load of 45% for WL and RC. The IRM (BP) in WL was larger (P<0.05) than those recorded in HP, RC, MAR and C in the bench press, average muscle power outputs in WL and HP were higher (p<0.05-0.001) than those in MDR, RC and C were maximized at a of 30% of IRM for WL and HP, and at 45% for RC, MDR and C, in addition, the velocities that elicited the maximal power in the lower extremities were lower (approximately 0.75 m.s (-1) than those occurring in the upper extremities (approximately 0.75 m.s (-1). The data suggest that the magnitude of the sports-related differences in strength and/or muscle power output may be explained in part by differences in muscle cross-sectional area, fiber type distribution and in the muscle mechanics of the upper and lower limbs as well as by training background.

Shim AI, Bailey ML & Westings SII (2001) The purpose of this study was to develop a field test capable of measuring upper-body power through the use of a common weight training apparatus, a smith machine (SM), set up for bench press (BP) movement. A small, battery-operated digital timing device was designed and constructed to allow a precise calculation of power (in conjunction with measures of distance and force) for this specific movement, which involved an explosive press from the chest to a position just short of full arm extension. In pilot work, 1 repetition maximum (IRM) were determined on the SM BP for 3 male subjects, and
by subsequently testing power on the same subjects at varying resistances, an average relative percentage of the IRM producing peak power values was found by power curve analysis for test standardization. Reliability was assessed (using 1 men) by SM power measurements taken over 3 days on the SM fitted with the timer. An interclass R (0.998) indicated a high correlation between the 3 separate field-test trials. Finally, 8 male subjects were used to compare SM scores with a criterion measures, the Linea Isokinetic BP station (Loredan Biomedical, Inc., Sacramento CA). A person product moment coefficient found a high correlation between the field test (SM) and Linea power score \( r = 0.987 \). A 2-tailed dependent t-test between the field and criterion scores was not significant, suggesting that no consistent error variable was present. It can be concluded that this is a valid field test of power for this movement.

Hakkien K, Kraemer WJ, Newton RU & Aien M (2001) The effects of a 6-month resistance training (2 day/week) designed to develop both strength and power on neural actuation by electromyography activity (EMG) of the agonist and antagonist knee extensors, muscle fiber proportion and areas of types, I, IIa and IIb of the vastus lateralis (VL) as well as maximum concentric one repetition maximum (1 RM) strength and maximum and explosive isometric strength of the knee extensors were examined. A total of 10 middle aged men (M40; 42±2), 11 middle aged women (W40;39±3), elderly men (M70;72±3) and 11 elderly women (W70;67±3) served as subjects. Maximal and explosive strength values remained unaltered during a 1 month control period. After the 6-month training maximal isometric and IRM strength values increased in M40 by 28±14 and 27±7% in M40, in W40, and in M70 but decreased in w70 (from 42±34 to 32±26%; p < 0.05) during the first 2 months of training. Significant increases occurred during the training in the means fiber areas of type I in W70 (P< 0.05) and of overall type II along with a specific increase in I Ila in both W40 (P< 0.05) AND IN W70 (p< 0.05), while the changes in the male groups were not statistically significant. The individual percentage values for type II fibers at pre-training correlated with the individual values for 1 RM strength in both W70 (r< 0.080;P< 0.05) and M70 (R< 0.61;P< 0.05) and also at post-training for maximal isometric torque in W70 (r= 0.77, P< 0.05).
findings support the concept of the important role of the neural adaptations in strength in power development in middle-aged and older men and women. The muscle fiber distribution (percentage type II fibers) seems to be an important contributor on muscle strength in older people, especially older women. Women of both age groups appear to be hypertrophically responsive to the total body strength training protocol two times a week including heavier and lower (for fast movements) loads designed for both maximal strength and power development while such a programme has limited defects on muscle hypertrophy in men.

Hrysomallis C & Kidgel ID (2001) here is limited research to support the notion that heavy resistive exercise immediately before a power movement may acutely enhance performance. Upper-body acute power enhanced during a stretch-shorten cycle (SSC) movement has not been previously investigated. The aim of this project was it determines whether a set of 5 repetitions of 5 repetition maximum (RM) bench press preceding explosives push-ups would significantly influence indictors of power; impulse and maximum rate of force development subject randomly performed either explosive push-ups only over a force platform of a asset 5RM bench press before the explosive push-ups. There were no significant differences for any of the force platform data when the explosives push-ups were preceded by a set of 5RM bench press. It appears that heavy dynamic resistive upper-body exercise on its own before an upper-body power activity is inadequate in augmenting short-term power.

Stockbruger BA, & Haennel RG (2001) The purpose of study was to evaluate the validity and reliability of a medicine ahall throw test to sees explosive power twenty competitive sand volleyball players (10 male players, 10 female players) performed a medicine hall throw and a standard counter movement vertical jump, the subjects attended 2 sessions; at each session, 3 attempts of each test were completed. The movement pattern for a medicine hall throw was a backward overhead toss. To standardize for body weight a power index was calculated for the counter movement vertical jump using the Lewis formula. Validity was assessed for the best score for both the throw and the jump, and reliability was assessed using the best score from each session there was a strong correlation between the distance of
the medicine ball throw and the lower index for the countermovement of the vertical jump ($r=0.96$, $p<0.01$), and for the medicine ball throw the test – retest reliability was 0.996 ($p<0.01$), and for the medicine ball throw the test – retest reliability was 0.996 ($p<0.01$), these findings suggests that the medicine ball throw test is a valid and reliable test for assessing explosive power for analogous total body movement and a general athletic ability.

**Rosch D, Odgson R, Peterson T1 & Graf-Baumann T (2000)** The most important variables for measuring performance in team sports such as football players are physical condition and technical and tactical performance. However, because of the complexity of the game of football it is difficult to ascertain the relative importance of each of these variables. The aim of the present study was to develop a standardized test battery to evaluate physical performance in football players. The F-MARC test battery was designed to close relate to the football players normal activity and comprised a functional, structured training session of approximately 2.5 hours. It included a “quality rating” of the warm-up procedure, test of flexibility, football skills, power, speed and endurance. The players finished with a cool-down. A total of 588 football players underwent the F-MARC test battery. Mean values for performance on each test are presented for group of differed age and skill levels. The test battery proved to be a feasible instrument to assess both physical performance and football skills. This study supports the proposal by balsom (1994) that analysis of and individual player’s physical profile, in relation to mean values for a similar age group and skill level, might be of assistance to the coach in objectively evaluating the effects of a specific training program. It may also be of use to the physician and physical therapist responsible for monitoring progress during rehabilitation after football injuries.

**Baca A (1999)** Drop jumping is a form of plyometric training. Different techniques are applied to determine parameter values quantifying drop jump, such as the jump height or the durations of the phases of downward and upward movements of the center of mass (CM) during foot contact with the ground after dropping. The flight time method estimates the jump height from the time between the instant of leaving ground and the instant of landing. In video-based, markers are
placed on the skill of the subject to determine the position of the body segments. The
time dependent positions of the CM and parameter values are then calculated
utilizing models of the human body. If the vertical velocity of the CM can be
estimated at one instant, the parameter values can be calculated from the vertical
ground reaction forces. **METHOD**: The purpose of the study was to find out which
technique yields the lowest errors compared with the results obtained by double
force plate technique. In this investigation, two force plates were used, one located
under the drop platform. Twenty five drop jumps were analyzed with eight different
methods. There were large differences between the reference method and other
methods. Using the height of the drop platform (0.39) to estimate the velocity at the
end of the free fall, in conjunction with data from one force plate, resulted in a mean
difference of 4.2% (SD:9.6%) in the calculated jump height. Using video
information to estimate the time that the velocity of the CM fell to zero after the
drop phases, in conjunction with data from on force plate resulted in difference in
the jump height of up to 17%. Results: difference between the reference method and
video based method were comparatively small (mean value of difference in jump
height: 0.007m, SD: 0.013m for the best of these methods) but not negligible.
**CONCLUSION**: nevertheless, video based methods turned out to be the most
promising alternative to the reference method to accurate variables concerning drop
jump performance.

supplementation during training on body composition, strength, sprint performance,
and hematological profiles. **METHOD**: in a double-build and randomized manner,
25 NCAA division IA football player matched-paired and assigned to supplement
their dies for 28 during resistance/agility training (8 hwxk(-1)) with a phophagen HP
(Experimental and applied sciences, Golden, CO) placebo (p) containing 99 gxd (-1)
of disodium phosphate, and 1.2 gxd (-1) of potassium phosphate (p) or phophagen
HP containing the P with 15.75 gxd (-1) of HPC1: pure creatine monohydrate (HP).
Before and after supplementation, fasting blood samples were obtained; total body
weight, total body water, and body composition were determined; subjects
performed maximal repetition test on the isotonic bench press, squat and power clean; and subject performed a cycle ergometer spring test (12x6-s sprints with 30-s rest recovery). RESULTS: Hematological parameter remained within normal clinical limits for active individuals with no side effects reported. Total body weight significantly increased (p<0.05) in the HP group (p0.85±2.2; HP2.42±1.4kg) while no differences were observed in the percentage of total body water. DEXA scanned body mass (p0.77±1.8; HP2.22±1.5kg), and fat-free mass (p0.33±1.1, HP2.43±1.4kg) were significantly increased in the HP group. Gains in bench press lifting volume (p0.5±134; HP225±246kg) the sum of bench press, squat and power clean lifting volume (p1, 105±429; HP 1.558±645kg), and total work performed during then first five 6-s sprints was significantly greater in the HP group. CONCLUSION: The addition of creatine to the glucose/taurine/ electrolyte supplement promoted gains in fat/free mass, isotonic lifting volume, and power performance during intense resistance/agility training.

There is a scarcity of descriptive data on the performance capacity of elite badminton players, whose fitness requirement are quite specific. The purpose of this paper is to investigate the physiological response of elite badminton players in a short-specific fitness test. Twelve Hong Kong national badminton players performed a field test on a badminton court. Six light bulbs were connected to a programming device causing individual bulbs to light up in a given sequence. The players were instructed to react to the flashes by running towards them and striking shuttles mounted in the vicinity of the bulbs. Exercise intensity was controlled by altering then interval between successive lightings. A low correlation (r = 0.65) was found between the results of the field test and the rank-order list of subjects, based on an objected on-field physiological assessment and subjective ranking. This may be explained by the requirements of other factors besides physical fitness which contribute to success in elite level badminton competition. These factors may include, for example, technique skill, method power, and aesthetic judgment on the court. Maximum mean (s.d) heart rate data (187(8) beats min-1) and blood lactate values (10.4(2.9) mmol .1-1) in this study showed that players were under maximal
load during the field test. From the testing data, it seems reasonable to speculate that the intensity of level 3 (20 light pulses.min⁻¹; 3.0s.pulse⁻¹) and level 4 (22 light pulses.min⁻¹;2.7s.pulse⁻¹) simulates the requirement of actual games energy expenditure of the Hong Kong badminton players exercising at close to their anaerobic threshold. The results also show that an estimate of fitness can be derived from measurements involving exercise closely resembling that which is specific for the sports activity in question. Improved training advice and guidance may result from such studies.

**Nieman DC (1994)** In this article, physical fitness has been defined as a energy and vitality that enable one to carry out daily tasks, to engage in active leisure time pursuit, and to meet unforeseen emergencies without undue fatigue. In addition, physical fit individuals are described as being at low risk for hypo kinetic diseases and being more able to function at the peak of intellectual capacity while experiencing “joie de vivre”. The measurable elements of physical fitness have been categorized in to two groups: skill related fitness and health related fitness. The former category includes agility, balance, coordination, speed, body composition, and musculoskeletal fitness, which incorporates flexibility, muscular strength, and muscular endurance. It is highly recommended that clinicians provide Comprehensive fitness testing that their patients because of the well-established health-related benefits that are related to each component.

**Bater (1992)** conducted a research for one hundred 17 and 18 year old boys. They were tested on agility test designed by the investigator turning rate was a important factor in determining performance scores. The relationship between distance and agility performance on the second traits was significant. Agility test must be administrated more than once to achieve reliable results. A study of the relationship between selected anthropometric measures and agility produce no substantial results. A research study “the reaction time, speed and agility of big muscle group to certain sports skills” was conducted by Doramhy Beise and Deasely. In this study it was generally assumed that individual skills in sports differ in their motor response from the unskilled.
Neshizaden (1987) investigated a study to determine if circuit training could be an effective method to improve aerobic capacity as well as strength. The 47 female volunteers between the age group of 17 - 36 years were assigned to circuit training, jogging and control groups each subject was tested prior and a test and of the eight weeks of training period on VO2 max and 1 ram bench press and leg press. Obtained data was analyzed by using the Manacova. Results showed that there was a 12% and 9.6% increase in VO2 max for the circuit training and jogging group respectively.

Circuit training is most definitely and effective technique for improving strength and flexibility. Certainly if the pace of or the time interval between stations is rapid and if work load is maintained at a high level of intensity with heart rate of or above target training levels, the cardio respiratory system may benefit from this circuit. Research evidence showed that circuit training was effective in improving cardio respiratory endurance. It should be and was most often used as a technique for developing and improving muscular strength and endurance. It should be and was most often used as a technique for developing and improving muscular strength and endurance.

O.Shean (1986) undertook and experiment to determine the effect of a 6 week progressive weight training programme on the development of strength and muscle hypertrophy. The experiment was carried out using one exercise, the deep knee bend with varying repetitions nine five and two. No significant difference was found between the three systems of training. All training procedures resulted in the improvement of static and dynamic strength.

Scoll (1985) compared strength training programme and a sports activity program is measured by performance on AAPHER youth fitness test. The weight training groups participated in a combination of weight training. While report activity group participated in a strength sports activity program. Both the groups were tested after and before 8 weeks of activities using the AAPHER youth Fitness test. So both groups showed a significant improvement (p<0.05) in several of next test.
items. The weight training improved pull ups, shuttle run, standing broad jump and 50 yards dash. The sports activity group improved in sit ups, shuttle run, standing broad jump and 50 yards dash. The sports activity group improved in sit ups, shuttle run, standing broad jump and 50 yards dash.

Roman (1984) studies the effects of circuit training on speed, endurance, and striking ability of footballers. The experimental group underwent three circuits, thrice a week; against time using primarily weight training exercise and running between stations the experimental group used a traditional training method of calisthenics, weight lift and play. It was concluded that experimental group showed better speed, endurance striking ability than the traditional training group.

Benarki (1983) conducted study on the training effort on an upper body circuit training programmed on heart rate on oxygen uptake. Eight college students (5 men, 3 women) were divided in to control and experimental group. Eight week training was given to experimental group. Training consisted of eight exercises, one circuit a day subjects exercised to a percentage of their body weight for a specific number of repetitions as developed by Vitace (1973). Control groups and experimental group were pre and post tested using physical work capacity test on monark bicycle a ergo mete. Result showed that following that training period, the experimental group showed on significant decrease in resting heart rat, but significant increase was seen in VO2 max of the group. Berger (1969) conducted a test on the effect of varied weight training programmed had undertaken. Training to place three times weekly with variations in programmed. The result showed that three sets and six repetitions per set were best for improving strength.

Oslen (1981) studies the effect of a set of circuit training programmed on strength and muscular endurance of college male (N = 42) enrolled in weight training classes participated in the study. Pre and post test for IRM strength absolute muscular endurance and relative endurance were given for bench and press. Treatment consists of two work outs session per week for seven weeks. In each session presents students were requested to complete two sets of ten exercise. Both
set of an exercise were completed before a student moved to the next activity. A work results ration of 20 sec/20 see was used. Test, retest procedure and analysis. Mean changes between pre and post tests for IRM strength in bench press were significant (<0.05). No significant change in relative muscular endurance in the leg press (p<0.05).

Robson (1981) her conducted a study to determine the selected physical fitness components of boys and girls at different stage of elementary school level. 20 boys and 20 girls were selected at random from each group from on to five. Their age ranged from five to eleven years, the components tested were speed, and shoulder strength, explosive shoulder strength than girls in all grades. Insignificant difference in the performance between boys and girls grade one and two boys of a grade three and four standing broad jump. It was revealed that oys of grade four were significantly superior to the girls at the same grade in 50 yards run and shuttle run.

Armbruster et al., (1971) expressed that muscular strength and power be developed more rapid through the progressive weight training.

Francis (1971) conducted a study on the influence of a weight training programmes on quadriceps reflex time. Quadriceps reflex time and muscle strength data were obtained from 65 male college students before and after a six week experimental periods, subjects (N=36) participated in an training programme. Specially designed to strength the muscles of the quadriceps group. While 29 control subjects were not enrolled in physical subject’s activity course. Although there was a significant increase in quadriceps muscle strength by the experimental group, there was no statistical relationship between muscle strength and reflex time, not between change muscle strength and a change in reflex time.

Cuper (1950) in his research, proved that systematic weight training increase strength muscle endurance, cardio - respiratory endurance, and athletic power. In his procedure, he used two groups of students as Group ‘A’ and Group ‘B’ consisted of 42 students of weight training class of sophomores at the University of Tennesen. In which only one student had any previous experience in weight
training. Group ‘B’ consisting of 29 students was a conditioning class of same 
university. Group devoted wholly to weight training exercise. One barbell and two 
pairs of dumbbells were supplied to each group of 4 students; with diligent 
utilization of 40 minutes the whole group was able to complete all the 14 exercise 
group ‘B’ participant in strenuous conditioning course for 40 minutes. According to 
findings both group performed the exercise twice a week for a total period of 11 
weeks on the first day of the critical testing and on the final testing the muscular 
strength and cardio-respiratory endurance events, were administered.

The results showed that the both the groups increased in body weight however group ‘A’ slightly increased than group ‘B’. No significant difference was 
found between the two groups in the improvement of muscular endurance and very 
neearly the same amount in cardio-respiratory endurance was found.

**Weiss (1969)** adopted a conducting programme that worked well for the 
wrestlers centers around the use of exercise stations set up a circuit fashion. The 
objective of the porogramme was developed both muscular strength muscular 
endurance. Having the wrestlers work continuously at each of the six stations for a 
period of ten minutes. He found this programme to be quite beneficial in 
conditioning the wrestlers for the touche scheduled ahead. The programme was 
flexibility enough to the coach to set up a station to meet the particular needs of 
wrestlers. It has also a good response from the wrestlers who actually look forward 
to working on the circuit at the beginning of the each wrestling season.

**Brown and Reily (1968)** conducted a study on the effect of weight training on 
vertical jumping ability. It was found that weight training group showed an 
increase of 0.6 inches at the 0.01 level significant.

**Brooks (1967)** compared the effects of circuit training and educational 
gymnastics programme using two groups of boys at Coventry. Training was given 
for a period of six weeks. Subjects were tested on sit ups, leg raises, bench jump, 
press ups, and squat jump circuit training produced significantly greater gains in 
three of the performances due to the increased speed of the muscular Response.
Miller (1967) investigated the effectiveness of circuit training and weight training on upper body strength of ninth grade boys. The boys were administered the Oregon simplification of Rogers physical fitness index to assess the development of the upper body strength. After a six weeks training program both weight training and circuit training programmers produced significant gains in upper body strength, with circuit gain being greater.

The effect of weight training on physical fitness of athletic squats was experimented by Cambell (1967). The results of the study revealed that weight training produced a significant greater increase in physical fitness than a normal conditioning programmed.

Dealy (1966) studied two groups of children and administered the five items of Washington state elementary school physical education test, before and after eight week programmed. Both the groups had regular physical education class four days a week for twenty minutes and spent the remaining six minutes in either equal exercise or circuit training. The squad exercise showed improvement in only one item, but the circuit training group improved in all item and their total physical fitness improvement was significant at the 0.01 level of confidence.

In the University of Massachusetts, men college student between 21 and 234 randomly assigned into three groups and were given training programmed thrice a week experimental group was give five minutes circuit training exercise and twenty five minutes games. Experimental group II was given for ten minutes circuit exercise and fifteen minutes game. The circuit consisted of bench steps, push ups, leg changes, squat thrust, sit ups and pull ups. The games were basketball, soccer, touch football, touch rugby and volleyball. The results showed experimental group I had obtained better but lower performance on bench steps when compared with experimental group II.

Urijers (1964) compared eleven volunteers to nine students in scheduled physical education class. The above two groups were considered equivalent to anthropometrics and functional tests. The experimental group participated in circuit
training programmed in addition to regular in physical education for a period of six weeks with three training sessions per week. The other volunteer group did not the any exercise. Favorable effects on both functional and morphological parameters were obtained. Maximal oxygen intake and pulse were increase. Pulse rate adoption was more efficient and heart volume and enlarged due to circuit training. The circuit training group improved 28.1% in leg press and 20.1% in bench press. There was no significant increase for jogging group in strength parameters but there was a positive change in leg press. The control group did not change significantly in any variable. The conclusion of the study was that continuous circuit training was an excellent modulates to develop strength as well as aerobic fitness.

According to Nelson (1964) the effect of weight training on basketball proved to be a big success in improving the shooting accuracy in one handset shot. The emphasized weight training is harmful to basketful shooting skill should be completely discounted.

Morgan & Adamson (1963) performed an experiment with progressive loading which let to circuit training. The boys aged 14-15 were in two balanced groups which had there physical education periods per week. The experimental Groups had an additional over load programmer amount to thirty minutes per week. The experimental groups had an additional over load programmer amount to thirty minutes per week for one month. Gains of the experimental groups over the control groups indicated that a relatively small amount of intensive overload training using the apparatus normally found in school produced.

Brown (1962) conducted a study on the effect of circuit training on the physical fitness on grade five girls. Two classes were tested on the AAIPER fitness test before and after eight week of regular physical education classes. The experimental class, by chance had supplemental ten minute circuit training before each class. The experimental class showed better improvement in Physical fitness after the training period.
Richard Bedger (1962) conducted a research on the effect of varied weight training programmes on strength. He conducted an experiment with bench press etc. In all 9 different weight training programmes has been undertaken. Training took place 3 times of a week with variation in programmes. The results showed that 3 sets and 6 repetitions per set were best for improving strength.

Kerr (1956) selected forty eight subjects including 24 basketball players and 24 physical education students. Who were divided into three groups on the basis of height, weight by means of Mccloy classification index. The weight training programme was conducted over a 12 week periods. Exercise group; one (18-15 repetition 2 set) and exercise group two (5-8 repetition 3 sets) and exercise group two (5-8 repetition 3 sets) performed the heel and the raise and the deep knee bend. The third group (control) did not participate in any resistance exercise. The experimental groups showed greater gain than the control group which indicate that heavy resistance has an effort upon the jumping ability of high school volleyball players.

Churi (1950) studied the effects of weight training on vertical jump using progressive resistance exercise which showed an increase in performance.

Copen (1950) studied the effect of systematic weight training on power, strength and endurance. Two groups of students were used. Both groups met twice in a week for 11 weeks, they were tested at the beginning and at the end. According to the result. It was seen that both group showed very nearly the same amount of improvement on power strength and endurance. It seems that weight training was an effect in the development of muscular and cardio respiratory endurance as the programme of group ‘B’ which especially emphasized these endurance elements.

Zeria (1949) conducted a study of find out whether at high school level involved in various athletic activities difference in their physical abilities in strength, speed, agility, endurance and coordination. The athletic activities concerned in the present study was measured among athletics in the team sports weight lifting, tennis.
and tracks data were gathered answer six questions of research investigation the difference among the weight lifting, tennis, and tracks teams in physical components of strength, speed, agility endurance and coordination. Finally it was concluded that no difference exist among the three groups of athletics with respect to all physical component of performance.