Chapter II

REVIEW OF RELATED LITERATURE

A study of relevant literature is an essential step to get full picture of what has to be done with regard to this study. Such reviews bring about a deep insight and clear perceptive of the overall field. The review will help the development of research procedure. The term literature is employed to include anything appropriate to the topic, such as theories, letters, documents, historical records, government reports, newspaper account, empirical studies, and so forth (James, 1993).

Literature reviews also provide a solid background for a research paper's investigation. Comprehensive knowledge of the literature of the field is essential to most research papers. This chapter usually presents the review of the literature related to the study and the implications drawn for the past study. The implications should match with the details of the actual study presented in the next chapter, methodology.

The literature reviewed for this study was divided for convenience in to four related areas. The first area of review was research studies concerning with talent identification programme. Other three areas dealt with relationship of Anthropometric variables and motor fitness, Somatotypes and track and field performance and anaerobic training.

2.1 Reviews Related to Talent Identification Programme

Success in sports, as measured by competitive performances, depends upon a number of significant method and physical components- Physical components like somatotypes, motor skills, physiological parameters, genetic endowment, training level, psychological components (such as motivation, anxiety and self confidence), and injury prevention, which plays a significant role in competitive performances. For the most part, motor skills are age and gender dependent. In general the efficiency of the movement progressively improves throughout the childhood and into early adolescence and is highly dependent on environmental influences. Performance is influenced by the effect of genetic factors on specific traits in 30 to 85 % of cases. It is suggested that sports performances may be optimized by the early identification of individual with positive genetic and somatotype markers and negative risk factors. Motor skill development and physiological parameters can be maximized by using regular, non-excessive training protocols, sound nutrition pattern, a safe environment and protective gear (Birrer and Levine, 1987). Although mesomorphy and lesser extent ectomorphy are positively associated with enhanced performances, successful athletes tend to have or acquire somatotype characteristic of individuals already successful in sports.

Gladis and Esther (2009, 23-50) studied the validity of the battery test. The multiple correlations (R) are actually validly coefficient of the series or battery. In working with long experimental lists of test, several combinations may be tried, and the 'R' indicates the relative validly of each combination, in terms of the original criterion. The battery can be chooses solely in terms of the highest 'R'. For considering the two or three skills in some sports, they may not be of equal importance in measuring specific sports playing ability and the scores must be adjusted because of this difference in size of scores. This adjustment, when combining tests into a battery, is called weighting. It is achieved by the regression equation, which specifies the proportion of the raw scores to be used. The alternative method to use of the regression equation when combining tests is to take the student's T-scores for each test and adds them together. The sum of the T-scores can be computed more quickly and is satisfactory substitute when tests are approximately equal value. T-score is based upon a comparison of the scores in terms of distances from the mean as measured in standard deviations. McCall devised a method of securing T scores by used this formulae. T-scores=50+10(X-M)/S.D.

Vaeyens et al. (2008) derived the talent identification model and future direction for younger generation. Many children strive to attain excellence in sport. However, although talent identification and development programmes have gained popularity in recent decades, there remains a lack of consensus in relation to how talent should be defined or identified and there is no uniformly accepted theoretical framework to guide current practice. The success rates of talent identification and development programmes have rarely been assessed and the validity of the models applied remains highly debated. This study provides an overview of current knowledge in this area with special focus on problems associated with the identification of gifted adolescents. There is a growing agreement that traditional cross-sectional talent identification models are likely to exclude many, especially late maturing, 'promising' children from development programmes due to the dynamic and multidimensional nature of sport talent. A conceptual framework that acknowledges both genetic and environmental influences and considers the dynamic and multidimensional nature of sport talent is presented. The relevance of this model is highlighted and recommendations for future work provided. It is advocated that talent identification and development programmes should be dynamic and interconnected taking into consideration maturity status and the potential to develop rather than to exclude children at an early age. Finally, more representative real-world tasks should be developed and employed in a multidimensional design to increase the efficacy of talent identification and development programmes.

Foreman (1989) outlined some of the characteristics related to successful performance in terms of relative importance in various events. In the area of sprints and hurdles, natural speed, power, stride cadence, strength, movement time and low percent fat were considered important. For middle and long distance runs, aerobic capacity, anaerobic power, natural speed, low percent fat, and strength were important factors. For jumpers, power, strength, morphological factors, natural speed, coordination and low percent fat were important factors. For throwers the important factors for successful performance were power, strength, morphological factors, coordination and natural speed.

Recev (1985) reported the two phase selection procedure with simple field tests which could be used to find potential track and field young athletes 9-12 years of age. The initial phase was responsible for spotting general sporting potential and included simple tests such as: standing long jump, vertical jump, 60 m sprint, sit-ups and bent arm hang. The second phase was designed to find young athletes suitable for specific track and field events. The selection was based on the morphological, physiological and psychological characteristics.

One of the earliest and most comprehensive studies to measure various aspects of physical fitness of athletes was calculated by cureton (1948). Cureton administered a series of tests which measured physique, motor fitness and cardiovascular characteristics of United States Olympic athletes, national champions, and sub elite athletes in different sport or event showed specific event related characteristics. Cureton concluded that certain tests provided a valid and objective means for distinguishing between high, average and low levels of fitness of athletes.

Studies conducted at Indiana University USA revealed that it is possible to accurately predict performance in selected track and field events using relatively simple tests. The tests assist coaches recognise the potential of young athletes and predict their performance in selected track and field events. The basic tests are standing long jump, vertical jump, five bounds and standing 30 metres for male athletes; Weight, standing long jump, stride length and stride frequency for female athletes (http://www.brianmac.co.uk/talent.htm).

Specific anthropometric characteristics and somatotypes were needed to be successful in certain sport events. It is also important to note that there are some differences in body structure and composition of sports persons involved in individual and team sports. The tasks in some events, such as shot put or high jump, are quite specific and different from each other and so are the successful physiques. George Abraham (Dec 2010) analyzed the anthropometry and body composition associated with performance of University level male track and field athletes of South India. This study was conducted on 93 track and field athletes from South India, comprised 22 sprinters, 20 middle distance runners, 16 long distance runners 20 throwers and 15 jumpers. Somatotype evaluations were made according to Carter and Heath (1990) method. The somatochart indicated that sprinters and middle distance runners are ectomorphic mesomorphs (2.53-4.31-3.06, 2.81-3.96-3.31), long distance runners are mesomorph-ectomorphs (2.60-3.72-3.56) while throwers are endomorphic mesomorphs (3.39-4.23-2.10). The jumpers fell into the somatotype category of balanced mesomorphs (2.87-4.03-3.18). Among all groups body fat percent is lowest in sprinters (6.23±0.83%) and highest in throwers (7.38±0.85%). This was reflected in their endomorphic components which is lowest in sprinters (2.53±0.45) and highest in throwers (3.39±0.65). Ectomorphic component is highly marked in long distance runners (3.56±0.65) while mesomophy was highest in sprinters (4.31±0.91). Throwers have significantly higher values of skin folds than other groups. Compared to their overseas counterparts, the athletes of both track and field events exhibited greater endomorphic values.

Pipes (1977) determined the body composition characteristics of 58 inter collegiate track and field athletes and they concluded that body types may predispose an individual's ability to perform in an event. Siris and Gaidarska (1986) noted that height and weight were important factors for athletic success. Aule and Locko (1983) stated that short athletes tend to be better coordinated, learn technique faster and produce short term result than their tall counterparts, although taller athletes have better potential.

Aule and Locko (1983) identified model anthropometric measurements and physical performance characteristics for selecting potentially talented athletes. His studies have shown that physique and certain in performance capacities are inherited and genetically established. Inherited characteristics that are poorly influenced by outside factors (i.e., the environment) are physique, flexibility, speed, strength, aerobic capacity, reaction time, agility and coordination. These characteristics that react easily to outside influences are body weight and absolute muscle strength.

Reviews Related to Talent Identification- Sprint and Jumping Events

Kruger et al. (2009) conducted the study to test the talent identification protocol and evaluate the development program for 10 weeks. He tested sixty-two (N=62) boys between the age of 10 and 15 years from two different farm schools in the Potchefstroom district. The boys were subjected to a talent search testing protocol. Potentially talented athletes (n=21), with a mean age of 12.0 ± 1.67 years, at one of the farm schools were randomly assigned to the experimental group. A control group was selected in the same way consisting of equally talented boys from the other farm school, with an average age of 12.1 ± 1.26 years. The talented children in both groups then underwent a specific test battery designed for sprinting and long jump. Maturity was determined by means of a maturity questionnaire. The development programme contributed statistically significant to the improvement in flexibility, muscle endurance, 0-40 meter speed and long-jump ability. Explosive power, reaction time, speed endurance, acceleration and stride length did not improve. The results revealed that a development programme of 10 weeks had a positive effect on the conditioning of motor and physical abilities and skills for sprinting and long-jump in talented 10 to 15 year old boys, regardless of poor socioeconomic circumstances and a restricted environment.

Kruger and Pienaar (2009) studied South African disadvantaged children for development of sprinting and long jump abilities. The most talented subjects (N = 39) were selected from 66 boys by means of a talent search testing protocol and then subjected to a sport specific test battery consisting of five anthropometric and 16 physical and motor variables. The results indicated that mean anaerobic power output, acceleration, body mass, reaction time, iliopsoas flexibility, speed endurance, sitting height, age and push-ups contributed to 86.5% of the total variance to performance in the 100 meter sprint. Horizontal jump, age, acceleration and ankle flexibility contributed to 81.5% of the total variance in the performance of the long jump. These anthropometric, physical and motor abilities can enable the coach and sport scientist to classify the talent of 10-15 year-old boys for sprinting and long-jumping athletes, and then to develop the potential of the athlete accordingly.

Ugarkovic et al. (2002) conducted the study to investigate whether variables routinely assessed while testing athletes can also predict movement performance. The relation between jumping performance and standard strength, anthropometric, and body composition variables was examined in elite junior basketball players. The 33 males were tested for maximal vertical jump, as well as for maximal isometric voluntary force and rate of force development of hip and knee extensors. Standard anthropometric and body composition measures (body height, lean body mass, as well as the percentage of fat and muscle tissue) were also taken. Except for maximal isometric forces (0.38 and 0.52 N•kg-1 for hip and knee extensors, respectively), all correlation coefficients between the selected variables and jump height were insignificant. As a consequence, the corresponding multiple correlation coefficient, R = 0.71, also suggested a moderate predictability of jumping performance by the standard strength tests and anthropometric and body composition variables. The results obtained dispute the use of the examined tests in sport performance assessment, and also question applying the tests for other purposes such as evaluation of training procedures or selection of young athletes. Therefore, the results are in line with the concept that a reliable performance assessment in homogeneous groups of athletes requires predominantly movement-specific testing.

Researchers have also identified various factors and test batteries for identification of potential talent in jumps. Jarver (1979) provided sample tests used in Soviet Union sports schools along with norms for boys and girls for 10 to 11 years of age. These measurements included height, 30 m sprint from the fly, 60 m sprint from the stand, standing long jump and triple jump, pull-ups and push-ups. In addition Jarver identified West German tests for the long jump. The tests were divided into four areas; basic tests, which are 30 m sprint, jump and reach, 1000 m run for males and 800 m run for females. Secondly, event specific tests which included five hops on the right for distance and five hops on left leg for distance; third anthropometric measures and finally best performance information.

Afanasiev (1982) identified three tests that Soviet specialist found to be closely correlated with high jump results; speed strength testing such as the vertical jump in place without using the arms, strength testing using the barbell squat and dynamometer testing measuring the static strength of the leg.

Reviews Related to Talent Identification- Throwing Events

Success in field events is taught to be largely the result of a single explosive contraction of muscle groups, for example, the shot-put event completed in about two seconds. An elite long jumper applies forces to the take-off board in a time slightly less than 0.14 seconds (Baily and John Grover, 1990).

Great Britain chief coach Max Jones (1998) opined that a major element for the success of the GDR model of sports development was the talent identification programme, which was most advanced in the world. It was observed from the Seoel 1988 Olympics, where the GDR athletes held five of the seven world records in throwing. From the review of literature it appears that only the GDR and USSR adopted a comprehensive policy of talent identification in athletics for throwing. Certainly they screened for talent at any early age (10 years old onwards) and it is probable these factors contributed a great deal to the excellent results of the GDR in world athletics.

Universally there appears to be a policy of only using simple field tests for talent identification, and no country appears to use sophisticated methods of talent identification for large number of athletes. From the literature it was seen that the tests used to fall in to distinct groups; sprinting, static jumps, multiple jumps and weight throwing. For the purpose of the general throwing talent identification of the novice athletes, the above tests were most commonly used. These tests were often used by coaches in track and field events and other sports to determine an athlete preparedness and anaerobic nature in track and field events and other sport. These tests are also used as crude indicators of talent for anaerobic events (Schomlinsky, 1978). In the United States, three commonly used field tests are the standing long jump, the vertical jump and the 50 yard dash (Foreman, 1989).

Jarver (1979), Siris and Gaidarska (1986) presented sample tests used in Soviet youth sports schools for selecting potential throwers. The tests included height, weight, arm span, 30 m flying start, 60 m standing start, standing long and triple jump, shot throw backwards over the head, pull-ups and push-ups. In addition control norms were provided for all throwing events for ages 11 to 17 years.

It is also interesting to note that many international and collegiate coaches place a great deal of emphasis in the training of throwers on sprinting short distances (30-60 m) and jumping activities such as the standing long jump, vertical jump, standing triple jump and plyometric drills. In fact, some authors believe a strong relationship exists between performance in these activities and maximum throwing distance (Bakarinov & Ozerove, 1987; Jacoby & Gambetta, 1989; McGill, 1984). These activities have also come to be used as talent identification measures or selection criteria for throwing events (Forman, 1989). The performance of the throwers in the field tests of short sprints and standing jumps often rival that of sprinters and jumpers (Forman, 1989; McGill, 1984).

2.2 Reviews Related to Relationship of Anthropometric and Motor Fitness

Researchers have investigated anthropometric and somatotype characteristics of athletes and have suggested characteristic physique for different events. Malina (1975) described anthropometry as the systemized technique for taking measurements from man in order to quantitatively express the dimension of the body. Such measurements have been generally divided into categories of mass, length and height, breadths, width or depth; circumstances or girth; curvature or arcs; and soft tissue or skinfolds. Somatotype has been described as a system of classifying physique by shape instead of size.

Vucetic et al. (Sep 2008) describes the morphological characteristics of 54 Croatian national level track-and-field athletes. 21 anthropometric body measures were taken on a sample of 15 sprinters (S), 16 endurance sprinters (S4), 10 middle-distance runners (MD) and 13 long-distance runners (LD). Body fat percentage, body mass index and somatotype were also calculated. Canonical discriminative analysis showed significant difference between the athletes of various running events, in the measures of body volume and body fat, while no significant difference was found in the variables of longitudinal and transversal dimensions of the skeleton. ANOVA and Student t-test for independent samples showed statistically significantly higher thigh and lower leg circumference in sprinters, as well as greater upper arm skinfold in middle-distance runners. The mesomorphic component is a dominant characteristic of somatotype of the runners in all events, whereas the ectomorphic component is the least marked.

Kalichman and Kobylian (2007) studied the body composition variation during the life span and association with sign of some happiness or existence of aging. The aim of the study was to describe the age and sex related variations of the somatotypes, employing Heath and Carter method. They taken the sample of 802 males aged 18-89 years (mean 46.9) and 738 females aged 18-90 years (mean 48.6). The result of the study shows that the endomorphy is generally higher values in women and with respect to males the endomorphy remained virtually unchanged after 30 years of age but endomorphy in females kept increasing up to 6th decade, and subsequently unchanged. The largest difference of all somatotypes components appeared between the ages of 18-30 and 31-40. Thereafter, somatotypes remained practically unchanged; mesomorphy components continued to increase until the 5th decade for both sexes.

Indian Pediatrics (2007) published the growth chart for both boys and girls from 2 years to 18 years. The chart clearly indicated the following results related to the subjects selected for the current study (www.Indianpediatrics.net).

Table 2.1

Growth Chart for Boys (a)

Age (years)	Weight (kg)	Height (cm)
12	17.5-37	125-160
13	27.5-45	135-165
13.5	27.5-48	140-170.5
14	31-51	142-172.5
14.5	32-52	145-175
15	34-54	148-177
15.5	36-57	150-180
16	38-60	155-180

Badenhorst et al. (2003) conducted a study to determine the influence of physical activity on the prevalence of specific somatotypes and blood pressure levels among 10 to 15 year old boys. Anthropometric data were collected according to the methods of Norton & Olds (1996) and blood pressure was measured with the Finapres ("Finger Arterial Pressure"). The previous day physical activity recall questionnaire (PDPAR) was used to access the different activity levels among the subjects. A total of 603 boys from four different ethnic backgrounds were measured. One-way analysis of variance (ANOVA) and two-way multiple analysis of variance (MANOVA) procedures were used for all comparisons. Although there were no statistically significant differences ($p < 0.05$) between physical activity level, somatotype and elevated blood pressure, a trend was observed which indicated that the blood pressure of the endomorphic boys was the highest and rose with an increase in physical activity levels. An increase in physical activity did not lower the resting blood values of endomorphic boys.

Table 2.2

Growth Chart for Boys (b)

Age (years)	Weight (kg)	Height (cm)
12	27.1±3.5 (20.5-34.1)	135±5.7 (125-145.5)
13	30.4±3.6 (25.8-39.3)	142.3±7.5 (130.5-157.5)
14	33.6±5.5 (27.9-45)	147.3±8.9 (131-161.5)
15	35.2±5.1 (25.4-45.8)	152±6.86 (135.8-165)
16	42.8±6.5 (31.7-55.3)	160.3±6.05 (148-165.5)

(www.Indianpediatrics.net)

Jurimae and Jurrimae (2001) studied the growth, physical activity and motor development of children. The tender period between childhood and adolescence is full of changes for young children. They are approaching the onset of sexual maturation, and because they are beginning their school careers, the possibilities for voluntary play and movement rapidly decrease while mental stress rapidly increases. It is very important that young children have a basic knowledge about correct running, jumping, throwing, and swimming as well as knowledge of how to play different sports and games. However, there are no criteria for acceptable levels of motor skills or how to correctly measure those motor skills. Focusing on a traditionally less studied age group, growth, physical activity, and motor development in prepubertal children presents concentrated and selected information about the relationships among health and anthropometry, physical activity, motor ability, and motor development in children between the ages of eight and twelve. Extensively referenced, this book features the results of comprehensive studies of development during the prepubertal years as they relate to environmental conditions. It devotes special attention to body composition and health-related physical fitness. The book discusses recommended testing methods, including their validity, objectivity, and reliability. The health of children depends on their levels of physical activity, their motor abilities, and their motor skills. With the tools and guidelines provided in growth, physical activity, and motor development in prepubertal Children, easily evaluates physical activity, and then confidently guide children toward optimum growth and development.

Jurimae et al. (2001) conducted the study was to examine the relationship of handgrip strength with basic anthropometric variables, hand anthropometric variables, total body and hand composition, total body and hand bone mineral density (BMD) and bone mineral content (BMC) in prepubertal children aged between 8 and 11 years (n=64, 27 boys, 37 girls). Height and body mass were measured and body mass index (BMI kg/m2) was calculated. Biceps and triceps skinfolds, arm relaxed, arm flexed, forearm and wrist girths, acromiale–radiale, radiale–stylion–radiale and midstylion–dactylion length and humerus breadth were measured. Stepwise multiple regression analysis indicated that the most important predictive value from the basic anthropometric variables was body height, explaining 76.1% (R2×100), 40.7% and 50.6% of the handgrip strength in boys, girls and total group, respectively. Measured skinfold thicknesses and breadths were not related to handgrip strength in any group. Forearm girths significantly predicted handgrip strength in boys (30.8%), girls (43.4%) and total group (43.4%). As a rule, handgrip strength was more dependent on the anthropometric and body composition variables in boys than girls. It was concluded that body height, forearm girth, midstylion–dactylion and acromiale–radiale length and hand LBM and BMC are the most limiting factors influencing handgrip strength in prepubertal children.

Cureton and colleagues studied the association of several physical performance items (eg. pull-ups, sit-ups, shuttle run, standing broad jump, 50 yard dash, softball throw, and 600-yard run) with body composition components in 49 prepubescent boys. A lower fat content, estimated by densitometry was significantly associated with good performance. In pull-ups, standing broad jump, 50 dash and 600 yard run and FFB was significantly correlated with power activities including the standing broad jump and softball throw (William, 2000).

In India, some authors conducted somatotypes studies to reveal the Indian somatotypes in different demographic region. The majority of the adult males of Northeastern India were found to be lean, (Khongsdier, 2001). The Santhals of West Bengal were highly ectomorphic and less endomorphic, (Malik and Prakash, 1989). Besides, somatotype studies were also conducted on Bods of the Western Himalayas (Malik and Singh, 1978; Malik, 1987; Pandey and Malik, 1990); Garhwali males (Gaur and Singh, 1997); Brahmins Dogras (Singh and Bhasin, 1990); Rajputs and Brahmins of Chamba, Himachal Pradesh (Singh and Singh, 1991). Sudipta Ghosh and S.L.Malik (2004) studied the somatotypes of Brahmin and Rajput boys in Himachal Pradesh. The results showed that in Brahmins endomorphy or the "component of relative fatness" in physique demonstrates its ranges from 1.62 to 2.35 in this age range from 10 to 14 years. A gradual increment of mesomorphic component is visible in Brahmins, which ranges from 3.64 (10 years) to 5.79 (19 years) in this age range, with slight fluctuations in between. On contrary, the ectomorphic components of Rajput boys vary throughout the ages with the fact that, younger boys are more linear than those of older age groups. Though there is no statistically significant difference between these two populations groups, Rajput boys are more ectomorphic than that of Brahmins especially in lower ages, which gradually decline with the increment of age. From the above results it can be concluded that both the Brahmins and Rajputs boys of Sundarnagar are more Ectomorphic and less Endomorphic.

Amatya Diwakar Lal (1999) studied the various anthropometric measurements and somatotypes of Nepalese sprinters. In most of the event Nepalese athlete has less mesomorphic development. Amatya compared the Nepalese sprinters somatotypes (1.56-3.89-2.63) with Indian sprinters somatotypes (2-3.5-3.4). While making comparison with Indian track and field athletes, there appeared to be similarity in most of the components between two countries.

Fuste et al. (1998) studied the sample of 303 Madrid Complutense University students (100 males and 203 females), aged 21–29 years has been studied in order to establish the relationship between somatotype components and physical work performance. Since particular interest is focused on a possible sexual difference in that relationship, males and females were analyzed separately. Results prove the high correlation of test scores implying muscularity (hand grips, pulling strength) with the mesomorphic component of the somatotype, mainly in males. Variability in tests relative to physical somatotype, mainly in males. Variability in tests relative to physical fitness is mainly explained by differences in endomorphy, although regarding the step test, ectomorphy is also a factor to be taken into account in females, as well as the pulling strength in males.

Carter et al. (1997) examined the stability of somatotypes of 63 boys in Saskatoon, Canada who were followed from 7 to 16 years of age. Somatotype photos were taken annually and rated by a criterion rater (BH-R). Comparisons were made longitudinally across all years using repeated-measures ANOVAs of the whole somatotype (S), somatotype attitudinal means (SAM), analysis of categories, separate components (endomorphy, mesomorphy, ectomorphy), and partial correlations. In the first year, the means were age = 7.1 yr, height = 121.0 cm, mass = 22.8 kg, S = 2.9-3.6-1.6, and SAM = 1.1. In the last year, the means were age = 16.7 yr, height = 172.6 cm, mass = 59.9 kg, S = 2.5-4.0-3.7, and SAM = 1.4. Mean somatotypes across years were different [$F(9,558) = 67.9$, $P < .01$], with the largest differences between 7-10 yr and 14-16 yr. These differences were largely due to significant increases in mesomorphy ($F = 24.6$, $P < .01$) and ectomorphy ($F = 159.9$, $P < .01$). Partial correlations between ages for each component, with the other two held constant, revealed poor predictions for three or more years apart ($r2 < .35$). Thus, both group and individual somatotypes changed between 7 and 16 years of age. The overall pattern was from endo-mesomorph through central to mesomorph-ectomorph somatotypes. The trends are similar to those observed in comparable samples from other countries.

Ji and Ohsawa (1996) studied the somatotypes of chinish youth. Heath-Carter anthropometric somatotypes were calculated for 7,710 Chinese youths (4,434 boys and 3,276 girls), 7-18 years of age in the context of sex and age differences in distributions during adolescence. Age-specific trends are characterized by a consistent increase in endomorphy in girls and generally stable mesomorphy in boys. Somatotypes are consistently dominant in mesomorphy in boys and in endomorphy in girls across all ages. A somatotype distribution in the 13 somatotype categories of Heath-Carter somatochart appear to be broader in girls than in boys, and is more influenced by age in girls than in boys. Comparisons with other Asian samples and with Canadian youth suggest racial/ethnic variation in somatotype.

Hebbelinck (1995) conducted a study was to investigate the stability of somatotypes in Belgian children and adolescents, 52 boys and 30 girls, followed longitudinally from 6 to 17 years of age. The anthropometric Heath-Carter somatotypes, with a stature correction for endomorphy, were estimated at 1-year intervals. Mean somatotypes were most different between the earliest and oldest ages in both boys and girls. For boys, the means from 9 to 13 years and from 14 to 17 years did not differ. Means were 2-4-2½, 2½-4-4, and 2-4-4 at 6, 12, and 17 years, respectively. The scatter of somatotypes about their means was smallest at 6-8 years and greatest at 11-13 years in both boys and girls ($P < 0.05$). For girls, the mean somatotypes from 8 or 9 years through adolescence were not different, although they tended to become more meso-endomorphic. Means were 2-4½-2½, 3-4-3½, and 3½-3½-3 at 6, 12, and 17 years, respectively. The average migratory distance for boys was 6.4 (range = 3.7-12.9) and 7.8 (3.9-21.8) for girls. Many subjects had changes that were three to four times greater than others. Boys were lower in ectomorphy at 6-8 years than at older ages, while girls were higher in mesomorphy at 6 than at 12-17 years ($P < .05$). Interage partial correlations for each component were highest (r2 .49) between adjacent years, but were poor to moderate as time intervals increased. The findings of this longitudinal study confirm and further define the instability of somatotypes previously observed in cross-sectional studies of Belgian children and adolescents.

Sodhi, J.M. (1985) studied the Indian athlete's body types. His result shows that sprinters have 2-3.5-3.4, long distance runners with 1.6-3.3-3.8 and marathon runners with 1.8-3.3-3.8. Polat et al (2010) studied the somatotypes of volunteer subjects at the age of 16. In this study the highest ectomorph value (2.13-3.16-3.58) was achieved from individual who engaged in fitness programme

Ellis et al. (1975) carried out field test on standing broad jump, flexed arm hang and bent knee sit ups performance of 106 boys tested annually from 10 through 16 years. The results indicated that there was a significant increase in performance for all three physical performance tests over the seven year test period. Trend analysis using orthogonal polynomials revealed significant linear and quadratic components in the standing broad jump and flexed arm hang growth curves with only the linear component significant in the sit ups growth curve. The largest percentage increase occurred between 14 and 15 years for standing broad jump and between 11 and 12 years for flexed arm hang and bent knee sit ups. The maximum increment in performance for the standing broad jump and flexed arm hang was evidenced during the occurrence of peak height velocity; for bent knee sit ups, one year prior to peak height velocity. The inter-correlations among the three physical performance tests revealed a high degree of specificity of individual differences. From year to year the stability of individual differences was high within each of the three physical performance tests (average r=.810) but low over the total six year interval (average r=.427). Subgroups selected from the main sample on the basis of strength/weight and skinfolds differed in all three tests (with the high and low groups respectively being superior). Early maturers were superior to late maturers in standing broad jump performance only while ectomorphs were superior to mesomorphs on flexed arm hang performance only.

Larson (1974,92) developed the performance related ICPPT test batteries includes, running speed measured by using 50 m dash, coordination measured by plate tapping test and cardio-respiratory endurance measured by 600-800-1000-1500-2000 m run for school boys. He also found some findings from Simon et al. (1969) study, which showed inter correlation between the battery tests. Static strength (Hand grip) is positively correlated with height and body mass. Tests of muscular endurance and power negatively correlated with height and weight.

De Garay et al. (1974) analysed the differences in somatotype components in six track events (sprints, 400 m, middle distance, long distance, marathon and walking) and in five field events (shot-put, discus, hammer, javelin, decathlon and pole-vault jumping). With respect to the track analysis sprinters were more endomorphic and mesomorphic than those in other events except walking. In field events shot put, discus and hammer throwers were more endo-mesomorphic and less ectomorphic than other events.

Singh and Meenakshi (1969) investigated some anthropometric measurements in south Indian boys. Two hundred fifty five (255) healthy school boys between the ages of 6 and 16 years have been analyzed. The subjects were from a lower middle socio-economic group of an urban population. The following result was found from the survey (based on Nutrition research Laboratories, 1968).

Wear and Miller (1962) studied the relationship of physique and developmental level, as determined by the Wetzel grid, to performance in fitness tests of junior high school boys. They found subjects who were medium in physique and normal in development to be the best performers, and the subjects of heavy physique to be the poorest in performance.

Somatotype ratings and anthropometric measurements were studied by Hebbelink and Postma (1963) as to their relationship to performances on motor fitness tests. Generally, in such performances the correlation between body measurements and motor performances were low. The subjects classified as mesomorphs were superior in all motor fitness tests except the 60 yard dash, and the ecto-mesomorph excelled, the endomorph except in the shot-put event.

Reviews Related to Motor Fitness Variables

Strength is believed to be a major factor in most motor performances. It is not important enough by itself to be predictive for success in many activities. Numerous studies have indicated that strength can be increased by isometric exercises. Many researchers reported that isotonic weight training increased strength and improved speed of movement. As a result of such findings, athletes in particularly all sports now use weight training as a valuable adjunct to their sports practice (Barry L. Johnson, 1988, 115-116).

Concerning the value of strength programme, increased the movement time and reaction time. Studies by different authors compared isometric and isotonic training programmes and found them to be nearly equal insofar as bringing about increases in speed of movement. In recent studies by Whitney and Smith, it was concluded that regardless of the type of strengthening exercises used, increasing the strength of the muscles involved in the particular task makes it possible to execute the movement faster (Barry L. Johnson, 1988, 115-116).

Barry (1988) concluded that strong muscles do not necessarily indicate better performances. Since dynamic training was found to be effective in improving athletic power performance, it was theorized that static training might equally be as effective. Numerous studies were concerned with the relationship of strength and speed to power. The results of such studies were listed as follows. Two studies found static strength and dynamic strength significantly related to leg power, thus indicatining strength as important variable in power measurements. Several studies indicated that speed was significantly related to power and it was more important than strength in athletic performance (Barry L. Johnson, 1988, 212).

Tharp et al. (1985) found a correlation of r= -0.69 between the WAnT for peak anaerobic power relative to body weight and the 50 yard dash in 56 male participants in a junior (aged 10 to 15 years) track and field programme. They also found a correlation of r=0.70 with peak power on the WAnT and the vertical jump. They also found a correlation of r=0.69 between the WAnT for peak power and the standing long jump. Costill et al. (1968) also found significant correlation (r= -0.625) between the vertical jump and 40 m dash. So the researcher concluded that these commonly accepted field tests, sergeant vertical jump, standing broad jump and 50 m dash were used to measure the sprint related ability without laboratory setting.

Kaczkowski et al. (1982) examined the relationship between muscle fiber composition and maximal anaerobic power and capacity. The correlation between percentage of type II fibers and peak anaerobic power (Wingate anaerobic power test) was found to be r=0.59. A correlation of r=0.91 was found between the peak anaerobic power and 50 m dash.

Strength and power are related. It has been shown that stronger subjects generally produce a greater maximum power output. Data shows that athletes with high leg and hip strength produce a high power output in the vertical jump. In other word, the athlete with higher 1 RM in the squat will more than likely have a higher vertical jump which typically measures explosive power (Weiss and Relyea, 1997).

Komi et al. (1977) studied the relationship between the muscle fiber composition and isometric leg strength. They found maximal isometric force of leg extensor muscles, vertical velocity in running upstairs and percentage of type II fibers in 89 athletes and 31 control subjects. The results showed that the isometric leg force correlated positively (r=0.38, p<0.001) with the percentage of type II fibers in m.vastus lateralis. The vertical velocity correlated positively (r=0.37, p<0.001) with the percentage of type II fibers in m.vastus lateralis samples obtained from all the male athletes.

Micheal (1963) found that isometric training increased both speed of movement and reaction time significantly. Several studies have indicated that individuals with greater muscular strength usually have greater muscular endurance.

Flexibility can be improved through training. Numerous independent studies reveal significant result of regular training. Flexibility training procedures involving static stretch and ballistic stretch methods have been studied with significant gains reported for each. Although no significant difference was found between the two methods. However, physical educators and athletic trainers have favored the static stretch method, claiming less chance for muscle tears and strains (Barry L. Johnson, 1988, 90-91).

Concerning the effects of physical education activities and sports on flexibility, the following findings have been reported; gymnastics and tumbling activities brought significant increases in flexibility for selected body parts. General physical education activities were superior to weight training and isometric training for increasing flexibility, but weight training did not decrease flexibility performance. Thus it can be seen that the human body responds in terms of increasing its flexion and extension as a result of the demands that certain sports, exercises and activities place upon it (Barry L. Johnson, 1988, 90-91).

2.3 Reviews Related to Somatotypes and Track & Field Performance

The ability to move rapidly has been an integral part of many athletes becoming highly successful in their respective sport. The athlete who is able to sprint faster, throw a ball faster and further, or jump longer and higher will have a distinct advantage over their fellow competitors. In athletics, sprinting is often used as a predictor of power and athletic potential (Nesser et al., 1996). Therefore, coaches and researchers have continually strived to find reliable tests that will not only measure power output but predict sprint speed potential in athletes.

Singh et al. (2010) studied the anthropometric measurements, body composition and somatotypes of high jumpers in India. Twenty (20) male University level high jumpers (10 high performers and 10 low performers) were assessed for the study during the all India inter University athletic meet held at Manonmaniam Sundaranar

University, Tirunelveli. The age of athletes ranged between 18 and 25 years. The result showed that in most of the anthropometric parameters, percentage of fat and somatotypes differed between low performer and high performers in high jump. The study concluded that the high performer and low performer high jumpers have the percentage of body fat 12.56 and 13.55 respectively ($p<0.05$). It also concluded that the somatotypes of high performer high jumpers was 2.29-2.76-3.95, which means high performer high jumpers falls in balanced ectomorph. And the low performer high jumpers somatotype was 2.56-1.56-4.38, which means they fall in endomorphy ectomorphy.

Malina et al. (2010) compared the two sexes and two age groups of 11-13 years and 14-15 years on speed, power and strength. The result shows that the total samples of males perform better than females on all parameters. Results varied for general athletics, the magnitude of sex differences was similar for strength in both age groups, greater for the throw at 11-13 years and greater for the jump and sprint at 14-15 years.

Swisher and Anna Meisinger (2009) conducted the study to identify the anthropometric, strength and power parameters that best predict throwing performances. He applied the linear regression to predict the shot put and weight throw performances through performance of anthropometric, strength and power characteristics. Both shot put and weight throw performances was correlated strongly with measures of explosive strength and power ($r=0.48-0.78$). The best predictors of performance were static vertical jumps and 7.26 kg shot over head throw; better thrower possess greater explosive strength and power.

Terzis et al. (July 2008) investigated the effect of short term resistance training and detraining on shot-put performance. For this purpose eleven (11) healthy young subjects with basic shot put skills were involved in the 14 weeks of resistance training, and 4 weeks detraining programme. The results indicated that, 1- RM strength was increased 22-34 % due to training but it was not significantly reduced due to detraining. The shot put performance increased 6-12 % ($p<0.05$) after training and remained unaltered after detraining.

It would then seem logical that greater power output shown through this test would correlate to better sprint performance. A study performed by Nesser et al. (1996)

examined several physiological tests in relation to 40-meter sprint performance. The results indicated a moderate negative (r = -0.464) correlation between vertical jump performance and 40-meter sprint speed. Theory related to the research studies.

Tanner (1964) studied 137 elite male track and field athletes prior to the 23rd Olympic Games in Rome in 1960. The researchers took 14 anthropometric measurements and determined athletes somatotypes. There were marked differences in somatotypes between competitors in different events. Sprinters were relatively short, with shorter leg and larger muscles than those of other runners. The 110 meter hurdles were taller and had longer legs than the sprint groups. The 400 m men were described as large, long legged, broad shouldered and fairly heavily muscled. The 400 m hurdler closely resembled 400 m flat runners, though were more slender. Distance runners were small, short legged, narrow shouldered, and relatively lacking in muscles compared to other track and field athletes. High jumpers were tall, about 6 feet and had the longest legs relative to trunk length than other athletes. The throwers were great in physique and differ from other athletes. As a group, the athletes were taller, heavier, had large muscles, long arms, and were fatter than the track athletes.

Morrow et al. (1982) evaluated anthropometric, strength and performance data for 49 American discus, hammer, javelin throwers and shot putters who participated in a pre-Olympic training camp. Results indicated significant differences in anthropometric and strength variables between event participants, with similar performance on motor performance variables. Strength correlated positively with performance of discus throwers. Fat weight correlated negatively with hammer performances. Leg strength, vertical jump and long jump correlated positively with shot put performance. For javelin throwers none of the variables was significantly related to performance.

Hellebrandt et al. (1961) studied the growth and development of horizontal jumping using the standing long jump. Their research indicated that level of performance is related to variety of factors such as height, weight and fitness.

2.4 Reviews Related to Anaerobic Training

Peyman Jamedar (2010) done a study was to determine whether there is a relationship between leg strength measured by 1RM squat test and the speed measured by 10, 20, 40, 60, and 100 meter sprint tests among female high school athletes. Of the 29 athletes that were recruited, 12 subjects completed both testing protocols. First testing protocol was 1RM squat test (P1) and the second testing protocol was the sprint test (P2). For the squat test (P1), the number of repetitions performed by participants within 3-12 repetition range was recorded as the percentage of 1RM according to the chart provided the National strength and conditioning association (2000). Sprint test (P2) was performed as an all-out 100 meter race and times were measured at 5 distances (10, 20, 40, 60 and 100 meters). A statistical analysis was performed by Pearson's product moment correlation coefficient established at ($r = \pm 1.0$) and ($p = 0.05$) to evaluate the correlation between 1RM squat test and 10, 20, 40, 60 and 100 meter sprint test. Although no significant correlation between estimated 1RM squat and any of the distances in sprint test were found, the correlations of the squat test and 4 of the sprint times were positive. Also, there was a significant positive correlation among all the components of the sprint test. In conclusion, leg strength did not have a significant impact on the speed of the participants. Further studies should focus on the correlation of strength and speed as well as the effects of strength training on improvement of sprint performance among young female athletes.

Sprint training or anaerobic training were specified to improve the muscle adaptation to the motor tendon units, which attributed to the stretch-shortening cycle of running and jumping. Kotzamanidis (2003) investigated the effect of sprint training upon the running velocity of pre-pubescent boys. There were two groups of 15 students acted as an experimental (11.1±0.5yrs old) group and control group (10.9±0.7yrs old). Fifteen boys followed a specific sprint programme for ten weeks (SPR group) and another group of fifteen boys followed the normal physical education programme. The sprint training programme consisted of short sprints from 5-30m with a resting interval of 3min between repetitions and 5min between sets. The total running distance was initially 150m and gradually increased to 300m. After the ten week sprint programme, the running velocity and the height of squat jumps in the SPR group increased significantly. This programme had a specific effect on the intermediary phases of the running performance; the velocity was increased for the distances 0-10m and 10-20m, but not for the distance 20-30m. The control group did not increase any of the tested parameters. These results indicate that the applied sprint training could increase the velocity of the acceleration phase, but not the phase of maximal velocity.

Kukols et al. (1999) conducted a study to examine relations between sprinting performance and some standard anthropometric, strength, and power tests. The obtained results demonstrated that, except for the height of the counter movement jump, all correlation coefficients between the selected variables and sprinting performance were low and, therefore, insignificant. As a consequence, multiple correlation coefficients were also low (0.43 and 0.56 for the initial acceleration and maximal speed phase, respectively).Finally they concluded that most of the standard anthropometric, strength and power tests could be poor predictors of sprinting performance. A better assessment of sprinting performance could be based on more specific tests that, unfortunately, require more complex measurements.

Baxter-Jones and Helms (1996) analysed the result found from a longitudinal study following the growth and development of young British athletes. Four sports were studied: gymnastics, soccer, swimming, and tennis. Four main areas of concern were identified and studied: sports injury, growth and development, psychological and psychosocial problems, and physiological functioning. No evidence was found to suggest that training affected growth or sexual development. The incidence and severity of injuries was low. Athletes were shown to have a healthy lifestyle. The negative effects of intensive training at a young age were outweighed by the many social, psychological and health benefits that a serious commitment to sport brought these young people.

Hakkinen, Mero and Kauhanen (1989) studied the specificity of endurance, sprint and strength training on physical performance capacity in young athletes Three prepubescent athlete groups of endurance runners (E; n = 4), sprinters (S; n = 4) and weightlifters (WL; n = 4) and one control group (C; n = 6) as well as one junior but post pubescent weightlifter group (JWL; n = 6) volunteered as subjects and they were tested during a 1 year follow-up period. The prepubescent E-group had higher ($p<0.05$)

V̇O2max (66.5 ± 2.9 ml x kg1 x min-1) already at the beginning of the study than the other three groups. The prepubescent WL-group demonstrated greater ($p<0.05$) maximal muscular strength than the E-group and the WL-group increased its strength greatly by 21.4% ($p<0.05$) during the follow-up. No significant differences were observed in physical performance capacity between the prepubescent WL- and S-group. Both groups demonstrated a slightly (ns.) better force-time curve recorded from the leg extensor muscles than the E-group and significant ($p<0.05$) increases occurred in these two groups in dynamic explosive performance during the follow-up. The post pubescent JWL-group demonstrated much greater ($p<0.001$) muscular mass and maximal strength than the prepubescent groups. No significant changes occurred in explosive types of performances in these athletes but significant ($p<0.05$) increase took place in the maximal neural activation and strength of the leg extensor muscles during the 1 year. The increase of 5.2% in maximal strength was, however, much smaller ($p<0.05$) than the corresponding increase of 21.4% in the prepubescent WL-group. The present findings demonstrate that already among prepubescent athletes' specific effects of endurance as well as strength training on physical performance capacity were rather clearly observable, while effects of sprint training did not differ very much from those of strength training. Among junior but post pubescent weightlifters typical specific effects of heavy resistance strength training on the neuromuscular system were clearly observable and comparable to those adaptations reported to take place among adult strength athletes.

Running speed over short distance appears to be fundamental to success in field and court sports (Baker & Nance, 1999). Many sports activities comprise of explosive sprint movements such as forward and backward shuffles at different intensities and sustained forceful muscle contractions (Mero, Komi & Gregor, 1992). The ultimate explosive short-distance running is manifested in sprinting events performed in the Olympics and college or high school track and field meets. Nature of sprinting requires high force production (Mero et al., 1992) and relies on anaerobic performance which is crucial in sports consisting of power and muscle capacity utilizing the phosphagen system (Bouchard, Taylor, Simanneau & Dulac, 1991). Muscular strength is another factor that is generally thought to have a great influence on athletic performance. In particular, explosive strength (power) has been accepted as a crucial component of anaerobic sprint performance (Dowson, Nevill, Lakomey & Hazeldine, 1998). Dowson et al., (1998) noted that the magnitude of force generated during dynamic muscle contraction is related to amount of speed an athlete can produce during a sprint performance. Arslan (2005) also believes that explosive leg strength is significantly correlated with anaerobic performance required for sprinting. The relationship between strength and power and running speed are of considerable interest to researchers and coaches attempting to identify possible mechanisms of performance enhancement (Baker et al., 1999).

Bernasconi et al. (1995) reported that running training of either type at aerobic work loads had no effect on the co-ordination between running and breathing rhythms. At anaerobic intensities, however, the degree of co-ordination between running and breathing rhythms was higher in the endurance trained athletes than in the sprinters or in the untrained subjects. The degree of co-ordination increased with increasing regularity of breathing. The ability to increase intentionally the degree of co-ordination by paced breathing was independent of running training and was lowest at anaerobic exercise intensities.

Muscular strength and anaerobic power are important factors in generating muscular contraction in short-term high-intensity activity such as sprint (Kin-Isler et al. 2008). Explosive muscular contractions are crucial components of sprint speed for track athletes (Alexander, 1989). Increasing the available force for muscular contraction in appropriate muscle groups may improve acceleration and speed necessary for sprint performance (Cometti et al., 2001). The relationship between force-generating capacity of the muscles and sprint ability has been shown in a number of studies (Alexander, 1989, Dowson et al, 1998, Baker et al, 1999 & Newman et al, 2004).

A study of healthy untrained men found that interval running exercise was *more* effective than sustained running of similar total duration (∼150 $\text{min}\cdot\text{wk}^{-1}$) in improving cardio respiratory fitness and blood glucose concentrations but *less* effective in improving resting HR, body composition, and total cholesterol/HDL ratio.

A review of related studies of aerobic and anaerobic training on muscular strength showed that mean strength increased approximately 40% in “untrained,” 20%

in “moderately trained,” 16% in “trained,” 10% in “advanced,” and 2% in “elite” participants over periods ranging from four weeks to two years.

Hesson and James Loren (1980) conducted the study to compare strength, body dimensions and body composition responses of selected somatotypes to a strength training programme. The three components in somatotypes subjects divided into three groups and underwent same strength training for 10 weeks. The result shows that changes in strength, dimensions and body composition are same for all body types when engaging in the same strength development programme.

Kerlinger and Lee (1999), authors of a highly respected text on research `methodology noted that “the basic purpose of the scientific research theory. Thus identifying a conceptual frame work for a research study typically involves immersing itself in the research and theoretical literature of the field (Kjelltrick and Fudestam, 2007).

Thus although the ideal body size and composition profile for optimal performance in a specific sports as well as an individual within a sport cannot be precisely estimated, using the characteristics of superior athletes for a specific sports may allow guarded inferences about the optimal body weight and composition required for elite performance (William, 2000).

2.5 Summary of Literatures

From the reported literatures, many publications related to the prediction of track and field performances with mathematical and statistical models. There has been some confusion as to what the track and field performance data provide and what the prediction models show. A review of the prediction models in literature leads us to believe that there is no prediction model available to accurately predict the future magnitude of any performance in track and field (Liu 2002, Liu and Schutz 1998).

The talent includes the following “the ability to display exceptionally high performance in a domain that requires skills and training and an innate abilities and aptitude. However, the belief that talent is innate implies that it is predetermined and relatively stable, that the course of its development cannot be altered, and that environment plays a negligible role. The individuals who lack innate precursors will never excel. A youth talent potential is not a stable innate trait but rather is constantly transforming during the maturation process.

In United States and western countries, five commonly used field test were standing long jump, vertical jump, standing triple jump, shot-put backward throw and 50 m dash for predictors of track and field performance.

Research evidence supports that fundamental motor abilities are essential to supporting success; it does not appear that children are currently being provided with appropriate movement experiences. Unfortunately the monitoring of fundamental motor abilities within talent identification programmes, will likely to those individuals who had relevant experiences being selected as opposed to children with talent potential. Therefore talent deduction or identification schemes need to be proceeded by fundamental motor abilities programme that is available to all (Academic Review).

Fundamental motor abilities are seen as essential precursors to excellence in sport (Moore et al., 1998; Jess et al., 1998). In a survey of elite English sports performers, Moore et al., identified that coaches believed that unless a child had developed the fundamental movements skills required within an activity by twelve or thirteen, success within that activity would be beyond reach.

Anaerobic training involves the several means or motor abilities, such as strength, speed, and endurance, over the same period, with the intention of producing multi-faceted development of physical fitness. From the above summary of literature clearly indicates the need of talent identification and development programme at younger age.