# THE INTERRELATIONSHIP OF PHYSICAL FITNESS, SOMATOTYPE, BODY CATHEXIS AND PERSONALITY IN A GROUP OF WHITE SCHOOLBOYS

BY

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# DECLARATION

This is to declare that the thesis entitled "The Interrelationship of Physical Fitness, Somatotype, Body Cathexis and Personality in a Group of White Schoolboys" is my own work.

..........F.R. Fieldsend..........

Date : ....1/12/1980.......

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# D E D I C A T I O N

To my Parents

## ABSTRACT

The evaluation of physical fitness is dependent upon the body and its capacity to generate requisite degrees of strength, speed, mobility and endurance, for effective physical performance.

The physical properties of the body, and in particular the degree of muscularity and adiposity, are affected substantially by varying levels of physical fitness.

This degree of muscularity and adiposity is closely related to the shape or physique of the body, which in turn, can influence the attitudes an individual adopts toward his body and himself (body cathexis).

The purpose of this study was to investigate the reciprocal relationship between physical fitness, somatotype (physique) and body cathexis (satisfaction). A secondary objective was to examine the relationship between these variables and personality.

The subjects who participated in this study were white schoolboys completing Standard Eight. Seventy seven subjects, all of whom were either 14 or 15 years of age, were studied. A total of 22 observations were made on each subject, which

included a battery of physical fitness tests, anthropometric and somatotypological observations, and two questionnaires.

Fleishman's Basic Fitness Test battery, which was slightly modified, was utilized to evaluate the subjects' level of physical fitness. Standardized anthropometric techniques and equipment were used to measure heights, mass, diameters, girths, and skinfolds. These basic anthropometric observations were then utilized to determine the subjects' Heath-Carter somatotype rating, absolute and relative body fat, and lean body mass. Body cathexis was measured by the Secord-Jourard Body Cathexis Scale and personality was assessed by the Howarth Personality Questionnaire.

The results indicated that physical fitness performance on the events which required the body mass to be displaced were highly and negatively related to the degree of excess adipose tissue. Significant differences in endomorphy ($p < 0,005$) were apparent in high and low fit groups, but no somatotypological differences were indicated for those events which did not involve the displacement of the body mass. The one exception to this was a static strength event, in which significant somatotypological differences between high and low fit groups were indicated for mesomorphy ($p < 0,005$) and ectomorphy ($p < 0,01$).

Body cathexis was not closely related to physical fitness, somatotype, or personality. A number of weak relationships were apparent: there was a negative correlation between body cathexis and the personality trait of inferiority; high levels of adipose tissue negatively influenced the level of body cathexis; and good performance on the strength events was positively associated with body cathexis. In the physical fitness events requiring strength and the body mass to be displaced, the body cathexis levels of high fit subjects exceeded that of low fit subjects at a statistically significant level ($p < 0,005$). No significant differences in body cathexis were indicated for those events which did not require the displacement of the body mass.

Personality was not related to physical fitness, somatotype or body cathexis. The only relationship that was discerned was the low correlation between inferiority and body cathexis.

The findings of this investigation suggest that, in this context, dynamic physical fitness performance, is closely related to physique; and in particular a high endomorphic content is a limiting factor. Body cathexis is not closely related to physical fitness, somatotype or personality. It is likely, however, that feelings of inferiority and excess adipose tissue are associated with a low body cathexis, while strength is related to a high body cathexis. Personality is not related to physical fitness, physique or body cathexis.

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# CHAPTER 1

# STATEMENT OF THE PROBLEM

## 1.1 INTRODUCTION

In a modern world which faces the problems of overpopulation, increased automation, technical expertise and mechanization, which in turn lead to pollution, underemployment and an upsurge in cardiac disorders, there has been a marked trend toward the appreciation and value of physical fitness. In the past man has relied on physical activity and energy to keep himself alive. The law of nature determined whether or not man possessed a functional level of physical fitness. If he did not, he was unable to hunt for food and defend himself and so he perished. Today the laws appear to be less harsh and man can survive with considerably lower levels of physical fitness. If climbing a flight of stairs leads to wheezing and palpitations of the heart, one can simply use the escalator, if walking to work in the mornings means tiredness and fatigue, one can simply drive the car - and so it goes on. Yet the lifestyle of today is, in many ways, harsher than that of our ancestors:

> We live in a highly mechanized society. Life in such a society requires much less physical exertion than that demanded by our ancestors in primitive times. As a result of inactivity our bodies are threatened by earlier deterioration. Research has linked inactivity with

> increased incidence and morbidity from coronary disease. It has also shown that regular exercise aids in the promotion and maintenance of health and well being.
>
> The Physical Exercise Committee of the Tennessee Heart Association. (1972 P.1.)

For centuries, humans have been vaguely aware that exercise and fitness are important to their well being. Tragically, many people have simply accepted early ageing and physical deterioration as the inevitable cost of technological progress. Recently science has begun to document the nature and extent of the relationship between exercise and health. Raab and Kraus (1961) describe a wide variety of human disorders that occur more often among sedentary people than among the physically active. Some of the hypokinetic (pertaining to insufficient movement) disorders they identify include chronic fatigue, shortness of breath, overweight, digestive upsets, headache, backache, anxiety states, muscular weakness and atrophy, musculoskeletal (muscle, bone, joint, ligament, tendon) pain and injuries, high blood pressure, atherosclerosis, coronary artery disease, and generalized, accelerated degenerative ageing. Paffenbarger and Hale (1972) have reported that vigorous physical exercise, as defined by an apparent threshold or critical level of energy output, is associated with reduced risk of coronary mortality, particularly the "sudden death syndrome". Physical fitness is more a means than an end, for it enables the organism to use its physical abilities to capitalise on its emotional, intellectual and social attributes and to achieve "total fitness". In summary it can be said that an unfortunate "by product" of the technological advances of the twentieth century has been the instigation and perpetuation of a sedentary society. Unlike our ancestors, who were forced to labour to heat their homes, collect water, gather food and defend themselves, most people today get far too little exercise; so that, although infectious diseases have largely been conquered, we are being killed by life styles and attitudes that admit little time for exercise.

The evaluation of physical fitness is dependent upon the body and its capacity to generate requisite degrees of strength, speed, mobility and endurance for effective physical performance. An assumption that few researchers dispute is that physical fitness is considered a most desirable quality to possess. There are, however, disputes concerning the manner in which physical fitness is most effectively evaluated. In particular, differences of opinion exist regarding the relative merits of fitness test batteries, and maximum oxygen intake as a means of assessing physical fitness.

The physcial properties of the body, and in particular the degree of muscularity and adiposity, are affected substantially by varying levels of physical fitness. Previous investigators have shown high levels of physical fitness and sporting performance to be closely related to the physique of the body. Insofar as the body must be used as a vehicle for attaining physical fitness, and recognizing the fact that the physique of the body (muscularity and adiposity) may be affected by differing levels of physical fitness, this study was undertaken to gain insight into this relationship.

The physique or appearance of the body can influence the attitudes an individual adopts toward his body. His body is a perceptual object from which he cannot escape, and being an inevitable accompaniment of his awareness it has great influence on him. Attitudes about its size, strength, attractiveness, cleanliness, agility, musculinity, femininity and other parameters can be of importance in affecting an individual's feelings toward his body. Everything he believes about the structure, limits and capabilities of his body can influence his perception and degree of satisfaction felt for his body. (Jourard 1963). Since physique refers to bodily shape or structure, it may well be an important determinant in the degree of satisfaction or dissatisfaction which an individual has toward his body. The relationship between body type and the degree of satisfaction with the body has received surprisingly little attention in the past, and considerable paucity of empirical data exists in this field.

5/Furthermore the ....

Furthermore the relationship between physical fitness and the satisfaction felt for the body has received even less attention. As physical fitness is associated with a healthy existence, it might be that the physically fitter one is the more satisfied one is with one's body. This study was undertaken in an effort to illuminate the interrelationships between satisfaction with the body, body type and physical fitness.

Through many centuries the belief has been held that body build reflects innate temperament and is thus an important aspect of personality. Although research has indicated that the relationship is not as strong as was initially believed, it is generally accepted that there is a link between body build and personality.

The attitudes an individual adopts toward his body are likely to be closely associated with his total personality structure. It is possible that satisfaction with one's body is closely related to specific personality traits. Very little research has been conducted in this area and clarification is needed.

Finally, it has often been claimed that physical fitness and sports experiences are of psychological benefit to the individual, and are conducive to the development of desirable personality traits. Considerable controversy exists in this area and clarity is required before conclusions can be drawn. It was hoped that this study would elucidate the interrelationships between personality, physical fitness, body build and the satisfaction felt for the body.

Since physical fitness is directly related to the performance capacities of the body, and physique to the physical appearance of the body (which in turn, might affect the degree of satisfaction or dissatisfaction with the body), it appears surprising that investigators have not tried to tease out the interrelationships between these variables.

## 1.2 STATEMENT OF THE PROBLEM

The main problem was to determine the relationship between physical fitness, body type and the degree of satisfaction felt for the body, amongst a group of boys 14 through 15 years of age. A secondary problem was to examine the relationship between personality and the aforementioned variables.

In order to achieve these objectives a number of sub problems of equal importance were identified. These sub problems involved selecting the most suitable, scientific and valid methods of evaluating :

1) the levels of physical fitness amongst these boys;
2) their body builds;
3) the degree of satisfaction or dissatisfaction they showed toward their bodies; and
4) their personality traits.

The achievement of these objectives would enable the examination of the reciprocal relationship between physical fitness, physique and the satisfaction felt for the body. Additionally the relationship between these variables and personality could be studied.

## 1.3 GENERAL HYPOTHESIS

It was hypothesized that a close relationship between the variables physical fitness, physique and satisfaction for the body would be discerned.

The first step in solving the aforementioned problem and sub problems is to locate and examine related studies which have been undertaken previously, in this area. An examination of these studies will allow a critical evaluation of the methods utilized, and of the relationships that have been discovered.

# CHAPTER 2

# REVIEW OF RELATED LITERATURE

## 2.1 PHYSICAL FITNESS

### 2.1.1 Introduction

Hardly a day goes by without a reference to physical fitness. The medical profession frequently states that obesity is our most common disease and that we suffer from a softness brought about by our highly mechanized lives (De Vries 1974). Throughout the history of human civilization man's capacity for physical activity has been of the utmost importance. Early man depended on physical fitness to hunt and defend himself from the hostile elements of the environment. There can be little doubt that man is "constructed" for physical activity and that regular exercise is essential for optimal functioning and health. Mechanical implements and devices, which have taken over tasks earlier performed by human power, have critically reduced physical activity levels. Regular physical activity results in a physical condition and degree of fitness that are well above that required for the routine job. A well trained individual has a broad margin of safety between his maximal power or capacity on the one hand, and what is being demanded of him physically on the other. (Astrand and Rodahl 1970).

The term "physical fitness" is often used, and yet its precise meaning is still ambiguous and obscure. There appears to be no universally accepted single definition of the term and it is impossible to find a definition which will satisfy everyone. The only real consensus of opinion is that it is considered a most desirable quality to possess. There is a necessity to distinguish between the terms health, total fitness, and physical fitness.

### 2.1.2 Total Fitness

Mathews (1958), in an analysis of all the definitions of physical fitness, found that the term "fitness" was most generally interpreted in its broadest concept, that of total fitness. Total fitness can be considered to be synonymous with health, and like health, eludes precise definition. Common to the definitions of both is the concept of an "optimal" quality or a "state of well being". While it is impossible to pin down the exact components of total fitness, many authors have emphasized the aspects of emotional, mental, social and physical fitness. Larson's (1973) definition of "fitness" epitomizes this approach :

> Total health results from a balance of mental, physical, social and emotional components of the human organism. There

> is some evidence demonstrating that exercise adds to mental health by promoting a sense of well being, by making one more alert and better able to withstand physical and mental stresses, by promoting better relaxation, rest and sleeping habits and by serving as a therapeutic tool for emotional release.
>
> P.1.

The interrelationship between the mind and the body is evident and a phrase from the Roman poet, Juvenal, succinctly describes this relationship:

> Mens Sana in Corpore Sana.

This translates as :

> A sound mind in a sound body

which is a famous slogan applied to physical education. The relationship between the soundness of the body and the activity of the mind is subtle and complex, but intelligence and skill can only function at the peak of their capacity when the body is healthy and strong. (Corbin *et al.*, 1970).

Total fitness, then, can be considered to be a combination of anatomical, physiological and psychological fitness. Anatomical fitness implies that the individual must possess all of the body parts essential for the performance of a task, as well as the appropriate body size and shape. Physiological fitness implies effective functioning of the appropriate physiological systems in the body for a given task. Psychological fitness requires that the individual possesses the necessary perceptions, emotional stability, motivation, intelligence and educability to accomplish a task. (Morehouse and Miller 1967).

Health and total fitness can be evaluated as equivalent concepts in that they are primarily concerned with emotional, mental, social and physical fitness for living. Physical fitness is only a part of total fitness, but it is with physical fitness that the author is primarily concerned.

2.1.3 Physical Fitness

The fundamental components of physical fitness are strength, speed, agility, power, endurance, co-ordination, balance, flexibility and body control. (De Vries 1974). An individual's physical fitness can be judged by his ability to meet these physical requirements. Little disagreement exists amongst authors who have specified the components of physical fitness. Corbin *et al* (1970) isolate factors identical to those described by De Vries, except that they split endurance into cardiovascular and muscular endurance. These factors will be present in proportions which vary from individual to individual which implies that physical fitness is specific. A marathon runner, for example, who has developed great cardiovascular endurance, would be totally unfit for a sport such as weight lifting.

The terms "physical fitness" and "motor fitness" are often used interchangeably and it is necessary to distinguish between the two terms. The President's Council on Physical Fitness and Sport, in America, contends that motor fitness subsumes both physical fitness and motor ability factors (in Baumgartner and Jackson 1975). They describe physical fitness as having three basic components :

1) muscular strength;
2) muscular endurance; and
3) circulo-respiratory endurance.

Motor fitness includes these three physical fitness factors and an additional four components :

a) muscular power;
b) agility;
c) speed; and
d) flexibility.

Clarke (1959) has identified the same basic components and is in agreement that motor fitness is a more general fitness designation than physical fitness.

He further maintains that motor fitness is a limited phase of general motor ability, with emphasis placed on the underlying elements of vigorous physical activity without including the primary elements of co-ordination and skills. The concept of motor and physical fitness are apparent in his diagram.

(Clarke 1959 P. 221)

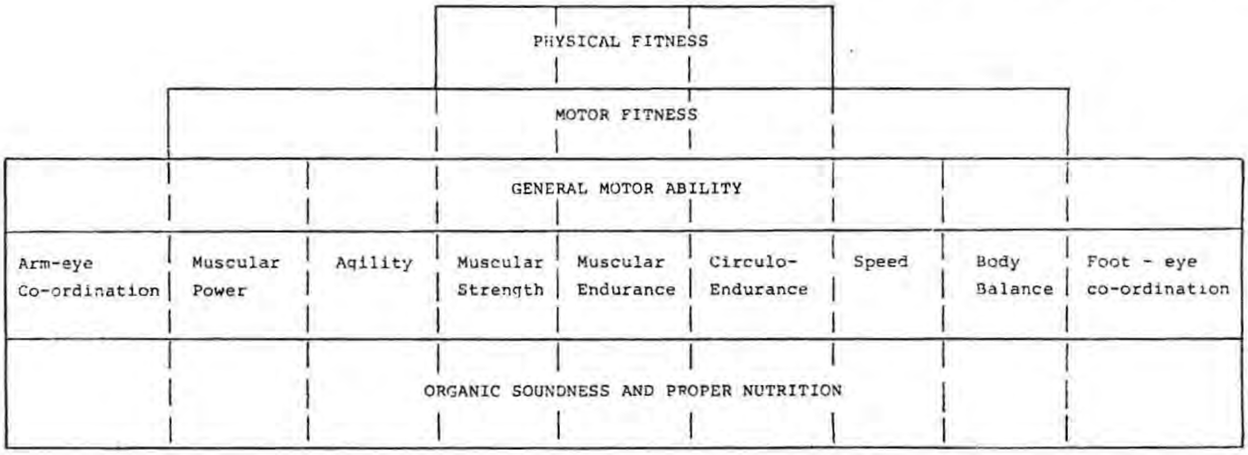


Figure 1 : Diagrammatic representation of the physical fitness components.

Once the components of motor and physical fitness have been discerned it is possible to make a distinction between basic fitness and specialized fitness. Basic fitness requires the all-round development of the major components of motor fitness, while specialized fitness involves the specific development of one or more of the major components. Basic physical fitness is a prerequisite for specialized fitness.

14/Once the components.....

Once the components of physical fitness have been specified it is necessary to consider how to evaluate them.

### 2.1.4 Evaluation of Physical Fitness

Two main approaches have been followed for the assessment of physical fitness :

1) physical fitness tests with the scoring of actual performance in situations which represent basic performance demands; and
2) studies of cardio-pulmonary function at rest and/or during exercise.

These two approaches may be broadly classified as motor fitness test batteries and the measurement of physical working capacity (p.w.c.). In the past, physical educators have stressed the importance of motor fitness components while physiologists have focussed on the physical working capacity.

### 2.1.5 Motor Fitness Test Batteries

In the past many tests have been constructed, measuring the components that were thought to comprise physical fitness. A single test could cover no more than a small part of physical fitness, and there was a need for a comprehensive battery of tests in order to cover all the components of physical fitness. A number of investigators have constructed tests measuring a specific component of physical fitness. During World War II these and other tests were assembled by the Americans, to form test batteries. These test batteries were utilized in an attempt to evaluate the fitness thought necessary for military personnel in the army, air force and navy. Every effort was made to provide tests that could be given to a large number of men in a short period of time, and would require a minimum of equipment or apparatus in their administration.

Since the initiation of these test batteries, physical educators have developed many batteries, which include such test items as running, jumping, throwing, pull ups, and push ups. The specific objective of these batteries is to measure the different components of physical fitness. A review of motor fitness test batteries may be found in Baumgartner and Jackson (1975).

While many of these test batteries were useful in evaluating basic physical fitness, relatively little scientific basis had been used in their construction. Consequently the physical fitness components that many test batteries claimed to measure, were open to doubt. During the years 1958 to 1962 Edwin Fleishman undertook a unique and extensive research programme in response to the need for specific guidance on what tests to use to evaluate an individual's physical proficiency and progress. The objectives of his research were to identify the different physical factors that need to be assessed and to develop specific test procedures which provide the best measurement of these factors.

## 2.2 FLEISHMAN'S RESEARCH

### 2.2.1 Introduction

In the inital phase of the study, Fleishman undertook research into the structure of human motor abilities in order to assess what basic motor abilities could be measured by different psychomotor tests. His results indicated that it was possible to describe motor abilities in terms of a relatively small number of broad psychomotor factors, and it was shown that these factors related to the learning of more complex skills. Further studies attempted to ascertain the structure of perceptual motor abilities, with the objective of describing certain skills in terms of more general motor ability components. These studies involved the use of a large variety of especially designed psychomotor tasks which were administered to the subjects. These psychomotor tasks included control precision, multilimb co-ordination, response orientation, reaction time, speed of arm movement, rate control, manual dexterity, finger dexterity, arm-hand steadiness, wrist-finger speed, and aiming. Using factor analysis to identify the common abilities underlying these tests, Fleishman was able to account for performance on this wide range of tasks in terms of a relatively small number of abilities. Fleishman concluded this phase of his study by stating that present evidence indicated that abilities in physical proficiency were independent of psychomotor abilities and could most usefully be considered separately. The understanding of motor skill performance, however, necessitates an understanding of many classes of motor abilities.

Fleishman then undertook a comprehensive review of the literature concerned with previous factor analytic research on the dimensions of physical fitness. The objectives of this review were :

1) to study previous and currently used fitness tests;

2) to identify the correlations found among these tests; and

3) to group them in terms of factors they were presumed to measure.

This investigation resulted in the emergence of a number of factors which appeared to fall into several broad areas of ability. These areas comprised strength, flexibility, speed, balance, co-ordination and endurance. As illustrated previously, (section 2.1.3) these comprise the fundamental components of physical fitness.

A. Strength Area

This was the most clearly defined area, and when intercorrelations among these tests were factor analysed, three broad factors repeatedly emerged. The three factors were termed explosive, dynamic and static strength and all had low correlations with each other.

(I) Explosive Strength

was identified more often than any other factor and appeared to emphasize the ability to exert maximum energy in one explosive act. Previous studies had referred to this factor as energy mobilization, power and velocity. Tests measuring this factor included vertical and broad jumps; medicine ball put; and short, dodging, and shuttle runs.

(II) Dynamic Strength

was almost as common as explosive strength and appeared to emphasize the strength of the muscles in the limbs in moving or supporting the weight of the body over a given period of time. Tests of this factor included pull ups, rope climb and dips. Some evidence for a dynamic strength factor involving the trunk muscles was also indicated.

(III) Static Strength

emphasized the ability to exert a maximum force for a brief period of time against an external object. Tests of this factor included dynamometrical tests applied to hand grip, as well as arm, back and leg muscles.

B. Flexiblity Area

Flexibility was an area that appeared to be distinct from strength. Flexibility appeared to emphasize the ability of the muscles to endure strain and distortion and to recover rapidly from this strain. Two separate factors repeatedly emerged, and were termed extent and dynamic flexibility.

20/(I) Extent Flexibility ......

(I) Extent Flexibility

emphasized the ability to move or stretch the body, as far as possible in various directions. Tests of this factor usually included the trunk or legs.

(II) Dynamic Flexibility

emphasized the ability to make repeated flexing or stretching movements. Tests of this factor included squat thrusts and deep knee bends. Many of these flexibility tests required both flexibility and speed of bodily movements and it appeared impossible to separate them. The motor fitness elements of speed, agility and muscular power (see diagram 1 in Clarke) seemed to be involved. Fleishman offered this heirarchical structure to describe the area.

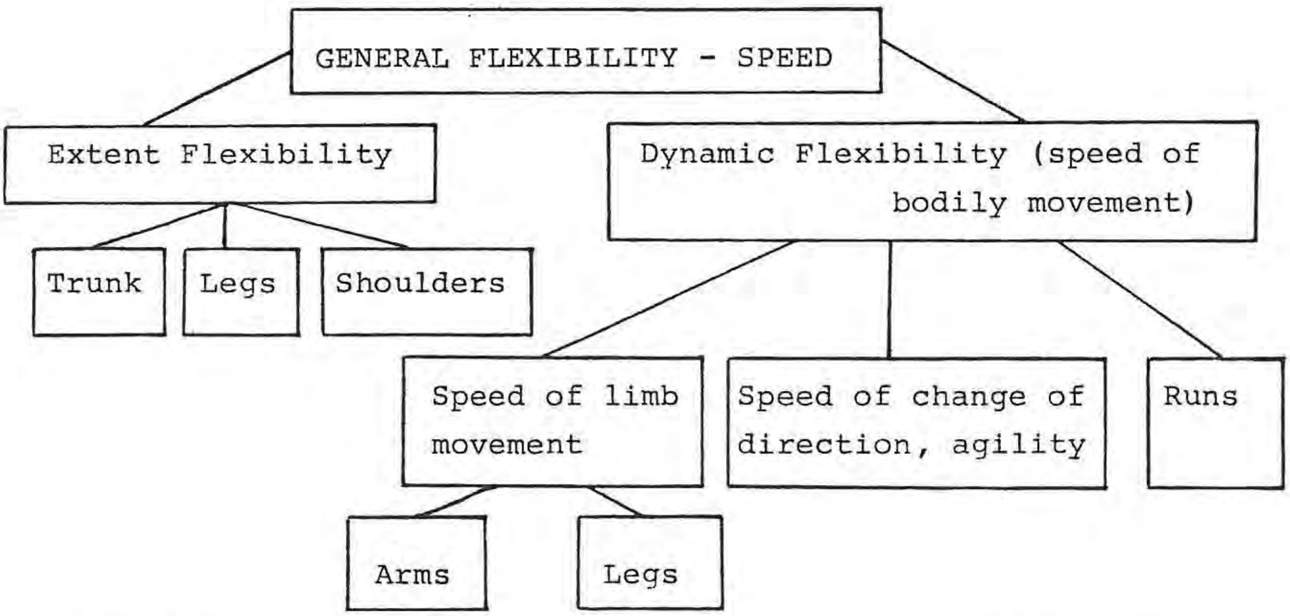


Figure 2: Diagrammatic representation of Flexibility - Speed area.

21/(III) Speed of Change of direction.....

(III) Speed of Change of direction
emphasized the ability to change direction rapidly while running. Tests of this factor included shuttle runs and dodging runs. This factor has often been referred to as agility.

(IV) Running Speed
emphasized the ability to cover a distance in as short a time as possible. Correlations with dynamic strength and endurance were found and clarification was needed.

(V) Speed of Limb movement
emphasized the ability to move the arms or legs as rapidly as possible where skill is not involved. Tests of this factor required subjects to break photo electric beams with rapid arm movements or to strike, with a stylus, two metal plates alternately.

C. Balance Area

This was not a very well defined area since relatively few studies had included balance tests. Evidence was found for a separate static and dynamic balance factor. Balancing ability also appeared to be related to whether or not the eyes were open.

22/(I) Static Balance .......

(I) <u>Static Balance</u>

emphasized the ability to maintain body equilibrium in some fixed position, and tests required the subject to stand on one foot, or on a rail.

(II) <u>Dynamic Balance</u>

emphasized the ability to maintain balance while performing some task, such as rail walking.

D. <u>Co-ordination Area</u>

Co-ordination appeared to be distinct from strength, speed, flexibility and other factors. It was suggested that there might be several types of co-ordination.

(I) <u>Multi-limb Co-ordination</u>

was common to psychomotor tasks in which the subject had to co-ordinate the simultaneous movements of two hands, two feet or hands and feet.

(II) <u>Gross body Co-ordination</u>

emphasized gross activity of the whole body such as hurdling and jumping.

23/E. Endurance Area ......

E. Endurance Area

The final physical fitness component that was identified was endurance.

A number of studies had isolated a factor labelled endurance but very often this factor became confused with :

a) muscular endurance (ie. dips, pull ups) and
b) circulo-respiratory endurance (aerobic physical working capacity).

Fleishman was of the opinion that allowance should be made for two types of endurance, both of which emphasize maximal effort over time, and resistance to fatigue. Muscular endurance would refer to skeletal muscle groups while cardio-vascular endurance would refer to prolonged exertions of the whole body, and is closely related to heart muscle capacity. This area will be fully discussed under section 2.4.1.

F. Conclusion

Once Fleishman had completed this review he was able to compile a comprehensive catalogue of tests according to the factors they seemed to measure. The conclusion he drew from this literature review was that many commonly used test batteries did not cover the range of possible fitness factors, and many of the tests which were used, overlapped with one another in the factors measured. Fleishman was now able to begin forming a motor fitness test battery devoid of previous pitfalls and false claims.

### 2.2.2 The Penultimate Stage of Research

In order to whittle down the number of individual test items into a workable test battery, considerable pre-testing of more than 100 tests was undertaken. The objective was to provide better measures of the fitness factors hypothesized from the literature review. The most reliable tests from these pre-tests were included with more familiar tests, in two large scale studies with United States Navy recruits. Testing teams were established at the Great Lakes Naval Training Centre, Illinois, and at the San Diego Naval Training Centre, California. At Great Lakes, 30 tests designed to measure different factors in the area of strength and endurance were administered; at San Diego, 30 tests in the area of flexibility, balance, speed and co-ordination were administered. Correlations among all these tests were obtained and subjected to factor analysis. Where previous factor analytic studies had focussed on relatively small test batteries, this unique study combined alternative measures of practically all previously identified factors, within these two large scale studies.

25/A. Strength and Endurance .....

A. Strength and Endurance

Factor analysis and objective analytical factor rotations confirmed the importance of three general factors, and a fourth more restricted factor, to account for performance on these 30 specific tests. The factors were labelled Dynamic, Explosive, Static, and Dynamic trunk strength. Pure measures of each factor were determined by taking into account the size of the factor loadings, the reliability of the tests, and their ease of standardization. A minimal test battery in the strength area would utilize one test from each factor, and these tests would reproduce most of the information derivable from the 30 tests. A complete list of these tests may be found in Fleishman (1964).

B. Speed, Flexibility, Balance and Co-ordination Area.

The same procedure was applied to this area and the results indicated that six factors accounted for performance on the 30 tests. These factors were labelled Explosive Strength, Extent Flexibility, Dynamic Flexibility, Gross Body Equilibrium, Balance with Visual Cues and Speed of Limb Movement. These tests may also be found in Fleishman (1964).

C. Conclusion

With this information Fleishman was able to select the most reliable and diagnostic tests and assemble them into "batteries". Fourteen tests, found to cover nine basic factors were administered to more than 20,000 boys and girls in 45 cities in America. These fourteen tests are presented in Table I (below). Norms were established, and from this information Fleishman selected his final motor fitness test battery.

Table I : Fleishman's initial fourteen tests.

| TEST | PRIMARY FACTOR MEASURED |
|---|---|
| Extent Flexibility | Extent Flexibility |
| Dynamic Flexibility | Dynamic Flexibility |
| Broad Jump | Explosive Strength |
| Softball Throw | Explosive Strength |
| 50 Yard Dash | Explosive Strength |
| Shuttle Run | Explosive Strength |
| Dodge Run | Explosive Strength |
| Hand Grip | Static Strength |
| Pull Ups | Dynamic Strength |
| Leg Lifts | Trunk Strength |
| Hold Half Sit Up | Trunk Strength |
| Cable Jump | Body Co-ordination |
| Balance | Body Equilibrium |
| 600 Yard Run Walk | Cardio-vascular Endurance |

## 2.3 FLEISHMAN'S BASIC FITNESS TEST BATTERY

Fleishman's recommended battery of ten Basic Fitness Tests is presented in Table II. Efficient measurement of nine physical fitness factors is provided. The primary criteria in selecting these tests, were the factor loadings, reliabilities and absence of overlap with included tests.

Table II : Fleishman's battery of Basic Fitness Tests.

| TEST | PRIMARY FACTOR MEASURED | RELIABILITY | PRIMARY FACTOR LOADING | OTHER FACTOR LOADING |
|---|---|---|---|---|
| Extent Flexibility | Extent Flexibility | ,90 | ,49 | - |
| Dynamic Flexibility | Dynamic Flexibility | ,92 | ,50 | - |
| Shuttle Run | Explosive Strength | ,85 | ,77 | ,39 DS |
| Softball Throw | Explosive Strength | ,93 | ,66 | ,32 SS |
| Hand Grip | Static Strength | ,91 | ,72 | - |
| Pull Ups | Dynamic Strength | ,93 | ,81 | - |
| Leg Lifts | Trunk Strength | ,89 | ,47 | ,32 DS |
| Cable Jump | Body Co-ordination | ,70 | ,56 | - |
| Balance | Body Equilibrium | ,82 | ,72 | - |
| 600 Yard Run Walk | Cardio-vascular Endurance | ,80 | - | - |

28/A. Reliability .......

A. <u>Reliability</u>

Reliability co-efficients tend to be high indicating considerable stability for the functions measured.

B. <u>Test Intercorrelations</u>

Low intercorrelations were found.

C. <u>Factor Loadings - Test Validity</u>

A factor loading is an index of the degree to which a test measures a particular fitness factor. The objective was to find tests with a high primary factor loading relative to any secondary factor loading.

Various tests were rejected because of low factor loadings on the factor they were expected to measure. Sit ups and medicine ball put, for instance, were inadequate measures of Dynamic and Explosive Strength. If pull ups were done as quickly as possible in a time limit, unwanted loadings on the explosive strength factor were introduced. Other tests were rejected because they sampled too many factors, and some appeared to measure none of the factors hypothesized.

29/These findings present ......

These findings present evidence of the construct validity of the tests. Whether or not fitness tests predict one's body build and body satisfaction is now amenable to research with these Basic Fitness Tests. This, then, is the history of the unique and scientific basis upon which Fleishman constructed his motor fitness test battery.

### 2.3.1 Critique

To the best of the author's knowledge, relatively little criticism has been levelled at Fleishman's Basic Fitness Tests. Eckert (1974) has criticized the dynamic flexibility factor by saying that the test incorporates the element of speed. It would also seem to include an anatomical component in that more time would logically seem to be required for a tall person to touch his toes than for a short person. She criticizes Fleishman for not incorporating a height factor. She further criticizes Fleishman's test for its increased equipment requirements in comparison to most motor fitness test batteries. This criticism is outweighed by the fact that this test battery includes a broader coverage of components than is usually found in motor fitness test batteries.

In praising the Basic Fitness Tests, Eckert (1974) writes :

> Fleishman can also prove statistically that there is little or no overlapping of the factors of physical performance in the tests selected for his Basic Fitness Tests. Such a claim cannot be made for the other fitness tests listed since statistical analyses of this type have not been made for these tests.
>
> P. 57.

Indeed, Olree *et al* (1965) demonstrated that, in the AAHPER Youth Fitness Battery, three of the test items correlated 0,925 with the results of the entire test. This would indicate that the use of three test items would suffice. Fleishman (1964) has criticized the AAHPER test as measuring only four factors. Four of the seven tests included in the battery load on Explosive Strength, indicating duplication in terms of components being measured. Fleishman's extensive factor analytical approach enables the large majority of motor fitness test batteries to be critically examined.

Fleishman's high reliability correlation co-efficients indicate that subject performance in these tests is consistent. His selection of test items measuring specific components of physical fitness is based upon logical validity and further supported by statistical analysis. As a motor fitness test battery, Fleishman's tests would appear to be efficient and accurate.

Perhaps the major criticism of Fleishman's test is the incorporation of the 600 yard run walk to measure cardio-vascular endurance. Earlier it was mentioned that one of the two approaches to the evaluation of physical fitness is the use of the physical working capacity (p.w.c.). It is necessary to discuss the physical working capacity before critically examining Fleishman's use of the 600 yard run walk test.

## 2.4 PHYSICAL WORKING CAPACITY

Clarke (1959) writes that physiological tests, especially those of cardio-vascular respiratory nature, have been experimented with since 1884, when Angelo Mosso, an Italian physiologist, invented the ergograph. Mosso's original premise was that the ability of a muscle to perform work was dependent upon the efficiency of the circulatory system, as regards the supply of oxygen to the working muscles and the removal of waste products. Since then, numerous experimenters have worked in this field, claiming that tests based upon the cardio-vascular function measured qualities previously described as functional health, physiological efficiency, organic condition, athletic condition, endurance and physical fitness.

32/The concept of .....

The concept of physical working capacity (p.w.c.) has gained wide acceptance among physiologists, pediatricians, cardiologists and other members of the medical profession. Physical work capacity can be defined as the maximum level of metabolism (work) of which an individual is capable (De Vries 1974). An individual's p.w.c. is ultimately dependent upon his capacity to supply oxygen to the working muscles, which, in turn, means that p.w.c. probably evaluates either directly or indirectly, the following elements of physical fitness :

1) cardiovascular function;
2) respiratory function;
3) muscular efficiency;
4) strength;
5) muscular endurance; and
6) obesity.

Obesity is a factor because the final oxygen consumption is usually expressed in millilitres of oxygen per kilogram of body weight. It is important to understand that work by human muscular effort can be produced by aerobic (with oxygen) and anaerobic (without oxygen) metabolic processes. Anaerobic processes when fully loaded, can only function for approximately 40 seconds, and it is for this reason that aerobic capacity is measured. Hence maximal aerobic power refers to the maximal amount of oxygen that can be

33/absorbed during strenuous.....

absorbed during strenuous physical activity. Further terms used to describe physical work capacity include $\dot{V}O_2$ max, maximal oxygen uptake, intake and consumption.

Many medical authorities (Astrand and Rodahl 1970, Cooper 1970) and exercise physiologists (De Vries 1974, Karpovich and Sinning 1971, Mathews and Fox 1971) attest that aerobic working capacity is the best single measure of cardio-respiratory fitness. Furthermore many maintain that aerobic working capacity is <u>the most important</u> measure of physical fitness. Fleishman (1964) included a cardio-respiratory fitness component in his battery which was evaluated by means of a 600 yard run walk test. It is necessary to consider how effective a technique this is for evaluating p.w.c.

### 2.4.1 Evaluation of Physical Working Capacity

P.w.c. can be measured directly in a laboratory or indirectly predicted from various sub maximal work load tests, using the heart rate as a criterion for prediction.

#### A. Direct Test

This is the most accurate and efficient test for the evaluation of p.w.c. The test entails the calculation of oxygen consumption in response to successive work (exercise) bouts. A detailed description of this test may be found in De Vries (1974). Since this test involves laboratory conditions it is not suitable for large numbers.

B. Indirect Tests

These tests usually involve sub maximal work loads and are based on the principle of the linear relationship between heart rate, work load and physical working capacity. Tests of this nature include the P.W.C. 170 test, the Astrand Rhyming Nomogram, the Harvard Step Test and the Progressive Pulse Rate Test. A detailed description of these indirect tests may be found in De Vries (1974). The disadvantage of most of these tests is that large numbers cannot be tested in a short period of time.

An indirect test, that is probably the most common means used by physical educators, to evaluate p.w.c., is the distance run.

(I) Distance Run

The 600 yard run walk was included in Fleishman's Basic Fitness Tests as a measure of cardio-respiratory endurance. Exercise physiologists,

35/however, maintain .....

however, maintain that 600 yards is not long enough to evaluate physical work capacity. Balke (1963) has indicated that the distance covered during 15 minutes of running or walking is a valid indicator of physical work capacity. Cooper (1968) reported a correlation of 0,897 between maximal oxygen uptake and the distance covered during a 12 minute run walk test. Katch and associates (1973) concluded that running at a steady pace is moderately related to maximal oxygen uptake after five minutes and highly correlated after ten minutes. Dick (1978), in discussing aerobic endurance, identifies the following categories of aerobic endurance and their related time specifications for running :

| | | |
|---|---|---|
| Short Aerobic | 2 mins - 8 mins of running | (lactic/aerobic) |
| Medium Aerobic | 8 mins -30 mins of running | (mainly aerobic) |
| Long Aerobic | 30 mins plus of running | (aerobic - fuel availability) |

Doherty (1971), in agreement, writes that during a 400 metres race the anaerobic processes are fully utilized and exhaustion occurs in approximately 40 seconds. In order to evaluate aerobic capacity effectively one needs to run considerably further than 400 metres and it is unlikely that the 600 yard run walk constitutes an aerobic test. Doherty offers the following table indicating the relationship between distance, aerobic and anaerobic requirements.

Table III : Relationship between distance, aerobic and anaerobic needs.

| DISTANCE | AEROBIC NEEDS % | ANAEROBIC NEEDS % |
|---|---|---|
| Marathon | 99 | 1 |
| 10,000 m | 95 | 5 |
| 5000 m | 90 | 10 |
| 2 miles | 85 | 15 |
| 1 mile | 70 | 30 |
| 800 m | 50 | 50 |
| 400 m | 25 | 75 |

Present evidence indicates that distance runs are correlated with maximal oxygen uptake provided that they involve approximately ten minutes of running. Distance runs can be considered to be a fairly reliable indication of an individual's p.w.c. but it is unrealistic to expect distance run tests to duplicate the measurements obtained in a highly controlled laboratory. Possibly the major limitation of a distance run is the question of motivation. Baumgartner and Jackson (1975) write that psychological factors have a pronounced effect on distance run tests as some subjects are not motivated to exert themselves fully. De Vries (1974) substantiates this opinion when he writes that distance runs can provide a good assessment of maximum oxygen uptake, but the accuracy of the estimate is directly related to the motivation of the subject.

The inclusion of the 600 yard run walk test in Fleishman's Basic Fitness Tests is open to criticism since evidence would seem to indicate that it is not of sufficient distance to evaluate p.w.c. The danger of substituting a longer distance for the 600 yard run walk test is that the subject's level of motivation may well contaminate the results. The question of psychological factors affecting a test highlights the controversy that exists concerning motor fitness test batteries and physical work capacity tests.

38/2.4.2 Comparison of Motor Fitness.....

## 2.4.2 Comparison of Motor Fitness Test Batteries and Physical Working Capacity as Measures of Physical Fitness.

Controversy exists regarding the relative value of motor fitness test batteries and laboratory testing techniques measuring physiological parameters, as a criterion for evaluating physical fitness. The most severe critics of motor fitness test procedures are Astrand and Rodahl (1970) who claim that most of the so-called fitness test batteries are related to specific gymnastic or games performance, and are not really suitable for an analysis of basic physiological functions. Practice and training in the performance of the actual test greatly influences the results and

> such data may cause confusion rather than solve problems.
>
> P. 343

Furthermore, in their opinion, any test battery for the evaluation of physical fitness is rather meaningless unless it is based on sound physiological principles. Such widespread use of test batteries in physical education can be justified from a pedagogic and psychological viewpoint only. They conclude with :

> test batteries represent applied psychology and may have no physiological foundation.
>
> P. 344

Olree (1971) in an answer to Astrand and Rodahl (1970), points out that laboratory tests of physical working capacity are not ideal indicators of physical fitness either :

> Physiologists often use work capacity tests to evaluate physical fitness and have found there is a great deal of variability in the capacity for work in normal healthy individuals. Even within the same age groups, in the same or comparable culture and society, individuals differ greatly. Physical work capacity may even vary rapidly in the same individual depending on a number of factors including nutrition, rest and activity.

Clarke (1975), in support of motor fitness test batteries stated that p.w.c. was not synonymous with the broad concept of physical fitness since it measured only one element. De Vries (1974) lends support to both motor fitness test batteries and p.w.c. by relating physical fitness evaluation to differing age groups. He draws the following conclusions :

1) P.W.C. is less important at the elementary age level since children of this age are active in vigorous physical activity by nature.
2) Motor fitness and p.w.c. are as important as each other amongst secondary level children.
3) Motor fitness declines in importance for middle age and elderly populations, as high levels of

strength, speed and agility generally become less necessary. Normality of weight, cardiovascular fitness, respiratory fitness, flexibility and the ability to achieve neuromuscular relaxation become the most important elements of fitness.

Table IV : Relationship between age, motor fitness and physical work capacity.

| Order of Importance | Pre-puberty | Adolescence | Young Adult | Older Adult |
|---|---|---|---|---|
| 1 | Motor Fitness | Motor Fitness | P.W.C. | P.W.C. |
| 2 | P.W.C. | P.W.C. | Body Weight | Body Weight |
| 3 | | | Relaxation | Flexibility |
| 4 | | | Flexibility | Relaxation |

De Vries (1974) P. 221

The controversy regarding the evaluation of physical fitness depends largely on the definition applied to fitness. A test involving the measurement of both motor fitness elements and p.w.c. is undoubtedly the most effective means of evaluating physical fitness, as defined in Section 2.1.3. Fleishman's Basic Fitness

Test battery effectively measures the components of physical fitness, with the exception of the 600 yard run walk test, which is too short to provide a reliable indication of p.w.c.

## 2.5 ANTHROPOMETRY

### 2.5.1 Introduction

Anthropometry is that branch of anthropology that is concerned with the taking of measurements on the human body. A detailed explanation of the techniques employed should be included in every anthropometric study so that the results of one study may be compared with another. (Sills 1960). Despite numerous attempts to standardize the science of anthropometry, a distinct lack of uniformity still exists among anthropometrists. Confirmation of this statement is borne out by the data obtained on 1960 Olympic athletes, which differed greatly as a result of differences in measurement technique.

The most basic principles to follow in anthropometrical studies include :

1) the selection of measurements, when possible, that are based upon acceptable standards;

42/2) the standardization....

2) the standardization of the subject's position;
3) the accurate location of anatomical landmarks;
4) the correct application of the instruments used to take measurements; and
5) the use of the proper statistical method in analyzing the data. (Sills 1960).

The large number of anthropometric observations that can be taken may be classified into three main categories : linear, girth, and fat. Single anthropometric observations such as stature, mass, limb girths and bone diameters are indicative of size. An index or ratio is obtained when two measurements are considered together and these can be used to compare subjects of different sizes. A somatotype rating, which is indicative of total body shape or form, can be obtained from a series of anthropometric observations. Skinfold measurements can be utilized to assess body composition in terms of adipose, muscle and bone tissues. (Copley 1980).

### 2.5.2 Anthropometric Observations

A. Linear Measurements

may be taken with a number of instruments, the most common of them being the flat sliding caliper. An anthropometer is used for measuring total height or stature.

B. Girth Measurements

should be taken with an anthropometric steel tape since other tapes are subject to errors as a result of stretching or shrinkage. Variation in circumferential measurements reflect changes which may occur as a result of training, growth, or inactivity.

C. Fat Measurements

are important because they yield information concerning changes in the total body mass that are influenced by increments or decrements in body fat and subcutaneous tissue. Fat measurements are taken with a skinfold caliper.

D. Body Mass

should be taken with a beam type weighing scale.

2.5.3 Body Composition

In the past anthropologists have been mainly concerned with the skeletal framework. The measurement of muscle and adipose tissue has remained a neglected subject. Recently, morphological and physiological studies have made it clear that body composition or the ratio of lean body mass to fat, is one of the most important features of human physique. It not only undergoes significant changes during growth, development and ageing, but it also depends more on energy intake and output than other anthropometric characteristics.

A. Measurement

The methods available for estimating body fat in man include :

1) direct physical and chemical procedures by fat solvent extraction of the whole body or parts of it;
2) indirect physical and chemical procedures, by measurement of body density or body water or a combination of the two. Such procedures include densitometry, roentgenogrammetry and ultrasound, total body water and total body potassium;

45/3) indirect anthropometric.....

3) indirect anthropometric procedures utilizing girths, lengths, diameters and skinfolds.

The major difference between anthropometric and physico-chemical methods is that the former offers information about the relative distribution of fat from region to region as well as indirectly about the total amount of body fat. The latter offers information only about the total amount of fat. The most searching studies of body fat should include a combination of both methods (Tanner 1959). For the purposes of this study, skinfold measurements were utilized.

(I) <u>Skinfolds</u>

Approximately half of the total amount of adipose tissue in the human body is located in the subcutaneous layer, and hence, skinfold measurements are frequently used for the estimation of body fat. Pinching the skinfold to obtain a rough estimate of the thickness of the subcutaneous adipose tissue, and subsequent inference of the fatness and leanness of a person, is an old clinical procedure. The measurements of the thickness of subcutaneous tissues plus skin were mentioned in the English literature for the first time, by a Czechslovakian anthropologist, Matiegka (1921). He developed a formula for estimating the total quantity of the skin plus subcutaneous tissue. Since then, skinfold measurements have been frequently used for the prediction of body fat employing methods and formulae developed by a number of investigators. It is important to bear in mind that these prediction formulae do not provide a precise assessment of total body fat and that they are population specific (Smit 1968).

Considerable disagreement exists regarding the number and location of points at which the skinfold should be measured. Oeder (1910) and Fellingham (1972) have utilized one skinfold, Sloan and Shapiro (1972) two skinfolds, Brozek *et al* (1963) three skinfolds, Durnin and Rahaman (1967) four skinfolds, Matiegka (1921) seven skinfolds, Haisman (1970) nine skinfolds and Richer (1953) twenty skinfolds. Durnin and Rahaman (1967) favour the use of four sites because a single small error in measurement becomes less important than when utilizing one or two sites. Furthermore, four sites are more representative of the distribution of fat than a smaller number, and are more practical than the use of ten sites, for example.

## (II) Skinfolds and Physical Fitness

Body composition can be particularly useful in the study of physical fitness, and its close relationship to functional indicators is one of the most suitable morphological characteristics for measuring fitness (Parizkova 1968). Most studies indicate that physically active people have a greater proportion of lean body mass to fat than inactive people. Since fat represents "dead weight" it is desirable to have a high lean body mass to fat ratio.

Keys and Brozek (1953) have shown that men whose occupations involve physically demanding work have a lower proportion of fat than men of equal body mass whose occupations are largely sedentary. Parizkova and Poupa (1963) have shown that when physical training is discontinued, body mass increases due to increased deposition of fat, and changes in body density indicate that the deposition of fat is associated with a reduction of lean body mass. Contrary to these studies, Grimm (1961), in a study on swimmers, found that subcutaneous fat was more highly developed amongst swimmers than other sportsmen. He attributed this to an adaptation to prolonged exposure in cold water.

48/Maximal aerobic capacity......

Maximal aerobic capacity appears to be affected by body composition. Buskirk and Taylor (1968) found a close relationship between lean body mass and maximal aerobic capacity, showing that the greater the proportion of lean body mass, the greater the maximal aerobic capacity, both absolutely and per kilogram of body weight.

Hence, the assessment of body composition utilizing skinfolds, can be useful in gaining insight into a person's degree of physical fitness.

The assessment of body composition does not consider the shape or form of the body, and in order to attain this objective, somatotyping is utilized.

## 2.6 SOMATOTYPING

### 2.6.1 Introduction

The problem of attempting to classify human shape has intrigued scientists for many years, and the history of the classification of body types is a long one. Before the year 400 BC, Hippocrates distinguished two extreme body types ; habitus apoplecticus (short and thick), and habitus phthisicus (long and thin). In 1797, Halle recognised four types; abdominal, muscular, thoracic, and nervous (cephalic). In 1928 Rostan also recognized four types; digestive, muscular, respiratory and cerebral. In 1925 Kretschemer suggested a three type classification: pyknic (round, compact), athletic, and leptosome (asthenic). All these classifications had one basic weakness. They had too few categories and it was impossible to classify all types into three or four categories. Few people belonged to one clearly discerned type. There was a need to classify total body form on continuous scales which could be expressed in a simple value. (Carter 1975).

A. <u>Sheldon's (1940) Somatotype Method</u>

It was Sheldon (1940) who came to the conclusion that there were three distinct types of body structure. Further investigations by Sheldon *et al* (1940), conducted on a number of cadavers, revealed interesting facts. One body type had large digestive organs, whereas the heart and kidneys were of moderate size. Another type had well developed muscles, large arteries, heart and bones. Finally, the third type had a predominance of skin surface area. Since embryologically the digestive organs are derived from the endoderm, muscles and bones from the mesoderm, and skin from the ectoderm, Sheldon named the body types as endomorphy, mesomorphy and ectomorphy. The term "somatotyping" was coined, which Sheldon *et al* (1940) defined as :

> a quantification of the three primary components determining the morphological structure of an individual expressed as a series of three numerals, the first referring to endomorphy, the second to mesomorphy and the third to ectomorphy.
>
> Carter and Heath
> (1971 P. 10)

Sheldon saw the somatotype as a trajectory or pathway along which an individual was destined to travel under average conditions of nutrition and in the absence of major illness.

The somatotype was determined from 17 measurements taken on a negative or photograph. This method, however, was soon replaced by the photoscopic procedure. An individual was rated on a seven point scale for the three dimensions. Although the photoscopic method appeared simple there were many subtleties, and satisfactory ratings could not be achieved without considerable practice and training.

As a result of Sheldon's work a number of varying somatotype methods were evolved. A review of these methods may be found in Carter and Heath (1971). The most significant of these methods has been the Heath-Carter technique.

B. <u>Heath-Carter Somatotype Method</u>

In 1963 Heath criticized certain limitations of Sheldon's method and described some modifications designed to overcome these limitations. Firstly, she stated that the seven point scale was arbitrary and proposed a rating scale with equal appearing intervals, theoretically beginning with zero (one half in practice) and having no arbitrary upper end point. Secondly, she eliminated the restriction on the limit of the sum of the components. Thirdly, she reconstructed Sheldon's table of somatotypes and height-weight ratios, in order to preserve a linear relationship throughout. Finally, she questioned the "permanence" of the somatotype, and then eliminated extrapolations for age and used similar height-weight ratio tables for both sexes and all ages.

Heath's somatotype ratings were neither predictions of future somatotypes, nor estimates of the somatotype at age 18, as were the Sheldonian somatotypes. Her somatotype ratings were present somatotypes or morphophenotypes, which reflected changes in physical status with ageing, training, and nutrition.

In 1967 Heath and Carter further objectified Heath's system by incorporating Parnell's M4 technique of somatotyping. This Heath-Carter somatotype method, which is widely used today, is expressed by a three numeral rating of the three primary components of physique, which describes individual variations in human morphology and composition. Their somatotype is defined as a "present morphological conformation." The first component, endomorphy, refers to relative fatness and leanness; the second component, mesomorphy, refers to relative musculoskeletal development per unit of height. This component can be thought of as lean body mass relative to height. The third component, ectomorphy, refers to relative linearity of individual physiques, and its ratings are based largely, but not entirely, on height-weight ratios which evaluate the form and degree of longitudinal distribution of the first and second components. Extremes for each component are found at both ends of the scale. Low first component ratings indicate physiques with little non-essential fat, while high ratings indicate high degrees of non-essential fat. Low second component ratings indicate light skeletal frames with little muscle relief and high ratings indicate significant musculo-skeletal development. Finally, low third component ratings signify great mass for a given height and low height-weight ratios, while high ratings indicate linearity of body segments, and of the body as a whole, together with high height-weight ratios. (Carter and Heath 1971).

(I) Heath-Carter Anthropometric Procedure

The Heath-Carter somatotyping procedure provides three methods of obtaining somatotype ratings : the anthropometric; the photoscopic; and the anthropometric plus photoscopic method. In this study the anthropometric method, which necessitates the taking of ten anthropometric observations, was utilized.

The feasability and validity of applying anthropometric observations for the estimate of a somatotype has been demonstrated by a number of authors. Furthermore, Carter (1975) feels that the utilization of anthropometry in obtaining a somatotype rating has certain inherent advantages, namely:

it is objective and can be obtained quickly and accurately; the subject does not have to undress completely or be photographed either in the nude or partially nude; the anthropometric observations can be utilized for other types of analysis and evaluation of body structure; and finally anthropometric observations provide a more precise measure of change in the somatotype components than a subjective rating does.

Once the anthropometric observations have been taken and the somatotype determined, it is necessary to present the data and consider further methods of analysis.

### 2.6.2. Presentation and Analysis of Somatotype Data

#### A. Presentation

The somatochart is a schematic, triangular, two dimensional representation of the range of known somatotypes. This arc-sided triangle has been named the Reuleaux triangle after Franz Reuleaux (1829-1905), who was the first to demonstrate its constant width properties. The somatochart allows individual somatotypes to be plotted as points, and

55/group concentrations...

group concentrations or dispersions to be examined. The somatochart is divided into sectors by three axes which intersect at the centre. These three axes are labelled endomorphy, mesomorphy and ectomorphy respectively. As the component ratings increase from the centre of the somatochart, along any axis, the somatotypes become more polar. Hence, extremes in any of the three components are said to lie at the poles of the endomorphic, mesomorphic or ectomorphic axes, respectively. (Carter 1975).

B. Analysis

In the past somatotype comparisons have been limited to comparisons of the individual components only. While the value of the individual component is important, treatment of the components as independent variables destroys the concept of relative dominance. In 1974 Ross *et al* developed a more sophisticated means of analyzing somatotype data.

(I) Bi-dimensional Technique (Disperson index)
Ross *et al* (1974) developed a procedure whereby the somatotype disperson distance (SDD) could be calculated. The SDD is a quantification of how far on the somatochart one somatoplot is

56/from another. ......

from another. From the SDD, the somatotype dispersion index (SDI) can be calculated. The (SDI) is the (SDD) group mean and is an indication of the relative cluster of the somatoplots. This technique enables the "total" somatotype rating to be compared in two dimensions.

(II) Tri-dimensional Technique

This technique proposed by Duquet and Hebbelinck (1976) is the most recent innovation. The somatotype is presented by a somatopoint or position in space located on an X, Y and Z co-ordinate (tri-dimensional grid) in the tri-dimensional approach. The three somatotype components are represented by these co-ordinates, and the units on the co-ordinates are component ratings with 0-0-0 at the origin of the three axes. The somatotype attitudinal distance (SAD) refers to the distance between any two somatopoints, and the somatotype attitudinal mean (SAM) refers to the mean of the SAD's around the mean somatopoint.

The SAD can be used in the description of a group with regard to statistics such as location, central tendency and absolute or relative

57/dispersion or it may......

dispersion or it may be used to measure distances between individual ratings, group ratings or between a group and an individual rating. (Duquet and Hebbelinck 1977).

> L. Carter, W. Ross, and J. Borms are of the opinion that the tri-dimensional technique constitutes the best method of somatotype description and analysis.
>
> (Copley 1980 P.44.)

Hence there are two parameters which characterize a somatotype distribution using either bi- or tri-dimensional technique. One is the location of its measure of central tendency (SDD or SAD), and the other is the distribution around the mean somatotype (SDI or SAM). Using either SDD or SAD values the differences among mean somatotypes or among sample dispersions can be analyzed by parametric statistics. The SDD should be used when describing somatoplots on a somatochart, or making comparisons in two dimensions. The SAD and its derivatives should be used when describing somatopoints and their distances in three dimensions. The tri-dimensional technique is preferable. (Carter *et al.*, 1978).

58/2.6.3 Somatotype and Performance .....

### 2.6.3 Somatotype and Performance

The observation that people with relatively similar body types tend to participate in selected sports is substantiated by numerous somatotype studies. It is important to remember, as Sills (1960) points out, that in the majority of studies outstanding performers are somatotyped, and it is then reported that certain somatotypes are associated with a particular sport. It does not follow that no other body types may be associated with success in the sport under consideration.

Since Kohlraush (1929) undertook anthropometric observations on more than 300 Olympic athletes numerous studies have shown the relationship between sporting performance and body type.

Cureton (1951) undertook extensive studies on the body builds of Olympic men and women. He concluded that heavy athletes are generally mesomorphic; track athletes are considerably higher in ectomorphy but with well developed musculature; swimmers are more frequently meso-endomorphic; weight lifters and weight throwers are frequently meso-endomorphic, and gymnasts and tumblers are often meso-ectomorphic.

59/His results showed....

His results showed that very seldom do men and women low in mesomorphy, succeed in athletics. Parnell (1958) substantiated his findings when he showed that sprinters tended to be endo or ecto-mesomorphic, while, distance runners, long and high jumpers are predominantly ecto-mesomorphic. Field athletes were again found to be endomorphic mesomorphs. These studies indicate that the successful athletic type possess an above average component of muscularity.

Swimmers tend to lean towards endomorphy. Pugh and co-workers (1968) have found channel swimmers to have high endomorphic ratings. Carter (1970) found somatotype and size differences between playing positions in College football. The dominant physique was endo-mesomorphic, and backfield players were lower in endomorphy and higher in ectomorphy than linemen.

Falls and Humphrey (1978), in a study on women gymnasts, concluded that certain body types may be requisite for championship performance. These body types were those with high mesomorphy and low endomorphy. They felt that the lower endomorphic component contributed to greater grace and economy of movement, and that higher mesomorphy was positively correlated with greater dynamic strength.

60/These and other studies .....

These and other studies suggest that successful performance is generally characterized by high mesomorphy and low endomorphy. Sills (1960) summarizes with: the endomorph is characterized by an excessive amount of weight which is a limiting factor in the performance of most skills; the ectomorph is muscularly weak and subject to injury, so that the types of contests and sports in which he can participate at a highly competitive level are limited by his body type; and finally the mesomorph is characterized by physical ruggedness and strength, that is without question, conducive to excellent physical performance. It would appear that sport, at a high level of performance, has definite physique requirements.

### 2.6.4 Somatotype, Physical Fitness and Motor Fitness

A number of investigations have been undertaken in an attempt to determine the relationship between somatotype and physical and motor fitness. Most studies have emphasized the handicap of excess weight (endomorphy), and the positive influence of mesomorphy.

In a study investigating the relationship between mesomorphy and physical fitness on 355 aviation

61/cadets. Sheldon ......

cadets. Sheldon (1940), found a low but significant correlation between the two. Sills and Everitt (1953) studied endomorphy, ectomorphy and mesomorphy in relation to performance of motor skills and strength tests. They concluded that excess weight was a handicap to the endomorphs and that insufficient strength was a handicap to the ectomorphs, while the mesomorphs were superior in both tests. Wear and Miller (1962), studying the relationship between physique, developmental level and physical fitness replicated these results and concluded that excess weight was definitely a handicap. Sills (1950) and Hawthorne (1954), studying the relationship between somatotype and motor fitness further augmented these results when they found that mesomorphs were superior in all skills and endomorphs poorest.

Strength in relationship to somatotype has been studied, and, not surprisingly, mesomorphs appear to be superior. In a strength study on boys, Clarke and Brom (1968) found that high strength groups on the basis of strength index scores had the highest mesomorphic means. Those who scored lower on the physical fitness index tended to be high in endomorphy. Laubach and McConville (1966) have reported mesomorphy to be correlated significantly with

62/muscle strength ......

muscle strength, but have found that flexibility was not related to somatotype. Irving (1959), in a study utilizing various strength tests in relation to somatotype found mesomorphs to have the highest mean physical fitness index. The mean of the ectomorphs, however, was nearly as high.

Hebbelinck and Postma (1963) studied the somatotypes of physical education majors in relation to performance on various motor skills. They found the extreme mesomorphs to be superior in all the tests except the 60 yard dash. The ecto-mesomorphs excelled the endo-mesomorphs in all tests except the shot putt. These results were not corroborated by Willgoose and Rogers (1949), who reported that the highest mean physical fitness index was attained by the mesomorphic-ectomorph group, and then the extreme mesomorph group. Endomorphy was again found to be a limiting factor. In a related study Arnold (1968),investigating the relationship between somatotype and physical fitness of pre-adolescent boys, reported that children attaining the highest physical fitness index levels also had the highest mesomorphic content. As the level of physical fitness declined so the degree of mesomorphy diminished.

63/These studies indicate....

These studies indicate the close relationship between somatotype and physical fitness and Cureton (1941) went so far as to say that the best predictor of motor capacity was the determination of one's somatotype rating.

Performance success on physical fitness tests and the relationship to somatotype amongst women has also been studied. In general results have again indicated the desirability of mesomorphy and the negative effects of endomorphy. Curruth (1952) has revealed a group tendency for the mesomorphs to perform consistently better on tests of motor ability, than either ectomorphs or endomorphs. Perbix (1954) replicated these results but found that there was no relationship between somatotype and flexibility. Garrity (1966) found meso-ectomorphs to score better than any other body type on physical fitness items.

A study which has not substantiated the positive relationship between somatotype and physical fitness was that conducted by Slaughter *et al* (1974). They studied the relationship between five physical fitness tests and somatotype amongst 7 to 12 year old boys. Their results indicated no clear cut pattern between physical fitness and somatotype.

64/In general it would.....

In general it would appear that successful physical performance tends to be associated with the amount of mesomorphy found. A combination of strong ecto-morphic and endomorphic components tends to limit an individual's ability to perform physical fitness tests efficiently. Endomorphy, however, appears to be the more important limiting factor.

## 2.7 BODY CONCEPT, ESTEEM

### 2.7.1 Personality

The word personality was derived from the Greek word "Persona" which originally referred to the theatrical mask worn by actors in classical Greek drama. Such masks enabled a person to appear to be something or someone other than himself. There is little doubt that people do wear a "mask" in their everyday contact with the outside world, and that individuals play roles which may change under different environmental conditions. (Whiting 1973). Over the years the noun "persona" has undergone numerous extensions that have transformed the word into an abstract term "personality". The term personality has a multitude of definitions and meanings which pervade the literature and are determined by the particular investigator's interest and theoretical approach. Hall and Lindzey (1970) point out that:

65/the way in which.....

> .... the way in which a given individual will define personality will depend completely upon his theoretical preference... Once the individual has created or adopted a given theory of personality, his definition of personality will be rather clearly implied by his theory.
>
> P. 9

Whiting (1973) suggests a continuum might be proposed along which the various theoretical systems could be placed, according to the amount of objective evidence produced in support of their beliefs. The psycho-analytic approaches of Freud and the post Freudians appear towards the more speculative end of the continuum, while the work of psychologists Cattell (1967), Eysenck (1967) and Witkin *et al* (1962) appear toward the more scientifically derived end of the continuum.

Personality theory is concerned with the nature of individual differences and most theories of personality are based on general principles of behaviour, which are characteristic of all or various sections of a particular population. Consider Allport's (1970) definition of personality :

> Personality is the dynamic organization within the individual of those psychophysical systems that determine his characteristic behaviour and thought.
>
> P. 28

66/His "essentialist".....

His "essentialist" definition of personality implies that an individual has an internal structure and range of characteristics which combine to form his personality. Within a particular culture each personality is unique but people do tend to develop in roughly comparable ways, and the presence of similar traits (consistent behaviour patterns) are often apparent. Psychometric tests, using paper and pencil techniques in conjunction with factor analysis have been used to assess these consistent behaviour patterns.

The type of theoretical framework that undergirds most direct, objective paper and pencil assessments of personality can be termed functionalism or individualism. Tests were constructed which asked an individual directly how he felt about himself, how he would react in certain situations, and what his preference or attitudes concerning other people were. Utilizing factor analysis, attempts are made to ascertain if a smaller number of questions, within the larger questionnaire, correlate. The composition of each group of "question clusters" which emerged was then examined to determine what they had in common (trait). Common traits are generalized dispositions in respect of which people can be profitably compared, and they are considered to be relatively enduring and consistent.

67/Whenever personality.....

Whenever personality tests prove to be reliable, common traits are empirically established and these traits offer a better method and theory for the comparative study of personality. Frequently studied common traits include sociability, aggressiveness, impulsiveness, nervousness, inferiority, emotionality and dominance, to name a few. Allport (1970) describes trait names as range names implying that if two people are classified as being sociable they are roughly, and only roughly comparable with one another. Most studies of personality are comparative and although common traits are not ideal, they suffice for comparative purposes.

### 2.7.2 Body Concept and Self Concept

The term "psychophysical" in Allport's definition of personality implies the functioning of both mind and body. Personality can be thought of as an individual's unique way of perceiving his environment including his bodily self.

The "self" has been of interest to psychologists and social scientists since 1890, when William James described the self as an object of knowledge and mental construction. (Layman 1974). The self is something of which we are immediately aware and is thought of as the warm, central, private region of our lives. It plays a crucial part in our consciousness (a broader concept than self), in our personality (a broader concept than consciousness), and in our organism (a broader concept than personality) and is some kind of core in our being (Allport 1970). The self is composed of one's distinctive characteristics, abilities, and unique resources in addition to the attitudes, feelings and values one holds about one's self. The self is formed by all that one has been and serves to contribute to the quality and form of all one's experiences. (Harris 1973).

Considerable terminological confusion pervades the literature on the self and its evaluation, and it is necessary to distinguish between body concept, self concept, body cathexis, self cathexis, and ideal self. The body concept or body image generally refers to the conscious concept a person has of different parts and processes of the body in terms of their potency (cognition of the body). Body cathexis refers to the degree of satisfaction with these parts and processes, and is concerned with the evaluation of the body (body esteem). The self concept refers to the cognition of the self, and can be considered the self

description (ie. white, educated, intelligent).
Self cathexis (satisfaction) or self esteem refers to the attitudes adopted toward the self and is concerned with the evaluation of the self. The term "self concept" is frequently used when referring to self esteem and it is necessary to distinguish between the terms. Ideal self refers to the self that one would like to be (affective).

For the purposes of this study the following definitions are offered :

The self concept and the body concept will be utilized to refer to the cognition of my self and body respectively.

Self esteem and body esteem will refer to the evaluation of my self and body respectively.

Body cathexis and self cathexis will be used when expressly referring to the Secord and Jourard Cathexis Scales. (fully discussed in section 2.9).

Evidence exists supporting the close interdependence of mind and body, and the bodily sense remains a lifelong anchor for our self awareness. (Allport 1970).

Lowen (1975), a disciple of Reich's, is of the opinion that the self cannot be divorced from the body, and self awareness cannot be separated from body awareness. Johnson (1962) partially disagrees with Lowen when he writes that only children are unable to differentiate between the body concept and the self concept. Body concept _is_ self concept and the child's body and emerging concept of self are conditioned by what he can do with his body potential. Self confidence, respect, acceptance and peer respect are conditioned by success in movement situations. With the advent of adulthood, body concept and self concept are not approximate equivalents. In spite of poor dimensions, fitness and gross motor skills, the body has been accepted and self esteem (he refers to self concept) might still be enhanced by ways of talking, thinking and living in general. Johnson does not specify exactly when this transition occurs and whether or not a two year old child differs from a four year old, for instance. The study does suggest, however, that important as bodily sense is, it is not the whole of one's self, and the sense of self depends on more than just the body. Cratty (1979) supports this viewpoint when he writes that only a portion of a child's perceptions about himself is related to the body.

71/A number of studies....

A number of studies have suggested a close relationship between body esteem and self esteem, and that an improvement in body esteem results in a concomitant increase in self esteem. Evidence supporting the close relationship between body esteem and self esteem is provided by Zion (1965). Utilizing body esteem measures which included scales of physical qualities in body movement and expressiveness and a self esteem scale, she studied the relationship between these parameters, amongst College women. She concluded that there was a significant relationship between body esteem and self esteem, and that the security one has in one's body and its functional abilities is related to the security with which one faces the world. These results were substantiated by Rohrbacher (1973) who studied the influence of a special camp programme on obese boys in relation to weight loss, self esteem and body esteem. Significant relationships between self esteem and body esteem were indicated for all phases of the study, supporting the idea that valuation of self and body are commensurate. Gussis (1971) studied 163 tenth grade boys, with 49 participating in tennis, 48 participating in soccer and 66 controls engaging in free play classes of physical education, during a 20 class instructional period. Pre and post tests on the

Tennessee Self Concept Scale and the Body Cathexis Test showed significant increases in both body and self esteem for all groups.

Evidence has been reported showing that an increase in body esteem results in an increase in self esteem. Indeed, the basis of Movement Education and Educational Gymnastics is deeply concerned with the enhancement of body esteem and improvement in self esteem. (Williams 1974). Cogan (1963), cited in Kane (1972), has questioned whether the mental and physical improvement among educationally subnormal boys after a systematic course in circuit training, reported by Oliver (1958), is not linked with positive changes in body and self esteem. A programme of activities intended to make people feel better about themselves and raise self esteem levels is further supported by Stone (1970). The effect of improvement in physical performance, in a nine week physical education class of selected activities, on self esteem of physically handicapped college students, was observed. Utilizing Bill's Index of Adjustment and Values to measure self esteem it was found that an improvement in physical activities was accompanied by an increase in self esteem. Unfortunately, a control group was not utilized in the study. Further studies supporting the close relationship between body and self esteem are reported in Section 2.8.1.

These studies indicate that perceptions and attitudes toward the body are closely related to the perceptions and attitudes toward the self. Wylie (1961) maintains that it is safe to say that self concept theorists support the general idea that body characteristics which are held in low esteem by an individual, may be expected to undermine his general self regard (esteem), while characteristics held in high esteem should enhance self regard (esteem). The interdependence of the body and the self are readily seen and a positive relationship between body and self esteem is commonly found. Layman (1974), in agreement, alleges that research has generally pointed to the validity of the generalization that there is a positive relationship between body and self esteem. Physical education researchers have hypothesized that programmes for the development of physical fitness will result in an enhancement of body esteem and consequent improvement in self esteem, and a decrease in the discrepancy between self and ideal self.

### 2.7.3 Body Concept, Esteem and Physical Fitness

Since body concept refers to the conscious concept of different parts and processes of the body, and body esteem refers to the attitudes toward these parts, and since physical fitness is influenced by the body, it is necessary to consider the relationship between these variables.

Several workers have claimed that physical activity programmes and the accompanying improvement in physical fitness have a positive effect on body concept and esteem. Relatively few studies have, however, been undertaken in this area and clarification is needed.

The following studies have reported positive relationships between physical fitness and body concept/ esteem. Sloan (1963), utilizing the Body Cathexis Test and a scale in conjunction with motor performance on the Barrow Motor Ability Test, discerned a significant relationship between motor performance and body esteem. Kreitler (1970) focussed on the distortion of the body concept, and suggested that a reduction of movement leads to distortion of the body concept. He cites the example of people over 50 years old, who, tending to move less, perceived their bodies to be broader and heavier than they really were. He suggested that a distortion of the body concept created bodily insecurity and lessened the desire for physical activity, and that a programme of physical activity could be utilized to enhance the body esteem, and counteract this distortion.

No relationship between physical fitness and body concept/esteem was found by Vincent and Dorsy (1968). They investigated the relationship between three measures of body concept/esteem (The Fisher-Cleveland Barrier Index, the Secord Homonym Test and the Body Cathexis Test) and two measures of physiological performance (hand grip and Harvard Step Test). It was concluded that a relationship does not exist amongst these variables.

A number of studies have been reported in the literature which have suggested the existence of a positive relationship between physical fitness and body concept/esteem. These studies have, however, been sketchily reported and it is difficult to know exactly the nature of the relationships discovered. Kane (1972) reports that Schultz (1961) administered balance, co-ordination, and power tests of motor performance in conjunction with a Semantic Differential and the Draw a Person Test. A positive relationship was discerned between the motor performance tests and both body concept measures. No explanation is offered concerning the nature of the Semantic Differential Test, and it is therefore difficult to evaluate the obtained relationship. Layman (1974) reports that Leighton *et al* (1966) studied the effect of a physical fitness programme on the body concept of ten mentally retarded children and found a distinct improvement in body concept following the fitness programme. The method utilized to measure body concept is not mentioned, and the absence of a control group weakens the results obtained in this study. Harris (1973) reports that Maloney and Payne's (1970) study lends credence to the theory that body concept may be changed positively through physical activity programmes. Maloney and Payne studied the effect of sensory motor training upon the body concept (they refer to body image) and results indicated that after two months of training, significant improvements were noted on two measures of body concept. Eight months after the termination of training, the re-administration of two body concept measures indicated that those who had participated in the sensory motor training, remained significantly better on measures of body concept than the control subjects. Harris omits to mention the type of body concept measure that was utilized in this study, which results in ambiguity. It is not known whether this measure constituted a body concept or a body esteem orientated evaluation.

77/Despite the confusion......

Despite the confusion that exists regarding the terminology in this field, a number of studies point to the positive relationship between physical fitness and body concept/esteem. More studies need to be undertaken in this area, and the relationship between physical fitness and body esteem, in particular, needs attention.

### 2.7.4 Self Concept, Esteem and Physical Fitness

Physical fitness has a positive effect on the body concept/esteem in many cases (section 2.7.3), and since self concept/esteem is related to body concept/ esteem it is necessary to study the effects of physical fitness on self concept and esteem.

A number of studies have affirmed the supposition that self esteem is enhanced by physical fitness and activity. Dowell *et al* (1968) concluded a study on the relationship between physical fitness and self esteem with some interesting disclosures. They discerned a significant positive relationship between the physical fitness factors strength, endurance, and speed and the physical self esteem (agile, attractive, co-ordinated, fashionable, healthy, presentable, strong). Physically unfit students displayed a lower self esteem rating than physically

78/fit students, ......

fit students, who also scored significantly higher on a physical self acceptance scale. A negative relationship, however, was found between physical fitness and the intellectual self esteem (accurate, clever, creative, intellectual, imaginative, logical, studious). These results suggest that aspects of one's self esteem are strongly influenced by the physical properties of the body. These results were substantiated in 1972 by Graves when he found a positive relationship between self esteem and the physical attributes of speed, strength, and physical skills. White (1974) investigated the relationship between three components of physical fitness, classified as : strength, flexibility and cardiovascular endurance, and self esteem as measured by the Tennessee Self Concept Scale. He found a significant relationship between these measures of physical fitness and self esteem.

Participation in physical activity, and not solely an increase in physical fitness, (although these areas overlap to a certain degree) has been associated with increases in self esteem. Collingwood and Willett (1971) reported that five obese teenagers were found to show an increase in self esteem after a programme of physical activity. The generality of these

79/results, however, .....

results, however, can be criticized in view of the extremely small sample. Martinek (1976) found that children who participated in physical activity and shared in decision making had significantly higher self esteems than those who did not. Whether this improvement is due to the participation in physical activity or a share in the decision making is not clear. Johnson *et al* (1968) (cited in Layman 1974) reaffirmed the positive relationship between self concept and physical activity when they administered three measures of self concept (it is not clear whether these measures were self concept or self esteem oriented) to children referred to a physical developmental clinic before and after a six week clinic programme. A comparison of pre and post test scores revealed a significant discrepancy in the self concept and ideal self. The authors indicate, however, that these measures have not been standardized and that the inclusion of a control group would have strengthened the results obtained. Zaichkowsky *et al* (1978) have reported that along with an improvement in body co-ordination as a result of organized physical activity, there is a concomitant increase in self esteem (as measured by the Piers-Harris Self Concept Scale).

80/Success and failure.....

Success and failure in relation to physical performance, and the effects on self esteem, have been studied by Read (1969). Using a body cathexis scale in conjunction with the Tennessee Self Concept Scale, it was found that constant winning and constant losing influence body and self esteem levels. Those subjects who were constant winners had significantly higher levels of body and self esteem than constant losers. Those subjects who were neither constantly winning or losing displayed relatively stable self and body esteem levels. Lay (1970) administered the Tennessee Self Concept Scale to a group of University men and women non-swimmers prior to a 20 lesson swimming course and again at its conclusion. Experimental groups of 45 women and 41 men were compared with control groups of 48 women and 41 men, and those who learned to swim were compared to those who failed to learn. Significant improvements in self esteem scores were found for both men and women who learned to swim, and declines in self esteem scores for those who did not learn.

Vincent (1976) utilizing the Tennessee Self Concept Scale amongst a random sample of College women athletes and non athletes found that athletes displayed significantly higher self esteem levels than non athletes. These results were not corroborated by Ibrahim and Morrison (1976), who, utilizing the Tennessee Self Concept Scale amongst a random sample of College male athletes and non athletes, found no significant differences between the groups. It is possible that the athletes in Vincent's study might have been particularly successful, which could have enhanced their self esteem levels.

In further studies on the relationship between physical fitness and self esteem, Yeatts and Gordon (1968), utilizing the AAHPER Youth Fitness Test battery and Gordon's "How I See Myself" scale, found a positive relationship between these two measures amongst elementary school children. Rothfarb (1970) using the Edward's Personal Preference Schedule in conjunction with the Tennessee Self Concept Scale, studied the relationship between self esteem and degree of exercise amongst College men. Men who exercised regularly were found to have the highest self esteem levels. Significant differences were also found between the non exercisers and those who exercised on occasion but not regularly. It was concluded that the positive relationship between self esteem and the degree of exercise engaged in, supported the premise that men who exercise regularly

82/tend to like themselves.....

tend to like themselves, to have confidence, and to feel they have value. These findings were corroborated by Samuelson (1969) (cited in Harris 1973) who found significant and positive changes in self esteem amongst tenth grade girls following specific physical education classes. Samuelson concluded that physical education classes could provide an opportunity for experiencing degrees of success and feelings of self worth, resulting in a more positive self esteem level.

Studies that have not corroborated the positive relationship between self esteem and physical fitness include Runyan (1973), who discerned no significant improvement in self esteem of elementary school children after participation in a perceptual motor training programme. Davis (1970), utilizing the Tennessee Self Concept Test and the Edwards Personal Preference Schedule in conjunction with a cardio-vascular fitness programme, discerned no relation-ship between these variables. Despite an improvement of fitness amongst the 39 College men, no concomit-ant increase in self esteem was evidenced for either the experimental or control groups. McClenney (1969), utilizing Bill's Index of Adjustment and Values to measure self concept, compared a group of physically fit men with a group of unfit men and reported no significant differences between the groups.

Despite these contradictory results many of the findings suggest a positive relationship between physical fitness and self esteem.

### 2.7.5 Personality and Physical Fitness

It appears that in many instances both body concept/ esteem and self concept/esteem are related to physical fitness and since these parameters are fundamental to the structure of personality, it is now necessary to consider the relationship between personality and physical fitness.

To the best of the author's knowledge, few studies have examined the relationship of physical fitness to personality. The studies that have been reported show conflicting results.

Jones (1946) studied the physical ability of 78 elementary school boys in relation to measurements of reputation and personality adjustment. He found that strength and other aspects of physical ability were closely related to such favourable traits as activity, aggressiveness and leadership. He concluded that boys, superior in strength, showed a tendency to be tall, mesomorphic, proficient in sports, high in popularity and social prestige and well adjusted. (Cited in Clarke and Clarke 1970). Since no mention of the method used to measure reputation and personality adjustment is made it is difficult to accept these results without a critical evaluation. Rarick and Mckee (1949), cited in Clarke and Clarke (1970), utilizing Seil's Battery of motor skills and a case study technique to ascertain personal characteristics, studied the personality characteristics of high motor proficiency and low motor proficiency children. Their results showed that children in the superior motor performance group tended to be more active, popular, calm, resourceful, attentive and co-operative. Children in the low motor performance group showed negative personality traits and were more often shy, retiring and tense. Since no mention is made of the method by which the personality characteristics were measured, it is again difficult to accept these results without question.

Contrary to these results Weber (1953) studied the relationship between physical fitness, as measured by

85/the Iowa ........

the Iowa Physical Efficiency Profile, and personality, as measured by the Minnesota Multiphasic Personality Inventory, of College students. He found no significant relationship between physical fitness and personality and concluded that physically fit subjects had no more stable traits of personality than did the physically unfit. France (1953) augmented these results when he found no relationship between physical fitness and personality, using a battery of three physical achievement tests (agility run, pull ups, hop step-jump) and the Minnesota Multiphasic Personality Inventory. Both these studies can be criticized, however, for utilizing the Minnesota Multiphasic Personality Inventory. This inventory is not strictly appropriate for these studies, since it is primarily directed at the psychiatric population.

More recently Fixx (1977), cited in Braun and Linder (1979), has studied the psychological benefits which can accrue from exercise. In addition to increasing self acceptance, running seems to reduce feelings of depression and anxiety, and can be an enjoyable method of relieving tension and providing temporary distraction from the stresses and strains of life. Physicians have reported that the deepest muscular relaxation occurs after a period of

86/increased muscular.....

increased muscular tension, which explains why psychological benefits can and do accrue from exercise.

Conflicting results are reported and clarification is needed in this field before conclusions regarding personality and physical fitness can be drawn. Conflicting results amongst the earlier studies are most likely due to methodological weaknesses and poor design, and studies devoid of these errors need to be undertaken.

## A. Personality and Physical Performance

Physical educationists and others have often claimed that the environment in which physical abilities are displayed (ie. Games and Sport) constitutes an ideal setting for the development of desirable personality traits such as confidence, sociability, self reliance, co-operativeness and general personal adjustment (Kane 1972). The study of personality profiles in sport is undoubtedly the most popular area of investigation in the psychology of sport, and numerous studies on sportsmen have been undertaken. Yet results of studies have been disappointing and confusing with relatively few consistent results. Rushall (1975) writes that personality research in sport is one major area of investigation which needs to be radically altered in terms of its' theoretical orientations, hypotheses and methodology. Ryan (1968) highlights the problem in this area with :

> The research in this area has largely been of the "shot gun" variety. By that I mean the investigators grabbed the nearest and most convenient personality test, and the closest sports group, and with little or no theoretical basis for their selection fired into the air to see what they could bring down. It isn't surprising that firing into the air at different times and at different places, and using different ammunition, should result in different findings. In fact it would be surprising if the results weren't contradictory and somewhat confusing.
>
> P. 75.

The need for carefully chosen and designed studies is again indicated.

### 2.7.6 Body Concept, Esteem and Somatotype

Earlier it was shown that both body composition and somatotype are influential in affecting physical performance (section 2.5.3). Furthermore it would appear that body concept/esteem is related to physical fitness (section 2.7.3). Since somatotype and body concept/esteem are related to physical fitness, how then does somatotype relate to body concept/ esteem?

Body concept refers to an individual's perception of his body and as both Kane (1972) and Whiting (1973) comment, it is surprising that few studies have investigated the way in which the actual body type is related to body concept and esteem.

Perhaps the best known study in this field was undertaken by Sugerman and Haronian (1964). They explored the relationship between body type (using Sheldon's somatotype method and Parnell's 1958 anthropometric technique) and the degree of primitiveness or sophistication of the body concept (cognitive) which was assessed by Witkin's (1962) five point scale. The authors discovered a moderate, positive link between sophistication of body concept and mesomorphy and a moderate negative relationship between the body sophistication scores and endomorphy. They concluded that endomorphy was positively related to primitiveness of body concept while mesomorphy was positively related to sophistication of body concept.

Sugerman and Haronian then considered the affective aspects of the body (body esteem) and they hypothesized that the degree of participation in sport was a behavioural variable, mediating the relationship between physique and body esteem. They felt that students high in mesomorphy were more likely to take part in strenuous activities which might increase their esteem for and interest in their bodies. To test these hypotheses they devised a scale of sporting participation which they administered, and related to mesomorphy ratings. The results of this study suggested that body esteem is favourably affected by the broad shouldered, narrow hipped mesomorphic physique.

It is possible that the development of positive body esteem depends on the differential, social and personal approval given to varying physiques. On this point McCandless (1960) writes :

> For us in the United States, the beautiful body serves purposes related to fantasy, displacement, projection and wish fulfillment; heroes of popular novels and in the movies and on the television screen are broad shouldered, narrow hipped, possess flat abdomens and are muscular.

Studies by Brodsky (1954) and Miller and Stewart (1968) have lent support to this viewpoint. Using body type silhouettes they found that positive personality traits were attributed to mesomorphs, less positive to ectomorphs while endomorphs received a thoroughly negative rating. Researchers Wells and Siegel (1961) and Dibiase and Hjelle (1968) have corroborated these results, finding that there was unanimous preference to look like the mesomorph silhouette.

Even studies on children have verified this common trend of results. Staffieri (1972) asked 60 seven to eleven year olds to assign 38 adjectives of various behaviour/personality traits to three silhouettes, representing extreme endomorphy, ectomorphy, and mesomorphy. All significant adjectives assigned to the mesomorph were favourable, and those assigned to the endomorph were unfavourable. Lerner and Korn (1972) substantiated this finding in a study of five to twenty year olds when it was found that at all age levels the mesomorph was viewed favourably and the endomorph unfavourably.

The relationship between height, weight, body measurements and the self perception of body contours has been studied. Cremer and Hukill (1969) reported that the greater the divergence from socially desired prototypes of body size, the greater the inability to perceive and estimate accurately actual body contour lines. A definite tendency to resist the actual body size and err toward the socially desirable body conformation was detected. This finding lends support to the idea that positive body esteem is dependent upon society's approval to varying physiques. In a related study Schonbuch and Schell (1967) compared underweight, overweight and normal weight College men and their ability to estimate their personal physiques from a grade series of pictures. Again a tendency to err towards the socially approved physique was detected.

Harlow (1951) has suggested that body esteem may be enhanced by altering the size of the body. He cites the examples of body builders who alter their body structure to fit their ideal concept of the body. It appears likely that the body builder attempts to increase bodily esteem by altering his shape in accordance with society's approval of physique ie. mesomorphy.

92/There appears to be.....

There appears to be a wealth of evidence suggesting that people react consistently to distinctive body builds, and that body type and body esteem are closely linked. Mesomorphy is associated with positive body esteem while endomorphy is associated with negative body esteem. This, however, is likely to be affected by the emphasis society places on varying body types.

### 2.7.7 Personality and Body Type

Evidence suggests that body esteem is closely related to somatotype, and since body esteem is a part of the total personality structure, what then is the relationship between personality and body type?

Scholars dating back to the Greeks and Romans have speculated that personality, intelligence, and emotional make up were somehow linked to body build and appearance (Cratty 1973). Kane (1972), in agreement with Cratty, writes that the proposed relationship between body type and personality has a long history in psychology. In the field of constitutional psychology certain basic human types have been proposed in an effort to simplify the large observable variations among individuals.

93/Constitutional types.....

Constitutional types have been presented as a characterization of the individual as a whole, in terms of his physical, intellectual and emotional traits. During the 1800's and 1900's a number of scientific attempts to determine whether, in fact, relationships do exist between body and personality, have been undertaken.

The German psychiatrist Kretschemer (1925) was a forerunner in this area. He studied classes of mental disease and concluded that :

1) there was a relationship between the psychic disposition of the manic depressives and the pyknic (roly-poly) body type; and
2) there was a relationship between the psychic disposition of the schizophrenics and the asthenic (slender) body type.

Kretschemer, however, had no scientific method of evaluating physique.

A. Sheldon's (1940) Theory

Elaborating on Kretschemer's propositions and following several years of work on "somatotyping", which produced the text "Varieties of Physique", Sheldon and co-workers began to focus on possible associations between appearance and behaviour. These studies resulted in the text "Varieties of Temperament", which attempted to clarify the theory that personality was an extension of an individual's biological structure, as represented by his somatotype. Sheldon developed a "constitutional theory" of personality, in which he suggests that one can predict what kind of personality traits will be evidenced by individuals possessing various body builds. He theorized that the three somatotype dimensions endomorphy (fat), mesomorphy (muscle) and ectomorphy (linearity) were significantly correlated with the three corresponding Sheldonian temperamental scales, visceratonia (relaxed), somatotonia (energetic) and cerebretonia (detached) as follows : endomorphy and visceratonia 0,79; mesomorphy and somatotonia 0,82; and ectomorphy and cerebretonia 0,83. He further proposed that the endomorph would appear fat, round and soft and evidence traits that fall into the commonly held "fat-jolly" stereotype. The muscular mesomorph would evidence a cluster of personality traits that characterize him as robust, and extraverted. The linear ectomorph would be characterized by a predominance of restraint, lack of self confidence, and introversion. A detailed list of corresponding traits may be found in Allport (1970).

(I) Critique

Psychologists have viewed Sheldon's physique classification and their high temperamental correlates somewhat sceptically. More thorough analyses of Sheldon's convictions have been undertaken and high correlations have not been reported. Possibly Sheldon's most severe critic has been Eysenck (1970) with:

> The belief that constitutional factors play an important part in personality is held very widely. Unfortunately there are few areas of psychology in which a greater superstructure has been built on so small a factual foundation.
>
> P. 318

Eysenck is particularly critical of the fact that :

1) serious statistical errors in Sheldon's correlations have been found; and
2) the even more important experimental error of having the same observer rate personality and body build in his subjects, when it is almost cetain that his hypotheses will influence his ratings.

Despite his harsh criticisms, Eysenck (1970) accedes that low correlations between physique and temperament probably exist and Sheldon's claims

> in spite of their messianic ring .... cannot be dismissed but neither can they be accepted at face value.
>
> P. 334

Subsequent studies have indicated that Sheldon's claim is excessive but that in many cases low correlations in the expected directions do exist.

Cortes and Gatti (1966) used Parnell's (1958) objective techniques for body typing and a self description questionnaire which was specially structured to give scores equivalent to the three Sheldonian scales, visceratonia, somatotonia, and cerebretonia. They found that endomorphs rated themselves significantly more often as visceratonic (ie. relaxed and warm); mesomorphs described themselves more often in terms of somatotonia (ie. confident, energetic); and ectomorphs rated themselves significantly more often as cerebretonic (detached and tense). Correlations ranged from between

0,31 to 0,74. Eysenck (1970) also lists a number of studies illustrating a weak relationship between physique and personality.

Contrary to these findings, Kane (1969), utilizing the Parnell method of body typing and the Cattell 16 P.F. discerned no significant associations between body type and personality.

Most studies would indicate that a weak relationship between physique and personality does exist, in Sheldon's specified direction. Allport (1970) concludes succinctly with :

> To conclude, we cannot doubt the fact that bodily constitution and temperament have some close relationship. They are paired raw materials from which we fashion in part our personalities through learning.
>
> P. 63

The preceding sections have evidenced the interrelationship of the parameters of body concept/esteem, self concept/esteem, physical fitness, somatotype, and personality. Body cathexis is a reflection of an individual's feelings about his body, its shape, its fitness and performance. It seems logical to assume that the above mentioned parameters will influence body cathexis.

98/2.8 BODY CATHEXIS.....

## 2.8 BODY CATHEXIS

Secord and Jourard (1953) centred their attention on the affective aspect of body perception, concerned with the individual's relative satisfaction or cathexis towards different parts of the body. They defined body cathexis as:

> the degree of feeling of satisfaction or dissatisfaction with the various parts or processes of the body.
>
> P. 343.

They argued that if the variable body cathexis was to be deemed important to personality theory, it was necessary to demonstrate that it was related to other personality variables which were recognized as being significant. They contended that body cathexis was integrally related to the self concept (esteem), although identifiable as a separate aspect thereof. Secord and Jourard further hypothesized that feelings about the body are commensurate with feelings about the self, when both are appraised by similar scales; negative feelings about the body are associated with anxiety, in the form of undue autistic concern with pain, disease or bodily injury; and finally, negative feelings about the body are associated with feelings of insecurity involving the self.

99/In order to test.....

In order to test these hypotheses the authors constructed three scales; the Body Cathexis Scale, the Self Cathexis Scale, and the Homonym Test of Body Cathexis.

The Body Cathexis Scale is a test which consists of 46 words describing body parts and functions. Subjects appraised their body cathexis by recording their reactions to these body parts and functions on a five point scale of intensity. The construction of the inventory involved considerable preliminary work in the form of pilot studies. Items which were difficult to understand, difficult for the subject to assign a meaningful rating, or which resulted in little variability from subject to subject, were generally eliminated, provided that they did not leave an important part of the body unrepresented. One exception to the latter qualification was allowed: organs pertaining to sexual and excretory functions were deliberately omitted from the body list because it was feared that their presence in the scale might give rise to evasive attitudes, which might transfer to other items, resulting in an avoidance of the two answer categories, representing negative feelings towards the body.

The Self Cathexis Scale listed 55 items believed to represent a sample of factors related to the satisfaction of the self. An identical rating scale was used for this test. The self traits included, were phrased in non technical, popular terms such as conscience, morals and personality, so that they might approximate the terms in which the individual actually thinks of himself.

Finally, the Homonym Test comprised a list of 75 homonyms, (word of same form as another but different sense) each of which had meanings pertaining to pain, disease, or bodily injury. Twenty five neutral or non body words were interspersed with the homonyms for purposes of disguise. This list was presented to the testees orally, the homonyms being read at the rate of one every five seconds. The subjects were required to respond with associations to the series of words having common body or non body meanings ie. colon - intestine or comma. This test was employed to provide an independent measure of anxiety related to body cathexis, and it was presumed that a high number of body associations are correlated with high concern for one's body.

### 2.8.1 Body Cathexis and Self Cathexis

Utilizing a sample of 70 College men and 56 College women, Secord and Jourard (1953) undertook the first study using the Body Cathexis, Self Cathexis and

Homonym Test in an attempt to test their hypotheses. In conjunction with these three tests they administered the Maslow Test of Psychological Security-Insecurity. Their results indicated high correlations between body cathexis and self cathexis ($r = 0,58$ men $r = 0,66$ women). A significant negative relationship was discerned between the Homonym scores and the anxiety indicator score. They also found that psychological insecurity, as measured by the Maslow Test, was positively linked with dissatisfaction on the Body Cathexis and Self Cathexis measures. These results enabled Secord and Jourard to accept their hypotheses. A further interesting result was that women tended to cathect their bodies more highly than men, irrespective of the direction of cathexis. Secord and Jourard tentatively suggested that this might be as a result of the greater social importance of the female body.

Following Secord and Jourard's initial study, a number of investigators have used their inventories. Many have re-affirmed the positive relationship between body and self cathexis. Johnson (1956) and later Gunderson and Johnson (1965) have substantiated the positive correlation between body and self cathexis. Weinberg (1960) attempted to cross validate Secord and Jourard's results when he administered identical tests to 212 College students. His results, in general, re-affirmed the previous observations. The original finding that negative feelings about the body are correlated with body concern on the Homonym Test was not, however, reproduced.

Clifford (1971), using the Body and Self Cathexis Scales reported that the two were closely linked. He also discovered that females expressed more dissatisfaction with themselves and their bodies than did males. Zíon (1965) has discerned a clear parallel between the way a subject appraised herself as a person and the way she evaluated her body.

Rosen and Ross (1968) questioned whether the relationship between body and self cathexis might not turn out to be even more positive, if one took into account the relative importance to the individual of the various body parts he rated. Eighty two College students were asked to complete the Body Cathexis Scale and indicate which body parts they considered to be most important to them. Self esteem was then measured by means of self ratings in relation to bi-polar dimensions defined by 17 adjectives. It was found that self esteem scores were

103/more highly......

more highly correlated with body parts that were considered to be important (the importance of body parts differed from subject to subject) than those which were less important.

Not all studies have reported a positive relationship between body and self cathexis. Riffle (1973), studying the expressed body cathexis scores of mothers and daughters, was not able to substantiate the inverse relationship between body cathexis and bodily concern (using the Homonym Test). Mahoney (1974), investigating the relationship between body cathexis and self cathexis, found no significant relationship existed. In a unique study, White and Gaier (1965) failed to find a positive relationship between body and self cathexis. Utilizing members from Alcoholics Anonymous, they found that during the first 12 months of sobriety there was a general increase in body cathexis. At 36 months or more, this increase declined. Exactly the opposite pattern was discerned for self concept. They attribute this result to the fact that an improvement in the control of drinking is particularly evident in bodily appearance. Other A.A. members frequently observe and comment on this bodily improvement. The alcoholic's initial self concept is artificially high because of the "residual effects of alcohol", and as sobriety is maintained he takes a more realistic view of

104/himself. ......

himself. This results in a decrease of self concept.

Most studies indicate that a positive relationship exists between body and self cathexis, just as a positive relationship exists between body and self concept/esteem.

2.8.2 Body Cathexis and Body Shape (Somatotype)

Somatotype, or the shape of the body has been shown to affect the body esteem level (section 2.7.6), and it is necessary to consider what effect somatotype has on body cathexis.

Jourard and Secord (1954) attempted to analyse an individual's subjective feelings about various parts of his body in conjunction with actual measurement of the body. Utilizing 62 College males, they administered the Body Cathexis Test and measured each subjects' height, weight, width of shoulders, and circumference of chest and biceps. Correlations were computed between these measurements and the corresponding five body cathexis items. Low but significant correlations indicated that large size of these body parts is associated with positive cathexis, while the reverse is true for small size.

Magnussen (1958) successfully re-affirmed this finding in another male sample.

If positive cathexis is linked with large size for males, the opposite pattern is evidenced for females. Jourard and Secord (1955) studied 60 female College students and their body cathexis ratings assigned to body areas and their size attributes. Body Cathexis ratings for 12 body parts were selected and direct measures of these body parts were taken. Results indicated that positive cathexis towards these body parts was linked with smallness in size. The only exception was the bust, where large size was desired. They also ascertained that the greater the discrepancy between estimated ideal and estimated size for certain body dimensions, the more negative was the cathexis rating assigned. Gunderson (1956) replicated the latter part of this study on a study of 670 Navy men. Using their heights and weights and the Body Cathexis Scale, he discerned that the amount of dissatisfaction with either height or weight tended to increase with its degree of deviation from the most preferred or ideal value in the group. Those who were either too short or too tall, too light or too heavy were most dissatisfied.

106/Further sex differences.....

Further sex differences in attitudes towards relative size of the body parts were discerned by Calden *et al* (1959). Their results demonstrated that males prefer largeness of body proportions and females wished to be smaller in all dimensions except for the bust. Silhouettes of endomorphs, mesomorphs and ectomorphs were rated for attractiveness by the same sample. The results indicated that both sexes perceived the extremely stout person (endomorph) as being least attractive in build. The women were significantly more negative in their evaluations of silhouettes with large body proportions than were the men.

Kurtz (1966), in a related study, investigated whether size and "build" attributes of an individual's body influence his satisfaction with it, and whether the direction of the relationship varies with sex. He hypothesized that men of a large size or mesomorphic build would evaluate their bodies more positively than men of a small size. His results indicated a border line trend for large men to like their bodies more than small men while mesomorphic men liked their bodies significantly more than non mesomorphs. Contrary to most findings, women of large size did not dislike their bodies more than those of a medium or small size.

107/Arkoff and Weaver's.....

Arkoff and Weaver's (1966) study supported the common trend of results when they administered the Body Cathexis Scale to students in Hawaii. Somatotype measurements of the height, weight, biceps and hips were taken and the subjects were asked to estimate and indicate preferred ideal sizes for these areas. Results indicated that, in general, males wished to be larger and women smaller. Japanese men exceeded Caucasian men in the degree to which they wanted to be taller and have larger biceps. The sexes did not appear to differ in the degree to which they over or under estimated the size of their body parts.

The majority of these findings suggest that large size and mesomorphy results in positive cathexis amongst the men, whereas small size, with the exception of the bust, is preferred amongst women. These findings would seem to support McCandless (1960) (section 2.7.6), who suggests that a positive body esteem depends on the social approval given to varying physiques. Western society emphasizes the "petite" slim physique for women whereas muscularity and "ruggedness" is associated with a positive body esteem amongst men.

### 2.8.3 Body Cathexis and Physical Fitness

To the best of the author's knowledge relatively few

108/studies have....

studies have investigated the relationship between body cathexis and physical fitness.

Sloan (1963) administered the Body Cathexis Test to a group of College men. He then divided the group into a high score and a low score group and gave them the following physical performance tests: medicine ball put; wall pass, zig zag run, standing broad jump and 60 yard dash. His results indicated that individual's with a more positive body cathexis level possessed higher levels of motor ability than their counterparts. Henderson (1974) administered the Body and Self Cathexis Scale to a group of 59 women before and after a six week physical conditioning programme. Results indicated a more positive cathexis level at the completion of the programme.

Negative results have been reported by Leahy (1966) who found no relationship between body cathexis and stabilometer balancing in College men. Fulton (1967) reported that both body cathexis and self cathexis levels of a group of subjects remained relatively stable over a 12 month period of physical activity, despite an increase in physical fitness. Vincent and Dorsy (1968) (discussed in section 2.7.3) discerned no significant relationship between body cathexis, the hand grip and the Step Up test.

109/The lack of.....

The lack of studies would indicate that more research is needed in this area for clarification.

110/CHAPTER 3 .....

# CHAPTER 3

# RESEARCH METHODS

## 3.1 SPECIFIC OBJECTIVES OF THE STUDY

Having reviewed the relevant literature it is now necessary to state the specific objectives of this study. The purpose of this investigation was to analyse the interrelationships existing between physical fitness, physique, and the satisfaction felt for the body, amongst a group of white South African schoolboys. A secondary objective of this study was to shed some light on the relationships existing between the aforementioned variables and personality.

A survey of the literature regarding the evaluation of physical fitness indicates that the two main approaches to the assessment of physical fitness have been

1) the use of motor fitness test batteries, and
2) the use of physical working capacity tests.

A compromise between these techniques would appear to be the most effective manner of evaluating physical fitness amongst adolescents (Table IV. Section 2.4.2.). Fleishman's (1964) Basic Fitness Test battery was selected to evaluate the level of physical fitness in this study. The test battery was slightly modified and the details of this modification are described in section 3.3.1.

The (1967) Heath-Carter Somatotype technique was selected to determine somatotype ratings. The determination of the somatotype ratings by this method, in conjunction with Fleishman's Basic Fitness Test battery, would allow the relationship of physique and physical fitness to be examined. A number of researchers have claimed that successful sporting performance is characterized by a particular physique or somatotype. Other studies have shown a high level of physical fitness performance to be positively related to mesomorphy and negatively related to endomorphy (Section 2.6.4). A number of motor fitness test batteries and individual components of physical fitness have been studied in relation to somtotype in the past. To the best of the author's knowledge, however, this study represents the first time that performance on Fleishman's Test battery has been examined in relation to the Heath-Carter Somatotype ratings.

The Secord-Jourard (1953) Body Cathexis Questionnaire was selected to evaluate the degree of satisfaction or dissatisfaction which an individual holds toward his body. In dealing with the morphology,(somatotype) composition,and function of the body (physical fitness), a questionnaire or test was needed which was solely and directly concerned with the satisfaction of the body and its related shape and functional processes. Following a review of the methods available it was decided that the Secord-Jourard Body

112/Cathexis Test was....

Cathexis Test was the most relevant with regard to assessing this objective. The selection of this test would enable the relationships between body cathexis, physical fitness and somatotype to be examined. Previous studies which have considered the relationship between body type and body cathexis (see sections 2.7.6 & 2.8.2) have generally used body type silhouettes and individual bodily measurements, which lack the scientific rigours of somatotyping. The utilization of the Heath-Carter somatotype technique in conjunction with the Secord and Jourard Body Cathexis Test which has not been used previously, would enable the relationship between body type and body satisfaction to be studied.

Few studies have been undertaken in an effort to clarify the relationship between physical fitness and body cathexis (section 2.8.3). The use of Fleishman's Basic Fitness Test battery in conjunction with the Secord-Jourard Body Cathexis Test is, once again, the first time that these parameters have been examined in relation to each other.

The Howarth Personality Questionnaire (1977) H.P.Q.3. was selected to measure personality traits amongst the sample of boys. The use of this test in conjunction with Fleishman's tests, the Heath-Carter technique and the

Secord-Jourard Body Cathexis Test would enable the examination of the relationships between personality, physical fitness, physique and body cathexis.

It was hoped that these techniques would lead to greater understanding and clarification of the relationships existing between physical fitness, somatotype, body cathexis and personality. The elucidation of these relationships might provide answers to specific questions such as :

1) Is a high level of physical fitness associated with a specific body type, and if so, what type?
2) Is a high level of physical fitness characterized by a concomitant high degree of body cathexis?
3) Is body cathexis influenced by body type, and if so, in what way?
4) Are the variables physical fitness, somatotype and body cathexis related to specific personality traits, and if so, what traits?
5) Can one equate body esteem with self esteem?

## 3.2 HYPOTHESES

Before describing the methods adopted in this study the hypotheses advanced are presented in detail.

114/3.2.1 General Hypothesis 1 ......

3.2.1 General Hypothesis 1

The first general hypothesis states that :

A close relationship will be discerned between the variables of : physical fitness and somatotype; physical fitness and body cathexis; and somatotype and body cathexis.

This general research hypothesis was translated into the following specific hypotheses :

A1 Good physical fitness will be associated with a low endomorphic component and a high mesomorphic component.

A2 Good physical fitness will be accompanied by high body cathexis ratings.

A3 High endomorphy will be associated with low body cathexis ratings.

3.2.2 Rationale

Results of previous studies which have compared physical fitness performance to somatotype have, in general, indicated the desirability of mesomorphy and the negating influence of endomorphy (section 2.6.4). Since endomorphy represents non functional tissue and mesomorphy is characterized by functional muscularity, it was felt that this study would prove to be no exception.

Despite the paucity of empirical data describing the actual body cathexis level in relation to somatotype, a number of studies have used silhouettes and individual bodily measurements to examine the relationship between body type and body esteem. Results from these studies have generally indicated that endomorphy is negatively related to body esteem while mesomorphy is positively related. (Section 2.7.6). It was felt that this study would show endomorphy to be negatively associated with body cathexis, since social approval of physique amongst men in Western society, is generally linked to a "fat free" physique.

Since it was felt that physical fitness would be negatively related to endomorphy, and that the endomorphic physique would be negatively cathected, it was felt that high levels of physical fitness would be associated with positive body cathexis. Since high

116/fit boys, ......

fit boys, according to this reasoning, are likely to have "fat free" physiques and "fat free" physiques are positively cathected, it is logical to assume that physical fitness will be associated with positive body cathexis.

3.2.3 General Hypothesis 2

The second general hypothesis states that :

Significant differences in the somatotype and body cathexis ratings of high and low fit boys will be found.

This general research hypothesis was translated into the following specific hypotheses:

B Significant somatotypological differences, indicating that endomorphy is a negating factor, will be found between high and low fit groups on the

B1 Physical Fitness Index

B2 Shuttle run

B3 Hand grip

B4 Pull ups

B5 Leg lifts

B6 6 lap run

C <u>Significant somatotypological differences, indicating that mesomorphy is a positive factor, will be found between high and low fit groups on the</u>

C1 Physical Fitness Index

C2 Shuttle run

C3 Hand grip

C4 Pull ups

C5 Leg lifts

C6 6 lap run

D <u>Significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups on the</u>

D1 Physical Fitness Index

D2 Shuttle run

D3 Hand grip

D4 Pull ups

D5 Leg lifts

D6 6 lap run.

118/E No significant.....

E <u>No significant somatotypological differences, indicating that endomorphy is negatively related and mesomorphy positively related to high performance, will be found between high and low fit groups on the</u>

E1 Extent flexibility

E2 Dynamic flexibility

E3 Cable jump

E4 Balance

F <u>No significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups on the</u>

F1 Extent flexibility

F2 Dynamic flexibility

F3 Cable Jump

F4 Balance

### 3.2.4 Rationale

It was felt that the physical fitness performance events which required strength and dynamic gross body movement (shuttle run, 6 lap run, pull ups, leg lifts,

119/hand grip) .....

hand grip) would be severely affected by excess fat. This reasoning was based on the premise that a preponderance of fat would increase the work load and hinder performance on these events.

As mentioned earlier it was felt that high endomorphy would result in low body cathexis. Hence, it follows, that low fit groups with their hypothesized high endomorphic components, would also display low body cathexis ratings.

The physical fitness performance events, flexibility, balance and the cable jump, are considerably less vigorous, and thus it was felt that they would not be severely affected by high endomorphy. Since it was felt that there would be no physique requirements for these events it was also felt that no differences in body cathexis ratings would be found.

Several more hypotheses will be advanced in section 3.5.2 when the subdivision of the body cathexis items is described and discussed.

In order to test these hypotheses and attain the specific objectives stated in section 3.1 the techniques that were utilized are now described in detail.

## 3.3 PHYSICAL FITNESS

### 3.3.1 Fleishman's Basic Fitness Test Battery

Fleishman's (1964) battery of Basic Fitness Tests was selected to measure physical fitness. These tests, as previously mentioned, have been shown to provide efficient measurements of varying physical fitness components. Fleishman has stated, however, that

> any test manual or proposed procedure which suggests it presents the final word should immediately be suspect.
>
> P. 26

The author decided to modify the test battery in the following way:

A. Softball Throw

was omitted from the battery for the following reasons: it loads highly (0,66) on explosive strength as does the shuttle run (0,77), hence its omission still meant that coverage of the nine fitness components was possible; Fleishman has reported that the shuttle run is the more general explosive strength test involving legs, speed and gross body propulsion; and finally Smit (1965) has reported that the softball throw was the cause of some testing difficulties, as it was not a common skill in South Africa, while it was one of the more common skills of American children.

B. <u>600 Yard Run Walk Test</u>

was omitted from the battery for the following reasons: earlier discussion (chapter 2 section 2.4.1) has indicated that exercise physiologists are of the opinion that a 600 yard run walk test is not long enough to evaluate physical work capacity. Cooper's 12-minute run walk test was then considered; but after a critical analysis the author decided to use a 6 lap (2400m) run walk test developed by Coghlan (1977). In comparison to the 6 lap run walk test, Cooper's 12-minute test uses a coarser scale of measurement which can easily be demonstrated.

If a boy covers 2,110 metres in Cooper's 12-minute test he will be scored as having completed 5 1/4 laps. If another boy covers 2,199 metres in 12 minutes he will also be scored as having completed 5 1/4 laps and yet he has completed a further 89 metres. Using the 6 lap run walk test, scores are recorded in seconds and a boy need only improve by two seconds to score higher on the scoring tables (based on the increased increment scale). The 6 lap run walk test is long enough to test aerobic endurance. It is also easier to administer and score than the 12 minute test because one need only have one person at the finish line calling out the time. The 12 minute test requires a person at the 100m, 200m and 300m mark to check that subjects remain where they are when the whistle is blown and to ascertain which quarter (of the lap) they are in.

For these reasons it was decided to adopt the 6 lap run walk test in preference to either the 600 yard run walk or Cooper's 12 minute run walk test.

### 3.3.2 Test Administration Order

In order to minimize fatigue by providing sufficient rest between tests, the order in which the tests were administered was carefully considered. Fleishman (1964) has written that, provided at least ten minutes rest was permitted between the more strenuous tests, the order of test administration has not been found to be a significant factor influencing test scores, with the exception of the 600 yard run walk test. Bearing this in mind, the author administered the tests to the four classes (8A, 8B, 8C, 8D) in the following manner.

A. First Week

Session 1 1) Extent Flexibility
2) Dynamic Flexibility
3) Pull Ups

A five minute rest was permitted between each test, and the extent flexibility test was administered before dynamic flexibility, in order to avoid differences in warm-up, and thus provide a more "pure" measure of this factor (Fleishman 1964).

B. Second Week

Session 2 1) Cable Jump
2) Balance
3) Shuttle Run

Again a five minute rest was permitted between each test except in the case of the balance test, where only one balance rail was available, and hence each subject was afforded considerably more rest time than five minutes.

C. Third Week

Session 3 1) Hand Grip
2) Leg Lifts

124/As only one.....

As only one hand dynamometer was available, subjects were tested individually, and following this the leg lifts were completed

D. Fourth Week

Session 4 1) 6 Lap (2400m) Run Walk Test

### 3.3.3 Raw Score Interpretation

Fleishman's National Norms for the Basic Fitness Tests were referred to, in order to interpret scores on the individual tests. These norms are broken down by test, age, and sex and are based on data from more than 20,000 students. Ideally the author would have liked to use South African norms but unfortunately none have been constructed. Smit (1965) and Sloan (1966) have compared results from samples of South African children with the AAHPER norms, and have found that the South African samples showed higher levels of physical fitness. Andrews (1975) has compiled norms for South Africans on the CAHPER tests but unfortunately the CAHPER tests differ markedly from Fleishman's tests, and the norms were considered unsuitable for this study. The use of the American norms was not considered to be a limitation since no international comparisons were being drawn. Each subject

125/was compared......

was compared using the same norms, and hence, no unfair advantages or disadvantages could be claimed. In the case of the 6 lap run walk test norms based on the increased increment scale were utilized.

A. The Physical Fitness Index (P.F.I)

was used to summarize an individual's overall performance, bearing in mind that the most useful information is probably still that provided by the separate tests. Fleishman's tests lend themselves to a fitness index since they tap separate factors, and the danger of weighting some areas unduly, at the expense of others, is thus minimized. In order to calculate the P.F.I. the following table was utilized.

Table V: Percentile equivalents and Fitness Index points.

| PERCENTILE INTERVALS | CONTRIBUTION TO FITNESS INDEX * |
|---|---|
| 97 and above | 9 |
| 90 to 96 | 8 |
| 80 to 89 | 7 |
| 65 to 79 | 6 |
| 35 to 64 | 5 |
| 20 to 34 | 4 |
| 10 to 19 | 3 |
| 4 to 9 | 2 |
| 3 and below | 1 |

P. 8

126/* Standard score.....

* Standard score (stanine) scale - the interval at each stanine level is approximately 1/2 a standard deviation.

The P.F.I. is then determined by finding a subject's percentile score from the norms, for a certain test, locating the corresponding fitness index score, and incorporating these into the following formula:

$$\text{P.F.I.} = \frac{\text{Total Index points}}{\text{Number of tests given}} \times 10$$

The P.F.I. then allows a quick, rough index of a subject's overall performance, but one must remember that a P.F.I. of 50 could be achieved by average performance in all tests, or by a combination of exceptional and inferior performances on a number of different tests.

B. <u>Selection of High and Low Fit Groups</u>

In order to split the sample into high physical fitness performance groups and low physical fitness performance groups, the mean and the standard deviation were utilized. Those boys falling into the area one standard deviation above the mean, and those falling into the area one standard deviation below the mean, were selected as the high and low fit groups respectively. This technique enabled the examination of high and low fit groups in order to ascertain whether or not significant differences existed between the groups.

### 3.3.4 Apparatus and Test Events

The following apparatus was used for the Basic Fitness Tests :

An anthropometric steel tape;
A Takeikiki Kogyo hand dynamometer;
A 60 cm nylon cable;
A balance rail;
An Olympic Horizontal Bar;and
A Casio stop watch.

The correct procedure for executing the tests was clearly demonstrated to each subject before commencement.

(I) Extent Flexibility

was measured using a test devised by Fleishman (1964). He defines extent flexibility as :

> the ability to flex or stretch the trunk and back muscles as far as possible in either a forward, lateral or backward direction.
>
> P. 3

A horizontal measuring scale 100 cms long, marked off in millimetres, was attached to the wall at shoulder height. The scale was adapted to cater for the difference in height amongst the subjects. A line was drawn on the floor, at right angles to the wall and opposite the 30,5 cm mark on the wall scale. The right handed subject stood with his left side towards the wall, toes touching the line on the floor, with his feet together and at right angles to the floor line. He stood far enough from the wall so that he could just touch the wall with his left fist. Without moving his feet, he raised his right arm sideways to shoulder level, palm down and fingers extended. From this position he twisted clockwise as far as possible to touch the wall scale with his right hand. In order to help stabilize the feet during this movement, an assistant placed his foot alongside the subject's right foot. The farthest point reached on the scale and held for at least two seconds or more, was recorded in centimetres to the nearest centimetre. Any errors in technique were corrected on the first attempt and the second attempt was recorded.

128/For the left handed .....

For the left handed subjects an alternate scale was used which read from right to left. The subject stood with his right side to the wall and twisted anti-clockwise to reach with the left hand. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,90, and a primary factor loading of 0,49 for this test.

(II) Dynamic Flexibility

was measured using a test devised by Fleishman (1964). He defines dynamic flexibility as :

> the ability to make repeated, rapid, flexing movements in which the resiliency of the muscles in recovery from strain or distortion is critical.
>
> P. 3

The subject stood with his back to the wall at a distance that allowed him to bend down without touching the wall. The feet were placed at a distance equal to shoulder width apart. An X was marked on the wall directly behind the middle of the subject's back, and another X marked on the floor between his feet. At a given signal the subject bent down, touched the X between his feet with both hands, rose, twisted to the left, and then touched the X on the wall with both hands. This counted as one cycle. In subsequent cycles the subject alternated the side to which he twisted. Using a Casio stopwatch the author recorded the number of cycles completed in 20 seconds to the nearest half cycle. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,92, and a primary factor loading of 0,50 for this test.

(III) <u>Shuttle Run</u>

was designed to measure explosive strength, which Fleishman (1964) defines as :

> the ability to expend a maximum of energy in one or a series of explosive acts.
>
> P. 3

Two parallel lines 20 metres apart were marked on a field. An assistant stood at one line and the author with a stopwatch, at the finish line. The subject stood behind the start line with one toe up to the line. On the command 'Go!' he ran to the opposite line 20 metres away, touched the ground on the far side of it with either foot and returned to the start line to repeat the procedure. The distance between the lines was covered five times to complete the 100 metres run. On the last lap the subject was encouraged to exert maximum effort to cross the finish line and complete the distance in the fastest time possible. The observers at each end checked that the subject touched the ground over the line. Before the test commenced, an efficient 'turn around' movement was demonstrated, and if a subject was making an error that grossly slowed him up at the turns, the fault was corrected. The time taken to complete the five laps was recorded to the nearest tenth of a second. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability coefficient of 0,85 and a primary factor loading of 0,77 for this test.

(IV) Static Grip Strength

which is defined as:

> the maximum force which a subject can exert, for a brief period, where the force is exerted continuously up to this maximum.
>
> Fleishman (1964 P. 4)

131/This was measured.....

This was measured with a Takeikiki Kogyo hand dynamometer for both hands. The force exerted was recorded to the nearest 0,1 kilograms force (Kgf). In order to ensure that the thrust was equally distributed the dynamometer was centrally placed in the subject's hand with the dial towards the palm. The subject used the usual technique whereby the upper limb was partly flexed and moved dynamically in an arc across the body whilst exerting pressure on the apparatus. In the execution of the movement the subject's hand or upper limb was not allowed to touch the body or any other object. Three trials were allowed for each hand, an interval of at least two minutes rest between each trial being allowed. All mistakes were rectified during the first trial, and when the rules were violated, the score was disregarded, but the trial counted. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,91 and a primary factor loading of 0,72 for this test.

(V) Pull Ups

was included to measure dynamic strength which Fleishman (1964) defines as:

132/the ability.....

> the ability to exert muscul-
> ar force repeatedly or contin-
> uously over time. It represents
> muscular endurance and emphasizes
> the resistance of the muscles to
> fatigue.
>
> P. 4

The pull ups were performed on an Olympic horizontal bar (H-bar) that was high enough for the subject to hang off the floor with his arms and legs fully extended. Prior to the test the author demonstrated one correct pull up.

The subject took an undergrasp grip on the bar. On the starting signal he pulled himself up until he could place his chin over the bar, and then lowered to a fully extended position of his arms (ie. elbows locked). This counted as one pull up, and the exercise was repeated until the maximum was reached. If the subject paused for more than two seconds, either at the top or bottom of the cycle, he was told to stop. If he did not pull the full distance, did not lower to a fully extended position of the arms, or jerked or kicked up whilst performing the movement, a half count only was recorded, and he was told this at the time. The author counted the number of pull ups out aloud to the subject each time he lowered himself fully. The legs were steadied to prevent body sway.

133/The score ....

the score was recorded to the nearest half count. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,93 and a primary factor loading of 0,81 for this test.

(VI) Leg Lifts

were used to measure trunk strength, which is also a dynamic strength test, but is specific to the trunk muscles, particularly the abdominal muscles. It was performed on a mat in the gymnasium.

The subject lay flat on his back with his hands clasped behind his neck. A partner held the performer's elbows down against the mat. The subject raised his legs, keeping them straight until they were vertical, and then returned them to the ground. This exercise was performed as many times as possible in 30 seconds. The following points were stressed :

1) Do not rock the body on the floor. The head, shoulders, and base of the spine must remain on the ground. The exercise should be a stiff one-two movement.
2) The elbows must remain flat on the ground.

134/3) The legs should....

3) The legs should be kept straight throughout and must be raised to the vertical each time.

Before testing, the movement was demonstrated and tried through two cycles, and any errors were corrected. The need for maximum effort during the short test period was emphasized. The subject started on the command 'Ready ... Go!' and was told to stop after 30 seconds. An assistant counted the leg lifts while the author timed the exercise. The number of times the legs were raised to the vertical position in 30 seconds was recorded to the nearest whole number. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,89, and a primary factor loading of 0,47 for this test.

(VII) Cable Jump

was used to measure gross muscular co-ordination which Fleishman (1964) defines as:

> the ability to co-ordinate the simultaneous actions of different parts of the body while making gross body movements.
>
> P. 4

The subject held a 60 cm length of nylon cable in front of him, each hand grasping opposite ends of the cable which protruded just outside the closed fists. The subject had to comply with the following requirements: jump over the cable without releasing it; take off and land on both feet; clear the cable with both feet and maintain balance on landing. The jump was not counted unless these requirements were met. The number of correct jumps out of five attempts was recorded, and no practice trial was permitted. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,70 and a primary factor loading of 0,56 for this test.

(VIII) Balance,

which refers to gross body equilibrium, was measured. Fleishman (1964) defines this as :

> The ability of an individual to maintain his equilibrium, despite forces pulling him off balance, where he has to depend mainly on non-visual (eg. vestibular and kinesthetic) cues.
>
> P. 4

A wooden balance rail 3,8 cm high, 1,9 cms wide and 60 cms long, mounted on a base board was used. The test was described to the subject, who had to balance on the rail using his preferred foot, which was placed along the rail. He was first given a practice trial with his eyes open, and was told that his score was the length of time from when he said 'Go!' until he touched the floor with any part of his body, or removed either hand from his hips, or opened his eyes.

The subject placed his hands on his hips, stood on the rail and when ready, said 'Go!'. At this point the author began timing. The subject was instructed not to touch the floor with any part of his body, or remove his hands from his hips.

After a practice trial, he was given two test trials with his eyes closed. The number of seconds that the subject maintained his balance for each of the two test trials was recorded separately and added for a total score. If a subject reached 20 seconds without losing his balance, he was told to stop, and a score of 20 was recorded. If he opened his eyes, removed either hand or both from his hips, or touched the floor, the trial was stopped and the time recorded. (Campbell and Tucker 1967). Fleishman (1964) reported a reliability co-efficient of 0,82 and a primary factor loading of 0,72 for this test.

(IX) 6 Lap (2400m) Run Walk

was used to measure physical working capacity (p.w.c.) which De Vries (1974) defines as :

> the maximum level of metabolism (work) of which an individual is capable.
>
> P. 228

The subjects ran in groups of six on a standard athletic track. The subjects stood behind the start line and on the commands 'Take your marks' and 'Go!' they ran or walked six laps on the track. Before starting they were informed that they were to complete six laps in as quick a time as possible, running on the inside lane. They were advised to pace themselves as evenly as possible, to try and run throughout the distance, and it was emphasized that they had to complete the specified distance. Using a Casio stopwatch the author read out the lap times as each boy passed, and assistants were used to inform respective boys how many laps they had completed, and to record their final time which was read out as each boy crossed the finish line.

## 3.4 ANTHROPOMETRIC OBSERVATIONS

The standardized anthropometric equipment utilized comprised the following: a Seca beam balance scale, an anthropometer, a Lange skinfold caliper, a steel sliding caliper, and an anthropometric steel tape. The equipment was subjected to periodic laboratory calibration.

All the anthropometric observations were taken on the right hand side of the body as recommended by the International Committee for the Standardization of Physical Fitness Tests (Larson 1974). When the observations differed by more than 0,4 mm in the case of skinfold measurements, and by more than 4 mm in the case of linear or circumferential measurements, up to four readings were taken. The three nearest readings were then averaged (Smit 1968).

In order to assess the Heath-Carter (1967) somatotype, the following anthropometric data were determined: body mass (Kg); stature (cm); skinfolds (mm), triceps, subscapular, supra-iliac and calf; bone diameters (cm), bi-epicondylar (humerus) and bicondylar (femur); girths (cm), calf and contracted arm. In addition, the biceps skinfold was determined in order to utilize it, in conjunction with the other skinfolds, for calculating percentage and absolute body fat and lean body mass.

139/3.4.1 Body Mass ......

3.4.1 Body Mass

was determined by means of a Seca beam balance scale and recorded to the nearest 0,5 Kg. The subjects wore running shorts and it was not considered necessary to make a correction for clothing.

3.4.2 Stature

defined as the distance from the soles of the feet to the highest point on the head in the median sagittal plane, was measured with an anthropometer.

The subjects were measured standing barefoot, erect, feet together, with heels, buttocks, upper back, and rear of the head in contact with the anthropometer. The head was held in the Frankfort Plane with the line of sight horizontal. As the square was brought onto the subjects vertex, he was instructed to take a deep breath and stretch upwards to his full height, thus eliminating the "diurnal variation". Care was taken to prevent the hair influencing the accuracy of the measurement, as firm contact with the scalp was determined.

3.4.3 Skinfolds

These measurements were taken with a Lange skinfold caliper which had a standard constant jaw pressure of 10 grams per square millimetre. All the skinfolds were taken on the right hand side of the body in a vertical plane, with the exception of the subscapular and supra-iliac skinfolds which were taken in oblique planes.

The objective was to measure the thickness of a complete double layer of skin and subcutaneous tissue without including any underlying muscle tissue. The skinfold was grasped with the thumb and forefinger, and held somewhat loosely. The jaws of the caliper were then placed on either side of the fold approximately 1 cm from the edges of the thumb and forefinger. After time had been allowed for the full pressure of the caliper to take effect a reading was taken to the nearest 0,1 mm.

A. Triceps

The subject stood with the arm by his side and the elbow extended but relaxed. The skinfold was located on the posterior surface of the arm at a level midway between the acromion and the olecranon. The skinfold ran parallel to the long axis of the arm.

141/B. Biceps ......

B. <u>Biceps</u>

The subject stood with the arm by his side and the elbow extended but relaxed. The skinfold was located on the anterior surface of the arm at the same level as the triceps skinfold. The skinfold ran parallel to the long axis of the arm.

C. <u>Subscapular</u>

The subject stood in an upright but relaxed position with his arms by his sides. The skinfold was measured just below the inferior angle of the scapula. The crest of the skinfold ran medially upward and laterally downward at an angle of 45° to the horizontal.

D. <u>Supra-iliac</u>

The subject stood in a relaxed position and was instructed to draw in a medium breath and hold it. The skinfold was measured about 3 cms above the right anterior superior iliac spine, with the crest of the skinfold running forward and slightly downward.

E. <u>Calf</u>

The subject sat on a chair with his foot on the floor,

142/and the knee......

and the knee flexed at right angles. The skinfold was measured on the medial side of the right calf just above the level of the maximum calf girth. The crest of the skinfold ran parallel to the long axis of the calf.

### 3.4.4 Bone Diameters

A sliding steel caliper was used to measure bi-epicondylar diameter of the distal extremity of the humerus and bicondylar diameter of the femur. The arms of the caliper were applied against the epicondyles and condyles in such a manner as to bisect the angle of the joint and to lie in the same plane as the limb. Firm pressure was applied on the contact surfaces in order to overcome the effect of soft adipose tissue. The measurement was recorded to the nearest 0,05 cm, and both limbs were measured, the larger measurement being recorded.

#### A. Bi-epicondylar Diameter (Humerus)

This is the distance between the outermost parts of the epicondyles (inner and outer) of the humerus. The measurement was taken with the subject's elbow flexed at right angles, and was usually oblique since the inner epicondyle is lower than the outer one.

143/B. Bicondylar Diameter (Femur) ......

B. Bicondylar Diameter (Femur)

This refers to the distance between the lateral and medial femoral condyles. For this measurement the subject sat on a chair with his foot on the floor and the knee flexed at right angles.

### 3.4.5 Girth Measurements

An anthropometric steel tape was used for measuring circumferences. Care was taken to apply the tape lightly around the limb so that the contour of the skin was not deformed. Maximum girth was recorded to the nearest 0,1 cm, and measurements were taken on both limbs and the larger girths were recorded.

A. Contracted Arm Girth

The arm of the subject was horizontal, the forearm supinated and the elbow fully flexed. The subject was instructed to clench his fist and contract his 'biceps' as powerfully as possible. The tape was passed around the arm approximately midway between the acromion and olecranon at the maximum circumference of the arm, at right angles to the long axis of the arm.

144/B. Calf Girth .......

B. Calf Girth

The subject stood on the floor with his feet six to nine inches apart, with his weight equally distributed through both lower limbs. The tape was passed around the leg near the top of the calf muscle and lowered until the greatest girth was located, at right angles to the long axis of the leg.

3.4.6 Prediction Formulae

The triceps, biceps, subscapular and supra-iliac skinfolds were later utilized in assessing adipose tissue, by means of Durnin and Rahaman's (1967) and Brozek *et al's* (1963) prediction formulae. Durnin and Rahaman's formula has been described by Desiprès (1978) as one of "the most acceptable field methods" to determine relative body fat, while Brozek *et al's* formula has been widely used and has been recommended by Novak (1974) for it's uniformity.

## 3.5 BODY CATHEXIS QUESTIONNAIRE

The Secord-Jourard Body Cathexis Scale is a questionnaire comprising 46 words describing body parts and functions. Subjects appraised their body cathexis by recording their reactions (feelings) on a five point scale of intensity.

### 3.5.1 Test Procedure and Scoring

The questionnaire was administered in a group situation to the 77 subjects. There was no time limit for the test, but otherwise examination conditions were observed. In the case of a subject not understanding the meaning of a word, his hand was raised and the author rendered assistance. Before handing in the scripts the subjects were instructed to check that they had answered every question.

A total body cathexis rating was obtained by summing the ratings for each individual on the 46 body items and dividing by 46.

### 3.5.2 Division of Body Cathexis Test

The author was of the opinion that a division of the Body Cathexis Test items into various categories might provide useful and interesting information concerning the manner in which an individual rates different parts of his body. This approach has been followed by Jourard and Secord (1954) and Magnussen (1958) (see Section 2.8.2) who item analysed the ratings on height, weight, width of shoulders, chest and arms, and then measured these items for correlational purposes.

146/The manner in......

The manner in which the test was divided in this study has not been used before. The division and rationale for this method is as follows.

A. Group 1.

*Neck Up*. This included hair, nose, ears, chin, neck, shape of head, profile, eyes, lips, teeth, forehead, face , back view of head.

Rationale. These items have little to do with the effective performance of physical activities and are not subjected to any anthropometrical observations. It is possible that individuals who are dissatisfied with their physique might compensate by rating these items highly. It was hypothesized that positive cathexis of these items (*neck up*) would correlate positively with high endomorphy.

B. Group 2.

*Waist Up*. This included hands, fingers, wrists, waist, back, width of shoulders, arms, chest and trunk.

Rationale. These items are considered important for the effective performance of physical activities and are closely related to physique. Anthropometric data is collected on the waist (supra-iliac), back (subscapular) and arms (triceps, biceps, contracted arm girth.) It

147/was felt that........

was felt that these items are paralleled by fitness and physique. Furthermore, the author considered these items to be closely associated with the three physical fitness events; pull ups, leg lifts, and hand grip. Pull ups require strong arms, back and shoulders, leg lifts require abdominal strength (waist) while hand grip requires strong hands, fingers and wrists. It was hypothesized that positive cathexis of these items (*waist up*) would correlate with pull ups, leg lifts and hand grip.

C. Group 3.

*Waist Down*. This included ankles, hips, legs, and knees. Rationale. Despite the fact that only one of these items (legs) is subjected to an anthropometric observation (calf) it was felt that these items were closely related to fitness and physique. Furthermore, the author considered these items to be closely associated with the performance of the shuttle run and the 6 lap run (ie. legs, knees, ankles). It was hypothesized that positive cathexis of this group (*waist down*) would correlate with the shuttle run and 6 lap run.

D. Group 4.

*Vigour*. This included facial complexion, appetite, elimination, breathing, energy level, exercise, skin

148/texture, voice, .....

texture, voice, health, sex activities, sleep, and digestion.

Rationale. Most of these items refer to abstract qualities and internal organs, and none of them are measured. It was felt that many of these items were closely associated with physical fitness and that satisfaction with these items was a function of total physical fitness (health). It was hypothesized that positive cathexis of these items (*vigour*) would be correlated with the composite physical fitness index.

E. Group 5.

*Waist.*

Rationale. It was felt that cathexis of this item would be an indication of physical fitness ie. lack of fat. It was hypothesized that endomorphy would be negatively correlated with this item while good physical fitness would be positively related. This reasoning is based on the premise that a physically fit person will not be an endomorph and thus will not have rolls of fat around his waist.

F. Group 6.

*Body Build.*

Rationale. It was felt that cathexis of this item would also be an indication of physical fitness ie.

149/mesomorphic physique.....

mesomorphic physique. It was hypothesized that a mesomorphic physique would be positively correlated with physical fitness and that positive cathexis of this item would be related to a mesomorphic physique (see Section 2.8.2).

To summarize, it was felt that cathexis of Groups 2,3, 4, 5 and 6 would be positively related to physical fitness performance and mesomorphy and negatively related to endomorphy. Cathexis of Group 1 would be negatively related to physical fitness performance and positively related to endomorphy.

### 3.5.3 Reliability

In a review of the literature the author was unable to locate any information concerning the reliability of the Secord-Jourard Body Cathexis Test. In order to determine the test-retest reliability co-efficient, the test was re-administered to the subjects approximately three months after the completion of the first test. The results may be found in Chapter 4.

## 3.6 HOWARTH PERSONALITY (H.P.Q.3) QUESTIONNAIRE

During the years 1969-1973 Howarth undertook a number of studies in an effort to develop a personality questionnaire.

Utilizing the test scores of 4,500 Canadians in conjunction with factor analytic procedures, Howarth (1973) evolved a ten factor test, the H.P.Q.3.

The H.P.Q.3. is the result of meticulous and intensive use of factor analysis on the Guilford, Cattell and Eysenck personality questionnaires. His objective was to pinpoint the desirable number of factors, without under or over extracting, that could be used in a personality questionnaire. Utilizing large scale item factor analysis to discover replicable factors, Howarth's work resulted in the emergence of a clear picture of primary personality factors. In conjunction with his own item factor analysis, Howarth utilized the replication of certain factors obtained in a very large item factor analysis carried out by Sells, Demaree and Will (1968) on 300 Cattell and 300 Guilford marker items. With this information, Howarth was able to demonstrate the replicability of primary factors, despite Eysenck's contention that primary factors were difficult to produce from one study to another.

The H.P.Q.3., derived from this item factor analysis, is unique in that it measures ten primary factors of personality but is still a relatively short questionnaire (120 items). The length of this questionnaire reduces the possibility of boredom and its resultant careless completion of test items. Since personality was considered to be a relatively minor section in this study, and the fact that the H.P.Q.3. questionnaire and its scoring programme were readily available, it was decided to utilize this particular personality measure.

### 3.6.1 Description of the Test

The questionnaire measures ten factors which include:

1) SY Sociability : This is a factor measuring a liking for social interaction ie. enjoying a party, liking going out a lot, preferring meeting people to reading.

2) AE Adjustment-Emotionality : An anxiety factor which is characterized by questions concerning worry, nervousness, tension and feelings of irritability.

3) AD Ascendence-Dominance : A widely recognised primary factor characterized by questions concerning; ease with which one loses one's temper, and never taking no for an answer.

4) SG Superego : A factor that has often been neglected, and is described by guilt feelings, worry about the past and worry about the future. Howarth envisages this factor as a bridge between the carefree outgoing personality and the shy, depressed individual.

5) HM Hypochondriac-medical : An anxiety factor that is separable from AE and is characterized by variations in mood, and insomnia.

6) IP Impulsiveness : An emotional factor that is characterized by acting on the spur of the moment ie. saying and doing things without stopping to think.

7) CC Co-operativeness-Considerateness : characterized by tolerance of others, tender mindedness and always acting in an acceptable manner.

8) IF Inferiority : A separable AE factor and is characterized by questions concerning self confidence, sensitivity of feelings and level of aspirations.

9) PS Persistence : A factor characterized by questions concerning one's persistence or determination in realizing one's work or life ambitions.

10) TS Trust vs Suspicion : A "paranoia like" factor which is characterized by feelings that everyone is against you and that people are generally "false".

The test contains 120 questions which includes 12 questions for each of the ten factors.

153/3.6.2. Reliability.....

### 3.6.2 Reliability

Howarth offers the following test-retest reliability co-efficients :

Table VI : H.P.Q.3. Test-retest Reliability Co-efficients.

| SCALE | MALE |
|---|---|
| SY | 0,85 |
| AE | 0,80 |
| AD | 0,72 |
| SG | 0,72 |
| HM | 0,73 |
| IP | 0,78 |
| CC | 0,43 |
| IF | 0,78 |
| PS | 0,70 |
| TS | 0,70 |

With the exception of co-operativeness-considerateness (r = 0,43) the reliability co-efficients are satisfactory.

## 3.7 STATISTICAL APPROACH

Use was made of the S.P.S.S. (Statistical Package for Social Sciences) system which is installed in the Rhodes University

Computing Centre and a fully programmeable Hewlett-Packard (H.P. 67) calculator.

The S.P.S.S. programmes selected were: Pearson product moment correlation analysis (included in this programme were the means and standard deviations); oblique rotation factor analysis; and multiple (stepwise) regression analysis.
A complete account of these techniques may be found in the S.P.S.S. Manual (See reference section).

The H.P. 67 was utilized to conduct student t- tests and to determine somatotype ratings.

The t-test for independent samples (parametric) was utilized. Since the direction of the difference between the groups is predicted (ie. that endomorphy will negatively affect performance etc.) (see section 3.2.3) the t-tests were one tailed, with the region of rejection located at the predicted end of the sampling distribution. A statistical level of significance $p < 0,05$ was decided upon, since the investigator considered that the consequences of making a Type I error would be equally serious for all comparisons.

## 3.8 SUMMARY

Figure 3 represents a diagrammatic illustration of the data collection.

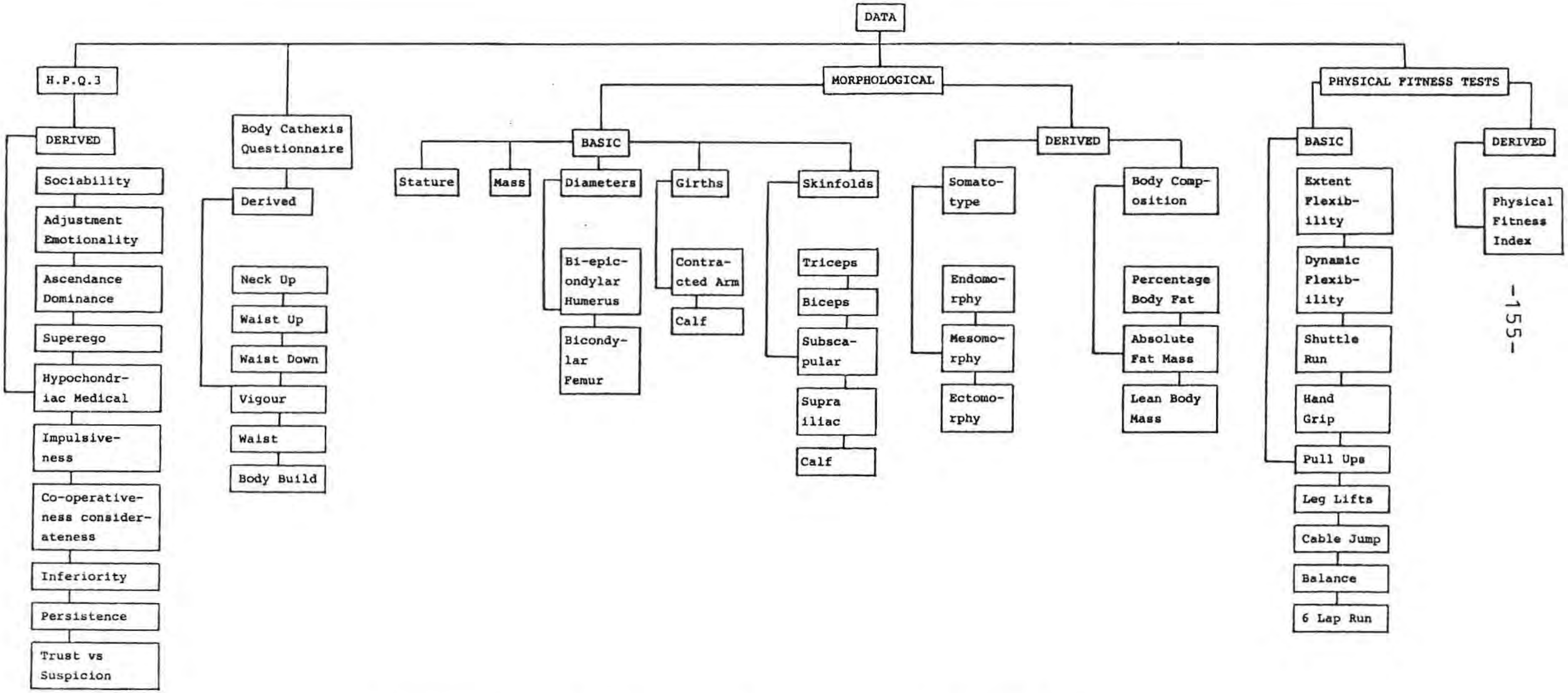


Figure 3 : Diagrammatic illustration of the data

A. Subjects

These data were collected from 77 male Caucasian subjects, all of whom were either 15 years of age or turning 15 during the course of 1980. All subjects were registered in Standard Eight at St Andrew's College, Grahamstown.

B. Test Administration

All the tests were administered by the author with the help of a few assistants, and were conducted during the months of March, April and May 1980.

C. Fleishman's Basic Fitness Tests

These were conducted in the St Andrew's College Gymnasium, and on the Rhodes University Athletic track, during physical education lessons. The subjects wore vests and running shorts with no shoes.

D. Anthropometric Observations

These were conducted in the St Andrew's College gymnasium, and in the Rhodes University Physical Education Department. The author conducted all the anthropometric observations himself in order to ensure uniformity and accuracy. Considerable practice measurements were taken by the author before the actual recording of data began.

E. Secord-Jourard (1953) Body Cathexis Questionnaire

This was administered to the subjects during prep time when silence was observed.

F. Howarth (1977) Personality Questionnaire (H.P.Q.3)

This was also administered to the subjects during prep time.

# CHAPTER 4

## PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

### 4.1 TEST-RETEST RELIABILITY CO-EFFICIENTS FOR BODY CATHEXIS AND ITS DIVISIONAL COMPONENTS.

Since no test-retest reliability co-efficients for the Secord-Jourard Body Cathexis Test were able to be located, the Body Cathexis Test was re-administered to the subjects approximately three months after the completion of the first test. Correlation co-efficients were then determined in order to ascertain the reliability of the test. These are presented in Table VII.

Table VII : Test-retest reliability co-efficients for body cathexis and divisional component scores.

| ITEM | RELIABILITY |
|---|---|
| Body Cathexis | 0,82 |
| Neck Up | 0,69 |
| Waist Up | 0,73 |
| Waist Down | 0,71 |
| Vigour | 0,61 |
| Waist | 0,86 |
| Body Build | 0,89 |

159/The test-retest......

The test-retest reliability co-efficient for the Body Cathexis Test was regarded as very satisfactory. It was also considered appropriate to include the subdivisions in the analyses since high reliability co-efficients were indicated for these items.

## 4.2 MEANS AND STANDARD DEVIATIONS (Entire Sample)

The means and standard deviations for the entire sample n = 77 (ie. for each physical fitness test, somatotype rating body cathexis) were calculated. Since the author was not primarily concerned with these data, these figures may be located in the appendix.

## 4.3 PEARSON PRODUCT MOMENT CORRELATION CO-EFFICIENTS

These were calculated in order to ascertain the interrelationships between physical fitness, somatotype, body cathexis and personality. The results of this analysis may be located in the appendix. It was extremely difficult to find or see any underlying patterns within this mass of correlation co-efficients. (See Appendix). Owing to this difficulty it was decided to utilize factor analysis.

## 4.4 FACTOR ANALYSIS

### A. Introduction

Factor analysis was selected for this study because the author was searching for structures or patterns within a particular domain, and, as an exploratory technique, factor analysis provides a powerful tool for studying a particular domain. Given an array of correlation co-efficients for a set of variables, factor analytic techniques enable us to see whether some underlying pattern of relationship exists. This reduces or re-arranges the data to a smaller set of factors that may be taken as source variables accounting for the observed interrelations in the data.

> Order and simplification are the first steps toward the mastery of a subject - the actual enemy is the unknown.
>
> Liba and Safrit
> (1969 P. 130)

This quotation can aptly be applied to factor analysis and serves to illustrate the practical use of this technique. Factor analysis orders and simplifies the data and is able to resolve a set of descriptive variables in terms of a small number of categories or factors in order to attain economy of description. Substantive conclusions about important domains of individual differences can then be drawn. Factor analysis appeared to be the ideal tool for structuring and simplifying the observed correlations between physical fitness, somatotype, body cathexis and personality. The purpose of this technique was to isolate patterns of common variance within the total set of variables, in order that the relationships existing might be identified and consequently analysed.

161/To factor analyse.....

To factor analyse at the most general level, means to express a variable as a linear combination of independent variables which may be either defined or inferred. Defined variables are exact mathematical transformations of the original data, and no particular assumption about the underlying structure of the variables is required. Inferred variables are based on the faith that observed correlations are mainly the results of some underlying regularity in the data. Inferential assumptions are made about the structuring of variables and their source of variation. S.P.S.S. offered five different methods of factoring which included:

| | |
|---|---|
| P.A. 1 | principal factoring without iteration |
| P.A. 2 | principal factoring with iteration |
| RAO | Rao's canonical factoring |
| ALPHA | alpha factoring |
| IMAGE | image factoring |

P.A. 2 was selected for the purposes of this study because it handles most of the initial factoring needs of the user and is, at present, the most widely accepted factoring method. P.A. 2 produces inferred factors, and the immediate result of this sub programme is the extraction of an unrotated factor matrix in which the factors are arranged in order of importance, and are all orthogonal.

162/Having selected....

Having selected the factoring method it is necessary to consider the best rotational method to arrive at the terminal solution. Rotation is utilized in order to simplify the factor structure and obtain theoretically meaningful factors. Two choices of rotation are available; orthogonal or oblique. Orthogonal factors are mathematically simpler to handle, but for this study, oblique rotation was preferred because oblique factors are empirically more realistic. In comparison to orthogonal rotation, oblique rotation allows the requirement of orthogonality among the factor axes to be relaxed. This implies that the oblique factor axes are allowed to rotate more freely to best summarize any clustering of variables (Jae-On-Kim. 1975). For these reasons oblique rotation was selected in preference to orthogonal rotation.

A total of 33 variables were subjected to factor analysis. A complete listing of these variables is provided in the appendix. The variables comprise three somatotype scores, three related body composition scores, nine physical fitness test scores, seven body cathexis scores, and ten personality trait measures.

## B. Results of Analysis

The results of the S.P.S.S. version P.A. 2 oblique rotated factor analysis were as follows : a total of ten oblique

163/rotated factors......

rotated factors accounting for the total variance were identified; three factors were isolated, which together accounted for 83,6% of the total variance existing within the input matrix; the remaining seven factors accounted for 16,4% of the variance. These factors were all orthogonally related (uncorrelated). In each factor, groups of strong and groups of weak factor loadings were discerned which will be presented in tables. Factor loadings below +0,20 or -0,20 were not considered. The complete factor analysis may be found in the appendix.

### 4.4.1 Factor 1

Table VIII lists the most important factor loadings identified under factor 1.

Table VIII : Major rotated factor loadings identified under Factor 1.

Strong ( > -0,45 or > +0,45) Rotated Factor Loadings

| POSITIVE LOADINGS | | | NEGATIVE LOADINGS | | |
|---|---|---|---|---|---|
| NO. | VARIABLE | LOADING | NO. | VARIABLE | LOADING |
| 6 | Shuttle Run SR | 0,50 | 1 | Endomorphy ENDO | 0,73 |
| 7 | Hand Grip HG | 0,46 | 21 | Percentage Fat F | 0,76 |
| 8 | Pull Ups PU | 0,81 | 22 | Absolute Fat FM | 0,57 |
| 9 | Leg Lifts LL | 0,57 | | | |
| 12 | 6 Lap Run LR | 0,67 | | | |
| 13 | Fitness Index FI | 0,78 | | | |
| 20 | Body Build BB | 0,55 | | | |
| | Weak ( > -0,30 or > +0,30) Rotated Factor Loadings | | | | |
| 19 | Waist ST | 0,34 | | | |

164/Variance Explained .....

Variance Explained by Factor 1 = 40,5% (of total).

Factor 1 is described by high positive loadings on the physical fitness tests, shuttle run, hand grip, pull ups, leg lifts, 6 lap run and the physical fitness index, and one body cathexis item, *body build*. High negative loadings are discerned for endomorphy, percentage body fat and absolute fat mass (Kg).

Of the physical fitness tests, the shuttle run is designed to measure explosive strength, hand grip measures static strength, pull ups measure dynamic strength, leg lifts measure dynamic strength of the trunk and the 6 lap run is an indication of the physical working capacity (aerobic). The composite fitness index is self explanatory. The body cathexis item loading positively on this factor, namely *body build*, is an indication of an individual's satisfaction with his overall physique.

Of the three variables that load negatively on this factor, endomorphy is a measure of relative fatness and relative leanness, in that component ratings are evaluations of degrees of fatness, which lie on a continuum from the lowest recorded values to the highest recorded values. Percentage body fat refers to the relative amount of adipose tissue in the body mass while

165/absolute fat.....

absolute fat mass refers to the actual weight (Kgs) of adipose tissue in the body mass.

## A. Discussion and Interpretation

Factor one is most heavily weighted with the physical fitness tests (with particular emphasis on strength) and the degree of adiposity. This is identified as an Energy (work) Output Factor, reasons for which will become apparent as the discussion proceeds. At this point the naming of factors and the pitfalls in it warrants some comment. It is easy to name a factor and then to believe that there is reality behind the name. Factor names are attempts by the investigator to focus on the essence of the variables represented in that factor and as such are very useful. Factor labels are always tentative and should be so viewed and should in no way be taken to describe a "real" phenomenon. It is not the label that is important but the underlying grouping of variables, and the precise nature of this grouping is not always readily discernible (Liba and Safrit 1969).

Quite clearly excess adipose tissue (fat) appears not to be associated with effective physical performance on these tests. This is not a surprising result since adipose tissue is, relatively speaking, metabolically inert. Adipose tissue is non contractile tissue, hence it constitutes a burden to physical activities involving the displacement of the body mass since it is effectively "dead weight", which increases the work load and hinders movement. An individual carrying an excess ten kilograms of fat would compete on equal terms with an individual of proportionate weight only if he was forced to carry ten kilogram weights strapped to his body. This "dead weight" with which the endomorphic individual has to contend, is a severe handicap.

Thorough interpretation of this factor necessitates a brief description of the components which comprise body mass. The human body may be regarded as being composed basically of internal organs, bone, muscle (fat free weight) and fat. We are primarily interested in muscle and fat since great changes in these components can be brought about by physical activity. As has just been mentioned, excess fat is a hindrance to physical activities which involve weight bearing skills (ie. running, walking, gymnastics). In some aquatic events (ie. water polo, long distance swimming) a small surplus of fat can be beneficial in that the body mass is less dense and consequently more buoyant, which is why it is necessary to stipulate that it negatively affects <u>weight bearing</u> skills. The greater the fat to muscle ratio is, the greater the limitation to performance.

167/Once the weight.....

Once the weight of the body fat is subtracted from the total body mass, the remaining weight is referred to as fat free weight or lean body mass. This lean body mass reflects mainly the skeletal muscle mass but it also includes the weight of other tissues such as skin and bone. It is logical to assume that the less body fat there is, the more lean body mass. Lean body mass is usually considered to be positively related to physical performance, since a large lean body mass component implies a large muscle mass and thus greater force potential. (Fox 1979).

(I) <u>Hand Grip. HG - Factor Loading 0,46</u>

The measurement of static strength, using the hand dynamometer emphasizes the ability of the muscles to exert kilogram forces of pressure. In contrast to the shuttle run, pull ups,and leg lifts, the force is exerted against an external object as opposed to supporting or propelling the body mass. Since the body mass does not have to be displaced, the strength/mass (lean body mass/mass) ratio does not necessarily have to be in proportion to score well. The slightly lower factor loading for hand grip would appear to support the fact, that the presence of endomorphy and its accompanying "dead weight", does not limit performance in this event to the same extent as the others. High endomorphy

168/is usually.....

is usually characterized by considerable body bulk (this will be fully discussed under Factor 2) and very often this type of individual will possess great absolute strength but low relative strength. The law of squares and cubes clearly demonstrates this relationship. The law states that if the shape and proportions of any material body remain the same, but its size varies, its strength increases as the square of any one dimension, while its weight increases as the cube. Consider the hypothetical situation of an endomorph doubling his length (ie. height) and undergoing no other change in his body dimensions. During this growth his height has doubled, his weight will have increased as the cube of two, and he will then weigh eight times as much; but the strength of his muscles will have increased as the square of two, and he will be only four times as strong. Undoubtedly this man will be able to apply great pressure on the hand dynamometer since his strength has quadrupled, (absolute strength) but when he endeavours to propel his mass either vertically or horizontally (relative strength) he would encounter extreme difficulty because his mass has increased eightfold. (Dart 1979).

169/(II) Shuttle Run SR.......

(II) <u>Shuttle Run SR -Factor Loading 0,50</u>

The nature of this activity requires rapid acceleration and deceleration within a distance of 20 metres and is dependent upon an individual's power or his rate of work. Force is equal to mass x acceleration and biomechanically, considerable muscular force is required to overcome the inertia of the body and produce the resultant acceleration. An endomorph, carrying extra weight in the form of adipose tissue, will need great muscular force to produce rapid acceleration. Furthermore an endomorph, who is most likely rather bulky, will not possess good relative strength, as the law of squares and cubes has illustrated. High relative strength is a prerequisite for rapid acceleration and consequent displacement of the body mass. Power is equal to the rate of work (work ÷ time) and since work is a function of force times the distance through which that force is exerted, it is evident that the endomorph's work output will be limited, since he is lacking in relative strength.

Hence an endomorph, lacking in relative strength, with a large body mass and a high proportion of excess fat, will be limited in obtaining rapid acceleration and consequent power, which is necessary for effective performance on the shuttle run.

(III) <u>Pull Ups. P.U.- Factor Loading 0,81</u>

Pull ups require the arms repeatedly or continuously to move and support the weight of the body. The crucial aspect of this factor is the requirement that muscular force be exerted continuously, to heave the body until the decrement in muscular force results in the inability to repeat this movement. The law of squares and cubes applies to pull ups and it is evident that high endomorphy (bulk) will be a severe limiting factor in the ability to perform pull ups. Furthermore the problem of leverage and body mass can be utilized to illustrate the capacity to perform pull ups. Biomechanically the ability to accomplish pull ups is proportional to the force of the muscles and their levers upon which it works. Hence pull ups are proportional to :

$$\frac{F \times a}{M \times A}$$

where F = muscular force

M = mass

a = levers for the muscles

A = levers for the body weight

171/It is evident.....

It is evident that the heavier or bulkier boy is handicapped by his greater body weight. Since an endomorph is carrying considerable "dead weight" his ability to accomplish a pull up becomes progressively more difficult. The very high factor loading for pull ups would seem to suggest that of all the fitness events, pull ups are most severely affected by excess adipose tissue. Hence to execute a pull up, one's strength/mass ratio must be in proportion (ie. relative strength). The endomorph lacks relative strength and is consequently severaly limited in his capability to perform this event.

(IV) Leg Lifts L.L.- Factor Loading 0,57.

The ability to perform leg lifts can be viewed in the same light as the ability to perform pull ups. In conjunction with the law of squares and cubes, the same problem of the levers for the muscles and the body weight must be considered. The mass that must be lifted is considerably less (ie. legs only), but considerable muscular force from the abdominals is required for efficient performance. Again it is evident that an endomorph, lacking in relative strength, will be limited in his ability to accomplish leg lifts. The noticeably lower factor loading for this event in comparison to pull ups, is most likely attributable to the fact that less mass has to be lifted.

(V) 6 Lap Run L.R. - Factor Loading 0,67

It is not difficult to understand how excess body fat negatively affects the physical working capacity. An individual's physical working capacity is dependent upon his capacity to supply oxygen to the working muscles. Excess adipose tissue, for runners, not only means more work to be performed since a "dead weight" is being carried, but it is also saturated with blood vessels which reduce available oxygen needed by the muscles for running. In short the adipose tissue, which does not contribute to performance, must still be moved at a definite cost in terms of energy. Even runners with a large mass comprising low excess fat and a high lean body mass content (ie. extreme mesomorphs) will be at a disadvantage when compared to the ectomorph. A number of studies have revealed that the oxygen consumption per kilogram of body weight is relatively constant at a given pace, regardless of the total mass of the runner. Hence the heavier the runner is, the more oxygen he must be able to process and distribute to his muscles at a given running pace. Hence the large endomorph is severely handicapped in running the 6 lap run. (Miller 1976).

Further evidence for the low performance of endomorphs in this event is provided by Astrand and Rodahl (1970). They write that it is conceivable that aerobic power might be adapted to a child's muscular machine since their studies showed that muscular strength in 8 to 16 year old boys was proportional to the maximal oxygen uptake. If this is true, the excess body fat which limited the endomorph's performance on the strength events, will have the same effect on the 6 lap run.

(VI) <u>Physical Fitness Index F.I.- Factor Loading 0,78</u>

The composite physical fitness index is a derivation of the scores on all the physical fitness tests. Quotients such as the P.F.I. are apt to be uninterpretable in factor analysis since they can create artifactual information (ie. combination of direct and derived scores); hence guarded comment on this factor will be made. Since the P.F.I. is a quotient of all the physical fitness tests, its high loading on the Energy Output factor nevertheless makes it one of the most important markers for this factor. It would appear that the five physical fitness tests (hand grip, shuttle run, pull ups, leg lifts and 6 lap run) are closely associated with the physical fitness index, which is negatively affected by excess adiposity.

Hence the Energy Output factor is characterized by events that require considerable muscular work to be done. This muscular work, which largely involves the displacement of the body mass, is negatively affected by high levels of adipose tissue, which constitutes a "dead weight", and consequently limits performance.

(VII) Body Build BB - Factor Loading 0,55

The high loading of the body cathexis item *body build*, on the energy output factor, would appear to suggest that positive cathexis of the *body build* is a function of high performance on these physical fitness events and the accompanying lack of excess adipose tissue. In other words, cathexis of *body build* is positively related to high energy output performance events, and negatively related to endomorphy and its associated high proportion of excess fat. Since the ability to perform these physical fitness events effectively is dependent upon a high lean body mass to fat ratio, it is logical to assume that positive cathexis of the item *body build* is a function of muscularity or lack of fat. This is not a surprising finding since in our culture, normal weight is considered to be desirable and even moderate degrees of obesity are perceived as disfiguring.

175/(VIII) Waist ST.....

(VIII) Waist ST. - Factor Loading 0,34

A considerably lower factor loading is obtained for the body cathexis item *waist*. This would suggest that a weak relationship exists between high performance on these physical fitness events and positive cathexis of the *waist* while endomorphy is negatively related to cathexis of the *waist*. This finding can be interpreted in a similar fashion to the item *body build*. It is highly unlikely that rolls of fat around the midriff will lead to satisfaction with the waist. (Nor, for that matter will rolls of fat anywhere else lead to satisfaction with the corresponding part of the body).

What of the four physical fitness events which did not load heavily on Factor 1, namely, extent flexibility, dynamic flexibility, balance, and cable jump (co-ordination)? The fact that these events did not load heavily on Factor 1 deserves some mention and interpretation.

(IX) Extent Flexibility EXFL.- Factor Loading 0,19
Dynamic Flexibility D.F.- Factor Loading 0,23

Extent flexibility is dependent upon the ability to stretch the trunk and back muscles as far as possible while dynamic flexibility is dependent upon the ability to make repeated, rapid, flexing

176/movements where....

movements where the resiliency of the muscles in recovering from strain or distortion is critical. The low factor loadings would seem to suggest that the performance of the strength events and the 6 lap run are not highly related to flexibility and neither is excess fat a limiting factor on flexibility. The explanation that can be offered is the fact that flexibility has been shown to be highly specific. Measurement of one of several body joints cannot be used to predict range of motion validly in other body parts (Clarke 1975). It could be inferred that the joints used in extent and dynamic flexibility, in this context, are, in part, alienated from those used in the strength and 6 lap run events. The fact that excess adipose tissue is not a limiting factor can be attributed to the fact that the body mass is not displaced.

(X) <u>Balance B.- Factor Loading 0,22</u>

A brief description of the physiological processes relating to balance is necessary for the interpretation of this result.

The cerebellum is concerned with balance, posture, and the co-ordination of complicated muscular movement and can be considered to be a co-ordinating centre for sensory impulses, which in turn, influence motor behaviour. Much of the information that the cerebellum receives is transmitted by the proprioceptors, which are the sense organs of the body and are stimulated by movement of the body itself. Proprioceptors lead to awareness of the movement or body position in space, and of the relation of various parts of the body to each other, which is essential for the production of precise motor responses. These proprioceptors may be split into two categories, namely General and Specific. General proprioceptors are located in tendons, skeletal muscles, and the joints, and are stimulated by degrees of tension, pressure and stretch. Golgi tendon organs, found at the insertion of the tendons into the muscle, are stimulated by tension, which occurs with muscle contraction and lengthening. Muscle spindles are located in the skeletal muscle and they provide information concerning stretch within the muscle and feedback involving contraction of the muscle. Within the joint capsule itself, Ruffini receptors and Pacinian corpuscles are found which appear to signal position and register movement respectively. (Dickinson 1974).

178/The receptors.....

The receptors of the vestibular system (specific proprioceptors) are located in the inner ear (labrynth) and are stimulated by movements or changes of position of the head in space. These end organs in the labrynth are linked through vestibular nucleii which contribute to adjusting posture and balance.

Proprioceptors are then stimulated by changes in locomotor systems of the body. The vestibular system (movements and position of the head in space), the tendons (tension and stretch), the muscles, (stretch) and the joints (stretch and pressure) provide the senses of balance and awareness of movement and position of the body in space.

The term kinesthesis has been used synonymously with proprioception, since it is primarily based on the internal stimuli from the sense receptors (proprioceptors) and the vestibular apparatus. Kinesthesis refers to the perception of movement but because it is a complex of many independent and interdependent constituents, it cannot be considered a general feature. Balance is highly integrated with kinesthetic awareness.

179/Balance with.....

Balance with its factor loading of 0,22 is not seen as being highly related to the performance of the four strength events and the 6 lap run. Furthermore it does not seem to be negatively affected by excess adipose tissue. The problem of balance is undoubtedly a vitally important factor in the acquisition of a particular skill but it seems evident that varying degrees of balance are required depending upon the skill in question. Roller skating, ice skating, skiing, and operating two wheeled vehicles are skills which would emphasize the balance ability; more so than for the successful performance of the shuttle run etc. Dickinson (1974) reports a considerable number of studies which have attempted to relate balance ability to the performance of physical skills, and conflicting results have emerged. Some studies have reported that static balance ability is correlated with skill in gross motor activities, while on the other hand, negative evidence has also been reported. Confusing evidence also exists with regard to the relationship between height, weight and balance ability and it would appear that no clear cut pattern of relationship exists. (Fully discussed in section 5.1).

180/This study....

This study would seem to suggest that static balance is not a vital factor in the performance of the four strength events and the 6 lap run, and neither is it adversely or positively affected by excess fat. The ability to balance does not involve the displacement of the body mass, or necessitate a high energy output, and nor does it seem dependent on the fat to muscle ratio. The conclusion that can be drawn is that the ability to balance is a function of the proprioceptors which do not appear to be adversely affected by excess adipose tissue.

(XI) Cable Jump (co-ordination) C.J. - Factor Loading 0,13

In most movements, groups of muscles are co-operating together and the key to skilled movement is the timing of the period of muscular tension development in a movement cycle, so that full utilization of internal tension under essentially isometric co-ordination is possible. Good co-ordination depends on the synchronous action of the agonists and antagonists, and the feedback loops from the proprioceptors are responsible for modulating the motor-neural activity. Good general co-ordination should be reflected in high achievement in a number of physical activities. The low factor loading for the cable jump would appear to contradict this. The findings of this study

181/would seem to .....

would seem to suggest that co-ordination is not highly related to any of the physical fitness tests and neither is it affected by excess adipose tissue. This result is a little difficult to interpret since good co-ordination must surely be a factor in the effective performance of the shuttle run, leg lifts, pull ups and 6 lap run. An explanation that can be offered is that perhaps the specific test of co-ordination, namely the cable jump, requires considerably more discrete co-ordination than do the physical fitness events. If this was the case one could score well on the physical fitness tests while achieving a low score on the cable jump. A further factor that might be considered in the performance of this event is the onset of adolescence. It is possible, if the cable jump does require more discrete co-ordination than the other tests, that adolescence (which is frequently accompanied by clumsiness) has a greater negative effect on the cable jump than on the other activities. The fact that the cable jump is not affected by excess adipose tissue could again be credited to the fact that no significant displacement of the body mass takes place.

182/(XII) Conclusion......

(XII) Conclusion

The major findings from Factor 1 indicate that performance on the high energy output events is severely limited by excess adipose tissue, while the events which do not require strength or the body mass to be displaced are not related to specific physique requirements. It seems likely that these events are affected by factors other than somatotype.

Body cathexis is not closely related to the high energy output events or endomorphy, although a relationship between the two individual body cathexis items *body build* and *waist* is discerned. This would suggest that positive cathexis of these items is a function of high energy output and its accompanying absence of endomorphy. The fact that only two cathexis items load on this factor, however, suggests that relatively little interrelationship exists. Besides the two items *body build* and *waist*, the subdivision of the body cathexis items failed to produce the expected results. (See section 3.5.2).

Personality is not related to the high energy output events or endomorphy, which indicates that little association exists between personality, physical fitness, and physique.

### 4.4.2 Factor 2

Table IX lists the most important factor loadings identified under Factor 2.

Table IX: Major rotated factor loadings identified under Factor 2.

Strong (> -0,75 or > +0,75) Rotated Factor Loadings

| POSITIVE LOADINGS | | | NEGATIVE LOADINGS | | |
|---|---|---|---|---|---|
| NO. | VARIABLE | LOADING | NO. | VARIABLE | LOADING |
| 1 | Endomorphy ENDO | 0,79 | 3 | Ectomorphy ECTO | 0,91 |
| 2 | Mesomorphy MESO | 0,83 | | | |
| 21 | Percentage Fat F | 0,76 | | | |
| 22 | Absolute Fat FM | 0,79 | | | |
| | Weak (> -0,20 or > + 0,20) Rotated Factor Loadings | | | | |
| 7 | Hand Grip HG | 0,38 | 12 | 6 Lap Run LR | 0,23 |
| 20 | Body Build BB | 0,26 | 19 | Waist ST | 0,31 |
| 23 | Lean Body Mass LM | 0,26 | | | |

Variance Explained by Factor 2 = 26,0% (of total)

Factor 2 is described by high positive loadings on endomorphy, mesomorphy, percentage body fat and absolute body fat (Kg). A high negative loading is discerned for ectomorphy.

Endomorphy, percentage fat and absolute fat are self explanatory in that they are measures designed to indicate the fat content of the body. Mesomorphy is a measure indicating the relative musculo-skeletal or lean body mass relative to height of the physique.

The one variable that loads negatively on this factor, ectomorphy, is a measure of the relative linearity of the physique.

A. Discussion and Interpretation

Factor 2 is most heavily weighted with somatotype and related body composition measures. At first glance this would appear to be a somatotype or physique factor. While this is essentially true, it would be more accurate to refer to this as a Body Bulk Differentiation factor, for the ensuing reasons. The fact that endomorphy and mesomorphy load highly and positively together, and that ectomorphy loads highly and negatively can be explained in the following manner. Ectomorphy or linearity refers to the relative "stretched-outness" of the first two components (ie. endomorphy and mesomorphy). A pencil thin person has little body bulk per unit of height, while the rotund person, who looks like a ball, has great body bulk per unit of height. The former will be rated high and the latter low on ectomorphy. Owing

185/to the fact.....

to the fact that endomorphy and mesomorphy account for the body bulk present, one cannot have high ectomorphy in the presence of high ratings in endomorphy or mesomorphy. This would account for the fact that endomorphy and mesomorphy load together while ectomorphy loads negatively. Further explanation for endomorphy and mesomorphy loading together is provided by Carter (1975). He writes that it is feasible that a moderate level of mesomorphy is necessary to sustain very high levels of endomorphy. These suggestions, that low ratings in mesomorphy are unlikely to occur in high endomorphy are the result of an increase in protein mass as well as fat mass in increasing obesity. For these reasons, Factor 2 is referred to as a Body Bulk Differentiation factor.

It is significant that neither physical fitness, nor body cathexis, nor personality factors appear to be strongly related to this factor. Weak relationships however, (as illustrated in Table IX) were evidenced which deserve mention.

(I) Hand Grip H.G.- Factor Loading 0,38

The positive loading for hand grip indicates a weak relationship between body bulk and static strength. The law of squares and cubes has clearly demonstrated why this occurs and has been discussed earlier. (Section 4.4.1 (I)). Suffice it to say that body

186/bulk implies.....

bulk implies high absolute strength which is conducive to good performance on the hand dynamometer.

(II) Body Build BB - Factor Loading 0,26

The positive loading for the cathexis item, *Body build* would seem to indicate that body bulk is weakly associated with positive cathexis of the overall physique. Factor 1 has indicated that endomorphy is negatively associated with cathexis of the *body build,* and the finding on Factor 2 might appear at first, to be a contradiction. This is not entirely true, since mesomorphy also loads highly on Factor 2. A possible interpretation of this result is that positive cathexis of *body build* is a result of the mesomorphic content of the body and not the endomorphic component. The conclusion that can be drawn, is that a large mesomorph, who will be characterized by great size, is liable to rate his physique satisfactorily despite the fact that he possesses some excess adipose tissue. An example of this type of physique is that found in the champion shot putter.

(III) Lean Body Mass L.M. - Factor Loading 0,26

The positive loading for lean body mass can be explained by relating it to the mesomorphic content of the body.

187/(IV) 6 Lap Run LR. ......

(IV) 6 Lap Run LR. - Factor Loading -0,23

The negative loading for this event is easily explained by the fact that body bulk is not conducive to distance running. This has been discussed earlier (section 4.4.1 (V)) and further evidence for this relationship can be gained by studying the physiques of long distance runners. Without exception, these athletes are characterized by high ectomorphy and small size. (Low bulk).

(V) Waist ST. - Factor Loading -0,31

The negative loading for the cathexis item *waist*, can be explained by the fact that it is highly unlikely that a person with great bulk, will have a "fat free" waist. An ectomorph is likely to have a slender waist, which as has been mentioned, is conducive to positive cathexis in our society.

(VI) Conclusion

Factor 2 appears to be a Body Bulk Differentiation factor and little relationship is discerned between this factor and physical fitness, body cathexis and personality.

The weak relationships found between physical fitness, body cathexis and this factor can be explained by

188/relating them to..

relating them to physique. For example, performance on the hand grip will be enhanced by body bulk whereas performance on the 6 lap run will be enhanced by a high ectomorphic component. Positive cathexis of the *body build* is related to large mesomorphic size, while positive cathexis of the *waist* is a function of high ectomorphy.

The major finding from this factor, however, is the notable absence of interrelationships between the variables somatotype, physical fitness, body cathexis and personality.

### 4.4.3 Factor 3

Table X lists the most important factor loadings identified under Factor 3. (See overleaf for Table X).

Factor 3 is described by high negative loadings on Body Cathexis and its derived components. This is very clearly a Body Cathexis factor and it is significant that high loadings for somatotype, physical fitness and personality are not to be found on this factor. This would seem to suggest that body cathexis is not highly related to any of these parameters.

Table X: Major rotated factor loadings identified under Factor 3.

Strong (> -0,45 or > +0,45) Rotated Factor Loading

| POSITIVE LOADINGS | | | NEGATIVE LOADINGS | | |
|---|---|---|---|---|---|
| NO. | VARIABLE | LOADING | NO. | VARIABLE | LOADING |
| | | | 14 | Body Cathexis BC | 1,0 |
| | | | 15 | Neck Up NU | 0,79 |
| | | | 16 | Waist Up WU | 0,77 |
| | | | 17 | Waist Down WD | 0,64 |
| | | | 18 | Vigour VIG | 0,72 |
| | | | 19 | Waist ST | 0,47 |
| | | | 20 | Body Build BB | 0,59 |
| | Weak (> -0,20 or > + 0,20) Rotated Factor Loadings | | | | |
| 1 | Endomorphy ENDO | 0,24 | 6 | Shuttle Run SR | 0,27 |
| 21 | Percentage Fat F | 0,26 | 7 | Hand Grip HG | 0,30 |
| 31 | Inferiority IN | 0,43 | 8 | Pull Ups PU | 0,21 |
| | | | 9 | Leg Lifts LL | 0,22 |
| | | | 13 | Fitness Index FI | 0,23 |

Variance Explained by Factor 3 = 17,1% (of total)

A number of weaker loadings are discerned, however, for these variables which deserve mention. Positive loadings are discerned for endomorphy, percentage body fat, and inferiority, while alongside body cathexis, negative loadings are found for shuttle run, hand grip, pull ups, leg lifts and the physical fitness index.

190/A. Discussion and Interpretation.....

## A. Discussion and Interpretation

The most noticeable feature about this factor, as has been mentioned, is the relative independence of body cathexis and its derived components. This would suggest that physical fitness, somatotype and personality characteristics are not highly related to the function or formation of one's level of satisfaction with the body. The level of body cathexis does appear to be weakly affected, however, by the following variables.

(I) Endomorphy. ENDO.- Factor Loading 0,24
Percentage Body Fat. F.- Factor Loading 0,26

The positive factor loadings for endomorphy and percentage body fat suggests that the presence of excess adipose tissue negatively affects the manner in which one cathects one's body. Factor 1 has indicated that both the cathexis items *body build* and *waist* were negatively affected by endomorphy and its excess adiposity; hence this is not a surprising finding. The cultural norms in our society depict excess adipose tissue as unaesthetic and disfiguring.

(II) Inferiority. IN.- Factor Loading 0,43

The positive factor loading for inferiority reveals a relatively strong relationship between this variable and the manner in which one rates one's body. It can be inferred that feelings of inferiority are paralleled by a low level of satisfaction with one's body. It would appear that an individual who considers himself unsuccessful and lacking in self confidence, and whose feelings are easily hurt, has a low body cathexis rating, which is not an unreasonable finding. Allport (1970) has written that males, in early adolescence, have reported fears of physical inferiority which include short stature and obesity. The fact that both endomorphy and percentage body fat also load with inferiority would seem to indicate that there is a weak relationship between feelings of inferiority and the level of adiposity. This in turn would seem to have a negative association with body cathexis.

(III) <u>Shuttle Run SR. - Factor Loading -0,27</u>
<u>Hand Grip HG. - Factor Loading -0,30</u>
<u>Pull Ups PU. - Factor Loading -0,21</u>
<u>Leg Lifts LL. - Factor Loading -0,22</u>

These four strength events which are measures of explosive, static and dynamic strength are all seen to load weakly with body cathexis and its derived components. The conclusion that can be drawn is that the possession of strength is instrumental in

192/positively affecting......

positively affecting the manner in which one rates one's body. Since Factor 1 has shown that strength is negatively affected by excess adiposity, these results would seem to further support the fact that excess fat negatively affects the level of satisfaction with the body. The slightly higher loading for hand grip (static strength) which requires considerable size to score well, might suggest that large mesomorphic size is a function of positive body cathexis.

(IV) <u>Physical Fitness Index FI.-Factor Loading -0,23</u>

Factor 1 has illustrated the close relationship between the composite fitness index and the four strength events, and it seems logical that this index should load negatively and weakly with these events.

(V) <u>Conclusion</u>

The major findings from Factor 3 indicate that the formation of body cathexis is not strongly influenced by either physical fitness, somatotype or personality. It does appear likely, however, that feelings of inferiority and excess adipose tissue are associated with negative body cathexis, while the four strength events are weakly associated with positive body cathexis.

193/4.4.4 <u>Factor 4</u>

### 4.4.4 Factor 4

Table XI lists the most important factor loadings identified under Factor 4.

Table XI: Major rotated factor loadings identified under Factor 4.

Strong (> -0,70 or > + 0,70) Rotated Factor Loadings

| POSITIVE LOADINGS | | | NEGATIVE LOADINGS | | |
|---|---|---|---|---|---|
| NO. | VARIABLE | LOADING | NO. | VARIABLE | LOADING |
| 25 | Adjustment-Emotionality AE | 0,74 | | | |
| 28 | Hypochondriac-Medical HM | 0,79 | | | |
| | Weak (> -0,30 or > +0,30) Rotated Factor Loadings | | | | |
| 29 | Impulsiveness IMP | 0,44 | | | |

Variance Explained by Factor 4 = 4,2% (of total).

Factor 4 is described by high positive loadings on the personality traits adjustment-emotionality and hypochondriac-medical. Both these factors are concerned with anxiety and this could be termed a general anxiety factor. One other factor, impulsiveness, loaded weakly and positively on this factor.

194/A. Discussion and Interpretation......

A. Discussion and Interpretation

Adjustment-emotionality is an anxiety factor which is concerned with feelings of nervousness, tension, worry, and irritability. Hypochondriac-medical can also be considered to be an anxiety factor and is characterized by worry about aches, pains, general health; and moodiness is also taken into consideration. It is a little surprising that impulsiveness loads weakly on this factor, since it is characterized by acting on the spur of the moment, and a quick and ready response to the environment. In terms of Eysenck's extraversion and neuroticism scale, impulsiveness could be considered as leaning towards extraversion while adjustment-emotionality and hypochondriac-medical towards neuroticism.

The most important feature about this factor, for the purposes of this study, is the fact that no physical fitness, somatotype or body cathexis factor loads significantly. This would appear to indicate the independence of these parameters from each other.

4.4.5 Factors 5-10

Factors 5 to 10 are listed briefly and since so little of the variance is accounted for, by these factors,

195/detailed discussions....

detailed discussions of the factors are not presented. Only the strongest factor loadings are reported.

A. Factor 5

Accounting for 3,9% of the variance is characterized by positive loadings on co-operativeness-considerateness (0,58) and persistence (0,50). A slightly lower negative loading for inferiority (-0,43) is obtained. No physical fitness, somatotype or body cathexis variables load heavily on this factor.

B. Factor 6

2,7% of the variance. High positive loadings are discerned for hand grip (0,89) and lean body mass (0,90). Lower loadings are found for cathexis of *body build* (0,52), and absolute fat mass (0,48).

C. Factor 7

1,9% of the variance. A high positive loading is obtained for sociability (0,56) and a high negative loading for superego (-0,73).

D. Factor 8

1,5% of the variance. High positive loading for extent flexibility (0,74) and lower loadings for shuttle run (0,48) and the physical fitness index (0,41).

E. Factor 9

1,2% of the variance. High negative loadings on dynamic flexibility (-0,64), cable jump (-0,67) and the physical fitness index (-0,79).

F. Factor 10

1% of the variance. Negative loadings are discerned for cathexis of *waist up* (-0,49), *waist* (-0,52) and *body build* (-0,52). A lower positive loading is found for suspicion (0,46).

G. Conclusion

What becomes abundantly clear even about these factors, which account for so little of the variance, is the independence of the four parameters; physical fitness, somatotype, body cathexis and personality. This would appear to indicate that very little interrelationship exists amongst these variables.

### 4.4.6 Summary

Factor analysis isolates three major oblique rotated factors which are orthogonally related (uncorrelated) accounting for 83,6% of the variance. These three factors are labelled an Energy Output, a Body Bulk Differentiation (somatotype) and a Body Cathexis factor. The most striking feature about these factors is their relative independence from each other. Furthermore, personality seems to be unrelated to these factors. This would suggest that relatively little relationship exists amongst these four parameters. The relationships that were identified are summarized below.

The presence of excess adipose tissue has a powerful negating effect on the performance of several physical fitness events. A high endomorphic component appears to be the major limiting factor in performance where the body mass must be displaced. Mesomorphy and ectomorphy do not have such a pronounced effect. Hence the hypothesis A1 which states that

> Good physical fitness will be associated with a low endomorphic component and a high mesomorphic content is only partially supported.

The presence of endomorphy seems to have a weak negative effect on the manner in which one rates one's body. The strength events, which are limited by a high endomorphic component, are also seen to have a weak positive influence on the level of body cathexis. Thus the hypotheses A2 and A3 which state that

> A2 Good physical fitness will be accompanied by high body cathexis ratings

and

> A3 High endomorphy will be associated with low body cathexis ratings

are both partially supported.

The personality trait inferiority, has a more powerful association with the level of body cathexis than any other variable, suggesting that a high degree of inferiority is related to a low level of body cathexis.

These findings represent the major relationships identified from factor analysis, and these findings will be fully considered in Chapter 5. It is necessary, however, to stress that the outstanding feature about these variables is the relative lack of relationships apparent.

199/4.5 MULTIPLE REGRESSION ANALYSIS.....

## 4.5 MULTIPLE REGRESSION ANALYSIS

### A. Introduction

Factor analysis by means of its data reduction capabilities, enabled simplification and interpretation of the data. Factor analysis, however, unlike regression does not make a distinction between independent and dependent variables (ie. between those which do the explaining and those which are to be explained). In fact it is very likely that the independent and dependent variables will be intermixed, since variables that are fairly strongly related will end up loading on the same factors. Hence multiple stepwise regression was utilized in an attempt to define the major determinants of body cathexis and of physical fitness, in a more formal manner. An additional feature of stepwise regression is its ability to detect partial effects. This enables the researcher to examine the impact of a particular independent variable on the dependent variable, while at the same time controlling for variation in the remaining independent variables. The "partial co-efficients" produced, can then be examined and analysed.

The objective of stepwise regression analysis is to establish a linear combination, of the independent variables, which best predicts the variation in the dependent variable.

200/Stepwise regression....

Stepwise regression analysis, in this study, was not utilized in an attempt to construct any specific prediction equations, since the author was not trying to predict body cathexis or physical fitness, but rather to illuminate the major determinants of these two dependent variables.

4.5.1 Dependent Variable. Body Cathexis

A number of S.P.S.S. multiple regression analyses were run in an attempt to find which combination of variables accounted for the maximum percentage of variance possible. The independent variables included in these analyses were the somatotype components, related body composition measures and the physical fitness components. It was not possible to include all the variables at any one time owing to multicollinearity which affected the results. Multicollinearity refers to the situation in which some or all of the independent variables are very highly intercorrelated. When multiple regression is used to evaluate the relative importance of the independent variables, the greater the intercorrelation of the independent variables, the less the reliability of the relative importance indicated by the partial regression co-efficients. Multicollinearity thus biases the estimators of the regression co-efficients. This necessitated running a number of regression analyses in which the variables causing multicollinearity were omitted.

201/The most....

The most meaningful (ie. the one which accounted for the most variance) multiple regression analysis proved to be one in which the variables endomorphy, ectomorphy, absolute fat mass and the physical fitness index were excluded. The remaining 22 variables accounted for 48,4% of the total variance. The first ten variables accounted for 44,1% of the variance while the first four most powerful variables accounted for 30,9%. The summary of the regression analysis may be found in the appendix. Table XII lists the four most powerful independent variables. Having sorted through all the variables the more common and more restricted application of multiple (stepwise) regression analysis, is now utilized to explore the effects and partial effects of these four variables, on the dependent variable, body cathexis.

Table XII : Most powerful independent variables accounting for body cathexis.

| STEP | Xi's INCLUDED | MULTIPLE r | △ MULTIPLE r | PARTIALS |
|---|---|---|---|---|
| 1 | IN | 0,43 | | SR 0,23 HG 0,27<br>PU 0,21 LL 0,20 |
| 2 | IN, HG | 0,49 | 0,06 | F -0,21 |
| 3 | IN, HG, F | 0,53 | 0,03 | LR 0,21 |
| 4 | IN, HG, F, LR | 0,56 | 0,03 | DF 0,23 |

202/(I) Step 1 .....

(I) Step 1

Negative inferiority, accounting for 18,6% of the variance on its own, is the most powerful variable accounting for body cathexis. This would suggest that lack of self confidence, sensitivity and the feeling that one is not successful is associated with a low level of body cathexis. Inferiority is the most powerful variable in that it accounts for a much greater percentage of the variance than any of the other variables. Multiple regression analysis, in this case, is not able to separate the dependent and independent variables. Whether feelings of inferiority result in a low body cathexis or whether a low body cathexis results in feelings of inferiority is not clear. Multiple regression analysis does, however, indicate that these two psychological variables are closely linked and it would appear that a low self esteem is paralleled with a low body esteem. This relationship will be fully discussed in Chapter 5.

(II) Step 2

Hand grip or static strength, entered at Step 2, accounts for 5,7% of the variance on its own. At first glance it would appear that the variable static strength is one of the major determinants of body cathexis but this is not strictly true. In Step 1, when inferiority is held constant, the residual variance of hand grip (partial r = 0,26) is only marginally higher than the other three strength factors, namely, shuttle run (partial r = 0,23), pull ups (partial r = 0,21), and leg lifts (partial r = 0,20). When hand grip is taken into account at Step 2, the residual variance of these three variables drops away sharply :- shuttle run (partial r = 0,16), pull ups (partial r = 0,11), and leg lifts (partial r = 0,14). Hence when hand grip is taken out and held constant, it extracts much of the common variance from the remaining three strength variables. For further confirmation of this pattern the investigator submitted a regression run in which the variable, pull ups, was specified for prior extraction. An identical pattern was observed, and pull ups were seen to extract the common variance from the other strength variables. The conclusion that can be drawn here is that hand grip represents a general strength factor which has a positive effect on the manner in which one rates one's body cathexis. The fact that static strength is marginally more important than the other strength factors, might be attributed to the finding that large size is important for performance in this event. It has been suggested earlier (section 2.8.2) that large mesomorphic size is conducive to positive body cathexis.

(III) Step 3

Percentage body fat (negative value) accounts for 3,3% of the variance on its own, supporting the finding that excess adiposity is instrumental in giving rise to a low body cathexis rating. A further interesting feature is that when percentage body fat is held constant, the remaining residual variance of the three strength factors drops away considerably (shuttle run, partial r = 0,08, pull ups, partial r = 0,007, leg lifts, partial r = 0,09). It can be inferred that since much of the common variance is extracted when percentage body fat is held constant, the performance of these events is limited by excess adipose tissue. This supports the factor analytic interpretation, and this excess adipose tissue would, in turn, seem to affect the satisfaction felt for one's body in a negative manner.

(IV) Step 4

6 lap run accounts for 3,7% of the variance on its

own. In steps 1 and 2 the residual variance for 6 lap run was negligible (partial r = 0,04 and 0,07). Only when percentage body fat is held constant at Step 3 does the residual variance for 6 lap run assume any importance (partial r = 0,21). This is not surprising, since excessive adipose tissue severely hinders running performance. It can be inferred from this result that once again excess fat is seen as having a negative effect on the level of body cathexis.

The remaining 17 independent variables account for 17,5% of the total variance and do not have as powerful an influence on the dependent variable as the first four independent variables have.

(V) <u>Conclusion</u>

It can be concluded that inferiority (negative) is the independent variable which most adequately accounts for the dependent variable, body cathexis. It can be stated that boys who do not suffer from feelings of inferiority and who are strong, with relatively little fat, are more satisfied with their bodies for at least 27,7% of the total variance. It would appear, however, that self confidence and believing that one is successful is more closely associated with body cathexis than either strength or somatotype.

206/The fact that.....

The fact that percentage body fat is negatively related to body cathexis partially supports hypothesis A3 which states that

A3 <u>High endomorphy will be associated with low body cathexis ratings</u>.

Multiple regression analysis, supports the factor analytic findings, indicating that inferiority and excess adipose tissue are associated with a low body cathexis while the strength events are associated with a positive body cathexis level.

### 4.5.2 <u>Dependent Variable. Physical Fitness Index</u>

A number of multiple regression analyses were run in an attempt to discover which combination of variables accounts for the maximum percentage of variance possible. The independent variables included were; somatotype, related body composition measures, body cathexis and its derived components, and personality traits. Problems of multicollinearity necessitated considerable "juggling" of the variables.

The most meaningful multiple regression analysis proved to be one in which the variables endomorphy, ectomorphy,

207/body cathexis....

body cathexis and absolute fat mass were omitted. The remaining 19 variables accounted for 57,5% of the total variance in physical fitness. The first ten variables accounted for 56,1% of the variance while the first four variables accounted for 50,1%. The summary of the regression analysis is listed in the appendix. Table XIII lists the four most powerful independent variables. Once again having sorted through all the variables,the more common and more restricted application of multiple (stepwise) regression analysis is now utilized to explore the effects and partial effects of these four variables, on the dependent variable physical fitness.

<u>Table XIII</u>: Most powerful independent variables accounting for physical fitness.

| STEP | Xi's INCLUDED | Δ MULTIPLE r | MULTIPLE r | PARTIALS |
|---|---|---|---|---|
| 1 | F | 0,54 | | MESO 0,43 BB 0,42<br>LM 0,41 ST 0,23 |
| 2 | F, MESO | 0,65 | 0,13 | ST 0,26 BB 0,26<br>LM 0,28 |
| 3 | F, MESO, LM | 0,69 | 0,05 | ST 0,24 HY -0,19 |
| 4 | F, MESO, LM, ST | 0,71 | 0,03 | HY -0,17 |

(I) Step 1

Percentage body fat (negative value) accounting for 29,5% of the variance on its own is the major determinant of physical fitness. This would suggest that boys scoring high on physical fitness tests are characterized by possessing a low percentage of adipose tissue. This, as previous discussion has revealed, is not a surprising finding. (Section 4.4.1).

(II) Step 2

Mesomorphy accounts for 13,1% of the variance on its own and appears to be closely related to physical fitness. Factor analysis had not previously identified this variable with physical fitness. However, since excess adiposity was shown to be a powerful negating factor, it could be assumed that the remaining body component, ie. muscle, was positively related to physical fitness. A mesomorphic individual is characterized by physical ruggedness and strength, characteristics which are conducive to excellent physical performance, in most sports.

(III) Step 3

Lean body mass, accounting for 4,5% of the variance, is closely related to mesomorphy. Lean body mass refers to the fat free weight of the body, in which the muscular structure plays an important role.

(IV) Step 4

*Waist* accounts for 3,1% of the variance which suggests that physical fitness is accompanied by positive cathexis of the item, *waist*. As factor analytic interpretation has shown, this is not an unreasonable finding since rolls of fat around the midriff are not likely to be conducive to positive cathexis, and nor are they likely to be characteristic of physical fitness.

The remaining 15 variables account for 7,4% of the total variance, and are considerably less important in explaining the variation in physical fitness.

Of these variables, the body cathexis item *body build* warrants comment. Factor analysis had revealed that positive cathexis of *body build* loaded highly with the physical fitness events, the inference being that cathexis of *body build* and physical fitness were closely related. In the regression analysis, however, cathexis of *body build* is entered at step 9 and its additional contribution to multiple r is a meagre 0,003. It would appear that regression analysis has failed to indicate the positive relationship between physical fitness and cathexis of *body build*, shown so clearly in factor analysis.

In Step 1 the importance of *body build* (cathexis) in explaining the residual variance of physical fitness is quite high. (partial r = 0,42). This would be a result of the fact that a negative correlation (-0,31) exists between cathexis of *body build* and percentage body fat (F) (entered at Step 1). When mesomorphy is held constant at Step 2, the importance of cathexis of *body build* in explaining the residual variance is reduced sharply (partial r = 0,25). When lean body mass is taken into account at Step 3, the importance of *body build* (cathexis) in explaining the residual variance is further reduced (partial r = 0,18). Thus much of the independent significance of cathexis of *body build* is lost when mesomorphy and lean body mass are taken into account. This appears to be a logical pattern, since mesomorphic boys with a high lean body mass and thus little excess adipose tissue are likely

211/to score highly......

to score highly on physical fitness tests and rate their bodies positively. The overall interpretation then, is that when percentage body fat (F) is held constant, cathexis of the *body build*, mesomorphy, and lean body mass all tend to be positively associated with physical fitness.

(V) Conclusion

It is clear from the regression results that percentage body fat (negative) is the independent variable which most adequately accounts for the dependent variable physical fitness. Mesomorphy and lean body mass are the second and third most powerful determinants respectively. The elementary conclusion which is derived from this analysis is that a preponderance of adipose tissue (percentage value) limits physical performance while mesomorphy and lean body mass enhance physical fitness performance. Hence, given that the relationship between the level of physical fitness and percentage body fat is negative, it can be inferred that fitness will not be characterized by a high degree of adipose tissue. These results support hypothesis A1 which states that

A1 Good physical fitness will be

212/associated.....

associated with a low endomorphic component and a high mesomorphic component.

Furthermore, the fact that both the body cathexis items *body build* and *waist* are associated with physical fitness would partially lend support to hypotheses A2 and A3 which state that

A2 Good physical fitness will be accompanied by high body cathexis ratings

and

A3 High endomorphy will be associated with low body cathexis ratings.

It would be incorrect, however, to accept these hypotheses fully since only weak relationships are apparent and only two body cathexis items are related. (ie. *waist*, *body build*). The remaining subdivision of the body cathexis items (ie. *waist up*, *waist down*, *vigour*, *neck up*) failed to produce the expected results and the hypotheses for these groups of items are rejected (see section 3.5.2).

The major findings from this multiple regression analysis indicate the undesirability of excess fat and the desirability of mesomorphy for physical fitness performance.

### 4.5.3 Summary of Multiple Regression Analyses on Body Cathexis and Physical Fitness Index.

Multiple regression analysis was useful in supporting the interpretation of the factor analytic results. Furthermore, it was particularly useful in formally defining the major determinants of both body cathexis and physical fitness.

It would appear that the variable which is most closely associated with body cathexis is inferiority, while strength and excess adipose tissue are related but are considerably less important. Multiple regression is particularly useful in revealing a general strength factor (section 4.5.1 Step 2) and illustrating the close relationship between excess fat and the three strength events (pull ups, leg lifts and shuttle run). (Section 4.5.1 Step 3.)

Physical fitness performance is strongly and negatively influenced by excess adipose tissue while mesomorphy is positively related. Again this regression technique

214/is particularly...

is particularly helpful in identifying mesomorphy as an important variable contributing to physical fitness. Factor analysis had not previously done this.

These results will be fully discussed in Chapter 5.

## 4.6 COMPARISON OF HIGH AND LOW FIT GROUPS

### A. Introduction

Factor analysis and multiple regression analysis had indicated that weak relationships existed between physical fitness and body cathexis, while somatotype appeared to be closely related to physical fitness, in terms of the level of adiposity. By categorizing the sample into high and low fit groups (ie. extremes) it was likely that these relationships would be magnified. Since the author was particularly interested in studying the relationship between the extremes of physical fitness, it was decided to split the sample into a very high fit group and a very low fit group. Utilizing the Student t-test to ascertain whether significant differences existed between the groups, the relationship between high and low fit boys with regard to somatotype and body cathexis was then investigated.

In terms of somatotypological differences between the high and low fit groups, five t-test results are recorded;

215/a tri-dimensional,.....

a tri-dimensional, a bi-dimensional, an endomorphy, a mesomorphy and an ectomorphic reading. While these parameters are closely interrelated, it is necessary to report them all for the ensuing reasons.

The individual somatotype components (ie. endomorphy, mesomorphy and ectomorphy) provide information about a particular aspect of the physique. This enables one to be more specific about the findings.

The bi-dimensional technique enables one to look at the somatotype as a whole or in totality. This generalization of the three individual somatotype components enables the somatotype to be plotted on a somatochart in terms of X and Y co-ordinates. These somatoplots can then be compared to each other and to their mean value, and their dispersion about the mean can be calculated.

The tri-dimensional technique is the most sophisticated method of somatotype analysis and enables one to compare somatotypes in terms of X, Y and Z co-ordinates.

By drawing an analogy to raindrops falling to the ground one can clearly illustrate the tri and bi-dimensional concepts. The bi-dimensional method is utilized to plot the positions of the raindrops as they strike the ground ie. somatoplots on a somatochart. In the tri-dimensional

216/method....

method the raindrops do not strike the ground but become suspended in space, and one is then able to consider their relative positions in space (somatopoints). This tri-dimensional method embodies completely a 3-dimensional 3 component somatotype rating, which a 2-dimensional somatoplot cannot achieve.

Hence the tri-dimensional technique is utilized in this study to consider whether significant differences exist between the total somatotype ratings of high and low fit groups in three dimensions. The bi-dimensional method is utilized to consider whether significant differences exist in two dimensions, and if so, to plot these somatotypes on a somatochart. Finally when total somatotype differences are found both tri and bi-dimensionally, the individual somatotype components are utilized to specify in which direction this difference occurs.

Figure 4 illustrates the specified subdivision of the distribution of a population on a somatochart. These categories are operationally useful in serving as a technique for counting the somatotypes falling within each category for analysis (Carter 1975). Figure 5 represents the somatotype distributions for the entire sample. (See overleaf for Figure 4 and 5).

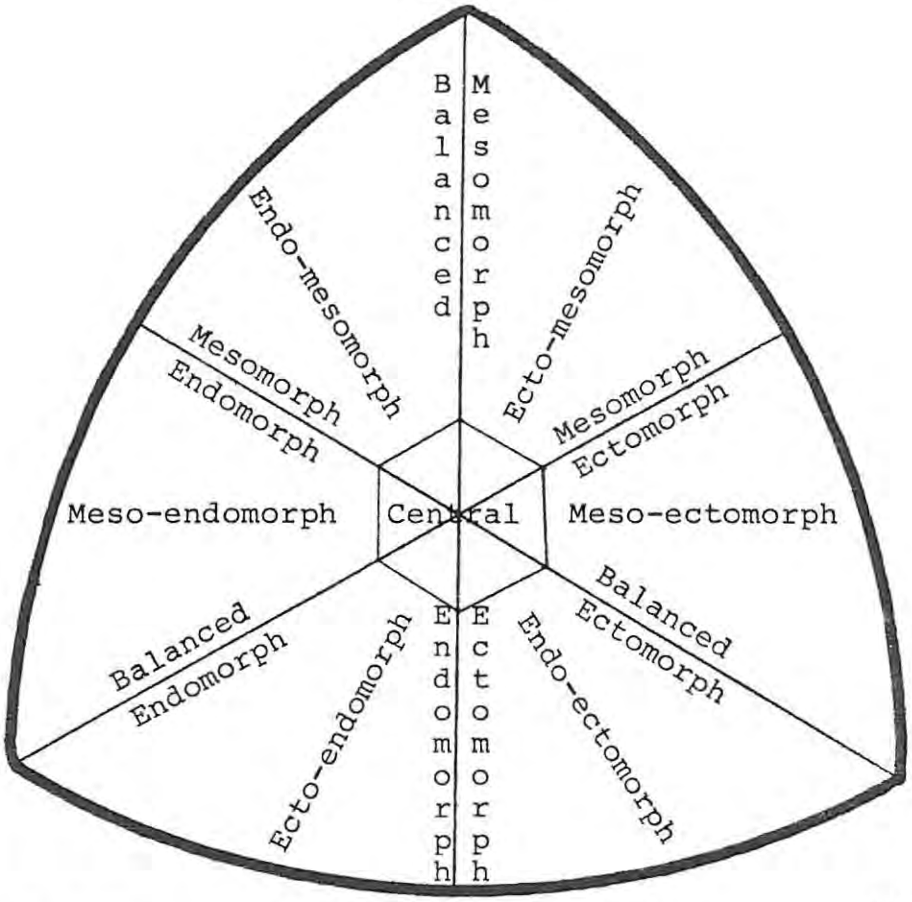


Figure 4: Diagrammatic representation of somatotype categories based on the axes and sectors of the somatochart

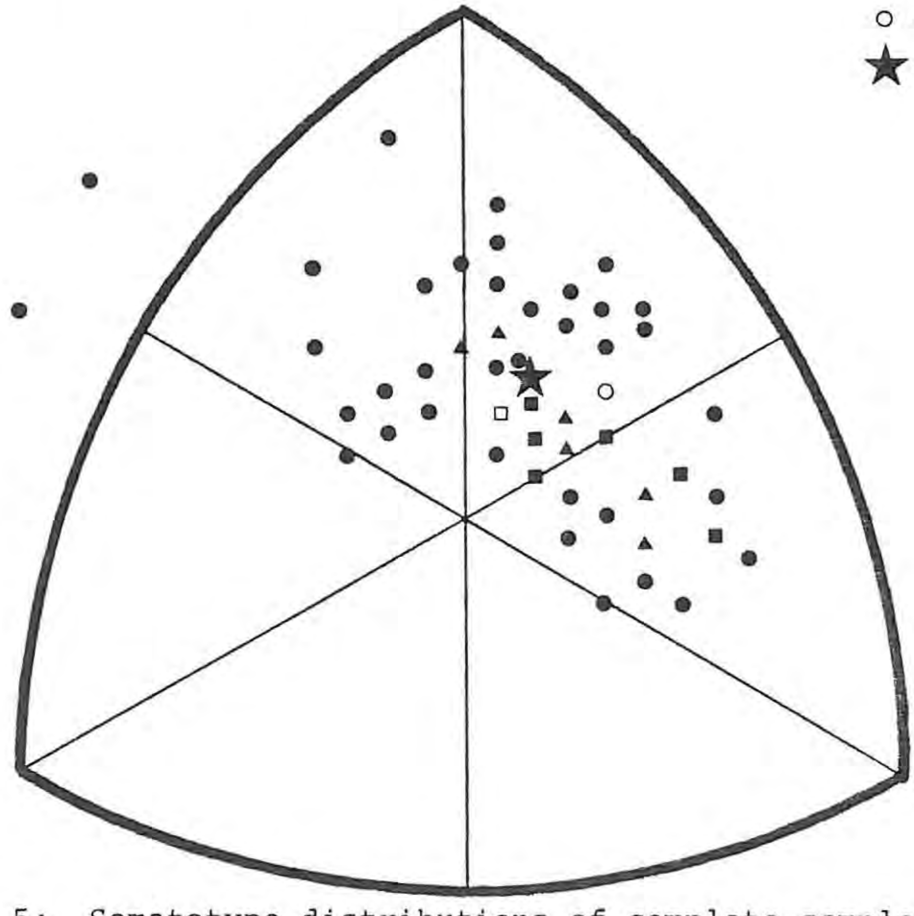


Figure 5: Somatotype distributions of complete sample

### 4.6.1 The Physical Fitness Index

Utilizing the composite physical fitness index as the criterion of physical fitness, those boys falling into the area one standard deviation above the mean, and those falling into the area one standard deviation below the mean, were selected as the high and low fit groups respectively. Table XIV lists the results for these groups.

Table XIV: Differences in the means of somatotypological and body cathexis ratings among high and low fit physical fitness index groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=13 $\bar{x}$ | n=16 $\bar{x}$ | df=29 | $p < 0,05$ |
| Tri-Dimensional | SAV 2,19 | SAV 5,32 | 4,16 | 0,005 |
| Bi-Dimensional | SDV 7,00 | SDV 10,00 | 2,97 | 0,005 |
| Endomorphy | 2,20 | 3,51 | -3,62 | 0,005 |
| Mesomorphy | 5,05 | 4,61 | 1,32 | NS |
| Ectomorphy | 3,02 | 3,39 | -1,06 | NS |
| Body Cathexis | 3,86 | 3,45 | 3,08 | 0,005 |

219/Since significant....

Since significant differences are indicated with regard to somatotype, both tri and bi-dimensionally, somatoplots were constructed to give a pictorial view of the data. Figures 6 and 7 illustrate these data. (See overleaf for Figures 6 and 7).

## A. Discussion and Interpretation

### (I) Somatotype

In terms of somatotype the high and low fit groups differ significantly. Factor analysis and regression analysis had indicated that excess adipose tissue was a negating factor in physical performance. The mean endomorphic ratings differ significantly between the two groups, and it is probably this difference in endomorphy which gives rise to the "total" somatotype difference. Thus the hypothesis B1 is accepted. The hypothesis states that

> Significant somatotypological differences, indicating that endomorphy is a negating factor, will be found between high and low fit groups.

Significant differences are not found for either mesomorphy or ectomorphy, but the mean mesomorphic

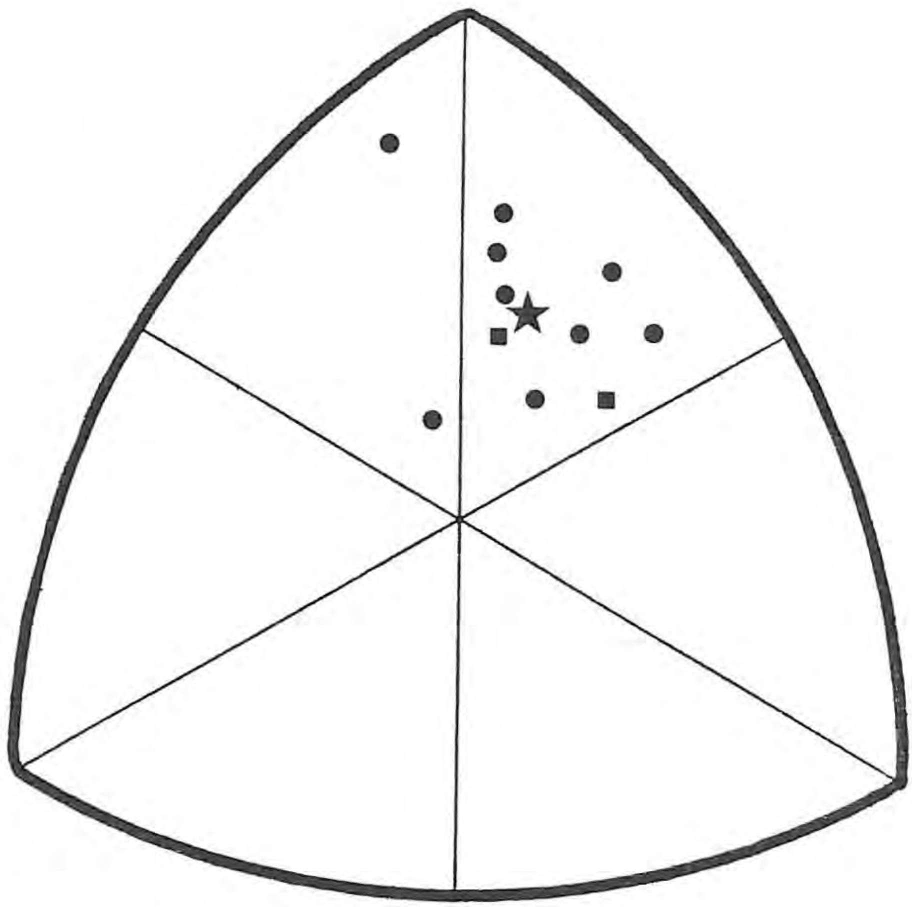

Figure 6: Somatotype distributions of high fit physical fitness index group

● = 1 somatoplot
■ = 2 somatoplots
▲ = 3 somatoplots
★ = mean

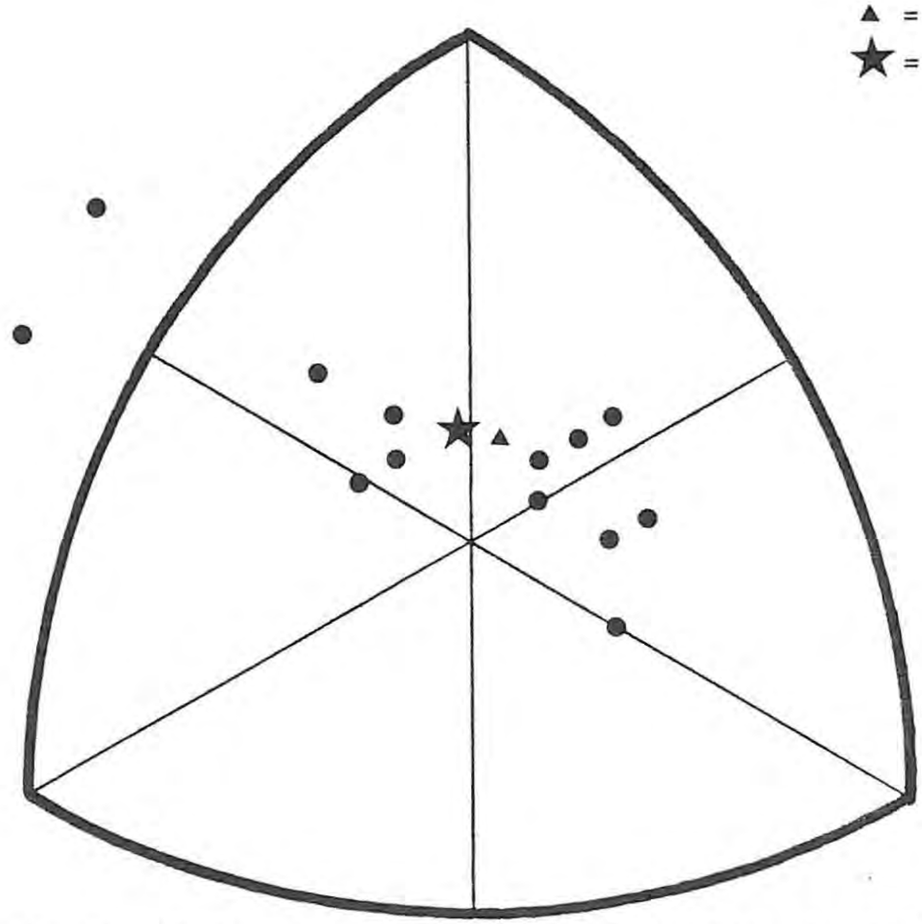

Figure 7: Somatotype distributions of low fit physical fitness index group

rating is, in the high fit group, higher than that of the low fit group. The mesomorphic difference is, however, insignificant, hence hypothesis C1 is rejected. The hypothesis states that

> Significant somatotypological differences, indicating that mesomorphy is a positive factor, will be found between high and low fit groups.

The mean somatotype rating for the high fit group (2,2 - 5,1 - 3,0) has lower endomorphic and ectomorphic ratings, and a higher mesomorphic rating than the low fit group (3,51 - 4,61 - 3,39). It would appear, as previous results have indicated, that endomorphy is the crucial factor in physical performance. The major difference between the two groups appears to be the fact that the high fit group has low endomorphic and high mesomorphic ratings, while the low fit group is characterized by high endomorphy.

(II) Body Cathexis

In terms of body cathexis, a significant difference exists between the mean of the high fit group (3,86) and the mean of the low fit group (3,45).

222/Thus the hypothesis....

Thus the hypothesis D1, which states that

> Significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups is accepted.

Factor analysis had previously indicated a weak relationship between some items of body cathexis (ie. *body build, waist*), physical fitness and endomorphy, while regression had shown that both percentage body fat and strength were important determinants of body cathexis. The t-test results would seem to confirm that the high fit groups, with lower endomorphic and higher mesomorphic ratings, are inclined to be more satisfied with their bodies than the low fit group.

### 4.6.2 Physical Fitness Events Loading on Factor 1

As has been pointed out earlier, the composite physical fitness index is not an ideal indication of physical fitness. It may be composed of either average scores on all the tests, or high scores for some tests and low scores for others.

223/Factor 1 had.....

Factor 1 had indicated that only five of the physical fitness tests were negatively affected by excess adiposity, and Factor 3 had indicated that only the four strength tests were instrumental in affecting the level of body cathexis. Bearing this in mind the author decided to explore the relationship existing between a high and low fit group for each individual fitness test. This entailed selecting a high and a low fit group (using the same criterion as for the physical fitness index) for each of the nine physical fitness tests, and comparing them in terms of somatotype and body cathexis

Factor 1 was characterized by high loadings on the shuttle run, pull ups, leg lifts, 6 lap run and the hand grip. Student t-test results for these events follow. Where significant somatotypological differences, both bi and tri-dimensionally, are indicated, somatoplots are constructed. Additionally individual component ratings are calculated in order to ascertain in which direction this "total" somatotype difference occurs.

224/A. Shuttle Run......

A. Shuttle Run

Table XV: Differences in the means of somatotypological and body cathexis ratings among high and low fit shuttle run groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=21 $\bar{x}$ | n=12 $\bar{x}$ | df=33 | $p < 0,05$ |
| Tri-Dimensional | SAV 2,24 | SAV 6,94 | 3,91 | 0,005 |
| Bi-Dimensional | SDV 5,93 | SDV 15,50 | 2,79 | 0,005 |
| Endomorphy | 2,33 | 3,58 | -2,80 | 0,005 |
| Mesomorphy | 4,86 | 4,83 | 0,08 | NS |
| Ectomorphy | 3,39 | 3,24 | 0,34 | NS |
| Body Cathexis | 3,70 | 3,33 | 3,25 | 0,005 |

(I) Discussion and Interpretation

Table XV lists the results for the shuttle run. Significant differences in terms of somatotype, both tri and bi-dimensionally between the groups are indicated. The somatoplots are presented in Figures 8 and 9. (Overleaf).

225/Figure 8:....

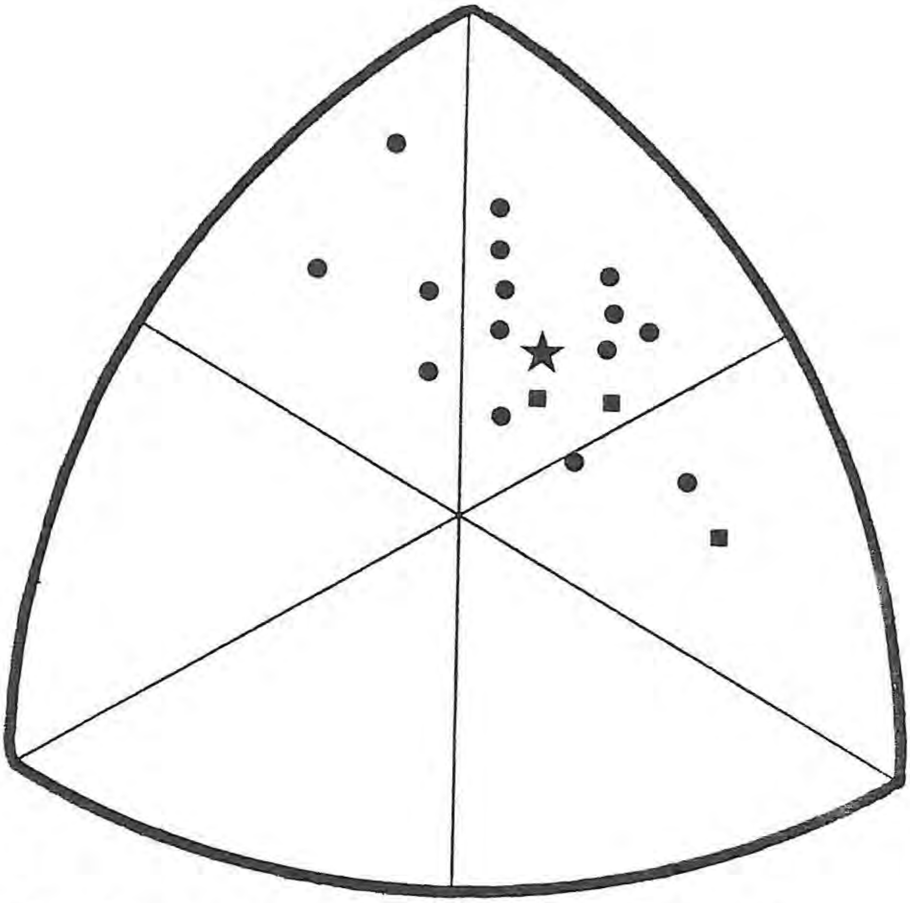

Figure 8: Somatotype distributions of high fit shuttle run group

● = 1 somatoplot
■ = 2 somatoplots
★ = mean

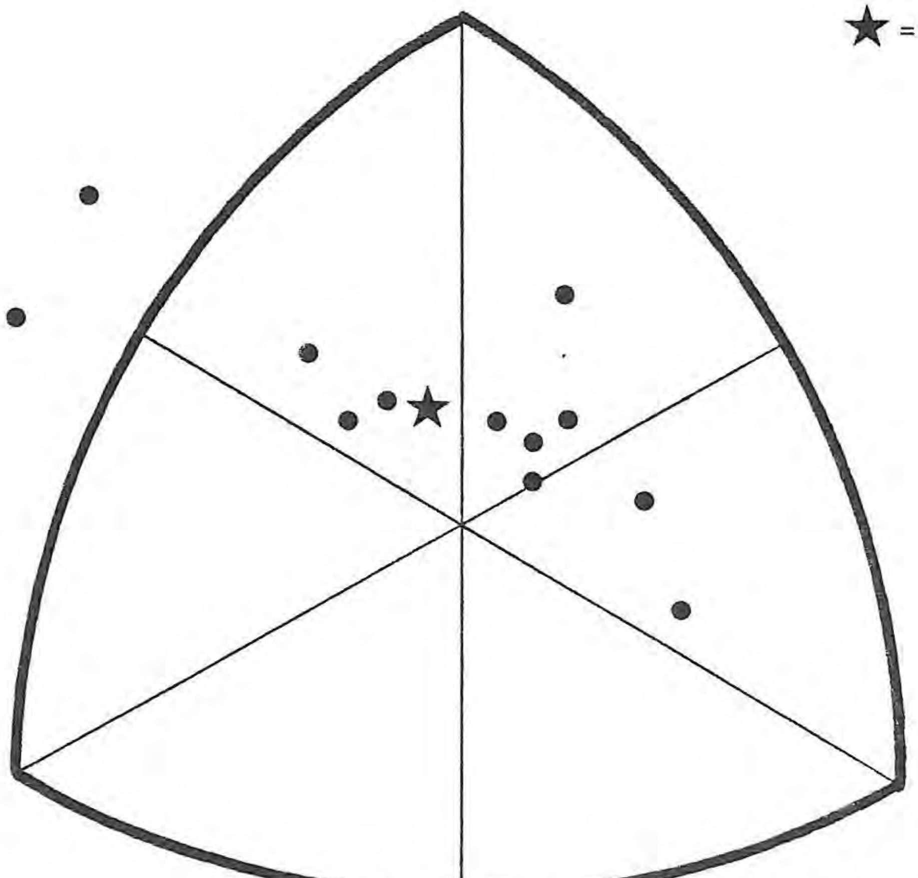

Figure 9: Somatotype distributions of low fit shuttle run group

The difference in "total" somatotype can probably be largely attributed to the endomorphic component. A significant difference between the groups is found for the mean endomorphic rating, but not for mesomorphy or ectomorphy. Again it can be inferred that endomorphy is the most important factor accounting for low performance.

The significant difference in body cathexis is most likely a result of the endomorphic component, which, as has been discussed, tends to result in negative cathexis. Factor 3 had previously indicated a weak negative relationship between endomorphy and body cathexis.

These results are in accordance with the factor analytic results.

B. Pull Ups

Table XVI (see overleaf for this table).

(I) Discussion and Interpretation

Similar results are evidenced for pull ups, and somatoplots are presented in Figures 10 and 11 (page 228). Despite the fact that only the endomorphic means show a significant difference, the mesomorphic mean for the low fit group is higher than that for the high fit group. This would suggest considerable size, which as the law of squares and cubes and the problem of leverage has illustrated, severely handicaps an individual in this event.

Table XVI: Differences in the means of somatotypological and body cathexis ratings among high and low fit pull up groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=12 $\bar{x}$ | n=9 $\bar{x}$ | df=21 | $p < 0,05$ |
| Tri-Dimensional | SAV 1,70 | SAV 8,43 | 3,95 | 0,005 |
| Bi-Dimensional | SDV 6,87 | SDV 19,79 | 2,93 | 0,005 |
| Endomorphy | 2,15 | 3,87 | -3,09 | 0,005 |
| Mesomorphy | 4,76 | 4,97 | -0,47 | NS |
| Ectomorphy | 3,32 | 3,07 | 0,48 | NS |
| Body Cathexis | 3,74 | 3,23 | 3,58 | 0,005 |

228/Figure 10....

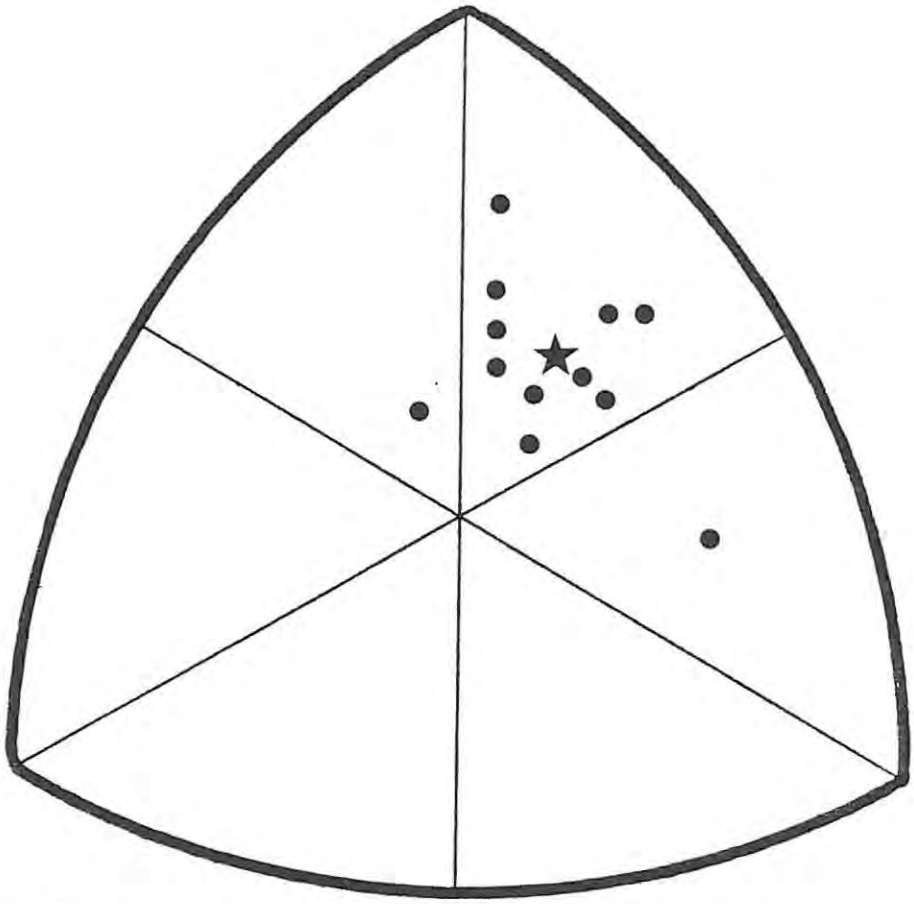

Figure 10: Somatotype distributions of high fit pull ups group

● = 1 somatoplot
★ = mean

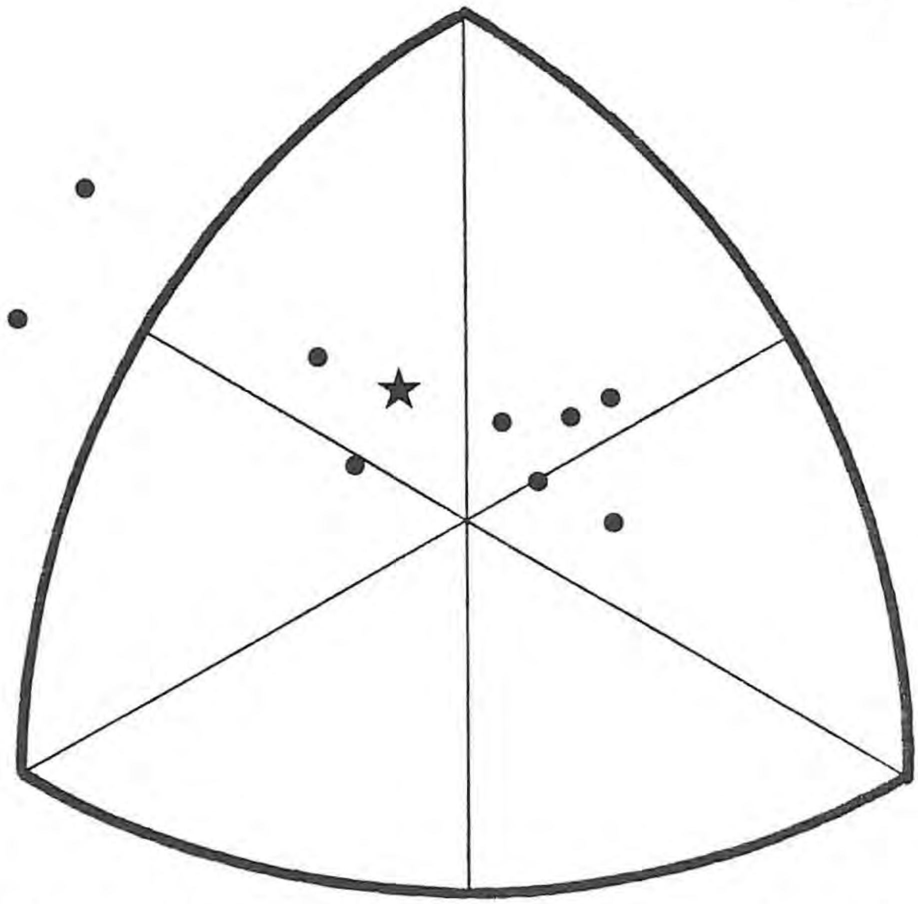

Figure 11: Somatotype distributions of low fit pull ups group

C. Leg Lifts

Table XVII: Differences in the means of somatotypological and body cathexis ratings among high and low fit leg lift groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=21 $\bar{x}$ | n=24 $\bar{x}$ | df=45 | $p < 0{,}05$ |
| Tri-Dimensional | SAV 2,39 | SAV 3,51 | 3,38 | 0,005 |
| Bi-Dimensional | SDV 4,61 | SDV 6,78 | 2,76 | 0,005 |
| Endomorphy | 2,19 | 3,01 | -3,18 | 0,005 |
| Mesomorphy | 4,55 | 4,34 | 0,71 | NS |
| Ectomorphy | 3,68 | 3,79 | -0,36 | NS |
| Body Cathexis | 3,78 | 3,23 | 2,87 | 0,005 |

(I) Discussion and Interpretation

An identical pattern is evidenced for leg lifts and the somatoplots are presented in Figures 12 and 13 (overleaf). Endomorphy, again, appears to be the crucial differentiating factor between low and high performance and the level of body cathexis.

230/ Figure 12:....

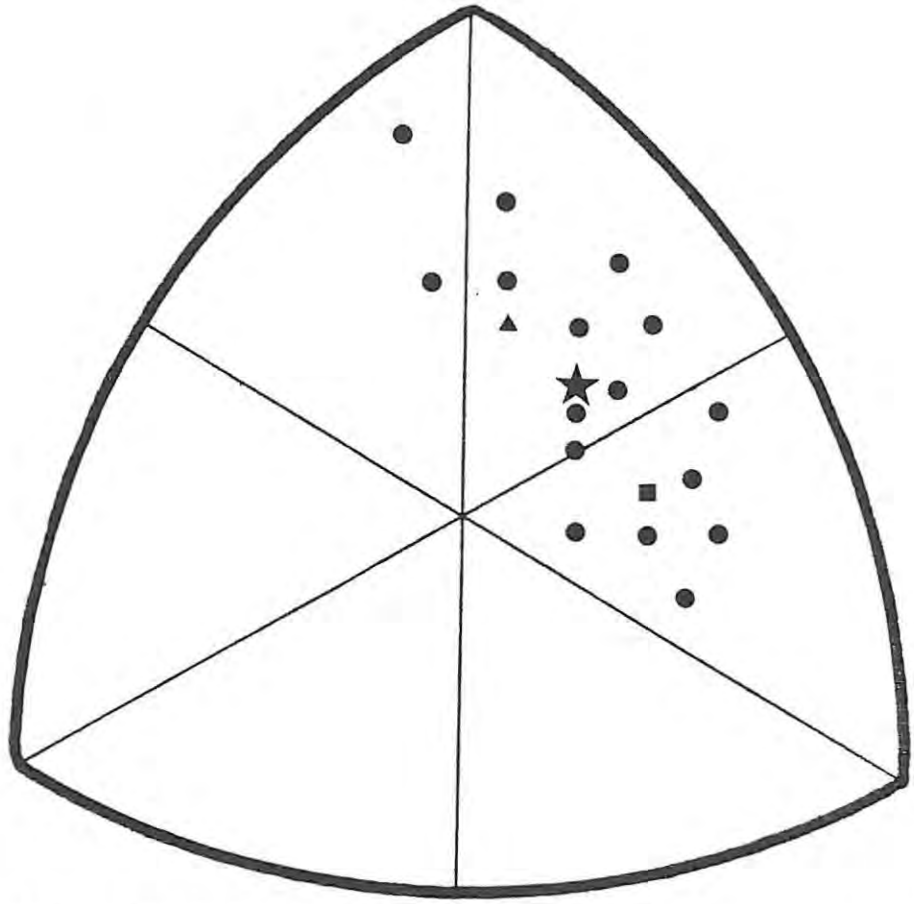

Figure 12: Somatotype distributions of high fit leg lifts group

● = 1 somatoplot
■ = 2 somatoplots
▲ = 3 somatoplots
★ = mean

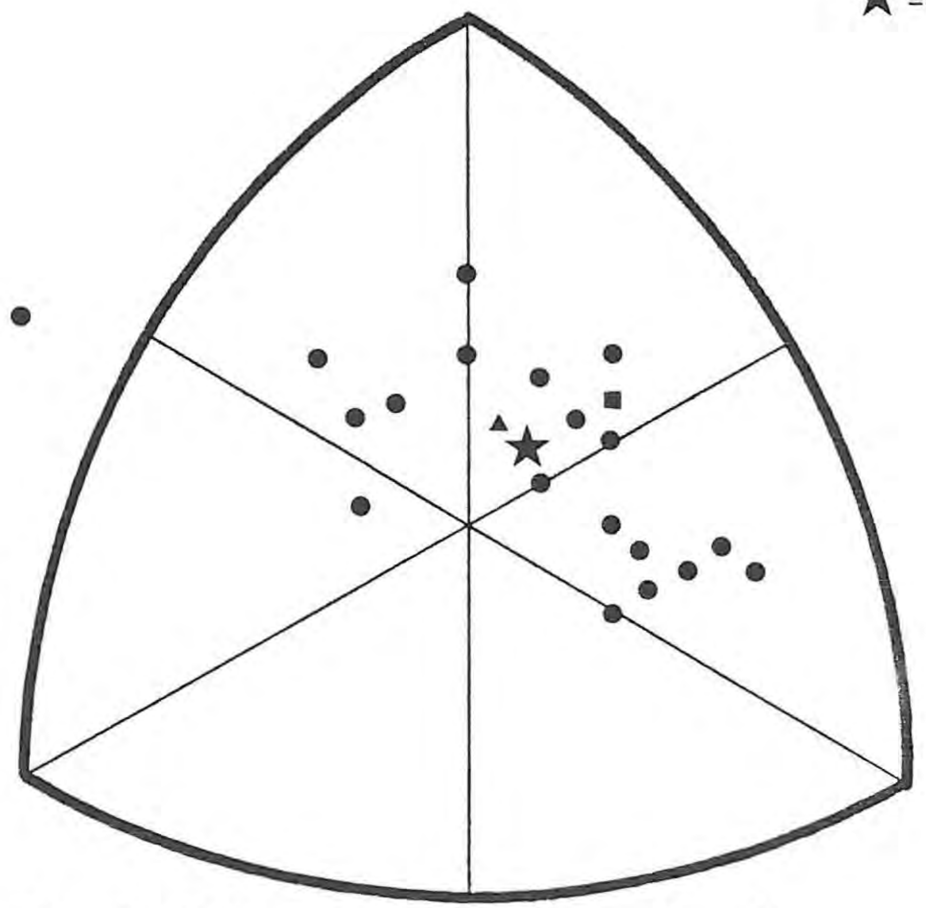

Figure 13: Somatotype distributions of low fit leg lifts group

D. 6 Lap Run

Table XVIII: Differences in the means of somatotypological and body cathexis ratings among high and low fit 6 lap run groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=12 $\bar{x}$ | n=16 $\bar{x}$ | df=28 | $p < 0,05$ |
| Tri-Dimensional | SAV 2,31 | SAV 5,67 | 3,74 | 0,005 |
| Bi-Dimensional | SDV 2,24 | SDV 11,98 | 2,84 | 0,005 |
| Endomorphy | 2,12 | 3,46 | -3,59 | 0,005 |
| Mesomorphy | 4,55 | 4,49 | 0,16 | NS |
| Ectomorphy | 3,73 | 3,40 | 0,77 | NS |
| Body Cathexis | 3,78 | 3,31 | 2,82 | 0,005 |

(I) Discussion and Interpretation

The same conclusions can be drawn from these results. It is perhaps a little surprising that a significant difference does not exist for the ectomorphic means. The somatoplots are presented in Figures 14 and 15 (overleaf).

232/Figure 14:....

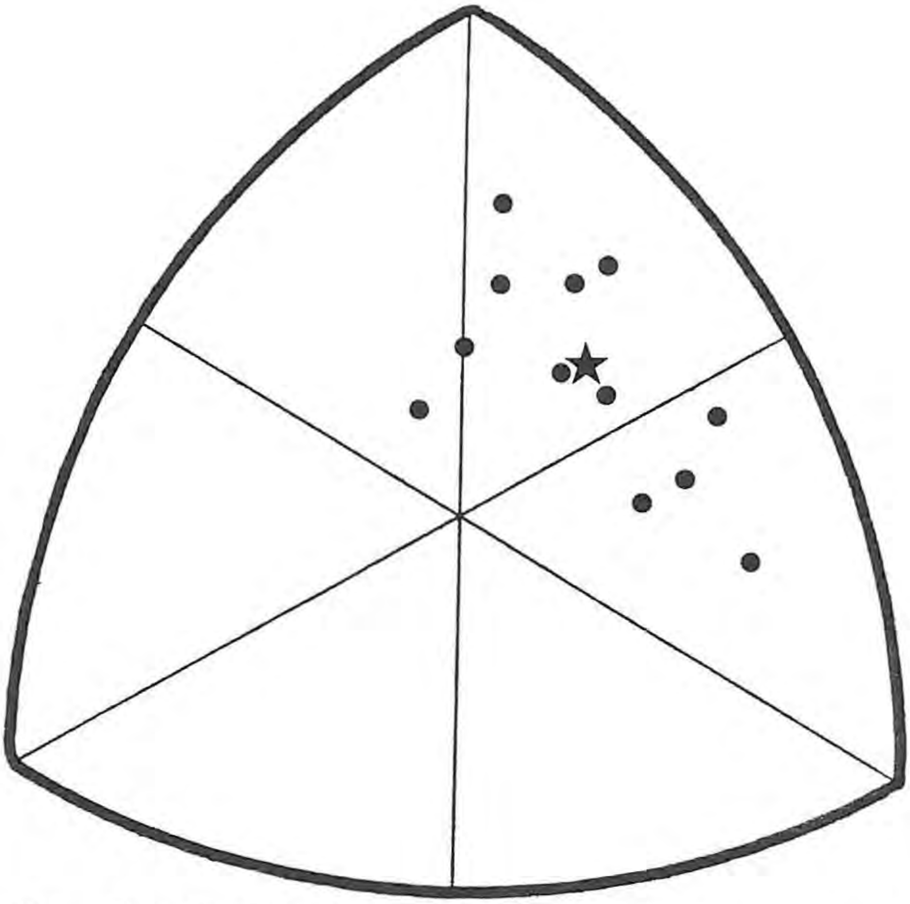

Figure 14: Somatotype distributions of high fit 6 lap run group

● = 1 somatoplot
■ = 2 somatoplots
▲ = 3 somatoplots
★ = mean

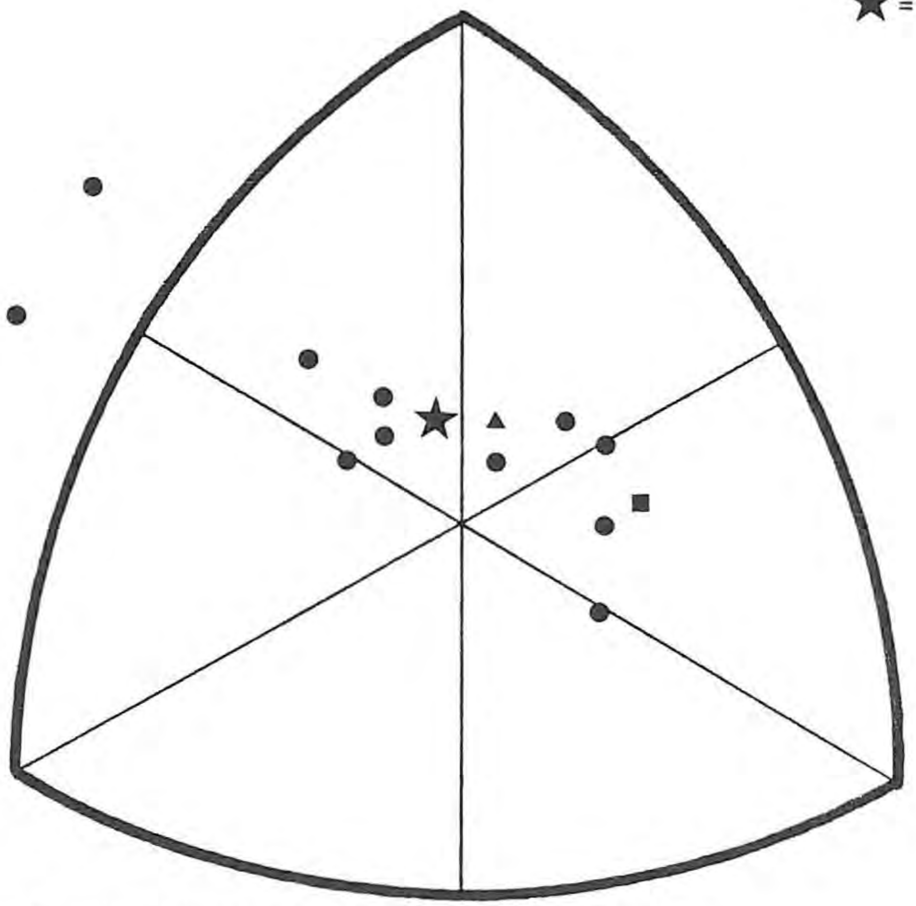

Figure 15: Somatotype distributions of low fit 6 lap run group

E. Conclusion

The t-test results are in accordance with the factor analytic findings. Endomorphy is seen as the crucial differentiating factor between high and low performance on the events where the body mass must be propelled or projected. Thus the hypotheses (B2, B4, B5, B6) for these events are accepted. These hypotheses state that

> Significant somatotypological differences, indicating that endomorphy is a negating factor, will be found between high and low fit groups.

Mesomorphy does not appear to be as important a differentiating factor as endomorphy for these events and the hypotheses (C2, C4, C5, C6) are rejected. These hypotheses state that

> Significant somatotypological differences, indicating that mesomorphy is a positive factor, will be found between high and low fit groups.

Furthermore, the high endomorphic component with its concomitant negative effect on these physical performance tests, would seem to be a negating factor on the level of the body cathexis. Thus the hypotheses (D2,

234/D4, D5, .....

D4, D5, D6) for these events are also accepted. These hypotheses state that

> Significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups.

F. Hand Grip

Table XIX: Differences in the means of somatotypological and body cathexis ratings among high and low fit hand grip groups.

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=14<br>$\bar{x}$ | n=10<br>$\bar{x}$ | df=24 | $p < 0,05$ |
| Tri-Dimensional | SAV 1,78 | SAV 1,38 | 5,00 | 0,005 |
| Bi-Dimensional | SDV 6,33 | SDV 2,78 | 2,92 | 0,005 |
| Endomorphy | 2,47 | 2,78 | -1,11 | NS |
| Mesomorphy | 4,99 | 4,17 | 3,48 | 0,005 |
| Ectomorphy | 3,26 | 3,81 | -2,24 | 0,01 |
| Body Cathexis | 3,73 | 3,33 | 2,79 | 0,005 |

235/(I) Discussion....

(I) Discussion and Interpretation

A slightly different pattern emerges for hand grip. In terms of bi and tri-dimensional somatotype, significant differences are discerned and the somatoplots are presented in Figures 16 and 17 (overleaf). No significant difference is discerned for endomorphy but a significant difference is indicated for both mesomorphy and ectomorphy (negative). Performance on the hand grip is largely affected by body bulk since the body mass does not have to be moved and great absolute strength is required. The t-test results support the slightly lower loading obtained on Factor 1, which suggests that endomorphy is not as powerful a limiting fact- or as in the events requiring relative strength. Thus the hypothesis B3 is rejected. This hypothesis states that

> Significant somatotypological differences, indicating that endomorphy is a negating factor, will be found between high and low fit groups.

The t-test results would suggest that the difference between the two groups lies with mesomorphic size.

236/Figure 16: .......

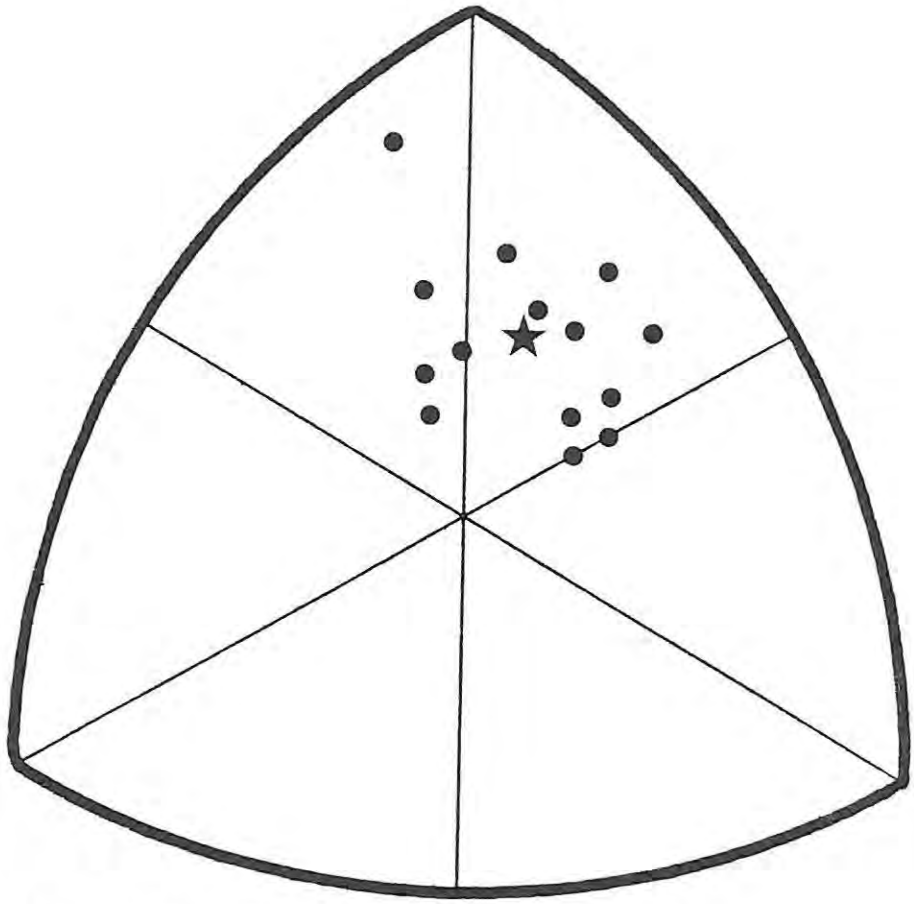

Figure 16: Somatotype distributions of high fit hand grip group

● = 1 somatoplot
■ = 2 somatoplots
★ = mean

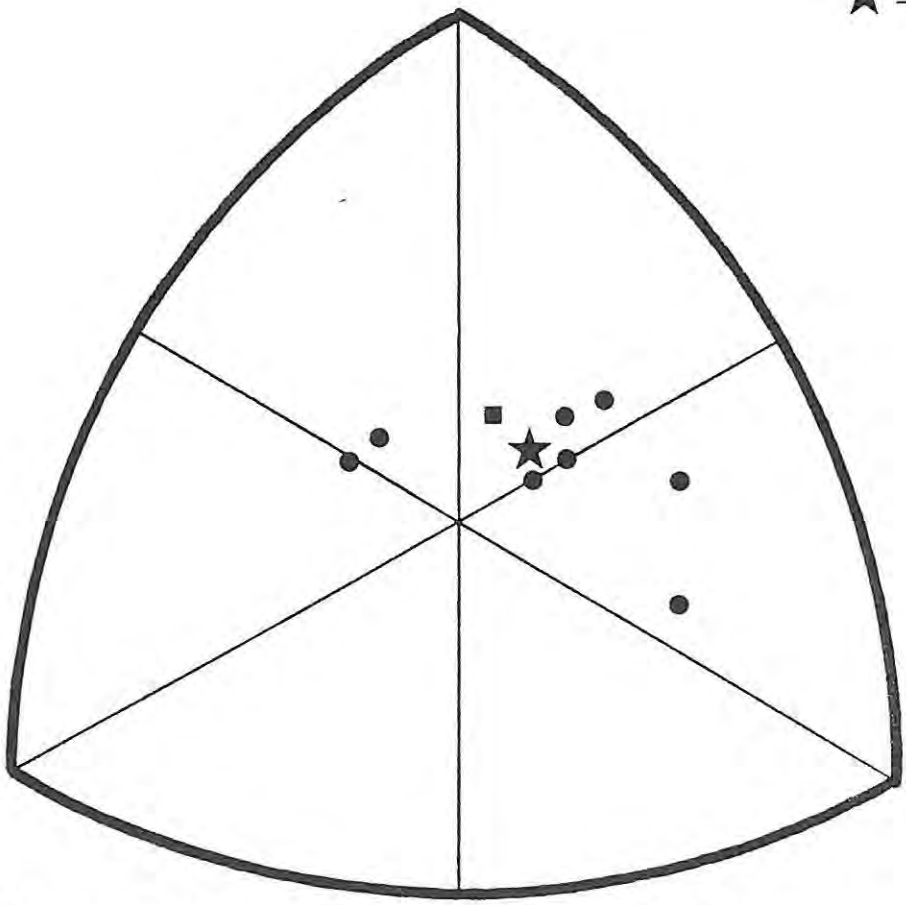

Figure 17: Somatotype distributions of low fit hand grip group

Thus the hypothesis C3 is accepted. This hypothesis states that

> Significant somatotypological differences, indicating that mesomorphy is a positive factor, will be found between high and low fit groups.

It would appear that this mesomorphic size is instrumental in the formation of a positive level of body cathexis amongst high fit groups. Thus the hypothesis D3 is accepted. This hypothesis states that

> Significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups.

G. Conclusion

The t-test results for these events would appear to support the factor analytic findings, and re-emphasize that endomorphy is a crucial negating factor in events where the body mass must be displaced. Furthermore this somatotypological difference would seem to have a negative effect on the level of body cathexis.

## 4.6.3 The Remaining Physical Fitness Events

### A. Introduction

Factor analysis had indicated that the physical fitness events that did not require the body mass to be displaced were not strongly affected by excess adipose tissue. Furthermore, body cathexis was not closely related to the performance of these events. Student t-tests for high and low fit groups on these events verified these findings and no somatotypological or body cathexis differences were indicated. Since no significant differences were indicated, tables of the Student t-tests conducted on these events may be located in the appendix. A brief discussion of each event follows.

### B. Extent Flexibility

Factor loadings for extent flexibility on Factors 1, 2 and 3 are 0,19 -0,10 and -0,02 respectively. The results of the t-tests confirm the factor analytic findings indicating that extent flexibility is not highly related to somatotype or body cathexis. No significant difference in tri-dimensional somatotype (t-value 1,45: df 24) is indicated which suggests that physique is not a differentiating variable on this event. Furthermore no

239/significant difference....

significant difference in body cathexis (t-value 0,61: df 24) between the high and low fit groups is indicated. This is probably attributable to the fact that neither strength nor adiposity seem to have a significant bearing on extent flexibility. Factor 8, with a loading of 0,74, appears to be an Extent Flexibility factor, since this event does not load highly on any of the other nine factors (see appendix).

C. Dynamic Flexibility

Factor loadings for dynamic flexibility on Factors 1, 2 and 3 are 0,23 0,16 and -0,17 respectively. The t-test results serve to emphasize the lack of relationship between this event and somatotype and body cathexis. Both the tri-dimensional (t-value 1,01: df 24) and body cathexis (t-value 1,55: df 24) t-test results are insignificant. Factor 9, with a loading of -0,64, is the only factor on which this event loads highly.

D. Cable Jump

Factor loadings for cable jump on Factors 1, 2 and 3 are 0,13 -0,05 and -0,10 respectively. Again both the tri-dimensional (t-value 0,96:df 28) and body cathexis (t-value 1,06: df 28) t-test results are insignificant,

240/confirming the.....

confirming the finding that little relationship exists amongst these variables. Factor 9, with a loading of -0,67 for this event, alongside dynamic flexibility, is the only factor on which cable jump loads strongly.

E. Balance

Factor loadings for balance on Factors 1, 2 and 3 are 0,22 0,01 and 0,05 respectively. The tri-dimensional (t-value 0,82: df 28) and body cathexis (t-value 0,52: df 28) t-tests again confirm that no relationship of any significant degree exists between these variables. Balance does not load highly on any of the ten factors reported.

F. Conclusion

These results are in accordance with the factor analytic findings, and re-emphasize that somatotype does not have a significant influence on the effective performance of these events. This is probably due to the nature of their activity, as has been mentioned. The body mass does not have to be displaced, and little strength is required for effective performance. Thus the hypotheses (E1, E2, E3, E4) are accepted for these events. These hypotheses state that

No Significant somatotypological differences, indicating that endomorphy is negatively related and mesomorphy positively related to high performance, will be found between high and low fit groups.

The fact that no significant differences for body cathexis were indicated can probably be attributed to the fact that body cathexis appears to be related to endomorphy and strength, and these events make little distinction here.

The hypotheses (F1, F2, F3, F4) are also accepted. These hypotheses state that

No Significant body cathexis differences, indicating that body cathexis is positively related to high performance, will be found between high and low fit groups.

4.6.4 Summary

The analysis of the differences between high and low fit groups was useful in strengthening and validating the conclusions drawn from factor analysis and multiple regression analysis. The most important information gathered was the re-affirmation of the following:

242/The four physical.....

The four physical fitness events that do not require the body mass to be displaced do not seem to be affected by somatotype. No significant differences in body cathexis levels are indicated between high and low fit groups on these events either.

The shuttle run, pull ups, leg lifts and 6 lap run are all adversely affected by high levels of endomorphy, which in turn, appears to be a crucial factor in determining the level of body cathexis. High fit groups, with significantly lower endomorphic means, displayed significantly higher body cathexis means, than low fit groups.

Finally the hand grip appears to be related to mesomorphic size but is not negatively affected by a high endomorphic component. This mesomorphic size would seem to be the crucial factor in determining a high level of body cathexis. The high fit group, on this event, with a significantly higher mesomorphic mean, displayed a significantly higher body cathexis mean than the low fit group.

# CHAPTER 5

## CONCLUSIONS AND RECOMMENDATIONS

In this chapter conclusions will be drawn from the findings, answers will be tendered to the questions posed in Chapter 3, section 3.1, and a number of recommendations and suggestions will be made.

### 5.1 PHYSICAL FITNESS AND SOMATOTYPE

It was hoped that this study would indicate whether or not good physical fitness performance was characterized by a specific body type. The observation that people with relatively similar body types tend to participate in selected sports has been substantiated by a number of somatotype studies. (Section 2.6.3). Many of these studies suggest that successful performance is generally characterized by high mesomorphy and low endomorphy. Accordingly, investigations which have been undertaken examining the relationship between physical fitness performance and somatotype (section 2.6.4) have generally concluded that high performance is associated with mesomorphy and low performance with endomorphy. A combination of strong endomorphy or ectomorphy tends to limit an individual's ability to perform physical fitness tests efficiently. On the basis of this literature it was hypothesized that good physical fitness performance would be

244/accompanied....

accompanied by a low endomorphic component and a high mesomorphic component.

The present data suggests that the ability to perform well on many of the physical fitness events is indeed, closely related to physique. Excess adipose tissue or endomorphy is a powerful negating factor in the performance of events where the body mass must be moved, either horizontally or vertically. Both factor analytic and multiple regression results indicated that high endomorphy was a powerful limiting factor in the performance of the dynamic physical fitness events (shuttle run, pull ups, leg lifts, 6 lap run). The significant somatotypological differences ($p < 0{,}005$) found between high and low fit groups on these events with regard to endomorphy, further strengthen the suggestion that the presence of excess adipose tissue is a crucial differentiating factor between high and low performance. These results are in agreement with previous studies which have identified endomorphy as a limiting factor and it can be concluded that excess fat is a definite handicap on the dynamic physical fitness events.

While mesomorphy is positively related to physical fitness in this study (section 4.5.2) it would appear that it is not as crucial a differentiating factor between high and low performance, as endomorphy is. The fact that no significant

245/differences in.....

differences in mesomorphy between high and low fit groups, were discovered on the dynamic fitness events, indicates that mesomorphy is not <u>the</u> decisive component. The mean somatotype ratings for mesomorphy amongst the high fit groups and the low fit groups on these events are 4,79 and 4,65 respectively. In comparison to the mean endomorphic ratings for high and low fit groups which are 2,24 and 3,50 respectively, the mesomorphic means are very similar. It can be concluded that high performance, on the physical fitness events requiring the displacement of the body mass (relative strength), is associated with a specific body type. The mean somatotype ratings for these events are 2,24 - 4,79 - 3,40 and it would appear that a low endomorphic component and a relatively high mesomorphic component is required for effective performance.

The one physical fitness event which was dependent on absolute strength but did not require the body mass to be displaced, namely the hand grip, was influenced by physique. In contrast to the events requiring relative strength, the hand grip was not negatively affected by endomorphy to the same extent. Significant somatotypological differences between high and low performers on this event were indicated for mesomorphy and ectomorphy (negative value) but not for endomorphy. The significant ectomorphic difference between high and low performers on this event indicates that high performers have lower ectomorphic means than the low performers.

246/This suggests....

This suggests that high performers are characterized by considerable bulk (section 4.4.2). The conclusion that can be drawn is that this event is positively affected by large mesomorphic size. A large mesomorphic individual, who is also relatively high in endomorphy, is likely to perform well on this event, since he will have great absolute strength. Olympic weight lifters and shot putters, with their large mesomorphic physiques, are likely to score well on the hand grip.

It was hypothesized (section 3.2.3) that the physical fitness events which did not require the displacement of the body mass (flexibility, balance and cable jump) would not be limited or enhanced by specific physique requirements. The results of this study support this hypothesis and no significant somatotypological differences between high and low performers in these four events are indicated. The mean somatotype ratings for high performers on these events 2,43 - 4,39 - 3,73 and the low performers 2,46 - 4,38 - 3,72 are very similar. It appears that efficient performance on these events is determined by factors other than physique.

Both Perbix (1954) and Laubach and McConville (1966), (section 2.6.4) studying the relationship between somatotype and physical fitness components, concluded their studies by saying that flexibility was not related to somatotype, which is in accord with the findings of this study. A possible reason

247/for this finding....

for this finding is the fact that flexibility is highly joint specific. It is possible that the joints utilized in testing flexibility in this study, are not vital to the efficient performance of the remaining fitness tests. This would imply that a boy could score very badly on the flexibility tests and still effectively perform the other fitness events. It is possible that height is an influential factor on the performance of the dynamic flexibility test. Eckert (1974) has criticized the dynamic flexibility test by saying that it incorporates the element of speed and hence it appears logical to assume that a tall person will take longer to touch his toes than a short person. The need for studies correlating height against performance on the flexibility tests is indicated.

It seems likely that the proprioceptive functions of the body are instrumental in determining one's balance ability. While somatotype appears to have little influence on the ability to balance, it is possible that height and weight are important factors. A lower centre of gravity may well be an important factor in the ability to balance. Conflicting evidence concerning the relationship between height, weight, and balance ability has been reported in the literature. Graybiel and Fregly (1965), Leonard (1966) and Dickinson (1968) could find no relationship between height, weight, and balance. Contrarily,Fearing (1924) has claimed that increasing both height and weight causes increases in body sway negatively

248/affecting balance....

affecting balance ability. It was suggested that height was a more important factor than weight. Miles (1950), in agreement, suggested that height was the greater influence in the ratio of 4:1. This conflicting evidence underlines the need for more studies to be undertaken in this area.

It is likely that the proprioceptive processes play an important role in the performance of the cable jump. They are important for the synchronous contraction and relaxation of the muscular structure, and additionally the cable jump incorporates a certain degree of balance, in that on landing one is required to remain perfectly stationary. Again a lower centre of gravity may well be an influential factor in the performance of this event.

It can be concluded that the four physical fitness events which do not require strength or the displacement of the body mass (flexibility, balance, cable jump) are not adversely affected by excess adipose tissue and no physique requirements are indicated.

To summarize, the major findings indicate that physical fitness events which require strength and the body mass to be displaced are related to a specific body type. The events which do not require the body mass to be moved are not associated with a particular body type.

249/5.1.1. Implications ....

### 5.1.1 Implications and Recommendations

Brozek *et al* (1963) have shown that a higher ratio of lean body mass to fat exists among physically active individuals, and that the level of adiposity is reduced by training and nutrition (section 2.5.3). Recognizing the fact that the level of endomorphy appears to be the crucial differentiating factor between high and low performance on some of the physical fitness events, in this study, theoretically it should be possible to effect an improvement by losing or reducing this excess adipose tissue. One method, although by no means the only method of reducing excess adipose tissue, is the implementation of a training programme. It is important to note that a loss in adipose tissue due to an exercise programme might not necessarily be evident in changes in the body mass. Increased physical activity might increase the lean body mass content while reducing the adipose tissue level. As a result there may be no changes in the body mass but the strength/mass ratio will have improved (ie. greater lean body mass implies greater force potential). The implementation of a training programme designed to lower the endomorphic component of the body ought to be effective in improving the performance of the events which require the displacement of the body mass. It seems unlikely, however,

250/that a reduction....

that a reduction of adipose tissue will either negatively or positively affect performance on the flexibility, balance and cable jump tests.

A suggestion for future research in this area would involve the undertaking of a longitudinal study, in which a group of individuals are tested on Fleishman's Basic Fitness Tests, somatotyped and then subjected to a training programme, before being tested and somatotyped again. This would be useful in exploring the conclusions drawn from this study.

It is important to realize that a greater and disproportionate increase in the size of the muscles (ie. muscular hypertrophy) without a concomitant loss in fat, which theoretically would produce greater force and thus better performance, would not be effective in increasing performance. This increase in muscle mass would result in a further and more cumbersome gain in weight which will have the effect of further reducing the strength/mass ratio ie. relative strength (law of squares and cubes). This would effectively lower performance on the shuttle run, leg lifts, pull ups, and 6 lap run but would produce improved performance on the hand grip (absolute strength). This implies that a heavy resistance progressive training programme would not be an effective means of increasing performance on the dynamic events.

251/5.2 BODY CATHEXIS AND SOMATOTYPE....

## 5.2 BODY CATHEXIS AND SOMATOTYPE

Body cathexis refers to the degree of satisfaction or dissatisfaction which an individual has toward the various parts and processes of his body. Studies which have been undertaken examining the relationship between body cathexis and body type have generally found that males view mesomorphy favourably and endomorphy unfavourably (section 2.8.2). In particular large mesomorphic size tends to result in positive cathexis. It was hypothesized that somatotype would be an important factor influencing the level of body cathexis, and that endomorphy would result in negative cathexis and mesomorphy positive cathexis.

The results of this study only weakly support this hypothesis and low correlations between the level of body cathexis and somatotype were obtained. The body cathexis level was weakly and negatively affected by endomorphy and it can be concluded that a weak relationship exists between excess fat and dissatisfaction with the body. In Western society particular emphasis is placed on obesity and the general reaction to fat is that it is undesirable and disfiguring. Fisher (1974) writes that the reaction to adding fat is as intense as that of a sinner who has violated a cardinal commandment, and he goes so far as to say :

252/Up to a point....

> Up to a point it is an unstated judgement that goodness and virtue are proportionate to how free one is of adipose bulges.
>
> P. 116

The low relationship identified in this study, however, would not support such an intense negative reaction to excess adipose tissue. The two fattest boys in the sample had endomorphic ratings of 7 and 6 which are extremely high. Their body cathexis ratings were 2,97 and 3,01 respectively, which were low, but not the lowest in the sample. This study supports the work done by Brodsky (1954), Miller and Stewart (1968), Wells and Siegel (1961) and Dibiase and Hjelle (1968) (see section 2.7.6), who, using body type silhouettes, found that the endomorphs were viewed unfavourably.

The above mentioned investigators, using the same body type silhouettes, found that there was unanimous preference to look like the mesomorph. Mesomorphy can be considered to be only weakly influential in affecting the body cathexis level, in the present study, for the following reason. Effective performance on the hand grip requires large muscular size, and the low relationship identified between hand grip and body cathexis (to be discussed later) would suggest the existence of a weak relationship between mesomorphic size and body cathexis in this study. This finding has been corroborated by a number of previous investigators (section 2.8.2) who have reported that the level of body cathexis, amongst men, is positively associated with large mesomorphic size. The present data, however, indicate that mesomorphy is not as important a factor as endomorphy in affecting the level of body cathexis.

Hence it can be concluded that the body cathexis level is weakly affected by somatotype. Excess adipose tissue is identified as the most important physique factor influencing the body cathexis in a negative manner, while mesomorphy affects the satisfaction for the body in a positive fashion, but to a much lesser degree then endomorphy.

### 5.2.1 Implications and Recommendations

Since only a low correlation is indicated between endomorphy and body cathexis and an even lower correlation between mesomorphy and body cathexis, it is quite possible that an important criterion affecting the body cathexis level is the hips to shoulder width ratio. The somatotyping technique does not take into account this relationship. McCandless (1960) has written that in the United States the beautiful body is personified as broad shouldered, narrow hipped and with a flat abdomen (section 2.7.6). It may well be that the hips to shoulder width ratio is one of the most important factors in determining the body cathexis level, and even a muscular individual, who nevertheless, has structurally wide hips will not be satisfied with his body. Fisher (1974) is of the opinion

254/that men...

that men identify masculinity with being large and that they wish their bodies to make an impression of muscular largeness. It is unlikely, however, that men wish for large, wide hips since this might be considered "womanly", resulting in low cathexis. It has been suggested that body builders alter their body shape to fit their ideal concept of the body. (Section 2.7.6). It is possible that body builders attempt to gain muscular hypertrophy of the deltoids (shoulders) which is effective in increasing the shoulders to hips width ratio.

The need for studies which involve the actual measurement of the width of the shoulders and the width of the hips in relation to body cathexis scores is indicated.

## 5.3 BODY CATHEXIS AND PHYSICAL FITNESS

The few studies which have been undertaken examining the relationship between body cathexis and physical fitness have reported conflicting evidence (section 2.8.3). Some studies have reported that good physical fitness performance and an improvement in physical fitness is associated with a positive level of body cathexis, while other studies have reported no relationship between body cathexis and physical fitness.
In the present study, it was hypothesized that good physical fitness performance would be associated with a positive level of body cathexis. This reasoning was based on the premise

255/that physically....

that physically fit boys would have functional and aesthetic physiques and would thus like their bodies more than unfit boys.

The present data only weakly support this hypothesis, and the level of body cathexis appeared to be positively but only slightly influenced by some of the physical fitness events. Furthermore, a closer examination of this relationship indicated that the positive relationship between physical fitness and body cathexis was, in fact, closely linked to the endomorphy present.

Four of the physical fitness events which require the displacement of the body mass (shuttle run, pull ups, leg lifts, 6 lap run) have been seen to be strongly and negatively affected by excess adipose tissue (section 4.4.1 and 4.6.2). The high fit groups, on these events, displayed significantly higher body cathexis levels than the low fit groups. Significant somatotypological differences in the endomorphic components were also found for these groups, indicating that endomorphy was a negating factor in the performance of these events. This endomorphic difference seems to be a negating factor in the formation of the body cathexis level as well. This excess adipose tissue has the effect of lowering the level of body cathexis, and it seems likely that the relationship obtained between physical fitness and body cathexis, on these events, is an indirect result of the endomorphy found. This conclusion is strengthened by multiple regression results (section 4.5.1, step 3) on the dependent variable body cathexis. When percentage body fat is partialled out and held constant the residual variance of the strength events drops away sharply. It can be inferred that since the common variance is extracted when percentage body fat is held constant, the performance of those events is limited by excess adipose tissue. This indicates that the relationship between body cathexis and physical fitness is closely tied with the amount of fat present.

No significant differences in the body cathexis levels were found between high and low fit groups on the events which did not require the displacement of the body mass (flexibility, balance and cable jump). No significant somatotypological differences were indicated for these groups either (section 4.6.3). This would further suggest that the positive relationship obtained between the physical fitness events requiring the displacement of the body mass and body cathexis,is a manifestation of the lack of endomorphy present.

The one physical fitness event which did not require the body mass to be displaced, was not affected by endomorphy and yet was still positively associated with the level of body cathexis, was the hand grip. Mesomorphy and not endomorphy seems to be the crucial factor (see section 4.6.2) influencing the body cathexis level on this event. It can be concluded that large mesomorphic size is conducive to positive body cathexis in this case.

To summarize, it can be concluded that the low but positive relationship obtained between the physical fitness events and the

257/level of...

level of body cathexis is an indirect result of body type (physique).

### 5.3.1 Implications and Recommendations

The weak association between physical fitness (low endomorphy) and body cathexis implies that a high level of physical fitness performance is not a major factor influencing the body cathexis level. It is quite possible that successful participation in sporting activities leads to positive body cathexis. Achievement on the sports field may well be a vital factor influencing the formation of the body cathexis. This implies that an individual likes his body because he is able to be successful with it, and without necessarily having to achieve a high level of physical fitness. Read (1969) has shown that success in sporting activities positively influences body esteem while failure results in low body esteem (section 2.7.4). Lay (1970) found significant improvements in self esteem scores amongst successful beginners who were learning to swim (section 2.7.4). Since self esteem and body esteem appear to be linked it is quite possible that these subjects would also evidence improvements in body esteem as a result of success. Fitness as measured by these tests does reflect achievement, but it does not reflect achievement on the sports field. To give an example of this, one subject achieved an average score on the basic fitness tests (51%) and yet he displayed a high body cathexis rating (4,40). This boy represented the

258/College 1st XI....

College 1st XI cricket side (in which he excelled) and the 1st XV rugby side. It seems likely that his high body cathexis rating is a result of his impressive sporting success as opposed to his very average level of physical fitness. It is of course, impossible, to pinpoint accurately the precise cause of this relationship since psychological factors such as motivation and the level of aspiration are not measured. Nevertheless a questionnaire with a "success" scoring scale designed to measure sporting achievement, and administered in conjunction with the Body Cathexis Scale could be utilized to examine the relationship between achievement and body cathexis.

The fact that all boys in the sample were physically active might have had a bearing on the body cathexis level (fully discussed in section 5.7.2). At St Andrew's College all boys are obliged to partake in sporting activities at least three afternoons per week. Furthermore the boys attend physical education lessons during the week where considerable emphasis is placed on physical fitness and cardio-vascular respiratory conditioning, which implies vigorous activity. As a result of these conditions all boys involuntarily attain a certain level of physical fitness. It would be interesting to compare the results of this study with

259/that of another....

that of another, in which boys who do not engage in any type of physical activity, are selected and administered the same tests. (Further discussed in section 5.7.2).

Longitudinal studies in which groups of subjects are administered training programmes designed to improve levels of physical fitness in conjunction with pre and post testing on the body cathexis scale would also be useful.

## 5.4 BODY CATHEXIS AND PERSONALITY

A number of studies have suggested that there is a close relationship between body esteem and self esteem, and that an improvement in body esteem results in a concomitant increase in self esteem (section 2.7.2). The present data indicate that body esteem and self esteem are indeed, related.

The level of body cathexis was negatively associated with one personality trait, inferiority. The correlation between inferiority and body cathexis was -0,43. Of all the variables included in the study (physical fitness, somatotype, and other personality traits) inferiority was the most closely associated with body cathexis. It can be concluded that high feelings of inferiority or low self esteem are closely associated with a low body cathexis. This low self esteem includes feelings of being unsuccessful in realizing personal expectations (level of aspiration), a lack of self confidence, high sensitivity and the suffering from a sense of inadequacy.

Allport (1970) writes that feelings of inferiority can be considered a wound to self esteem, and that they arise with recurrent failures,which result in a sense of deficiency. This sense of deficiency may be due to different causes, including physical weakness, unpleasant appearance, sexual impotence or sexual inadequacy. The inferiority complex is defined as

> a strong and persistent tension arising from a somewhat morbid emotional attitude toward one's felt deficiency in his personal equipment.
>
> P. 130

Whether feelings of inferiority determine a low body cathexis or whether a low body cathexis determines high feelings of inferiority, is not possible to ascertain. The author would like to suggest that the personality trait, inferiority, is a more global term which encompasses the more specific Body Cathexis Test. This would imply that not being satisfied with one's body is only one part of feeling inferior. In order to illustrate the reasoning

261/behind this....

behind this, consider a question concerning inferiority, in the personality questionnaire.

I usually succeed in anything that I attempt.

| YES | NO |
| --- | --- |

If an individual felt that he was not successful at anything he attempted he would answer 'NO', indicating feelings of inferiority. Then consider the endomorphic individual who is hopeless in all sporting activities but is intellectually brilliant and is a highly successful professional man. He is likely to answer 'YES' on this question, and yet it is likely that he will not score well on the Body Cathexis Test.

It would appear that, in this study, feelings of inferiority are related to the degree of endomorphy present. The loading of endomorphy and percentage body fat on the same factor as inferiority (see Factor 3, section 4.4.3) indicates a link between excess adipose tissue and feelings of inferiority. Despite the fact that a very low Pearson product moment correlation co-efficient (r=0,11) between inferiority and percentage body fat (see appendix) was indicated, the factor analytic results suggest that a relationship exists between these variables. In order to verify this conclusion, a regression run on the dependent variable body cathexis was submitted, in which the variable percentage body fat was specified for prior extraction. The prior extraction of this variable resulted in considerable variance of the personality trait inferiority being extracted. Prior to extraction of percentage body fat, the residual variance for inferiority was 0,42. Once percentage body fat had been extracted the residual variance of inferiority dropped sharply to 0,29. This serves to illustrate that common underlying variance exists between inferiority and excess adipose tissue indicating an association between them. It can be concluded that the trait, inferiority, is most closely associated with body cathexis and that excess fat contributes to feelings of inferiority.

### 5.4.1 Implications and Recommendations

The conclusion that excess fat contributes to feelings of inferiority implies that a programme designed to lower the adipose tissue level might be effective in increasing self esteem (ie. reduce feelings of inferiority) and is an area for future research. A number of researchers (section 2.7.4) have shown that improved physical fitness results in a more positive self esteem. Of particular relevance to this study was that conducted by Collingwood and Willett (1971). They

263/reported that....

reported that five obese teenagers displayed an increase in self esteem after a programme of physical activity. Theoretically, by lowering the level of adipose tissue, in this study, one ought to reduce feelings of inferiority and raise the body cathexis level. In order to test these suggestions, future research, in which a physical activity programme designed to lower the level of adiposity is administered in conjunction with the Body Cathexis Test and personality questionnaire, is indicated. A longitudinal study involving pre and post testing on these parameters would be useful in exploring these tentative suggestions. It is again stressed that a weighing scale is not an effective indication of excess adipose tissue loss (see section 5.1.1) and it is necessary to evaluate body composition changes.

## 5.5 SUBDIVISION OF BODY CATHEXIS ITEMS

Both Jourard and Secord (1954) and Magnussen (1958) have item analysed the body cathexis ratings on height, weight, width of shoulders,chest and arms and then measured these items for correlational purposes (section 2.8.2). Large size of these body parts was found to be associated with positive cathexis. It was decided that the Body Cathexis Test could be split up into various subdivisions, which would provide useful and interesting information concerning

264/the manner....

the manner in which an individual rates different parts of his body.

It was hypothesized (section 3.5.2) that all items in the *neck up* category, which were not subjected to anthropometric observations would not be related to physical fitness, but would act as compensatory items for endomorphic boys. This reasoning was based on the fact that an endomorph might thoroughly dislike his waist, legs etc. but would compensate by rating items such as hair, eyes, teeth etc. highly. This hypothesis was not supported and it would appear that items in the *neck up* category do not show a different pattern.

It was hypothesized (section 3.5.2) that all items in the *waist up* category would be closely associated with physique and the performance of pull ups, leg lifts and hand grip. This reasoning was based on the premise that the items arms, back, shoulders etc. were important factors in the performance of these events. This hypothesis was not supported and again this category revealed no significantly different pattern.

It was hypothesized (section 3.5.2) that all items in the *waist down* category would be closely associated with physique and the performance of the shuttle run and 6 lap run. It was felt that the items ankles, legs, knees, etc.

265/were important....

were important factors in the performance of these events. Again the hypothesis was not supported.

Finally, it was hypothesized (section 3.5.2) that the abstract items included in the category *vigour* would be closely related to total fitness or health. It was not, however, correlated with the composite physical fitness index, and the hypothesis was not accepted.

The two individual body cathexis items, *waist* and *body build* evidenced a different pattern. It was hypothesized (section 3.5.2) that the item *waist* would be negatively correlated with endomorphy and positively correlated with the dynamic physical fitness events. This hypothesis was supported and positive cathexis of the item *waist* appears to be a function of dynamic physical fitness and its accompanying low level of endomorphy.

It was hypothesized (section 3.5.2) that the item *body build* would be positively correlated with physical fitness and mesomorphy. This hypothesis was supported and it can be concluded that positive cathexis of *body build* is a function of physical fitness and is also related to mesomorphic size.

In general, however, the subdivision of the body cathexis items failed to produce the expected pattern of results.

266/No explanation...

No explanation for this can be offered and it appears that the arbitrary basis on which this subdivision was taken is ineffective in identifying patterns of common variance.

### 5.5.1 Implications and Recommendations

The fact that the present subdivision of body cathexis items revealed no significant patterns suggests the value of undertaking a factor analysis of each individual item in the body cathexis test. This would enable one to ascertain which items have common underlying variance and could be considered together. Having done this it would be interesting to take actual measurements on these groups of items, where possible, (ie. circumference of arms, waist, width of shoulders, hips) in order to ascertain the influence of actual size on the ratings of these body parts. This would enable the elucidation of the hips to shoulder width relationship which has been mentioned previously. (Section 5.2.1).

## 5.6 GENERAL CONCLUSIONS ON BODY CATHEXIS

The major conclusion that can be drawn for body cathexis from this study, is that it appears not to be closely related to either physical fitness, somatotype or personality. These variables do not have a pronounced effect on the level of body cathexis, and it seems likely that there are variables which are not included in this study which influence body cathexis. The fact that multiple regression analysis indicates that only 48,3% of the total variance in body cathexis is extracted by these variables, further strengthens this conclusion.

## 5.7 PERSONALITY

The most striking feature about personality, in this study, is the notable absence of relationship with either physical fitness, somatotype or body cathexis. With the exception of the single trait, inferiority, which was correlated with body cathexis, (section 4.4.3) there seems to be little relationship between these variables.

### 5.7.1 Personality and Somatotype

The proposed relationship between personality and body type has a long history in psychology, although Sheldon's (1940) initial claims of a strong relationship between physique and temperament, have been viewed somewhat sceptically. Many studies, however, indicate (section 2.7.7.) that a weak relationship between physique and personality does exist, in Sheldon's specified direction.

268/The present study.....

The present study does not support the existence of a relationship between physique and personality, and it can be concluded that body build is not related to personality. These findings are in agreement with Kane (1969) who found no significant associations between body type and personality using the Cattell 16 P.F. and the Parnell method of body typing amongst 400 male and female subjects. Thus the findings of this study do not lend support to the concept of the "fat, jolly" stereotype, the "anxious, nervous, and thin" or the "self confident, extraverted, muscular" individual.

5.7.2 Personality and Physical Fitness

Relatively few studies have been undertaken examining the relationship between personality and performance on a battery of physical fitness tests. The studies that have been undertaken show conflicting results, and they suffer from methodological weaknesses (section 2.7.5).

No link is discerned between personality and physical fitness performance on this test battery. This would suggest that physically fit boys, in this context, have no more desirable or undesirable traits than physically unfit boys

269/The concept of......

The concept of the stable, extraverted, physically fit individual is not supported in this study, but it is important to note that it is still quite possible to be a good sportsman and achieve low scores on the fitness tests administered (see section 5.3.1). Sports such as golf and rifle shooting, for example, are often played by individuals who possess relatively low levels of physical fitness. Hence one cannot conclude, from this study, that no relationship exists between personality and sporting performance.

This study is not in accord with Fixx (1977) (section 2.7.5) who has reported that psychological benefits such as a reduction in tension, depression and anxiety can accrue from exercise. Physical fitness performance, in this study, is not associated with low scores on the anxiety traits, hypochondriac-medical and adjustment-emotionality. There may well be a "threshold" effect between exercise and psychological benefits accruing from exercise. By this I mean that the amount of exercise engaged in can be seen on a continuum from

0% 100%

ie. no exercise to exercising all day. It is possible that people who fall at the 30% level, for example, evidence psychological benefits from exercise in

270/comparison to....

comparison to those who do no exercise. Above this level, however, no increasing psychological benefits are evidenced. Since all the boys in this study were active, this "threshold" effect might not be noticeable. A physically inactive person, who then decides to exercise, may evidence psychological benefits from this activity. It would be incorrect, however, to claim that the results of this study disprove that exercise leads to a <u>temporary</u> decrease in anxiety and stress. The so called "runner's high", which reduces anxiety and provides temporary distraction from the stresses and strains of life, almost certainly occurs <u>immediately</u> following exercise and running. Two American physicians, Rapoport and Sheftell (1980) write that the "runner's high" is a feeling of well being provided through exercise, and is generated in the central autonomic system. The euphoric feeling associated with running is probably related to the production and release of certain chemical agents in the brain. These chemicals (endorphins, serotonin, and norepinephrine) are probably released through running and promote a general sense of well being and play a vital role in providing the anti-depressant benefits gained from running. The personality questionnaire was not administered directly following vigorous exercise which makes it impossible to evaluate the immediate after effects of exercise. We can conclude, from this study, that if the "runner's high" does indeed occur, it is temporary since the physically fit subjects are no less anxious than the unfit subjects.

Thus the conclusion that can be drawn from this study is that physical fitness performance is not associated with specific personality traits.

### 5.7.3 Implications and Recommendations

Earlier it was suggested that poor physical fitness with its accompanying high proportion of adipose tissue is influential in contributing to feelings of inferiority and a low body cathexis (section 5.4.1). It was further suggested, as an area for future research, that by improving physical fitness, and thus lowering the level of adiposity, it might be possible to effect psychological benefits such as an increase in self confidence, heightened level of aspiration, and greater satisfaction with one's body (section 5.4.1). It is stressed that this is a recommendation for future research in this area, and is in no way considered to be therapeutic advice for overweight boys or physical education teachers. It is suggested that a similar approach be adopted to study the effects of an exercise programme on personality.

A longitudinal study, in which a group of subjects are tested for personality, subjected to a training programme, and then tested again might be useful in exploring this relationship. Interestingly Kane (1972) has reported three related longitudinal studies in which personality and extended sporting involvement (not physical fitness performance) have been compared. Werner and Gottheil (1966) investigated the effect of sports participation over four years on West Point Cadets, and found no evidence to indicate that sports involvement affected the 16 P.F. structure of these men. Similarly Rushall (1968) could find no consistent personality changes among participants in track and field, football and swimming over a three year period (no mention is made of the personality measure used). Finally, Kane (1970) found no changes in the personality profiles (16 P.F.) of men and women physical education students taken at the beginning and end of a three year course. These studies would seem to suggest that personality is not influenced by sporting involvement. It would be useful, however, to consider the effects of a fitness training programme, on the personality structures of these subjects.

## 5.8 GENERAL CONSIDERATIONS

Finally it is necessary to consider whether or not the results obtained in this study are representative of boys in general.

St Andrew's College is a private school, and whether private school pupils differ from Government school pupils is a question which cannot be answered from this study. The need for similar studies utilizing a sample drawn from all types of South African schools, enabling more generalized conclusions to be drawn, is indicated.

The undertaking of cross cultural studies and studies amongst both sexes would also be valuable for comparative purposes. Studies which have been undertaken on women in the past (section 2.8.2) have generally found that women desire small body size in contrast to men who desire large size.

Arkoff and Weaver (1966) comparing Japanese men to Caucasian men found that the former exceeded the latter in the degree to which they wanted to be taller and have larger biceps. In the South African context it would be interesting to compare studies which involve both black and white subjects. The cultural differences between these races might substantially affect the results. For example, many Xhosa men in the Eastern Cape consider large, buxom size to be attractive amongst women.

> Ideas of suitability of a bride are based largely on a girls' capability and energy. Looks are not very important to the average man but he likes his wife to be buxom, strong and able to work hard, and also considered fit to bear many children because fertility is regarded as a gift of great goodness.
>
> Elliott (1970 P.44)

To the best of the author's knowledge no studies have been undertaken in this area and it would be interesting to compare cultural ideals of beauty.

St Andrew's College is a boys only school and despite the fact that some of their class lessons are mixed, they are not constantly exposed to the attitudes that girls might hold toward varying physiques. It is possible that boys in a co-educational school might show different attitudes toward their bodies. Similar studies need to be undertaken in co-educational schools to examine this relationship and again enable more generalized conclusions to be drawn.

It has already been mentioned that boys are obliged to partake in sport (section 5.3.1) and studies comparing physically active to non active subjects are required.

It is possible that the onset of adolescence affects the results of this study. Personality theorists have proposed that a sense of identity begins to develop by the end of adolescence. Adolescence is characterized by a search for identity and neither society nor the adolescent knows when maturity starts. (Allport 1970). In many societies 18 year olds are eligible for military service but they cannot vote. Parents sometimes treat the adolescent as a child and sometimes they expect him to shoulder mature responsibilities. Some countries permit the adolescent to drive a car at the age of 16 years and yet he is not allowed to enter a public bar until he attains the age of 19 years (Zimbabwe). In South Africa one is not a "major" (ie. allowed to sign legal documents etc.) until the age of 21 and yet one can drive a car, vote, and die for one's country at age 18. These stipulations vary from country to country, and adolescence is indeed, an age of uncertainty.

This age of uncertainty may well affect the body esteem levels of the subjects. Nash (1951) cited in Fisher (1970) undertook a study to ascertain whether there are changes in perception of body size associated with the radical physical transformations of puberty. Utilizing prepubescent and postpubescent boys, the discrepancies between subject's estimates of their own body dimensions and the actual measurement of these dimensions were computed. In the prepubescent group, a high degree of error in estimating stature was observed. It was suggested that this possibly reflected :

> the uncertain status of being a prepubescent who stands uncertainly in-between childhood and manhood.
>
> P. 22

Fisher does not mention the actual age of these subjects and it is difficult to evaluate the precise relationship obtained. The fact that prepubescents are described as standing between childhood and manhood suggests that they might be considered as adolescents. In another study Rowe and Caldwell (1963) presented subjects with silhouettes representing seven major classes of Sheldon's somatotypes. Each subject was asked to select a figure that looked most like himself and subsequently one that looked least like himself. The subjects comprised 58 male Negro adolescent delinquents (no control group was utilized). A general trend to under-estimate body size was detected. This finding was interpreted as possibly reflecting the fact that there may be a lag in the adolescent, because of his rapid growth, between his feelings about his size and his actual size.

Body size has been identified as a positive influencing factor, if only a weak one, on the level of body cathexis, in this study. It is possible that some boys underestimated their body size, which in turn affected the manner in which they rated their bodies.

277/The fact that....

The fact that adolescence might have a bearing on the results of this study indicates the need for the undertaking of studies aimed at the adult population. It appears feasible that, since body size is a criterion affecting the body cathexis level, this age of uncertainty might have affected the results (ie. error in estimating size).

## 5.9 SUMMARY OF RECOMMENDATIONS

In order to aid further research in this area the recommendations which have been suggested are now summarized.

The following research recommendations are those which the author intends to undertake utilizing data from the present sample.

1) Height and weight measurements need to be correlated with the flexibility, balance and cable jump scores. The correlations obtained between these variables might clarify the considerable confusion that exists in this area. Section 5.1 has underlined the need for more studies to be undertaken concerning the relationship between height, weight, balance and flexibility.

2) The hips to shoulder width ratio needs to be computed and correlated with the body cathexis scores.

278/By measuring.....

By measuring the bi-iliac (bicristal) and biacromial diameters of the subjects it will be possible to determine the ratio between hips to shoulder width. It will then be possible to examine the relationship between the wide shouldered and narrow hipped individual (which according to McCandless (section 2.7.6) personifies the beautiful body) and his level of body cathexis.

3) A factor analysis needs to be undertaken on the Body Cathexis Test in order to ascertain which items have common underlying variance and can be considered together. The arbitrary subdivision of body cathexis items utilized in the present study failed to produce the expected results. Factor analysis will provide an objective method of illustrating the clustering of individual items.

The following recommendations are geared towards researchers interested in undertaking further work in this field.

1) A similar study needs to be conducted in a longitudinal manner, in conjunction with a physical activity programme. Pre and post testing on the fitness tests, somatotype, body cathexis and personality measures should be undertaken. This research

279/ would enable.....

would enable the examination of many of the tentative suggestions and conclusions drawn in this study which include : whether an improvement in physical fitness leads to a reduction in adipose tissue; whether a reduction in adipose tissue leads to a higher body cathexis level and higher self esteem; and whether an increase in physical fitness is related to specific personality changes.

2) An achievement questionnaire with a specially designed success scoring scale ought to be administered in conjunction with the Body Cathexis Test. This will enable the examination of the relationship between sporting achievement and the satisfaction felt for the body.

3) A similar study needs to be conducted on a range of physically active to non-active individuals. This will enable the examination of the effects of varying levels of physical activity on the body cathexis level, somatotype and personality. The possible "threshold" effect of exercise could also be investigated.

4) Similar studies need to be conducted amongst varying populations, including: all types of South African

schools; both sexes; the adult population; and cross cultural studies. This will enable more generalized conclusions to be drawn.

5) On a slightly different note, the widespread use of Fleishman's Basic Fitness Tests is recommended. This will enable South African norms to be compiled which will be useful for researchers using this test battery in South Africa. In addition, it will allow the physical fitness levels of South African children (see section 3.3.3) to be compared with those of children in other countries.

## 5.10 IMPLICATIONS FOR PHYSICAL EDUCATION TEACHERS

It has been shown that a high level of physical fitness with its accompanying low level of fat is weakly and positively associated with the satisfaction felt for the body (section 5.3). Furthermore, feelings of inferiority (low self esteem) have been seen to be linked with dissatisfaction with the body (low body esteem) (section 5.4). Additionally excess fat appeared to be instrumental in giving rise to this low self and body esteem. It has been suggested that a training programme designed to lower the level of adipose tissue might result in an increase in body and self esteem (section 5.4.1).

281/However, even....

However, even if a training programme does result in higher body and self esteem levels, it seems highly unlikely that the In-School Physical Education programme could be utilized to attain this desired goal. A great deal of hard and vigorous activity would be required to reduce the fat content appreciably, through exercise alone. Two or three 45 minute physical education lessons per week are extremely unlikely to have any noticeable effect on the fat content of the pupils.

The fact that fat boys have displayed low body and self esteem levels in this study indicates that physical education programmes might be geared toward helping these boys. It is highly unlikely, however, that the physical education teacher will markedly improve the body esteem levels of the fat boys, by sending them around the cross country course, in an attempt to reduce their fat content. This will probably have exactly the opposite effect, of further lowering self esteem levels since these boys will experience great difficulty completing the course. The sense of failure at not having done well might result in greater feelings of physical inadequacy and inferiority. Possibly physical education programmes should rather be geared toward activities that all boys can attempt and feel successful at. Movement study is one means of attaining this objective and consequently making boys feel better about themselves.

282/Movement and play....

Movement and play are vital factors in the normal development and growth of the child. Physical education in its modern concept implies more than the learning of specific skills and techniques required for games and other activities.

> Physical education can be looked upon as a process through which an individual learns to appreciate psychologically the capacities of his body; what pleasures he can uniquely express through it and derive from it by means of motor activity.
>
> Cooper (1969) P. 21

It seems important that the physical education teacher should try to steer away from the rigid programmes that will constantly result in failure for the fat boys and possibly lower self esteem levels further, reinforcing the opinion that :

> The fat child, like the thin learns that the playground gives the rewards to the mesomorph not to him.
>
> Allport (1970) P. 62

Programmes which cater for all aspects, and not only for the outstanding performers are required. Individual expressiveness, and not the army P.T. drill instructor approach, is implied. A programme of movement experience in which the practice of skills is mingled with the performance of other tasks where the pupil is led to an awareness and comprehension of movement form is one method of achieving this objective. The term movement sense is used to designate a general condition of motor sensitivity and competence. Like common sense or musical sense it is seen as a consistent personal characteristic operating in a wide field of activity. It implies the ability to move appropriately in a variety of situations both familiar and unfamiliar. The indefinable quality of beauty in movement is, in some way, related to the appropriateness of the movement to the task and the occasion, which is the hallmark of good movement sense.

Physical education programmes which include this approach are likely to be considerably more beneficial to the fat boys than those which emphasize excellence of specific games techniques and physical fitness performance. Programmes and teachers whose

> .... feeling for the importance of their subject and imagination and human sympathy renders them willing and able to draw out and encourage the fat, the lazy, the awkward, the flat-footed, and the physically shy and retarded.
>
> Percival (1967)
> (cited Whiting *et.al.*, 1973 P.116)

are required.

The very broad recommendations in this section are intended to stress that physical education lessons ought to cater for all boys and not only for the outstanding sportsmen. The fact that endomorphic individuals, with their low levels of physical fitness, have shown low self esteem levels, in this study, indicates the necessity for lessons to be geared toward their needs.

## 5.11 CONCLUSION

Previous research has indicated that good sporting performance and high levels of physical fitness performance are closely linked to the physique of the body. The present study proved to be no exception, and boys with high levels of physical fitness were characterized by particular body types. Physique and physical fitness performance were closely related, and it appears that an excess of fat is a severe limiting factor in performance where the body mass must be displaced. The excess weight with which the endomorphic boys had to contend critically hindered their performance on the dynamic physical fitness events. It can be concluded that a high degree of excess adipose tissue is identified as the most influential factor affecting physical fitness performance, in this study.

285/It was initially.....

It was initially felt that the physique and level of physical fitness would be an important criterion in affecting the degree of satisfaction an individual felt toward his body. Previous research had indicated that the social approval given to varying physiques by society was influential in determining the degree of satisfaction felt for the body. In Western society muscularity, amongst men, is generally perceived as desirable, whilst stout and chubby physiques are considered undesirable. The present study indicated that the satisfaction felt for the body was not <u>strongly</u> influenced by either physique or physical fitness (which have been shown to be interrelated). The relationship between these variables is not as simple or as clear cut as was initially believed. It appears that fat boys with their accompanying low standard of physical fitness performance, are only marginally more dissatisfied with their bodies, than the boys with lean physiques and high levels of physical fitness. Physique and physical fitness only partially contribute in affecting the degree of satisfaction an individual has for his body, and the weak link between these variables suggests that the formation of body cathexis is by no means solely a function of physique and physical fitness. It appears that there are variables, which have not been evaluated in this study, that significantly affect the likes and dislikes an individual has toward his body.

286/Finally, it has....

Finally, it has often been claimed that physique and physical fitness are associated with specific personality traits. Personality, in this study, however, was not closely related to physical fitness, body type or body cathexis. The single relationship that was discerned was that between the personality trait of inferiority and body cathexis. This suggests that inferiority feelings are linked to dissatisfaction with the body and it appears that a low self esteem and a low body esteem can be equated, in this study. Besides this one trait, physically fit boys with their lean physiques displayed no more desirable or undesirable personality traits than unfit boys with their endomorphic physiques.

APPENDICES

Appendix A: Table of means, $h^2$ and standard deviations

| NO | VARIABLE | | MEANS | $h^2$ | SD |
|---|---|---|---|---|---|
| 1 | Endomorphy | ENDO | 2,63 | 0,99 | 0,90 |
| 2 | Mesomorphy | MESO | 4,45 | 0,59 | 0,88 |
| 3 | Ectomorphy | ECTO | 3,64 | 0,22 | 0,94 |
| 4 | Extent Flexibility | EXFL | 44,82 | 0,39 | 11,62 |
| 5 | Dynamic Flexibility | DF | 17,55 | 0,54 | 2,16 |
| 6 | Shuttle Run | SR | 20,62 | 0,45 | 1,12 |
| 7 | Hand Grip | HG | 38,41 | 0,82 | 7,18 |
| 8 | Pull Ups | PU | 7,55 | 0,75 | 4,65 |
| 9 | Leg Lifts | LL | 22,38 | 0,63 | 2,88 |
| 10 | Cable Jump | CJ | 4,25 | 0,49 | 0,80 |
| 11 | Balance | B | 5,06 | 0,30 | 1,68 |
| 12 | 6 Lap Run | LR | 613,84 | 0,51 | 63,26 |
| 13 | Fitness Index | FI | 51,14 | 0,75 | 8,88 |
| 14 | Body Cathexis | BC | 3,55 | 0,84 | 0,43 |
| 15 | Neck Up | NU | 3,63 | 0,79 | 0,41 |
| 16 | Waist Up | WU | 3,37 | 0,84 | 0,72 |
| 17 | Waist Down | WD | 3,42 | 0,66 | 0,59 |
| 18 | Vigour | VIG | 3,70 | 0,76 | 0,52 |
| 19 | Waist | ST | 3,21 | 0,50 | 1,21 |
| 20 | Body Build | BB | 2,97 | 0,69 | 1,40 |
| 21 | Percentage Fat | F | 17,37 | 0,99 | 3,18 |
| 22 | Absolute Fat | FM | 10,09 | 0,80 | 2,71 |
| 23 | Lean Body Mass | LM | 47,70 | 0,82 | 7,40 |
| 24 | Sociability | SOC | 8,19 | 0,20 | 2,71 |
| 25 | Adjustment Emotionality | ANX | 5,31 | 0,56 | 2,83 |
| 26 | Ascendence Dominance | DOM | 5,48 | 0,28 | 2,89 |
| 27 | Superego | SUP | 6,68 | 0,39 | 2,20 |
| 28 | Hypochondriac Medical | HY | 4,39 | 0,56 | 2,24 |
| 29 | Impulsiveness | IMP | 5,34 | 0,32 | 2,58 |
| 30 | Co-operativeness Considerateness | CO | 6,51 | 0,39 | 2,32 |
| 31 | Inferiority | IN | 3,73 | 0,25 | 1,81 |
| 32 | Persistence | PER | 6,83 | 0,27 | 2,09 |
| 33 | Trust vs Suspicion | SUS | 8,10 | 0,20 | 2,00 |

288/Appendix B....

| | ENDO | MESO | ECTO | EXFL | DF | SR | HG | PU | LL | CJ | B | LR | FI | BC | NU | WU | WD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENDO | | 0,47 | -0,60 | -0,27 | -0,03 | 0,42 | -0,11 | -0,51 | -0,27 | -0,16 | -0,09 | 0,49 | -0,50 | -0,24 | 0,06 | -0,12 | -0,17 |
| MESO | | | -0,85 | -0,15 | 0,16 | -0,06 | 0,40 | 0,08 | 0,09 | 0,01 | 0,09 | 0,05 | 0,08 | -0,01 | 0,05 | 0,15 | -0,09 |
| ECTO | | | | 0,20 | -0,20 | 0,01 | -0,28 | -0,05 | -0,07 | -0,03 | -0,03 | -0,15 | -0,03 | -0,01 | -0,12 | -0,16 | 0,08 |
| EXFL | | | | | 0,15 | -0,36 | 0,03 | 0,15 | 0,23 | 0,04 | -0,11 | -0,18 | 0,39 | 0,03 | -0,04 | 0,09 | 0,06 |
| DF | | | | | | -0,22 | 0,15 | 0,25 | 0,30 | 0,37 | 0,01 | -0,24 | 0,54 | 0,19 | 0,25 | 0,17 | 0,09 |
| SR | | | | | | | -0,34 | -0,45 | -0,35 | -0,08 | -0,07 | 0,39 | -0,63 | -0,31 | -0,09 | -0,28 | -0,14 |
| HG | | | | | | | | 0,45 | 0,29 | 0,15 | 0,21 | -0,09 | 0,52 | 0,32 | 0,22 | 0,32 | 0,01 |
| PU | | | | | | | | | 0,57 | 0,18 | 0,19 | -0,53 | 0,75 | 0,23 | 0,05 | 0,24 | 0,05 |
| LL | | | | | | | | | | 0,08 | 0,07 | -0,39 | 0,63 | 0,25 | 0,09 | 0,27 | 0,11 |
| CJ | | | | | | | | | | | 0,03 | -0,13 | 0,49 | 0,17 | 0,10 | 0,12 | 0,12 |
| B | | | | | | | | | | | | -0,11 | 0,30 | 0,01 | -0,04 | -0,05 | -0,06 |
| LR | | | | | | | | | | | | | -0,59 | 0,05 | 0,17 | 0,02 | -0,02 |
| FI | | | | | | | | | | | | | | 0,28 | 0,10 | 0,25 | 0,08 |
| BC | | | | | | | | | | | | | | | 0,78 | 0,84 | 0,66 |
| NU | | | | | | | | | | | | | | | | 0,59 | 0,43 |
| WU | | | | | | | | | | | | | | | | | 0,52 |
| WD | | | | | | | | | | | | | | | | | |
| VIG | | | | | | | | | | | | | | | | | |
| ST | | | | | | | | | | | | | | | | | |
| BB | | | | | | | | | | | | | | | | | |
| F | | | | | | | | | | | | | | | | | |
| FM | | | | | | | | | | | | | | | | | |
| LM | | | | | | | | | | | | | | | | | |
| SOC | | | | | | | | | | | | | | | | | |
| ANX | | | | | | | | | | | | | | | | | |
| DOM | | | | | | | | | | | | | | | | | |
| SUP | | | | | | | | | | | | | | | | | |
| HY | | | | | | | | | | | | | | | | | |
| IMP | | | | | | | | | | | | | | | | | |
| CO | | | | | | | | | | | | | | | | | |
| IN | | | | | | | | | | | | | | | | | |
| PER | | | | | | | | | | | | | | | | | |
| SUS | | | | | | | | | | | | | | | | | |

| | VIG | ST | BB | F | FM | LM | SOC | ANX | DOM | SUP | HY | IMP | CO | IN | PER | SUS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENDO | -0,29 | -0,47 | -0,2[illegible] | -0,98 | 0,80 | -0,07 | -0,05 | -0,04 | 0,07 | -0,05 | 0,09 | -0,06 | 0,13 | 0,09 | -0,16 | -0,01 |
| MESO | -0,13 | -0,21 | 0,29 | 0,44 | 0,59 | 0,34 | -0,07 | -0,13 | 0,10 | -0,03 | -0,01 | -0,05 | -0,09 | [illegible] | -0,12 | 0,15 |
| ECTO | 0,08 | 0,22 | -0,21 | -0,56 | -0,64 | -0,25 | -0,04 | 0,05 | -0,18 | 0,06 | -0,02 | 0,05 | 0,07 | -0,06 | 0,16 | -0,05 |
| EXFL | -0,04 | 0,31 | 0,02 | -0,28 | -0,22 | 0,04 | 0,09 | 0,10 | -0,16 | -0,01 | -0,01 | -0,01 | 0,06 | -0,01 | -0,14 | 0,11 |
| DF | 0,09 | 0,23 | 0,21 | -0,05 | 0,01 | 0,10 | 0,10 | -0,11 | 0,12 | -0,02 | -0,16 | -0,05 | -0,13 | -0,03 | -0,08 | -0,02 |
| SR | -0,18 | -0,42 | -0,44 | 0,45 | 0,20 | -0,30 | -0,10 | 0,10 | -0,05 | 0,06 | 0,33 | 0,24 | -0,04 | 0,24 | 0,01 | 0,09 |
| HG | 0,12 | 0,14 | 0,59 | -0,15 | 0,37 | 0,82 | 0,04 | -0,11 | 0,18 | -0,16 | -0,16 | 0,01 | -0,18 | -0,19 | -0,28 | 0,06 |
| PU | 0,19 | 0,34 | 0,44 | -0,54 | -0,30 | 0,28 | 0,19 | -0,06 | 0,08 | -0,11 | -0,21 | -0,02 | -0,16 | -0,09 | 0,07 | 0,11 |
| LL | 0,21 | 0,24 | 0,35 | -0,30 | -0,15 | 0,16 | 0,14 | 0,04 | 0,11 | 0,02 | -0,05 | 0,02 | -0,02 | -0,16 | 0,04 | 0,05 |
| CJ | 0,06 | 0,25 | 0,25 | -0,18 | -0,06 | 0,14 | 0,11 | -0,09 | 0,05 | -0,04 | -0,03 | -0,04 | -0,12 | -0,06 | 0,10 | 0,03 |
| B | -0,03 | 0,03 | 0,10 | -0,10 | -0,05 | 0,08 | -0,09 | 0,02 | 0,10 | -0,12 | 0,03 | 0,12 | -0,03 | -0,03 | -0,10 | 0,09 |
| LR | -0,01 | -0,16 | -0,15 | 0,50 | 0,38 | -0,06 | 0,02 | 0,02 | 0,03 | -0,05 | 0,05 | 0,02 | 0,07 | -0,04 | -0,23 | -0,14 |
| FI | 0,18 | 0,43 | 0,50 | -0,54 | -0,22 | 0,40 | 0,16 | -0,08 | 0,09 | -0,12 | -0,20 | -0,04 | -0,13 | -0,16 | 0,02 | 0,07 |
| BC | 0,76 | 0,48 | 0,68 | -0,26 | -0,08 | 0,22 | 0,18 | 0,01 | -0,02 | 0,07 | -0,20 | -0,15 | -0,04 | -0,43 | 0,01 | -0,11 |
| NU | 0,52 | 0,20 | 0,32 | 0,03 | 0,14 | 0,18 | 0,20 | -0,06 | 0,06 | 0,06 | -0,17 | -0,18 | -0,03 | -0,40 | -0,05 | 0,08 |
| WU | 0,47 | 0,50 | 0,68 | -0,14 | 0,02 | 0,24 | 0,12 | 0,01 | -0,05 | -0,03 | -0,15 | -0,06 | -0,07 | -0,36 | 0,07 | -0,15 |
| WD | 0,45 | 0,25 | 0,40 | -0,15 | -0,14 | -0,01 | 0,08 | 0,08 | -0,21 | 0,17 | -0,06 | -0,20 | 0,13 | -0,23 | -0,01 | -0,08 |
| VIG | | 0,27 | 0,47 | -0,31 | -0,23 | 0,06 | 0,15 | 0,06 | -0,01 | 0,12 | -0,16 | -0,06 | -0,11 | -0,28 | 0,04 | -0,17 |
| ST | | | 0,44 | -0,48 | -0,35 | 0,12 | 0,17 | 0,01 | -0,05 | -0,12 | -0,11 | -0,04 | -0,20 | -0,14 | -0,04 | -0,18 |
| BB | | | | -0,31 | 0,01 | 0,48 | 0,01 | -0,08 | 0,02 | 0,03 | -0,12 | -0,06 | -0,06 | -0,36 | -0,02 | -0,11 |
| F | | | | | 0,78 | -0,10 | -0,06 | -0,04 | 0,05 | -0,06 | 0,09 | -0,03 | 0,15 | 0,11 | -0,15 | -0,03 |
| FM | | | | | | 0,51 | -0,05 | -0,11 | 0,22 | -0,17 | 0,06 | -0,01 | 0,01 | -0,03 | -0,25 | -0,01 |
| LM | | | | | | | 0,04 | -0,09 | 0,28 | -0,21 | -0,02 | 0,03 | -0,18 | -0,24 | -0,23 | 0,01 |
| SOC | | | | | | | | 0,10 | 0,19 | -0,34 | -0,02 | 0,08 | -0,16 | -0,17 | -0,01 | 0,14 |
| ANX | | | | | | | | | 0,24 | 0,02 | 0,55 | 0,22 | 0,05 | 0,23 | -0,08 | 0,13 |
| DOM | | | | | | | | | | -0,12 | 0,26 | 0,16 | 0,12 | -0,21 | 0,05 | 0,20 |
| SUP | | | | | | | | | | | -0,01 | -0,39 | 0,39 | 0,02 | 0,25 | 0,03 |
| HY | | | | | | | | | | | | 0,32 | 0,05 | 0,15 | -0,08 | 0,14 |
| IMP | | | | | | | | | | | | | -0,26 | 0,18 | -0,18 | 0,02 |
| CO | | | | | | | | | | | | | | -0,09 | 0,26 | 0,15 |
| IN | | | | | | | | | | | | | | | -0,08 | -0,10 |
| PER | | | | | | | | | | | | | | | | 0,10 |
| SUS | | | | | | | | | | | | | | | | |

Appendix B: Pearson product moment correlation matrix

Appendix C: Oblique rotation factor analysis table

| | FACTORS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| ENDO | -0,73 | 0,79 | 0,24 | -0,01 | -0,02 | -0,08 | -0,01 | -0,14 | 0,20 | 0,28 |
| MESO | 0,08 | 0,83 | 0,03 | -0,05 | -0,04 | 0,37 | -0,03 | -0,10 | -0,07 | 0,04 |
| ECTO | 0,12 | -0,91 | 0,02 | -0,01 | 0,04 | -0,25 | -0,06 | 0,11 | 0,10 | -0,08 |
| EX FL | 0,19 | -0,10 | -0,02 | 0,02 | -0,02 | 0,01 | 0,04 | 0,74 | -0,13 | -0,05 |
| DF | 0,23 | 0,16 | -0,17 | -0,13 | -0,04 | 0,07 | 0,13 | 0,22 | -0,64 | 0,01 |
| SR | 0,50 | 0,10 | -0,27 | 0,19 | 0,21 | 0,30 | 0,10 | 0,48 | -0,24 | -0,25 |
| HG | 0,46 | 0,38 | -0,30 | -0,11 | -0,07 | 0,89 | 0,15 | 0,06 | -0,22 | -0,07 |
| PU | 0,81 | -0,09 | -0,21 | -0,12 | 0,03 | 0,32 | 0,21 | 0,14 | -0,36 | -0,08 |
| LL | 0,57 | 0,02 | -0,22 | 0,01 | 0,12 | 0,19 | 0,13 | 0,27 | -0,31 | -0,01 |
| CJ | 0,13 | -0,05 | -0,10 | -0,05 | 0,04 | 0,11 | 0,07 | -0,01 | -0,67 | -0,10 |
| B | 0,22 | 0,01 | 0,05 | 0,07 | -0,06 | 0,20 | 0,05 | -0,09 | -0,09 | 0,03 |
| LR | 0,67 | -0,23 | -0,07 | -0,04 | 0,07 | 0,04 | 0,06 | 0,15 | -0,31 | -0,02 |
| FI | 0,78 | -0,08 | -0,23 | -0,14 | 0,06 | 0,42 | 0,19 | 0,41 | -0,79 | -0,09 |
| BC | 0,13 | -0,04 | -1,0 | -0,15 | 0,17 | 0,21 | 0,13 | 0,16 | -0,24 | -0,32 |
| NU | -0,10 | 0,12 | -0,79 | -0,18 | 0,13 | 0,16 | 0,18 | 0,09 | -0,21 | 0,11 |
| WU | 0,14 | -0,12 | -0,77 | -0,11 | 0,18 | 0,21 | 0,17 | 0,20 | -0,20 | -0,49 |
| WD | 0,02 | -0,08 | -0,64 | -0,06 | 0,13 | -0,04 | -0,12 | 0,21 | -0,11 | -0,23 |
| VIG | 0,18 | -0,16 | -0,72 | -0,08 | 0,05 | 0,05 | 0,07 | 0,01 | -0,12 | -0,21 |
| ST | 0,34 | -0,31 | -0,47 | -0,06 | -0,01 | 0,09 | 0,23 | 0,36 | -0,35 | -0,52 |
| BB | 0,55 | 0,26 | -0,59 | -0,10 | 0,17 | 0,52 | 0,01 | 0,08 | -0,33 | -0,52 |
| F | -0,76 | 0,76 | 0,26 | 0,01 | -0,03 | -0,11 | -0,01 | -0,16 | 0,23 | 0,27 |
| FM | -0,57 | 0,79 | 0,10 | -0,02 | -0,01 | 0,48 | 0,09 | -0,12 | 0,06 | 0,18 |
| LM | 0,15 | 0,26 | -0,12 | -0,03 | 0,01 | 0,90 | 0,22 | 0,05 | -0,21 | -0,08 |
| SOC | 0,09 | -0,03 | -0,19 | 0,04 | 0,05 | 0,01 | 0,56 | 0,10 | -0,15 | 0,12 |
| ANX | 0,03 | -0,07 | -0,03 | 0,74 | -0,02 | -0,08 | 0,05 | 0,09 | 0,12 | 0,12 |
| DOM | 0,06 | 0,13 | 0,04 | 0,18 | 0,35 | 0,30 | 0,34 | -0,16 | -0,12 | 0,32 |
| SUP | 0,05 | -0,05 | -0,15 | -0,05 | 0,30 | -0,23 | -0,73 | 0,03 | 0,06 | 0,46 |
| HY | -0,12 | 0,02 | 0,17 | 0,79 | -0,01 | -0,01 | 0,01 | -0,12 | 0,09 | 0,13 |
| IMP | 0,02 | -0,07 | 0,18 | 0,44 | -0,33 | 0,08 | 0,34 | -0,18 | 0,04 | -0,02 |
| CO | -0,12 | 0,01 | 0,01 | 0,02 | 0,58 | -0,16 | -0,37 | 0,15 | 0,17 | 0,23 |
| IN | -0,04 | 0,05 | 0,43 | 0,21 | -0,43 | -0,25 | -0,21 | -0,06 | 0,09 | -0,01 |
| PER | 0,17 | -0,17 | -0,01 | -0,11 | 0,50 | -0,29 | -0,16 | -0,20 | -0,06 | 0,04 |
| SUS | 0,15 | 0,05 | 0,07 | 0,16 | 0,19 | 0,05 | 0,06 | 0,01 | -0,01 | 0,45 |

290/Appendix D....

Appendix D: Factor intercorrelation matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | -0,18 | -0,08 | -0,01 | 0,06 | 0,20 | 0,05 | 0,12 | -0,21 | -0,08 |
| 2 | | | 0,02 | -0,02 | -0,02 | 0,21 | 0,01 | -0,07 | -0,01 | 0,13 |
| 3 | | | | 0,13 | -0,17 | -0,10 | -0,08 | -0,16 | 0,17 | 0,19 |
| 4 | | | | | -0,07 | -0,01 | 0,09 | -0,08 | 0,09 | 0,14 |
| 5 | | | | | | -0,01 | -0,09 | 0,04 | -0,03 | 0,16 |
| 6 | | | | | | | 0,21 | 0,01 | -0,16 | -0,05 |
| 7 | | | | | | | | 0,01 | -0,15 | 0,03 |
| 8 | | | | | | | | | -0,12 | -0,07 |
| 9 | | | | | | | | | | 0,07 |
| 10 | | | | | | | | | | |

291/Appendix E....

Appendix E: Summary table of multiple regression analysis on the dependent variable body cathexis

| VARIABLE | MULTIPLE R | R SQUARE | RSQ CHANGE | SIMPLE R |
|---|---|---|---|---|
| IN | 0,43175 | 0,18641 | 0,18641 | -0,43175 |
| HG | 0,49370 | 0,24374 | 0,05734 | 0,31987 |
| F | 0,52591 | 0,27658 | 0,03284 | -0,25928 |
| LR | 0,55627 | 0,30944 | 0,03286 | 0,05557 |
| DF | 0,58826 | 0,34606 | 0,03662 | 0,19318 |
| DOM | 0,60760 | 0,36917 | 0,02312 | -0,02223 |
| ANX | 0,63374 | 0,40162 | 0,03245 | 0,00984 |
| SUS | 0,64500 | 0,41602 | 0,01440 | -0,11093 |
| PER | 0,65732 | 0,43207 | 0,01605 | 0,00152 |
| HY | 0,66421 | 0,44118 | 0,00911 | -0,20203 |
| SOC | 0,66908 | 0,44767 | 0,00649 | 0,18207 |
| SUP | 0,67934 | 0,46150 | 0,01383 | 0,07842 |
| EXFL | 0,68473 | 0,46885 | 0,00735 | 0,03096 |
| SR | 0,69031 | 0,47653 | 0,00767 | -0,30747 |
| LL | 0,69361 | 0,48110 | 0,00457 | 0,25157 |
| CJ | 0,69500 | 0,48302 | 0,00193 | 0,16958 |
| LM | 0,69531 | 0,48346 | 0,00043 | 0,22759 |
| B | 0,69568 | 0,48396 | 0,00051 | 0,00262 |

F - LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

292/Appendix F....

Appendix F: Summary table of multiple regression analysis on the dependent variable physical fitness

| VARIABLE | MULTIPLE R | R SQUARE | RSQ CHANGE | SIMPLE R |
|---|---|---|---|---|
| F | 0,54308 | 0,29494 | 0,29494 | -0,54308 |
| MESO | 0,65236 | 0,42558 | 0,13064 | 0,08550 |
| LM | 0,68612 | 0,47076 | 0,04518 | 0,40228 |
| ST | 0,70810 | 0,50141 | 0,03064 | 0,43417 |
| HY | 0,71938 | 0,51751 | 0,01610 | -0,20918 |
| SOC | 0,72689 | 0,52837 | 0,01087 | 0,16296 |
| CO | 0,73217 | 0,53607 | 0,00769 | -0,13259 |
| SUP | 0,73736 | 0,54369 | 0,00762 | -0,12299 |
| BB | 0,73982 | 0,54733 | 0,00364 | 0,50516 |
| WU | 0,74886 | 0,56079 | 0,01346 | 0,25221 |
| NU | 0,75069 | 0,56354 | 0,00275 | 0,10473 |
| VIG | 0,75333 | 0,56751 | 0,00397 | 0,18310 |
| PER | 0,75455 | 0,56935 | 0,00184 | 0,02276 |
| ANX | 0,75600 | 0,57153 | 0,00218 | -0,08575 |
| WD | 0,75674 | 0,57266 | 0,00112 | 0,08136 |
| IN | 0,75740 | 0,57365 | 0,00099 | -0,16481 |
| IMP | 0,75796 | 0,57450 | 0,00085 | -0,04719 |
| DOM | 0,75834 | 0,57508 | 0,00058 | 0,09537 |

F - LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

Appendix G: Tables of student t-test results conducted on

Extent Flexibility

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=9 $\bar{x}$ | n=15 $\bar{x}$ | df=24 | $p < 0,05$ |
| Tri-Dimensional | SAV 13,10 | SAV 8,40 | 1,45 | - |
| Bi-Dimensional | SDV 3,79 | SDV 3,60 | 1,01 | - |
| Endomorphy | 2,46 | 2,83 | -1,31 | - |
| Mesomorphy | 4,40 | 4,85 | -0,92 | - |
| Ectomorphy | 3,73 | 3,23 | 1,08 | - |
| Body Cathexis | 3,57 | 3,47 | 0,61 | - |

Dynamic Flexibility

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=13 $\bar{x}$ | n=11 $\bar{x}$ | df=24 | $p < 0,05$ |
| Tri-Dimensional | SAV 2,05 | SAV 2,19 | 1,01 | - |
| Bi-Dimensional | SDV 2,74 | SDV 3,29 | 1,69 | - |
| Endomorphy | 2,27 | 2,45 | -0,83 | - |
| Mesomorphy | 4,35 | 3,95 | 1,15 | - |
| Ectomorphy | 3,72 | 4,18 | -1,34 | - |
| Body Cathexis | 3,75 | 3,49 | 1,55 | - |

294/Cable Jump

Cable Jump

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=33<br>$\bar{x}$ | n=11<br>$\bar{x}$ | df=28 | $p<0,05$ |
| Tri-Dimensional | SAV 2,09 | SAV 2,13 | 0,96 | - |
| Bi-Dimensional | SDV 2,59 | SDV 3,18 | 0,68 | - |
| Endomorphy | 2,47 | 2,88 | -1,49 | - |
| Mesomorphy | 4,35 | 4,25 | 0,42 | - |
| Ectomorphy | 3,66 | 3,76 | -0,29 | - |
| Body Cathexis | 3,53 | 3,35 | 1,06 | - |

Balance

| | HIGH FIT | LOW FIT | t VALUE | SIGNIFICANCE |
|---|---|---|---|---|
| | n=16<br>$\bar{x}$ | n=12<br>$\bar{x}$ | df=28 | $p<0,05$ |
| Tri-Dimensional | SAV 1,61 | SAV 2,66 | 0,82 | - |
| Bi-Dimensional | SDV 5,66 | SDV 3,43 | 0,54 | - |
| Endomorphy | 2,39 | 2,65 | -0,82 | - |
| Mesomorphy | 4,40 | 4,40 | -0,17 | - |
| Ectomorphy | 3,71 | 3,56 | 0,42 | - |
| Body Cathexis | 3,58 | 3,51 | 0,52 | - |

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