

**CONSTRUCTION OF
HEALTH RELATED PHYSICAL FITNESS NORMS
FOR COLLEGE MEN IN KERALA**

By

ANTONY. A. M.



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for the award of the Degree of
DOCTOR OF PHILOSOPHY
IN
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UNIVERSITY OF CALICUT
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DECLARATION

I, **Antony A.M.** hereby declare that the thesis titled "CONSTRUCTION OF HEALTH RELATED PHYSICAL FITNESS NORMS FOR COLLEGE MEN IN KERALA" submitted to the University of Calicut for the award of the **Degree of Doctor of Philosophy in Physical Education**, is an original record of studies and bonafide research carried out by me during the period 1999-2004 under the guidance of **Dr. P.T. Joseph** and that it has not been previously formed the basis for the award of any degree or diploma in any Indian and foreign university.

Calicut University Campus,
18-2-2004.


ANTONY. A.M.

Dr. P. T. JOSEPH

Co-Ordinator

Department of Physical Education &

Sports Sciences

UNIVERSITY OF KANNUR

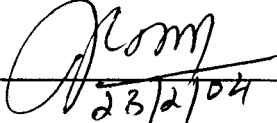
CERTIFICATE

I, **Dr. P.T. Joseph**, do hereby certify that this thesis titled "CONSTRUCTION OF HEALTH RELATED PHYSICAL FITNESS NORMS FOR COLLEGE MEN IN KERALA" is a record of bonafide study and research carried out by **Sri. Antony A.M.** under my supervision and guidance.

Kannur University Campus,
18-2-2004.



Dr. P. T. JOSEPH
(Supervising Teacher)

APPROVED: 
(Dr. P.T. Joseph)

CURRICULUM VITA

NAME OF AUTHOR : **A. M. ANTONY**
PLACE OF BIRTH : **Nayarambalam**
DATE OF BIRTH : **30th November, 1956.**

EDUCATIONAL INSTITUTIONS ATTENDED

Mar Augen High school Kodanad, Ernakulam District, Kerala
Govt. Manavedan High School, Nilambur, Malappuram District, Kerala.
M.E.S. College, Mampad, Malappuram District, Kerala.
Nethaji Subash National Institute of Sports, Bangalore, Karnataka.
University College of Physical Education, Mysore, Karnataka.

DEGREES AWARDED

Bachelor of Arts 1979, University of Calicut, Kerala.
Diploma in coaching (Athletics) N S N I S Bangalore
Bachelor of Physical Education, 1982, University of Mysore
Master of Physical Eduation, 1983, University of Mysore
Vth Degree Black Belt in Taekwon-Do (ITF)

AREAS OF SPECIAL INTEREST

Social Service
Association activities
Physical fitness
Martial arts.

AWARDS AND HONOURS

International Instructor in Taekwon –Do (ITF)
Disciplinary Committee Chairman Taekwon -Do Association of India
(1995-2000)
Vice president Tae kwon Do Association of India (1995- 2000)
Programme Officer, National Service Scheme, MES Ponani College, Kerala
(1996-97)

Secretary, Association of College Teachers in Physical Education under the University of Calicut (1999-2000, 2000-2001, 2001-2002 and 2003-2004)

First place in 400 mts hurdles in Mysore inter collegiate tournaments 1981-82.

First place in 400 mts in Mysore city inter collegiate tournaments 1981-82

First place in 400X100 mts Relay in Mysore inter collegiate tournaments 1981-82.

Second place in 110 mts hurdles in Mysore city inter collegiate tournaments 1981-82.

Member, Mysore University Athletic team (1981-82)

Hon. Secretary, Amateur Athletic Association, Malappuram District (1992-93)

Member, M.E S. MAMPAD College Football Team which won the Zone championship (1977-78)

Captain, MES Mampad College Athlete Team (1977-78)

Member Malappuram District Athletic team (1977-78)

PROFESSIONAL EXPERIENCE

Junior Lecturer, M E S Kalladi College Mannarakkad 1983-84

Lecturer M E S K V M College Valanchery 1984-1995

Lecturer, MES Ponani College 1995-1997.

Lecturer, Sr Scale, D G M M E S Mampad College 1997-1998.

Lecturer, Sr Scale, M E S Asmabi College Kodungallur 1998-2000.

Lecturer Sr Scale M E S K V M college Valanchery 2000 on wards.

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Chapter - I

Introduction

INTRODUCTION

Over the years, physical fitness has become the well-built foundation of a structure that supports the many concrete blocks on it which represents all the activities that makes life worth living: intellectual life, spiritual life, love life and social life.

One of the most beautiful, valuable and incalculable things that God has created on earth is human life. Hence as we are part of that amazing creation, it is the responsibility of the humans to protect and maintain human life in order to achieve higher goals and objectives, to live a happy and meaningful life. This can be made possible by paying attention wellness that includes health and fitness and for the same purpose; scientists, researches and health experts have devoted their precious time to the field of health and fitness.

In the modern society, life has become so complex due to various reasons. The modern way of life has lowered people's biological fitness levels. They lead sedentary life, as machines have made their life easy and comfortable. Without adequate physical exertion man has become a storehouse of unreleased tensions. Modern man in the electronic and computer age tends to become complacent and forget the need of physical training, for his survival. The modern man due to his luxurious, easy and comfortable life has become an easy prey to various fatal diseases.

The early men who lived in caves and hunted down animals were aware of the fact that physical fitness was inevitable to keep them going. Even when man took up farming, he knew that the more fit he is, the more is his dominance. Our ancestors worked very hard to survive and they remained active because of their daily physical activities. It is said that some sort of physical training and education existed in pre-historic period of human evolution. The old rule of "Survival of the fittest" itself calls for how much, even in the time immemorial, physical fitness was valued. The primary function of existence is related to physical activities rather than intellectual. We can see that periods in history which man has progressed more are the times when he has made progress in the promotion of his health. Thus progress in health has always been associated with the advancement in various pursuits of learning and with progress in providing for man's material needs. Whenever health has been neglected, civilization has declined and mankind has deteriorated. However, as man progressed intellectually and as he began to reduce the importance of physical activities, he became an easy victim to many diseases.

Anderson said, "to live an effective and enjoyable life has been the central dominant purpose of mankind from the beginning of recorded history. To attain this goal, mankind has studied the phenomena of the

universe, control in the forces of nature, developed languages, invented various devices instituted new practices, written law and regulations, established institutions and even sought to improve man's basic endowment."¹ Hence no one can belittle the need and scope of physical fitness in this world of troubles, tensions and toil. So the primitive man recognized physical fitness as an absolute necessity for survival.

The concept of physical fitness has become a point of attraction in the modern period. Physically fit citizens are a major asset for a strong nation. Few decades ago, when the Americans realised the need to develop the fitness standard of their youth, much research was carried out on youth fitness and as a result, they could not take proper steps to develop youth fitness on a national scale. The government as well as the people is aware of its importance, as it is essential to increase the productivity power of labour and in every aspects of development. In the modern context, the field of physical education and sports has imparted refined knowledge and skill that has developed due to an impetus provided by the large strides in technology. Concurrent growth in the field such as Bio-mechanics, Exercise-physiology, Sports psychology, Sports medicine, etc impart a sound basis to the higher degrees of competence in contemporary society. Its contribution

1. C.L. Anderson, *School Health Practice*. IVth Edition. Saint Louis: the C.V. Mosby Company, 1968, p.1.

towards building up a peaceful and better world, consisting of non-discrimination, mutual understanding, friendship, solidarity and co-operation; is universally accepted.

According to Hal Higdon² a fitness writer, "after the age of 30, muscle fibres decline at 3 to 5 percent each decade. This can add up to a decline of muscle power of about 30 per cent by the age of 60." Fitness programme will help to regain some of the lost muscle strength as well as to improve cardiovascular and respiratory efficiency.

Fit and healthy people are in control of their life and their body will be supple and will have the resources of strength and stamina. Suppleness prevents from getting injured soon, and keeps one active. Cardiovascular endurance enables one to go through without getting tired. So it is to be kept in mind that exercise is the best investment one can make for a long and healthy life.

Physical fitness is one's richest possession, it cannot be purchased, and it has to be earned through a daily routine of Physical exercise.

"Fitness is a measurable state or condition partially determined by genetics. Health is also a condition but is not merely as easily measured or

2. Les Snowdan. *Fitness walking*, Maggie Humphery Paper Back 2002, p.34.

defined in précised terms as fitness. Heath is not merely the presence or absence of disease, rather, it's a complete state of physical mental & social well being, a complex factor that represents all level of vitality from the highest to the lowest. On the other hand W.H.O defines fitness as the ability to perform work satisfactorily thus making the definition of who is fit and who is not some what dependent on personal inclination and social contacts."³

Claude Bouchard⁴ the internationally renowned Canadian exercise physiologist, estimates that 25 to 40% of one's fitness is genetically determined which is a figure achieving certain respectability these days. It leaves an estimated 60 - 70% within our control which can be gained through regular exercise and healthful diet that makes us more active, lose excess weight, and become more fit - and of course more healthy as well.

Physical fitness is the ability to carry out daily tasks with vigour, and alertness without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies. It can be said that the physical fitness is the ability to last, to bear up and persevere under different circumstances, where an unfit person would give up. It is the

3. Ralph S Paffen Barger Jr. and Eric Leolsen , *Life it*, 1996, p 47.

4.Ralph S. Paffer Barger, Jr. and Eric Leolson, *Life Fit*, 1999, p.50.

opposite of being fatigued from ordinary efforts, to lacking the energy to enter best fully into life and to be exhausted from unexpected exercise demanding physical exertion.⁵

“Physical fitness refers to the ability to carry out daily tasks without being overly tired. People who are fit have energy not only to compete everyday work, but also to participate in planned and unplanned activities outside the house and other work place”.⁶

Physical fitness is a positive and dynamic quality extending on a continuum from death to abundant life. It is an essential quality in humans.

Slowly but surely we are changing our eating habits. These changes are all aspects of wellness movement, which recommends adapting a life style that helps one to feel well and stay well, which emphasize prevention of illness rather than re-medication of diseases.

Wellness is not just for the benefit of the individual, nor is lack of wellness merely an individual problem. The active, healthy life style is a public health issue because the enormous costs of health and health care have made it so.

5. P.K Pande, O.P Sharma (ed.) *The New Encyclopedia of Physical Education*, 5th volume, 1998 edition, p. 21.

6. *ACSM Fitness Book*, Leisure Press Campaign, Illinois, 1992, Leisure Press, p.9.

“Enhancing and expanding the movement vocabulary of a young child is just as important as improving word and reading vocabularies. Since movement is the child’s first language, a variety of experiences will help make that language as precise and expressive as possible.”⁷ Health was viewed as the absence of illness. “Ways of measuring health were to assess the five D’s, - death, disease, discomfort, disability and dissatisfaction.”⁸

The main feature of the wellness is that, wellness does not happen to you rather you must work towards it. The holistic view suggests that, physical, mental and psychological problems are interrelated and that, to achieve wellness, one must make sure that, you must involve in some fitness activity, work and play. Social lives not only are positive in them but also are appropriately balanced.

Fitness and wellness have been approached primarily as if they are personal and individual issues. More recently, however, health has become a national- issue; for no other reason than that, an increasingly large part of our national wealth goes for health care.

7. Boucher, *Introduction to Physical Education, Fitness and Sports*, 1988, p.42. 2nd edition 1994 Daryl Siendentop, p.27.

8 Edlin and Golanty, *Introduction to Physical Education, Fitness and Sports*, 1982. 2nd edition 1994 Daryl Siendentop, p. 83.

There is now little doubt that physical activity of the appropriate frequency, intensity and duration produces significant health benefits. Most important is the achievement of those specific fitness components which help to reduce the risk of hypo kinetic conditions including heart diseases back pain, diabetics, osteoporosis, and obesity.⁹

Looking good, feeling good and increasing the chance of living longer are the few benefits of physical fitness. Slim look was the fashion a generation ago, but athletic look is clearly the fashion today. The current fitness programme however is by no means simply a manifestation of latest fashion; rather, it is a part of larger life style trend that has a strong health basis.

According to Bucher¹⁰ "Fitness is the ability of an individual to live a full and balanced life. It includes physical, mental, emotional, social and spiritual factors and a capacity for their wholesome expression."

In the opinion of Marica E Hart¹¹ "physical fitness is the ability of a person's body to meet the demands placed upon it by his work, by his way of life and by the necessity to meet emergency situation."

9. Corbim, *Introduction to Physical Education, Fitness and Sports*, 1987, p. 50. 2nd edition 1994 Daryl Siendentop, p.154.

10. Bucher, *Foundation of Physical Education and Sports* (1958), p. 8.

Fitness allows one to perform work more efficiently and with less effort. Physical fitness is the capacity for sustained physical activity without excessive fatigue or the capacity to perform everyday activities with reserve energy for emerging situations.

In view of Carl E. Willgoose¹² regarding physical fitness is "physical fitness provides capacity for activity" the greater physical fitness the better the physical endurance and precision of movement which are essential for every sport.

Modern days considerable interests has been shown in both public and private sectors to develop physical efficiency and physical fitness by making physical education programme compulsory in many educational and social service institutions.

Physical fitness is related to the ability to meet the demands of the environment specifically, to preserve, to withstand stress, to resist fatigue and to possess the energy for vigorous and well-rounded life. Physical fitness is minimal in the seriously ill and is maximal in the highly conditioned person.

-
11. Marica E. Heart, "Relationship between Physical fitness and academic success," *Research Quarterly*, 34, 1963.
 12. Carl. E. Willgoose, *Evaluation in Health Education and Physical Education*, New York: Mc Graw Hill Book Co., 1961.

"Physical¹³ fitness is the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies."

1. COMPONENTS OF PHYSICAL FITNESS

Components of physical fitness are speed, strength, endurance flexibility and coordinative abilities.

1) Speed

"It is the performance prerequisite to do motor actions under given conditions (movement task, external factors, individual prerequisites) in minimum of time."¹⁴

"Speed is the ability, on the basis of the mobility of the nervous system and the muscular apparatus, to perform movements at a certain velocity."¹⁵

13. H. Harrison Clarke, *Application of Measurement to Health Physical Education*, 5th ed. Eaglewood Cliffs, N.J: Prentice Hall Inc. 1976, p. 22.

14. Hardayal Singh, *Science of Sports Training*, Ph.D., D V S Publication New Delhi, 1995 p.115

15. Gerhardt Schmolinsky "Track and Field" Spartvertag Berlin 1978 I Edition Inter Druck Graphischer Grofpe tribe Leipzig p 38.

2) Strength

“Strength is the ability to overcome resistance or to act against resistance.”¹⁶

“Strength is the capacity of overcoming a certain or acting against it by muscular tension.”¹⁷

Pull ups, flexed arm, hangs or push ups are commonly used to measure strength.

3) Endurance

“Endurance is the ability to do sports movements with the desired quality and speed under conditions of a fatigue.”¹⁸

It is the capacity to do an activity with desired quality and speed under condition of fatigue. Endurance enables the athlete to do activity efficiently without getting tired and to recover quickly from fatigue and

16. Hardayal Singh, *Science of Sports Training*, Ph.D., D V S Publication New Delhi, 1995 p. 85

17. Gerhardt Schmolinsky “Track and Field “ Spartvertag Berlin 1978 I Edition Inter Druck Graphischer Grofbe Tribe Leipzig p37

18. Hardayal Singh, et al. "Norms of Physical Fitness for Hockey Goal Keepers." *NIS Scientific Journal*. 10:3, July, 1987, p. 3.

during activity. It involves performing a task to exhaustion. The bend knee sit ups is a common exercise to measure this trait.

4) Co-ordinative abilities

“Co-ordinative abilities are understood as relatively stabilized and generalized pattern of motor control and regulation process. These enable the sportsman to do a group of movements with better quality and effect.”¹⁹

5) Flexibility

“Flexibility is the ability to execute movements with greater or range”²⁰

Today's is a world where one can never predict what is going to befall the next moment. In such an unsure world only a man with a fit body and mind can move confidently without fear and tension. Only one who is physically fit can be a body guard to himself. Thus physical fitness boosts up one's confidence.

Physical fitness is a positive quality and it is closely related to diet, exercise, rest, and sleep, emotional and mental poise. It can be referred as

19. Hardayal Singh, *Science of Sports Training*, Ph.D., D V S Publication New Delhi, 1995 p.165).

20. *ibid.*, p. 156

organic vigour and vitality. Physical fitness helps us to feel good, to be able to turn, bend, and twist in any direction with reasonable ease and grace.

The following are the benefits of exercise in the elderly:

1. Improves self care capabilities and general well being.
2. Improves cardio vascular condition, strength and endurance.
3. Improves flexibility, co-ordination and balance.
4. To get over hypo kinetic diseases like diabetics, osteoporosis etc.
5. Maximise social contact and enjoyment of life.
6. Enhances pancreatic activity, digestion and reduce constipation.
7. Promote relaxation, relieve anxiety and depression.
8. Sustains sexual vigour
9. Enhances a healthy life even at a very old age.

Some people lead sedentary lives, working behind the desk and spending their leisure time watching television. If they are having enough strength and endurance to do that, are they really fit? No. Physical fitness can be defined in reference to a list of characteristics.

Physical fitness tends to vary from one individual to another. Apparently, it varies in accordance with the nature of a person, depending on whether he is sedentary or dynamic.

Daily physical activities results in the proper growth and maintenance of health. All living beings acquire control over their limbs and brain to co-ordinate the brain and the body and develop them through physical activities. It is a biological principle that function builds structure and structure decides the functions. The organ and muscles that are used will develop and those that are not used will suffer atrophy. The strength of the muscle is not important and necessary for an individual so as to perform his daily activities in more efficient manner than he would do otherwise.

Those who think have not time for bodily exercise will sooner or later have to find time for illness.²¹

Man found that playing makes him healthy and more efficient. Therefore man wants to play for the sake of health, personal-physical development and strength. All animals and humans instinctively are driven to play. The young animals in their lairs, the human infants in their cradle all play. They play because the nature prompts them, because their instincts

21. Edward Stanley, Earl of Derby, *Life It*. Seminar paper on *The Conduct of Life*. Paper presented at Liver Pool College, December 20, 1987.

propel them. Play brings its own satisfaction. Exercise builds confidence, physical and mental ability, cultivates power of will and determination. It promotes personal efficiency and all mental characteristics.

People are engaged in jogging, playing sports, practicing yoga, cycling etc to protect the body from diseases and various postural deformities. No doubt, physical fitness is an important part of the normal growth and development of an individual to lead an active life style.

The progress of any country in the fields of games and sports mainly depends upon the scientific programme and proper facilities provided to the youth to be outstanding sports men and women. Particularly the age between 12 and 16 years is very crucial in the life of an individual to become outstanding in sports.

Sports provide an ideal mean of bringing people closer together on the basis of shared understanding and mutual respect. Sports play a vital role in health and community development and individual fulfillment.

The characteristics of participation in sports can be summarised as follows:

- 1) Sports is usually a recreational activity undertaken;
- 2) Sports is usually undertaken for fun;

- 3) Sports usually imply a challenge of a physical nature and demands skilful performance.

Recreation is generally understood as a process of refreshment of the mind and of the body. The word recreation is associated with the idea of well being, both physically and mentally. Indeed, sports participation sometimes means the same as physical recreation, describing people's involvement in activities which are in some way physically demanding.

That which is used develops; that which is not used wastes away (Hippocrates).²²

Participation in sports activities are designed primarily to maintain or improve physical working capacity or physical fitness. Sports activities can develop flexibility in the skeleto muscular system, strength in the muscle groups and cardio-vascular endurance or endurance fitness. Activities like aerobics, circuit training, weight training and jogging fall into this category.

The conditioning activities can apply to mental fitness as well as physical fitness. The concentration perseverance with formal physical training will lead to mental discipline. Activities like yoga, and the non-competitive elements of the martial art, have mental training aspect to them.

22. Snowden Humpherys, *Fitness Walking*, 8th Edition, 2002.

Fundamental to success in all types of games and sports is to achieve higher level of physical fitness. Under any hypothesis, a sound and fit body is a pre-requisite for a top level performance in any game or sport. It is considered a matter of common sense that even all the contributory factors are controlled; an improvement in the level of physical fitness shall definitely lead to improvement in the performance level of the sportsman participating in any activity. Fitness is a pre-requisite for exhibiting better performance in all games and sports. Fit players or athletes can delay the onset of fatigue during a match or competition. The more tired the player the more prone he is to making errors and a player who makes a lot of errors narrows his confidence.

A recent report of the British Heart foundation suggested that lack of exercise can be as bad as smoking 20 cigarettes a day having high blood pressure or high levels of cholesterol. Another independent report indicated that the least active population has almost twice the incidents of heart disease as the most active. In Britain someone has a heart attack every three minutes and lack of exercise is a contributory factor. W.H.O estimates that worldwide, four million people die pre maturely each year from smoking cigarettes. The four million lives claimed each year by smoking related

fitness in the U.S matches the number of Americans who died in the II world war.²³

In fact, we become more sedentary as we grow older and that is bad news for our cardio vascular health, general health and fitness.

In a world of technology where information is at one's finger tips, some people are too idle to do exercise. Here are seven common misconceptions about exercises:²⁴

1. I just don't have time.
2. There is no place to workout.
3. Uncle Phil did not exercise (lived up to 95 years).
4. Look what happened to Jim Fixx (he died at 52 while jogging)
5. Medical technology will bail me out.
6. There is no point.
7. It is too late.

23. R. Brown, *The Hindu Sunday Magazine*, May 20th 2001, p. 2.

24. Ralph S Paffen Barger Jr. and Eric Leolsen , *Life Fit*, 1996, p 23-24..

Physical fitness can improve and promote the vitality of health of the individual. A fit person can carry out task for a prolonged period without undue fatigue. Regular exercise is a pre-requisite for physical fitness, which leads to healthy life.

Physical fitness can be classified into two; those pertaining to health and those pertaining to motor skill performance. Health related fitness is concerned with the development of those qualities that offer protection against diseases that is associated with physical activity. Performance related physical fitness on the other hand is associated with those qualities which are conducive to better performance in sports and other physical activities such as those requiring strength, endurance, agility and speed.²⁵

“By health I mean the power to live a full, adult, living, breathing life in a close contact with what I love - I want to be all that I can capable of being.”²⁶

Health related fitness is important for all individuals throughout their life span. Motor performance fitness emphasis the development of the qualities that improve sports performance. Participation in exercise

25. Bucher and West, *Foundation of Physical Education and Sports*, p.17.

26. Katherine Plansfield, *Fitness Walking*, p.23.

regularly increases physical fitness. Individual with regular exercise has an improved sense of general well being and an enhanced self-image.

The socio ecological view also makes it clear that fitness is not health.²⁷ Indeed too much fitness and too much exercise can endanger health, as seen as when Elite athletes become bulimic; when highly trained aerobic athletes become susceptible for viral infection, when athletes use steroids to improve performance develop sever side effects, and when chronic problems such as arthritis develop from long term over use injuries. There is optimum level of fitness for health purpose and it is probably less than we have heretofore for estimated.²⁸

At present in Physical education, physical fitness is either considered health related or performance related. Health related physical fitness is concerned with the development of those qualities that offer protection against diseases and frequently are associated with the physical activity. Performance related physical fitness on the other hand is associated with those qualities which are conducive to better performance in sport and

27. "The use of fitness test educational and psychological consideration." *Journal of Physical Education Recreation and Dance*, 59:2, 1988, pp.45-53.

28. Daryl Siedentop, *Introduction to Physical Education and Sports*, 2nd Edition 1994, p. 166)

other physical activities as those requiring strength, endurance, agility and speed.

Health is not merely of continuum of physical well being or of mental or spiritual or social well being but a combination of all four dynamically interrelated. Modern points of view of health place emphasis on the whole individual and his/her interrelationship with society.

Even in the health conscious U.S.A. the public health service has estimated that only 20 per cent of American adults take regular exercises, to benefit their cardio-vascular health that is exercise, which develop a strong heart and blood vessels. Health related physical fitness includes those aspects of physiological function that offer protection from disease resulting from a sedentary life style. Specific components of health related physical fitness include cardio vascular fitness, muscular strength and endurance flexibility of the low back and body composition.

2. COMPONENTS OF HEALTH RELATED PHYSICAL FITNESS TEST ITEMS

The components and test items are:²⁹

29. AAPERD, *Health Related Physical Fitness Test Manual*. 1980. Association Drive Reston Virginia 22091. ISBN 0-88314-098-5.

1. Cardio respiratory function

- a) One mile run

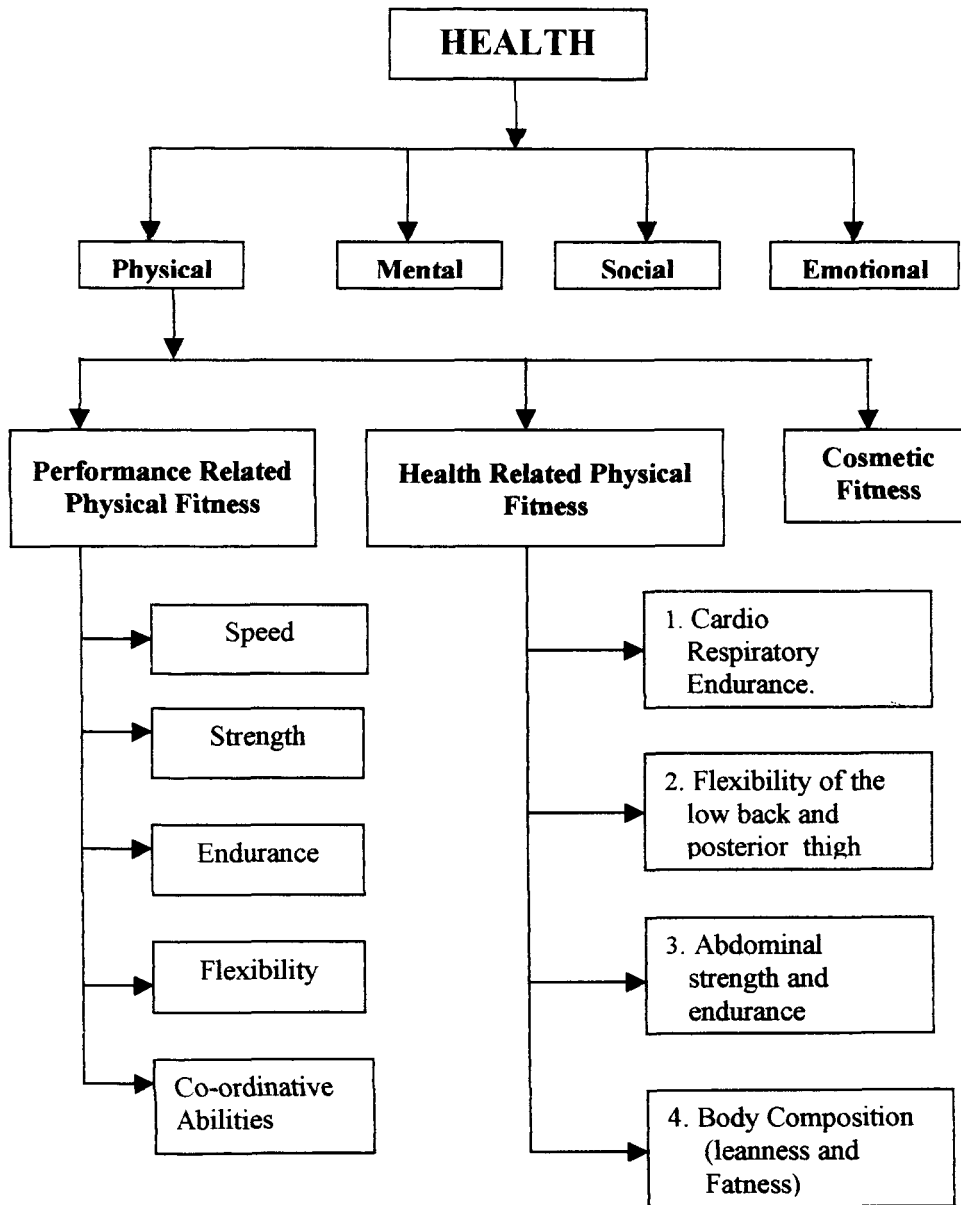
2. Body composition (Leanness/ Fatness)

- a) The sum of triceps and sub scapular skin folds.

3. Abdominal and low back- Hamstring Musculoskelton function.

- a) Modified timed sit-ups.
- b) Sit and reach.

Health/Fitness may be summarised as detailed below.



One of the prominent tests to measure the health related physical fitness is AAHPERD Health Related Physical Fitness. AAHPERD Health Related Physical Fitness refers to the aspects of physiological functioning, which are believed to offer the individual, some protection against degenerative diseases such as coronary heart disease, obesity and various muscle skeletal disorders.

In 1980 American Alliance to Health, physical Education, Recreation and Dance (AAHPERD) developed a new fitness test to emphasis Health Related Physical Fitness instead of motor/Athletic fitness. The new test measures cardio-respiratory fitness, body composition, and low back and hamstring strength and flexibility. These components, which can be measured in the field, reflect changes on exercise habits and are related to some aspect of health.

The components of health related and performance related fitness are similar, for example, cardio-vascular function, body composition, strength and flexibility. However, the degree of development of each varies with the two types of physical fitness. Performance related physical fitness may be required to a greater degree in various sports. For example, A football player needs more physical strength than an average citizen who is interested primarily in maintaining his or her health. Therefore, the

emphasis today for the majority of the population is on physical fitness that is related to functional health.

Performance related physical fitness is associated with those qualities conducive to better performance in sports and other physical activities such as those requiring strength, endurance, agility and speed. It is otherwise known as skill related physical fitness and the qualities of this fitness do not necessarily make us healthier, but possessing these fitness characteristics make us better in games and sports. Skill related aspects of fitness such as agility, balance and co-ordination may be necessary for high quality sports performance and they do not directly promote health.

The qualities essential for health related and performance related fitness are cardio respiratory fitness, body composition, strength and flexibility.

1) Cardio respiratory fitness

It is associated with heart, lung and circulatory system. It is the capacity to exercise the entire body for extended period of time without undue fatigue. The improvement in cardio-respiratory fitness permits higher quality of life by increasing the rate at which energy can be provided to support work and play activities.

Cardio-vascular fitness is also referred to as cardio-vascular endurance, cardio-respiratory capacity and circulatory function.

2) Body composition

It refers to the amount of body fat a person carries if a person has a relatively low percentage of body fat.

There are many genes that play a part in weight regulation. Peptides in the brain's hypothalamus and the gut send signals to increase or decrease hunger depending on energy stores in the body.

The word obesity is derived from Latin word for "to over eat" but now it mean over fat. Obesity has been linked with the onset of various health problems.

Current research indicated that defects in a number of blood gut peptides play a role in weight. There are many genes which play a part in weight regulation peptides in the brain's hypothalamus in us and the gut sent signals to increase or decrease hunger, depending on energy stores in the body. Brain and gut peptides either increase appetite through the alpha - adrenergic system, or decrease it through the beta - adrenergic system.

According to the W.H.O, India will have 50 million people with diabetics by 2005. Risk of diabetics increases when the BMI for Asians crosses over 23 through by W.H.O standards a BMI of 25 to 29 is overweight and above 30 is obesity.³⁰ An excess amount of fat in the body is unhealthy because, it requires more energy for movement and may reflect a diet high in saturated fat. Furthermore, it is believed that obesity contributes to degenerative diseases. Obesity can also result in psychological maladjustment and it also may shorten the life span. A balance between caloric intake and caloric expenditure is necessary to maintain proper body fat content. Exercise will help to control the body fat.

3) Muscular Strength

It is the ability of the muscles to extent force. Muscular endurance is the ability of muscles to extent force over an extended period of time.

According to Basco and Gustafson³¹ “strength is the muscular force utilized in creation or prevention of movement.” Strength is needed for all kinds of work and physical activity. Muscular strength helps in

30. *The Hindu Health Watch Magazine*, 9th March 2003, p. 7.

31. James S. Basco and William F. Gustafson, *Measurement and Evaluation in Physical Education Fitness and Sports*, New Jersey: Prentice Hall Inc., 1983, p. 78.

maintaining proper posture, greater endurance, power and resistance from fatigue.

4) Flexibility

Flexibility refers to the quality of freedom of movement. It is a measure of the range of motion allowed by a body joint or joints. Flexibility is important for performance in sports and important to maintain good posture. It can help to prevent muscle strain and orthopedic problems.

The goal of health in this new century calls for not only to the cure or alleviation of disease, but for the prevention of disease. Rather it looks beyond to strive for maximum physical, mental and social efficiency for the individual, for his family and for the community.

According to AAHPERD health related physical fitness can be viewed thus "physical fitness is a multifaceted continuum extending from birth to death. Affected by physical activity, it ranges from optimal abilities, in all aspects of life through high and low levels of different physical fitness to severely limiting disease and dysfunction³²

32. *Evaluation in Physical Education assessing Motor Behaviour*" Englewood Cliffs: New Jersey: Prentice Hall, Inc. 1973, p.243.

Health related physical fitness is concerned with the development of those qualities that offer protection against disease and frequently are associated with physical activity.³³

The recent development of Health Related Physical Fitness Tests constitutes a shift in the concept of fitness testing. The most prominent of these tests is the AAHPERD test. A Manual was published in 1980 and a technical manual in 1984. Prior proposals for these tests were evident in Texas, South Carolina, and elsewhere. A committee was appointed in 1975 to review possibly revise the AAHEPERD youth fitness test; represented on this committee were the physical fitness, Research and Measurement and Evaluation Councils of Associations of Research, Administration and Professional Annals and Societies, AAPHERD. Instead of revising the youth fitness test, the committee recommended that a Health Related Physical Fitness Test should be constructed. It was felt that a differentiation should be made between functional health and physical performance related primarily to motor ability.

During the early 1950s American Association (now alliance) for Health Physical Education and Recreation began exploring tests that could

33. *Foundation of Physical Education and Sports*, p.34.

be used to measure fitness on a broad scale in the public schools and that could be standardised, including table of norms. The outcome of this exploration was the development of the AAHPER youth fitness test which is now sponsored by the AAHPERD. Although the developing of this test did not define physical fitness before developing the test, the latest version of the test manual (AAHPER 1976) states that the criterion was that the test measure different components of fitness. The manual further noted that this test measures elements of strength, agility and endurance as well as proficiency in running and jumping. This test has become very popular in the U.S. The test items are reasonably familiar, require little or no equipment, can be administered to both boys and girls, can be administered to the entire range of grades 5 through 12, and allow self testing by students (AAHPER 1976:10). On the other hand the test has been criticised as a test Health Related Physical Test because of the types of items included. This criticism became proved in the early 1970s when physical educators and exercise scientists became more concerned about Health Related Physical Fitness of Americas. AAHPER youth fitness test was generally viewed as a measure of physical informative related primarily to athletic ability. Furthermore, the test did not convey a definition of fitness that would be appropriate across the life span. In other words, a test measuring Health

Related Physical Fitness should be appropriate for person of any age whether young, middle aged or elderly. As a result of these courses the AAHPERD Health Related Physical Fitness Test was developed in 1980.

In justifying the recently proposed AAPHERD Health Related Physical Fitness Tests it was pointed out that Health Related Physical Fitness refers to the aspects of physiological and psychological functioning which are believed to offer the individual some protection against degenerative disease such as coronary heart disease, obesity, and various musculo-skeletal disorders. Performance related fitness, as for the AAPHERD youth fitness test, includes those qualities of function that provide the individual with the ability to participate in sports activities with greater power, strength, endurance, skill etc. than would otherwise be the case.

The skill related fitness comprises of agility, balance, co-ordination, speed, power and reaction time.

A lot of studies have been conducted to assess the fitness of different age groups and norms have been constructed. But so far no attempt has been made to construct a norm for health related physical fitness of

University students of Kerala State. Therefore the scholar has undertaken the present study.

3. STATEMENT OF THE PROBLEM

The Problem of the study was entitled 'CONSTRUCTION OF HEALTH RELATED PHYSICAL FITNESS NORMS FOR COLLEGE MEN IN KERALA'. The primary purpose of this study was to develop physical fitness norms for men students in the age group 18 to 23 in Kerala state.

4. DELIMITATION

The study was delimited to the age group of 18 to 23 in men students of Kerala state.

5. LIMITATIONS

1. Certain factors like habits, daily routine, work, diet etc may influence the results which are not considered in the study.
2. The subjects for the study do not come from the same socio-economic and cultural background.
3. The motivation and willingness to perform the test with 100% effort may be a limiting factor.

4. The non-availability of sophisticated equipment to measure the body composition was the prime limitation of the study.

6. NEED AND SIGNIFICANCE OF THE STUDY

The present study is significant in the following ways.

- 1) The norms can be used as a statement to assess the Health Related fitness of college youth in Kerala.
- 2) The study will enable the students to be aware of their fitness.
- 3) This study will help them to compare the fitness with the students of different age groups.
- 4) The study will help to understand the fitness level of the men students in Kerala.
- 5) The study may help to understand the present condition of physical education programmes in college curriculum, preference for physical education in professional area, and also various plans of the government for the upliftment of health and fitness among citizens.
- 6) It will help to compare student's health fitness standards, based on public health research.

- 7) The study may help to find out the relationship between age, weight and height with respect to physical fitness. It may also throw light on the field of measurement highlighting the need for and direction of further research.
- 8) The study will motivate students to improve their amount of fitness status and, will educate students about health related fitness.
- 9) As no one has attempted to construct norm for health related physical fitness for college men in Kerala. This study will enable in the realisation of the need for fitness and may be used as criterion for the selection of teams and athletes.
- 10) The norms developed will be of immense help to the physical education teachers and the coaches in identifying the talented youth, who could be trained further for elite level competitions.
- 11) It enables the teachers to recognize that fitness test scores are influenced not only by exercise habit but also by genetic ability, maturation, skill, level of motivation and test conditions.

7. DEFINITION AND EXPLANATION OF TERMS

1. Health related Physical Fitness

According to AAHPERD health related physical fitness can be viewed thus "physical fitness is a multifaceted continuum extending from birth to death. Affected by physical activity, it ranges from optional abilities, in all aspects of life through high and low levels of different physical fitness to severely limiting disease and dysfunction."³⁴

2. Norms

Norm is a standard against which students are to be judged or tested. Norm is a scale that permits conversion from a raw score to a score capable of comparison and interpretation.

3. Cardio-Respiratory Endurance

"Endurance is the ability to do sports movements with the desired quality and speed under conditions of a fatigue."³⁵

34. *Evaluation in Physical Education assessing Motor Behaviour*" Englewood Cliffs: New Jersey: Prentice Hall, Inc. 1973, p.243.

35. Hardayal Singh, et al. "Norms of Physical Fitness for Hockey Goal Keepers." *NIS Scientific Journal*. 10:3, July, 1987, p. 3.

Cardio respiratory fitness is the ability to exercise the entire body for extended periods of time without undue fatigue. A strong heart is necessary to supply oxygenated blood to the muscles of the body effectively.

Improvement permits a higher quality of life by increasingly the rate at which energy can be provided to support work and play activities.

4. Body Composition (Leanness/Fatness)

It is the combination of base muscle mass and fatty tissues. Percentage body fat, the percent of total weight represented by fat weight, is the preferred index used to evaluate a person's body composition

Body composition refers in simple term to the amount of fat in relation to the percentage of non-fat in the total body tissue.

Body composition is centered mainly on the presence of obesity. It was considered that obesity is a co-existing factor associated with four types of hazards to health, disturbance of various normal function of the body, increased risk of developing certain disease, and adverse psychological effects.

5. Flexibility

“Flexibility is the ability to execute movements with greater or range.”³⁶

Flexibility implies that the human body is able to perform a wide range of movements.

Abdominal and low back - hamstring muscle skeletal function is also another feature of flexibility. The maintenance of minimal levels of trunk and hip strength/endurance and flexibility is believed to be important in the prevention and alleviation of low back pain and tension.

6. Muscular strength

“Strength is the ability to overcome resistance or to act against resistance.”³⁷

“Strength is the capacity of overcoming a certain or acting against it by muscular tension.”³⁸

36. Hardayal Singh, Science of Sports Training, Ph.D., D V S Publication New Delhi, 1995 p. 156

37. Hardayal Singh, Science of Sports Training, Ph.D., D V S Publication New Delhi, 1995 p. 85

38. Gerhardt Schmolinsky “Track and Field” Spartvertag Berlin 1978 I Edition Inter Druck Graphischer Grofbe tribe Leipzig, p.37 Gerhardt Schmolinsky “Track and Field” Spartvertag Berlin 1978, I Edition Inter Druck Graphischer Grofbe tribe Leipzig, p.37

Chapter - II

Review of Related Literature

REVIEW OF RELATED LITERATURE

The research scholar has attempted to locate the related literature of the study and some are detailed below.

"The literature in any field forms the foundation upon which all future will be built."¹

Chen, W. Lin CC, Peng CT, Li CI, WU HC, Chiang J, Wu JY, Huang PC of the Department of Pediatrics, China Medical College and Hospital, Taichung, Taipei, Taiwan conducted a study on current body mass index (BMI) norms for children and adolescents from a reference population that includes obese and slim subjects. They hypothesised that the performance of children in health-related physical fitness tests would be negatively related to increase BMIs, and therefore fitness tests might be used as criteria for developing a more appropriate set of BMI norms. They evaluated the existing data from a nation-wide fitness survey for students in Taiwan. 444652 boys and 433555 girls were selected to examine the relationship between BMI and fitness tests. The fitness tests used included: an 800/1600-m run/walk; a standing long jump; bent-leg curl-ups; and a sit-and-reach test. The 85th and 95th BMI percentile values of the fitter 18 years old

1. J.C. Agarwal, *Educational Research*. New Delhi: Arya Book Depot, 1975, p. 109.

students [23.7 and 25.5 kg m(-2) for boys; 22.6 and 24.6 kg m(-2) for girls] linked well with the adult cut-off points of 23 and 25 kg m(-2), which have been recommended as the Asian criteria for adult overweight and obesity. They expected that the new norms based on this approach will be used not only to assess the current status of obesity or overweight, but also to encourage activity and exercise.²

Lehnhard HR, Lehnhard RA, Butterfield SA, Beckwith DM, Marion SF of the College of Education, Health, Physical Education and Recreation, University of Maine, Orono 04469 conducted a study to assess current fitness levels in the state of Maine. More than 8,000 public school students, ages five through nine, were assessed using a nationally known (American Alliance for Health, Physical Education, Recreation and Dance) health-related physical fitness test. Maine students were then compared with a national norm group on (1) the one-mile walk/run (minutes : seconds), (2) skin fold thickness (centimeters), (3) one-minute timed sit-ups (number performed correctly), and (4) the sit and reach test for flexibility (centimeters). Maine boys and girls scored higher than the norms on the sit-up, sit and reach, and one-mile walk/run; however, they had significantly

2. Related Articles *Links*. *Obes Rev.* 2002 Aug.3(3):225-32. PMID:12164476 [PubMed-indexed for MEDLINE].

larger skin fold thicknesses. Implications for assessment of health-related fitness in this age group were discussed.³

Brown DA, Miller WC of the Exercise Science Programs, The George Washington University Medical Center, Washington, DC 20052, USA conducted a study to derive normative data for muscular fitness in women 20-70+ years old, and to compare these data to the most recently published norms of the American College of Sports Medicine (ACSM). A total of 304 independent-living women were evaluated for maximal performance of bench press, leg press, modified push-ups, grip strength, and sit-and-reach. Tables of normative values for each measurement were generated along with percentile rankings. Large discrepancies were found between these new data and those of the ACSM norms. Bench press norms from ACSM are comparatively high so that the average woman in this current sample scored below the 10th percentile of the ACSM rankings. Similarly, the average women in their sample ranked in either the poor or fair category of the ACSM norms for modified push-ups, and in the poor ACSM category for sit-and-reach. In contrast, leg press scores for the average women in this study fell within the good or excellent category of the ACSM norms, suggesting that the ACSM norms are too low. Grip strength for the middle-

3. Related Articles *Links*. Percept Mot Skills. 1992 Dec; 75(3pt 1):819-26. PMID:1454480 [PubMed-indexed for MEDLINE]

aged women in this study was higher than that in previous norms. These newly established norms are better suited for interpreting women's fitness test results than previously published norms.⁴

Payne, N, Gledhill N, Katzmarzyk PT, Jamnik VK, Keir PJ of the Department of Kinesiology and Health Science, York University, Toronto, Ontario, Canada conducted a study to provide representative norms for measurements of musculoskeletal fitness (partial curl-ups, vertical jump, and leg power) for which Canadian norms are not currently available. Partial curl-ups, vertical jump, trunk flexion (sit and reach), grip strength, muscular endurance (push-ups), body mass index, and subcutaneous adiposity (sum of five skin folds) were assessed, and leg power was calculated in 571 self-reportedly healthy participants (312 females and 259 males) aged 15-69 year. The sample was confirmed by statistically comparing the fitness characteristics of the participants in the present study to those in the Canada Fitness Survey of 1981 and the Campbell's Survey of 1988.⁵

4. Related Articles *Links*. Eur. J. Appl. Physiol Occup Physiol. 1998 Jun; 78(1):77-82. [Pub Med-indexed for MEDLINE]

5. Related Articles *Links*. Can J Appl. Physiol. 2000 Dec; 25(6):430-42. [PubMed-indexed for MEDLINE]

Lehnhard RA, Lehnhard HR, Butterfield SA, Parker C, Young R of the Department of Kinesiology and Physical Education, University of Maine, Orono 04469-5740, USA conducted a study in 226 low-income children, ages 10 through 14 years. Two parameters, tricep skinfold and one-mile walk/run, from the American Alliance for Health, Physical Education, Recreation and Dance health-related fitness test were assessed. Group means by age and sex were compared with state and national norms. As a whole, on both fitness parameters, this low-income sample fell in the bottom quartile for the state of Maine. The group's national ranking was even lower. The study assessed that not only are low-income families burdened financially but also it appeared that the children are also at health risk.⁶

Evans N, Gilpin E, Farkas AJ, Shenassa E, Pierce JP of the Cancer Prevention and Control Program, Cancer Center, University of California, San Diego, La Jolla 92093-0901, USA conducted a study to determine the relative importance adolescents place on preventive health behaviours. Data were from a survey of California adolescents (N=5040). Respondents were asked how important it was to their peers to avoid drugs, marijuana, cigarettes, heavy drinking, and drinking and driving and to maintain seat

6. Related Articles *Links*. Percept Mot Skills. 1995 Dec; 81(3 Pt2):1187-91. [PubMed-indexed for MEDLINE]

belt use, fitness, weight control, and healthy eating habits. Results were compared with data from a similar national survey (n = 6126). California teenagers perceived that their peers have top priority to weight control. Avoiding drugs, not drinking and driving, and maintaining fitness ranked in the top five behaviours. The lowest ranked health behaviours were seat belt use, heavy drinking, and, last, eating healthy. In the national survey, healthy eating also ranked last. Although not identical in rank, teenage priorities for other health behaviours were consistent with the California results.⁷

A modification of the Astrand (1960) nomogram procedure was applied to Canadian Home Fitness Test data obtained on 13,258 subjects, ages 15 to 69 years, during the 1981 Canada Fitness Survey. Norms were developed to allow an empirical five-level categorisation of aerobic fitness, based on the attained rate of stepping and the recovery pulse count 5 to 15 following exercise.⁸

Song TM, Moore J conducted a study on anthropometry and physical fitness of Canadian militia infantry (n=19) and militia service battalion

7. Related Articles *Links*. Am J Public Health. 1995 Aug; 85 (8 pt 1): 1064-9. [Pub.Med-indexed for MEDLINE]

8. Related Articles *Links*. Can J Appl Physiol. 1993 Sept; (3):304-16.. PMID:8031343 [Pub Med-indexed for MEDLINE]

(SVC, n=27) men, ranging in age from 17 to 21 years and compared it with recent Canadian fitness norms. The height of the infantry was taller (p less than 0.05) than that of civilians. Skinfolds and muscular endurance of the militia were above the average, and BMI and maximum oxygen consumption rate of the militia were below the average for civilians.⁹

Elnashar AM, Mayhew JL evaluated the fitness of Males (n=399) and females (n=311) Egyptian school children, aged 9-18 years using the 6-item AAHPER test. Comparisons of the 50th percentile of the AAHPER norms with the median scores for the Egyptian sample revealed that the latter were substantially below average fitness levels. Egyptian boys performed significantly better than girls on all comparable test items, even when the effects of age, height, and weight were held constant by covariance. Eight weeks of twice weekly intensified physical education instruction produced significant improvements in all test items for both sexes.¹⁰

Sterin N. Blair¹¹ conducted a study on Health Related Physical Fitness in young children and the results of these study were important because

9. Related Articles *Links*. Mil Med. 1989 Sep; 154(9):477-9. [PubMed-indexed for MEDLINE]

10. Related Articles *Links*. Br J Sports Med. 1984 Mar; 18(1):26-9. [PubMed-indexed for MEDLINE]

11. D. Sterin, N. Blair, Harold B. Falls and Russel R. Pate. "A New Physical Fitness Test." *The Physician and Sports Medicine*. 11:4, April 1983, p.83.

they provided much needed new information about Health Related Physical Fitness in young children. The data presented have suggested strongly that physical education programmes of school activity habits and parental activity habits had a significant impact on cardio respiratory endurance and body composition.

Mistkawi¹² prepared national norms for one minute basketball throw for goal, pull-ups, potato race, standing hop, step and jump, push-ups, standing broad jump and softball throw, items of the Y.M.C.A. National Athletic Achievement Programme. Y.M.C.A's throughout the United States tested 2000 boys in each age groups and the other obtained 5% of the score at the Saleim Y.M.C.A. origin.

Manojkumar¹³ developed norms on selected motor fitness components in the age group of 13 to 17 year students of schools of Gwalior District Test items to measure the motor fitness components were 50 metres dash, standing broad jump, sit-ups for one minute, stork for balance and 600 meter run/walk.

12. John J. Mistkawi, "Norms of Eight, Nine and Ten Years Old Boys and Y.M.C.A. Athletic Achievement Test." *Completed Research in Health, Physical Education and Recreation* 8 (1961): 101.

13. Manojkumar, *Development of Norms on Selected Motor Fitness Components in the Age Group of 13 to 17 Year Students of School of Gwalior District*. Unpublished Master's Thesis, L.N.I.P.E. Gwalior, 1996.

Singh¹⁴ prepared physical fitness norm for high schools boys of Punjab State. Data were collected on 5000 subjects from various schools in the state. The test consists of eight items that is, 1) Standing broad jump, (2) Sit and reach test, (3) Agility run (4) Bend knee sit up (5) 50 mts run/walk (6) Push up (7) Cricket ball throw and (8) 600 mts run/walk.

Percentile norms for physical fitness test were found to be valid and suitable to assess the physical fitness level of the high school boys of 12 to 15 years of age.

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14. Reet Mahinder Singh, *Physical Norm of Punjab High School Boys*. Unpublished Doctoral Thesis, Punjab University, Chandigarh, 1986.

15. Reet Mahinder Singh, *Physical Norm of Punjab High School Boys*. Unpublished Doctoral Thesis, Punjab University, Chandigarh, 1986.

Jackson and Baker¹⁶ conducted a study on 825 young females with AAHPERD Health Related Physical Fitness test to measure back and hamstring flexibility. The measurement included the sit and reach test and passive hamstring flexibility. The correlation between the sit and reach test and total back were low. These findings indicate that the sit and reach test has moderate criterion related validity when used as an assessment of hamstring flexibility in the health related fitness.

Bos¹⁷ prepared percentile norms tables for selected measures of strength, power, agility, flexibility, body composition and cardiovascular and muscular endurance, from data collected in five schools of unity of Christian School System at Hudsonille.

Yadav¹⁸ conducted a study on standardisation of physical fitness norms for the school children of Haryana (13 to 16 years) with the purpose of estimating the fitness and comparing the standard of physical fitness of urban and rural boys of Haryana. For the purpose of this study 3600 school

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16. Allan W. Jackson and Alice A. Baker. "The Relationship of Somatotype and Body Composition to Physical Fit Performance in 7 to 12 years old boys." *Research Quarterly*, 48 (March 1997).
 17. David, L. Boss, "Physical Ability Testing of Male Students in Grades Four through Twelve." *Completed Research in Health, Physical Education and Recreation* (1967): 77.
 18. Bhup Singh Yadav. *Standardisation of Physical Fitness Norm of School Children of Haryana 13-16 years*. Unpublished Ph.D. Thesis, Kurukshethra University, 1986.

boys of 12 districts of Haryana were randomly selected and the performance of the boy were recorded on 50 mts. dash, shot put, standing broad jump, zigzag run, sit up and step up test. The norms in terms of percentile rank of said group were developed.

In 1980 AAHPERD published its new Health Related Physical Fitness test normal. The test was designed for boys and girls of age from 6 to 17. Data were collected for 12000 boys and girls from throughout the nation and used to develop gender specific percentile rank norms for each test (Jance Kay Nelson).¹⁹

Holding and Jackson²⁰ conducted a study on physical fitness. The norms reflected standards were developed from scores of over 1500 men and women, who were tested at different Young Men's Christian Associations in the United States. The standards included the test scores associated with selected percentiles. A percentile was the percentage of people of a given age group and gender who achieved the score. A maximal oxygen uptake of 54 ml/kg, minimum fall in the ninety fifth percentile, for

19. Jance Kay Nelson. *The Junction of Age Gender and Boys Size Characteristics on Physical Fitness Performance*. Unpublished Doctoral Dissertation, University of Houston, USA, 1982.

20. Lawrence, A. Holding and Andrew S. Jackson, "New National Norms 'Y' Way to Physical Fitness," *Journal of Physical Education*, 78:4 (November/December 1980), 44-45.

men in the age group of thirty five years and below. This means that of all men tested who were 35 years and younger, ninety five percent had a score of 54 ml/kg minimum for lower and only five per cent had a score higher than 54 ml/kg minimum.

The impact of national curriculum physical education on the teaching of Health-Related fitness: A case study in one English town²¹ (Matthew D. Curtner-Smith, Iain G. Kerr and Anthony J. Clapp. The research reported in this paper was aimed at discovering the impact of the health related element within National Curriculum Physical Education (NCPE) on (a) the percentage of lesson time pupils was engaged in Moderate to Vigorous Physical Activity (MVPA) (b) the percentage of lesson time allocated by teachers for pupils to engage in fitness activity or acquire health related fitness knowledge and (c) the percentage of time teachers used behaviours likely to encourage pupils to participate in health promoting physical activity. Subjects were 20 physical education teachers employed in one town in southwest, England. Two lessons of each teacher's choice in which they taught any activity to year's u, 8, or 9 were video-taped. Lessons were coded with SOFIT were entered into and SPSS programme to produce

21. Matthew D. Curtner-Smith, Iain G. Kerr and Anthony J. Clapp. *The impact of national curriculum physical education on the teaching of Health-Related fitness: A case study in one English town*

descriptive statistics. Results indicated that, with the exception of lessons on tennis in which pupils were engaged in walking or very active activity for 55.90% of lesson time, pupils were provided with limited opportunities to engage in MVPA. Teachers allocated very little time for pupils to participate in fitness activity (3.42%) or to acquire health-related fitness knowledge (0.07%) and spent little time promoting (0.04%) and demonstrating (2.48%) fitness. A comparison of the data collected at these five schools during the present study with those collected in the summer term of 1992, indicated that the introduction of NCPE may have negatively impacted the amount of time pupils participated in MVPA lessons on all summer activities except tennis and had a slightly positive impact on the amount of health related content included during lessons on all activities but swimming. Qualitative analysis of lessons videotaped in the two summer terms, however, suggested that any changes in lesson context were subtle (New Mail Folder, p.1 of 1 [ethwebmail]).

Ikeda²² computed the physical fitness norms in order to compare the physical fitness of children in Iowa and Tokyo, Japan. The Iowa test of motor fitness was given to 395 Tokyo children and 355 Iowa children of 9 to 12 years of age. The test battery included sit-ups, standing broad jump,

22. Namik Ikeda, "A Comparison of Physical Fitness of Children in Iowa, USA and Japan." *Research Quarterly* 33:4 (December 1962): 541-552.

shuttle run, forward bend, grass hopper, pull-ups for boys, bend arm hang for girls and 50 yard dash. Anthropometric measurements were taken in height, weight, knee-finger length and leg length. It was concluded that Iowa children were heavier, taller and had longer legs than Tokyo children but Tokyo children scored better in all the motor performance tests except sit ups.

Knuttgen²³ conducted this study to compare the physical fitness of Danish school children with that of American standards. 319 male and 134 female Danish school children were randomly selected as the subject and AAPHERD Youth Fitness Test was administered to these subjects, which correspond to the 7th through 12th grades in the United States. Then results of the testing were compared to the American standards, which were compiled in terms of both age and to Neilson Corzens classification index. It was concluded that Danish boys, who scored more than 50 per cent did exceed the American average in six of the seven events. The only event in which they fell short of American averages was the softball throw. In pull-ups 59%, sit ups 62%, shuttle run 90%, of Danish boys were as high as or higher than the American average in all the seven of the tests. In 50 yard dash 71%, softball throw 76%, sit ups 82%, standing broad jump 89% and

23. Howard G. Knuttgen, "Comparison of Physical Fitness of Danish and American Children," *Research Quarterly* 32:1 (March 1961): 190-196.

pull ups 90% Danish girls equalled or exceeded the American averages. The best results for Danish girls' scores were in shuttle run and 600 yard run/walk. Two per cent of the boy's scores and 86% of the girls' scores exceeded the various American Mean scores.

Tuteja²⁴ conducted a study to find out the comparison of physical fitness of rural and urban from school students of Delhi. The subjects were 100 male students from rural and 100 male students from urban area of high school of Delhi. The age of the subjects ranged from 14 to 17 years. AAHPERD Youth Fitness Test and N.P.E.D. tests were administered to obtain the physical fitness levels of the subjects. The raw scores from AAHPERD Youth Fitness Test and N.P.E.D. test were statistically treated and 't' scale was computed for the test items of both the tests. It was found that in AAHPED Youth Fitness Test the mean of the urban high school students was slightly higher than that of the high school students in N.P.E.D. test. It was also found that there was no significant difference in the physical fitness level of rural and urban high school students of Delhi.

24. G.K. Tuteja, "A Comparison of Physical Fitness Test of Rural and Urban Students." Unpublished Master's Thesis, Jiwaji University, Gwalior, 1978.

Saha²⁵ compared the selected anthropometric measurement and physical fitness variables of the tribal and non-tribal students of Tripura. The subjects were 60 male students of tribal origin and 60 male students from non-tribal group and their age ranged from 14 to 18 years. Anthropometrics measurement was taken systematically in all subjects. Three selected items ie., 50-metre dash, 50 meter shuttle run and 600-meter run-walk of AAPHERD Youth Fitness Test were administered and were statistically analyzed by using t-scale. It was concluded that in anthropometric measurements and physical fitness components, the mean scores of the composite scores of tribal school students was higher than that of the non tribal school students, 2) there was no significant difference in anthropometric measurement and in physical fitness level (3) the tribal students were superior in upper arm girth, calf girth and body weight while non-tribal students were superior in shuttle run. But there was no difference in chest girth, thigh girth, height, 50-meter dash and 600-meter run-walk of the both tribals.

25. Umesh Chandar Saha, "Comparison of Selected Anthropometrics Measurement and Physical Fitness Variables of Tribal and Non-Tribal Students of Tripura." Unpublished Master's Thesis, Jiwaji University, Gwalior, 1980.

Ray²⁶ compared the physical fitness of urban and tribal students of Agartala. Sixty males students from each age group ranged from 16 to 18 years were randomly selected as subjects. Data were obtained by administering the AAPHERD Youth Fitness Test and were statistically analysed by using percentile scale. It was concluded that the performance of urban students in pull ups and softball throw for distance was significantly greater than the tribal subjects and also there was no significant difference between the urban and tribal students in standing broad jump, shuttle run, 600 metre run/walk, 50 metre dash and sit ups. Results also showed that there was no significant difference in physical fitness level between urban and tribal college students of Agartala.

Tyagi²⁷ conducted a study on physical fitness norms for boys and girls in grades nine through twelve of Delhi State. Six thousand students (3000 boys and 3000 girls) belonging to senior secondary school in grades nine through twelve of Delhi State acted as subject for the study. For this purpose 1000 boys and 1000 girls were selected at random from selected 50 schools in each age group of 14, 15 and 16 years. To measure the physical fitness of selected subject, AAHPERD Youth Fitness Test namely pull-ups

26. Bijay Krishna Ray, *Comparison of Physical Fitness of Urban and Tribal Students in Tripura.* Unpublished Master's Thesis, Jiwaji University, Gwalior, 1979.

27. Sarita Tygi, *Physical Fitness Norms for Boys and Girls in grade Nine through Twelve of Delhi State.* Unpublished Ph.D. Thesis, Jiwaji University, Gwalior, 1993.

(boys), flexed arm hang (girls), bent knee sit ups, standing broad jump, 4 x 10 m shuttle runs, 50 m Dash, 600 m Run/walk and height and weight were selected. Age-wise norms for boys and girls in terms of percentile scales and 6-sigma scales were constructed for each item of the AAHPERD Youth Fitness Test separately and compared across by applying Analysis of Variance. To find out the relationship of physical fitness to height and weight, Zero Order Correlation was computed. For testing the hypotheses 0.05 level of significance was chosen. Analysis of the data revealed that various age groups employed in this study exhibited no significant differences in physical fitness across age in both boys and girls as the obtained F-ratio of 0.41 and 0.81 were less than $F_{.05}(df 2,2997) = 2.99$. It was also observed that physical fitness was significantly correlated to height and weight ($r = .177$ and $r = .083$) respectively) in the case of boys. The obtained correlation was significant at $.05 (df = 2998) = 0.62$, whereas in the case of girls, height was not significantly related to physical fitness, as obtained correlation coefficient $r = -.060$ was less than $r = .05 (2998) = .062$ but weight was significantly and negatively correlated with physical fitness as obtained coefficient of $r = -.223$ was greater than $r .05 (2998) = .062$.

Ajmer²⁸ constructed physical fitness norms for four thousand male students belonging to pre-university classes of Punjab University, Chandigarh. Flishman's Physical Fitness Battery was administered on them. The three scales namely - Percentile scale, Hull scale and T-scale were prepared. It was also concluded that physical fitness improved linearly with age and the students belonging to rural areas were significantly superior in their performance when compared to the students of urban areas.

Robins²⁹ conducted a normative study for Alabama students. AHPERD Youth Fitness Test (YFT) and AAHPERD Health Related Fitness Test (HRFT) was given to 2,545, six to fourteen years old boys and girls. Percentile tables were constructed for each item based on age and sex. Alabama and national means were compared. Alabama students scored better on events measuring agility, speed and cardio-vascular endurance but the national score in abdominal muscular endurance and flexibility was better.

28. Ajmer Singh, *Normative Study of Physical Fitness of Punjab University Men Students*. Unpublished Doctoral Thesis, Punjab University, Chandigarh, 1986.

29. William Callaway Robins, *Alabama Motor Fitness and Health Related Fitness Norms, Ages 6-14*. *Dissertation abstracts International* 46:1 (July 1985): 101.

Rao³⁰ conducted a study on construction of norms for health related physical fitness variables for high school boys of 15 year age in Andhra Pradesh. He selected 1005 subjects from various schools in Andhra Pradesh. the following variables were selected for this study. Aerobic endurance, body composition, muscular strength and upper body strength. Mean, Standard Deviation and Hull scale were the statistical techniques used. In aerobic endurance as per the qualitative grading for the constructed norms, 185 subjects were poor, 194 subjects were fair, 319 subjects were average, 182 subjects were good, 84 subjects were very good and 41 subjects were excellent. In body composition as per the qualitative grading for the constructed norms, 181 subjects were poor, 218 subjects were fair, 383 subjects were average, 102 subjects were good, 63 subjects were very good and 58 subjects were excellent. In flexibility as per the qualitative grading for the constructed norms, 170 subjects were poor, 259 subjects were fair, 242 subjects were average, 210 subjects were good, 72 subjects were very good and 52 subjects were excellent. In muscular strength/endurance as per the qualitative grading for the constructed norms, 334 subjects were poor, 249 subjects were fair, 202 subjects were average, 97 subjects were good, 68 subjects were very good and 55 subjects were excellent. In upper

30. Bommadevara Hanumantha Rao, *Construction of Norms for Health-Related Physical Fitness Test for High School Boys and Fifteen Years of Age in Andhra Pradesh*. Unpublished M.Phil Thesis, Alagappa University, July 1983.

body strength/endurance as per the qualitative grading for the constructed norms, 296 subjects were poor, 159 subjects were fair, 290 subjects were average, 170 subjects were good, 52 subjects were very good and 38 subjects were excellent.

Das³¹ prepared physical fitness norms for classes nine through eleven of Delhi administration school. In each school ten per cent of students were tested on the items of AAPHERD Youth Fitness Test and NPEP battery 'A'. The items in the N.P.F.P. Battery were the same as included in the syllabus of Central Board of Secondary Education. A percentile norm was prepared and was statistically analysed which concluded that the abdominal strength of Indian students seems to be very poor compared to that of American students. The performance of students of class IX was very poor in all items of fitness tests and there was a remarkable spurt of performance in classes X and XI though still lower than that of students in America except in pull-ups measuring shoulder girdle strength.

Watson³² conducted a study to construct norms for Nebraska boys and girls. The test items for the Neb ELE physical fitness test were standing

31. Tapan Kumar Das, *Norms in Physical Fitness Tests for Boys of Classes IX to XI of Government Schools of Delhi Administration*. Unpublished Master's Thesis, Jiwaji University, Gwalior, 1980.

32. Rick E. Watson, *The Establishment of Norms of Nebraska Physical Fitness Test. Completed Research in Health, Physical Education and Recreation* 19 (1978): 103.

long jump or vertical jump, 50 yard dash, sit ups, stick jump and 300 yard distance run. The items for secondary test were pull ups, or flexed arm hang, 50 yard dash, standing long jump, sit ups. Side step, and a mile or 9-minute or 12-minute runs. A random sample of schools in Neb (1%) was selected to participate in the establishment of these norms. The norms were established for each test items for girls, boys and the groups according to the chronological age, the following recommendations were formulated on the basis of the result: (1) there should be a test item included in ELE test, grade 1 to 6, to evaluate shoulder girdle strength, (2) Norms need to be established for the one and half or 12 minutes run, (3) The secondary girls need to establish norms for the girls' chin ups.

Clarke and Schope³³ in their study of a strength test for boys 9 through 12 years of age in grades IV, V and VI was based upon cable tension strength tests. From 18 cable tension strength tests, the following four were selected by multiple correlation procedures: shoulder extension, trunk extension, knee extension and ankle plantor flexion (angle extension). The total of the four tests were designated the strength composite, utilizing Roger's method in the construction of strength index norms; the subjects were 826 boys from ten communities located in various parts of Oregon.

33. H. Harrison Clarke and Theodore Schope, Construction of a Muscular Strength Test for Boys in Grades IV, V, VI. *Research Quarterly* 3 (December 1962): 515.

Zuti and Corbin³⁴ conducted a research on physical fitness norms for college freshmen in which 3000 freshmen of Kansas State University, within the age from 17 to 19 years were taken into consideration.

Bitcon³⁵ constructed norm tables for grade 9-12 by taking four physical fitness items, as pull ups, two minutes sit-ups, standing broad jump and 300 yard shuttle run. It was found significantly valid with AAHPER fitness test score.

Mood³⁶ conducted a study of two forms of tests of physical fitness knowledge which were constructed to measure the physical fitness knowledge of senior physical education major students. One hundred and eighty four experimental test items, the contents of which were based on 60 physical fitness facts secured from recent physical education literature and on the opinions of 73 members of the Research Council of AAHPERD, were administered to 1,360 physical education major students enrolled in 35 collegiate institutions in the United States. As a result of time analysis data,

34. William B. Zuti and Chaslan B. Corbin, "Physical Fitness Norms for College Freshmen." *Research Quarterly* 48 (May 1977): 499.

35. Lawrence E. Bitcon, "Validation of a Four Item Fitness Test and Norms for Higher Schools Boys in the State of Iowa." *Completed Research in Health, Physical Education and Recreation* 8 (1965): 7.

36. Dale Mood, "Test of Physical Fitness Knowledge Construction, Administration and Norms." *Research Quarterly*, 42, 1 (1971): 423.

two parallel forms of the tests were constructed. For the purpose of obtaining validity and reliability of data and establishing national norms, the two final test forms were administered to 4, 167 students enrolled in 150 collegiate institution in the United States. Two forms of the test of physical fitness knowledge were constructed so that growth in comparison of physical fitness might be measured. For this reason and to adjust for the slight differences between the two final forms, the raw score distributions were normalized through a T score transformation. Percentile ranks of the T-scores for the female and male members each of four categories were constructed.

Singh³⁷ constructed physical fitness norms for four thousand male students belonging to pre-university classes of Punjab University, Chandigarh. Flishman's Physical Fitness Battery was administered on them. The three scales namely - percentile scale, Hull scale and T-scale were prepared. It was also concluded that physical fitness improved linearly with age and the students belonging to rural areas were significantly superior in their performance when compared to the students of urban areas.

37.Singh, Physical Fitness Norms for Four Thousand Male students belonging to pre-university classes of Punjab University, Chandigarh. Unpublished doctoral thesis, Punjab University, Chandigarh, 1986.

Singh³⁸ constructed physical fitness norms for male teenagers of Jammu and Kashmir State. He used AAHPER Physical Fitness Test to measure physical fitness which included - pull-ups, bent knee sit ups, standing broad jump, shuttle run, 50 metre dash, 600 metre run/walk. The study concluded that the subjects belonging to age group 16 to 19 years showed better performance in all the test items, over the other age group 13 to 15 years. On the average physical fitness improved linearly according to age. The scales, percentile scale, hull scale and T-scale were also prepared for each age group separately.

Callway³⁹ constructed a percentile norms for Alabama students in grade 1-9 based on AAHPERD youth fitness test. The subjects were 2545 Alabama boys and girls. Norms were constructed for each item based on age and sex. The obtained mean performance on each test item was compared with national norms.

Koko⁴⁰ states that, prevention is better than cure. This trend became desirable in many countries of the south East Asia Region, with health

38. Prem Singh, *Normative Study of the Physical Fitness of Male Teenagers of the State of Jammu and Kashmir*. Unpublished Doctoral Thesis, Jiwaji University, Gwalior, 1988.

39. Rabloine William Callway. "The Alabama Motor Fitness and Health Related Fitness Norm Ages 6-14. *Dissertation Abstract International* 34;2 Aug. 1976, p.116.

40. V. Koko, *Health for All - All for Health*. New Delhi: World Health Organisation, 1988, p.1.

related sectors becoming increasingly aware of the benefits of total health care embracing preventive, promotive, curative and rehabilitative care rather than mere stress on curative measures to tackle the priority health problem.

The American Association of Health Physical Education (AAHPER) launched youth fitness project in 1957 and surveyed 18500 boys and girls from 5th to 12th grade to assess the general fitness level in USA (AAHPER, 1975). The battery of tests has become very popular all over the world as it is required minimum equipment, easy to conduct, less time consuming and well informative. However, such study of fitness assessment on Indian School children is very scanty (Mukherjee, 1978, Jraben, 1961, Tuteja, 1978, Brar, 1984, Dhillon, 1982, Kaur, 1982, Saini, 1982 and Sandhu, 1982). However, motor fitness test of the school children was available (Gharote and Ganguli, 1975). The battery of motor fitness tests might be utilized to assess the effects of various types of training on the sports persons. These could also be used for screening their potential. The present study was undertaken on the sportsmen to document the level of motor fitness as well as to compare the level of motor fitness of the rural and urban sportsmen.

Veeraswami⁴¹ conducted a study to evolve physical fitness norms for higher secondary schools of Greater Gwalior. 212 male students from four higher secondary schools and 793 male students from remaining 23 schools were selected and AAHPER Youth Fitness Test and ICHPER Physical Fitness Test were administered on them respectively. The percentile norms for each test items were evolved for the boys of age group 13 to 17 years. It was also concluded that in all items except pull-ups of the AAHPER Youth Fitness Test, the mean scores of Indian boys in all age groups were lower than the 50th percentile of American Norms. There was a positive but lot order of relationship between physical fitness and participation in physical activities. There was a positive correlation through low ($r = .13$) between physical fitness and academic achievement.

Das⁴² prepared physical fitness norms for classes nine through eleven of Delhi Administration Schools. In each school ten per cent of students were tested on the items of AAHPER Youth Fitness Test and N.P.F.P. Battery 'A'. The items in the N.P.F.P. battery were the same as included in the syllabus of a Central Board of Secondary Education. Percentile norms

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41. B.M. Veeraswami, *A Normative Study of the Youth Physical Fitness Test for Boys in Grades Nine Through Eleven in Grater Gwalior*. Unpublished Master's Thesis, Jiwaji University, Gwalior, 1973.
 42. Tapan Kumar Das, *Norms in Physical Fitness Tests for Boys of Classes IX to XI of Government Schools of Delhi Administration*. Unpublished Master's Thesis, Jiwaji University, Gwalior, 1980.

were prepared and was statistically analysed which concluded that the abdominal strength of Indian students seems to be very poor compared to that of American students. The performance of students of class IX was very poor in all items of fitness tests and there was a remarkable spurt of performance in Classes X and XI though still lower than that of students in America except in pull-ups measuring shoulder girdle strength.

Kim⁴³ conducted a study to investigate the relationship between the Korean Youth Fitness Test (KYFT) and the AAGPER Health Related Physical Fitness Test (AHRPFT) for male Korean Middle and High School Children. Eleven experimental test items were administered on three hundred male Korean students of grades 7 to 11. The analysis indicated that the KYFT and AHRPFT were significantly related. AHRPFT can be substituted for KYFT, since this test has fewer and easier test items.

Guruvammal⁴⁴ constructed norms in selected physical fitness test items for secondary school girls in Madras city. 10 girls from each ten randomly selected schools were taken as subjects and tested on the selected

43. Jony Tack Kim, "Relationship between Korean Youth Fitness Test and the AAHPER Health Related Physical Fitness Test for Male Korean Middle and High School Children." *Dissertation Abstracts International* 46:10: (April 1986): 2961-A.

44. P.G. Guruvammal, *Construction of Norms in Selected Physical Fitness Test Items for Secondary School Girls in Madras City*. Unpublished contributed to a greater extent in the construction.

physical fitness test items, consisting of sit-ups, vertical jump, flexed arm hang, 4 x 10 metre shuttle run, 50 metre dash and 600 metre run. The percentile scales were computed for the combined samples of the girl students. It was also concluded that performance of the girl students was very poor in the selected test items.

HRPF tests and development of norms for different types of population. The review of literature further reveals that in India very few studies have been reported with regard to measurement of physical fitness and construction of norms. Out of these, most of the studies on construction of physical fitness norms for different age groups were conducted in nineteen hundred and seventies and eighties. A scrutiny of these studies apparently reveals that the physical fitness norms were mainly constructed for male population and for testing the physical fitness, most of the research scholars have used AAPHER Youth Fitness Test.

In 1980 the AAHPRED Health Related Physical Fitness test measured back and hamstring flexibility of 825 young females. They were administered two trails of three tests. The measurement included the sit and reach test and passive hamstring flexibility. The correlation between the sit and reach test and total back flexibility, upper back flexibility and lower back flexibility were low. These findings indicated that the sit and reach

test has moderate criteria related reliability when used as a assessment of hamstring flexibility in the Health Related Physical Fitness (Allen W. Jackson and Alice A Backer).

Howard⁴⁵ conducted a study of the Physical abilities of academically high achieving children. The purpose of this study was to compare academically high achieving and average boys and girls in grades 4 and 5 on accepted tests of balance, coordination, strength, endurance, and flexibility, as well as measures of age, height, and weight, to see if, as some researchers have found, high achieving children are taller, heavier, stronger, more flexible, exhibit better balance, and are better coordinated than their non gifted classmates. Graders earned in physical education class were compared to see if high achieving children performed better in physical education than average children. All boys and girls in grader 4 and 5 in an upper middle class school district were tested on the variables of balance, coordination, physical education grade, pull ups, push ups, sit and reach, sit ups, and the 600 yard run. In addition, age height and weight were compared to national norms. Only students completing all tests were used in the study of 949 children. A 2 x 2 Factorial Design was used with gender and IQ group as independent variables. Multiple analysis of covariance was

45. Stern William Howard. "A Study of the Physical Ability of Academically High Achieving Children." *Dissertation Abstracts International* 59 (January 1999): 2421-A.

used on the independent variables of balance, coordination, physical education grade, pull-ups, push-ups, sit-and-reach, sit-ups, and the 600-yard run.

Mooneyhan, et al.⁴⁶ conducted a study on the effects of frequency and duration of physical education programmes on the Health Related Fitness of Sixth Graders. The purpose of this investigation was to determine the effect that the number of weekly physical education lessons and the number of minutes of physical education per week had upon the health-related fitness of sixth-grade children. Seven hundred eighty nine sixth grade children (boys = 409, girls - 380) participated in the study. All were participants in the Fit for Life (Brynteson, Barber, Gaines, and Adams, 1991) project that includes fitness testing at the beginning and end of the students' sixth-grade year. The fitness levels of each child were determined using the procedures and criteria established by the Physical Best Health Assessment (McSwegin, Pemberton, Petray, and Going, 1989). Fitness items included; cardiovascular fitness (1-mile walk/run test), Body composition (skinfold test), muscular strength (pull-ups test), muscular endurance (sit-ups test), and flexibility (sit-and-reach test). Additionally, height, weight, number of

46. Andy Mooneyhan, et al. "The Effects of Frequency and Duration of Physical Education Programme on the Health Related Fitness of Sixth Graders." *Research Quarterly for Exercise and Sports* 70 (March 1999): A 29.

sit-ups and pull-ups and blood pressure were determined. Using Walks' a criterion, multivariate analysis of covariance indicated significant differences in both frequency and duration of physical education programmes. Subsequent univariate analyses based on frequency revealed significant differences in flexibility, aerobic capacity, muscular strength, muscular endurance, and body composition. In addition, univariate analyses based on duration indicated significant differences in aerobic capacity, body composition, muscular endurance, but not flexibility, and muscular strength. Post hoc analysis of simple contrasts using the Bonferroni technique determined that the 5 days week and 30 min/class groups had significantly greater aerobic capacity and muscular endurance than the other comparison groups. However, no significant practical or gender differences were noted on the other health related fitness parameters. It was concluded, in general, the more days a physical education class meets per week the greater the level of health-related fitness, thus greater the aerobic capacity and muscular endurance. In addition, it appears that meeting 50-min per class does not yield any higher level of fitness than class meeting 30-min.

Falls⁴⁷ (1979) established norm on the AAHPERD youth physical fitness. The norms were computed for more than 10,000 young subjects. Those who fell below the 50 percentile in any area were advised to participate in a fitness development programme.

Sree Devi⁴⁸ constructed motor fitness norms for secondary school girls. For this purpose the selected eighty students of central school No.1 Gwalior, from grades eight and nine as subjects for this study. AAHPER Youth fitness Test was administered on all the subjects. Based on mean and standard deviation values T-scale, 6 Sigma scale and Hull scale were prepared for each test items. Also it was concluded that a common scale of AAHPER Youth Fitness Test could be used for the grades eight and nine and 6 Sigma scale and Hull scale were more suitable than T-scale.

Elizabeth⁴⁹ prepared percentile norms for girl's age 12 to 15 years on the North Carolina AAHPER Test. The norms were prepared for each of the five test items, sit ups, side stepping, standing broad jump, modified

47. Harold B. Fall, "AAHPERD Implements, New Health Fitness Tests." *Physical And Sports Medicine* 8:6 (June, 1979), p.27.

48. R. Sree Devi. *Construction of Norms for a Motor Fitness Test for Secondary School Girls*. Unpublished Master's Thesis, Jiwaji University, Gwalior, 1984.

49. Francis Elizabeth. "North Carolina Association for Health, Physical Education and Recreation, Physical Fitness Percentile Norms for Girls Age 12, 13, 14, 15." *Research Quarterly* (1960): 85.

pull-ups and squat thrust. The sit-up item provided effective differentiation on the percentile scale for each age group. The concentration of scores in the middle of the distribution for the side stepping test and the squat thrust test resulted in effective discrimination in the centre of the ranges for all age groups. The standing broad jump test provided the greatest ranges and the test differentiated the lower end of the distribution for all age groups but did discriminate above the 20th percentile.

Blair, Falls and Pate (1983) conducted a study on Health Related Physical Fitness Test. Percentile norms were developed by testing 12000 children from age 5-17 in seventeen states. Test excepting the skin folds were administered in standardised manner by volunteer Physical Education Teachers. Percentile norms for the skin fold tests were obtained from the national health examination survey. In an effort to assess the requirements of standard criterion, recommendation for interpretation of test results had been included in the test manual.

Blair⁵⁰ Falls and Pate say that the results for this study are important because they provide much needed, new information about health related physical fitness in young children. The data presented here suggest strongly

50. Steven N. Blair, Harold B. Falls and Russell Pate, "A New Physical Fitness Test." *The Physician and Sports Medicine*, II: 4 (April 1983), 87-88.

that physical education programmes, out of school activity habits and parental activity habits have a significant impact on cardio-respiratory endurance and body composition. Because the participants in this study were drawn as a random sample, the findings can be extrapolated to the population of America's third and fourth graders.

Taddnio⁵¹ constructed national norms based on the 1975 National Survey of Youth Fitness. The measure of physical fitness was the AAHPER Youth Fitness Test. Twelve school districts participated in the study from which 75 schools, 146 classrooms, and 779 students were selected. The study concluded that (1) there was no difference in the physical fitness of boys and girls from the economically deprived sample and boys and girls represented by the 1975 national norms and (2) within the sample, there was no difference in physical fitness of boys and girls from high poverty areas and boys and girls from the low poverty areas.

The AAHPERD Health Related Physical Fitness norms published in 1980 were based on a 12000 boys and girls. A cluster sample representing several geographic regions was followed in 1985 and the results of children and youth fitness study were published in the January issue of the Journal

51. Dominick Anthony Taddnio, "A Comparison of Physical Fitness of Public School students from Economically Deprived Areas with National Norms." *Dissertation Abstracts International* 43:6 (December 1982): 1878-A.

of Physical Education Recreation and Dance. Over 8500 boys and girls in grades 5 through 12 were administered health related motor skill tests. This represented a national probability sample with few exceptions for selected age group. The children that comprised the 1980 Health Related Physical Fitness Test sample were fit than the 1985 Neyes sample.

Martin and Keogh⁵² conducted a study on 320 men and women enrolled in bowling classes in the elective physical education programme at the University of California, Los Angeles. Students were classified as non experienced if they had bowled 10 lines or less. All other students were classified as experienced according to their verbal reports of previous participation.

Men and standard deviation were computed separately for men, and women in each of the ability groups. Normative ratings were developed in five categories for each set of data. A superior rating included scores 1.2 standard deviations above the mean; good included scores 0.6 to 1.2 standard deviations above the mean; average included scores -0.6 to 0.6 standard deviations from the mean; and inferior included scores 1.2 standard deviations or more below the mean.

52. Jean L. Martin and Jack Keogh, "Bowling Norms for College Students in Elective Physical Education Classes." *Research Quarterly*, 35: 3 (October 1964), pp. 325-326.

Blair, Falls and Pete⁵³ conducted a study on health-related physical fitness test. Percentile norms were developed by testing 12,000 children from age five to seventeen in seventeen states. Tests excepting the skin folds were administered in standardized manner by volunteer physical education teachers. Percentile norms for the skin folds tests were obtained from the national health examination survey. In an effort to assess the requirements of standard criterion, recommendation for interpretation of test result had been included in the test manual.

Sittmann⁵⁴ developed norms for 372 male and 648 female students enrolled in the health and physical fitness concept classes of North East Missouri State University. The subjects were tested for the sum of six skin folds, predicted 1% fat, and predicted VO₂ max. grip strength, leg strength, back strength, vertical jump distance and vertical jump power. Means, standard deviations, and range for all variables were calculated. Percentiles in increments of five were constructed for each variable in each classification.

53. "A New Physical Fitness Test," *The Physician and Sports Medicine*, p. 94.

54. Lucinda E. Sittmann, "Physical Fitness Norms for North East Missouri State University Students." *Completed Research in Health, Physical Education and Recreation* 23 (1981): 182.

Robins⁵⁵ conducted a normative study for Alabama students. AAHPER Youth Fitness Test (YFT) and AAHPER Health Related Fitness Test (HRFT) were given to 2,545, six to fourteen years old boys and girls. Percentile tables were constructed for each item based on age and sex. Alabama and national means were compared. Alabama students scored better on events measuring agility, speed and cardio-vascular endurance but the national score in abdominal muscular endurance and flexibility was better.

Corner and Cureton⁵⁶ developed a motor fitness test for high school girls. The tests consisted of two forms - a single period test of 6 items and a double period test of 12 items. The test comprised of following paired items - foot and toe balance and dizziness recovery, trunk extension and trunk flexion, kneeling and jump and Illinois agility run, sit-ups and kneeling push-ups, basketball throw and standing broad jump and squat thrust (30 seconds) and Brouka step test. Test item correlation with the composite item scores ranged from .39 to .62. Percentile norms based on a limited sample are available.

55. William Callaway Robins, "Alabama Motor Fitness and Health Related Fitness Norms, Ages 6-14." *Dissertation Abstracts International* 46: 1 (July 1985): 101.

56. Mary E.O. Corner and Thomas K. Cureton, "Motor Fitness Test for High School Girls." *Research Quarterly* 16:4 (December 1945): 302.

A motor fitness test battery with thirty test items for lower classes of elementary school boys was constructed by Shore.⁵⁷ On the basis of the rotated factor loading of the test items, two test batteries with seven items each were developed. The test battery one consisted of highest loaded test items for each factor: (1) Clarke's strength composite, (2) McCloy's endurance race, (3) Well's sit and reach, (4) Bass balance on stick, (5) Leg Flexion and extension flexibility, (6) Arm flexion or the back flexibility, (7) Modified pus-ups. The test battery two consisted of more feasible test items: (1) Grip strength, (2) 300 yard run, (3) Well's sit and reach, (4) Bass balance on stick lengthwise, (5) Leg flexion and extension flexibility, (6) Arm Flexion or the back flexibility and (7) Modified push-ups.

Cable⁵⁸ conducted a study with 30 test items of 183 girls subjects and constructed a motor fitness test battery. In his motor fitness test battery items were muscular strength, cardio-vascular endurance, flexibility, agility, balance and power. The 30 test items were not true measures of motor fitness as only 63 per cent of the total variance were result oriented.

57. John Rozer Shore. "The Construction of a Motor Fitness Test Battery For Boys in the Lower Elementary Grades." *Dissertation Abstracts International* 33: 5 (November 1972): 2154.

58. Patricka Ross Cable. "The Construction of a Motor Fitness Test Battery for Girls in Lower Elementary Grades." *Dissertation Abstracts International* 33 (November 1972): 2146-A.

A modified form of the AAHPERD Health Related Physical Fitness Test was administered to a sample of 200 college physical education majors by Dinucci et al.⁵⁹ The skinfold measures were changed from the original test, and the flexed arm hang was added to the test battery. The validity and reliability of the test battery has been established for middle school boys and girls. This study determined the multivariate reliability of the modified test battery using a canonical correlation model. The univariate interclass reliability of the test items ranged from .91 to .99.

Ikeda⁶⁰ computed the physical fitness norms in order to compare the physical fitness of children in Iowa and Tokyo, Japan. The Iowa test of motor fitness was given to 395 Tokyo children and 355 Iowa children, 9 to 12 years of age. The test battery included sit ups, standing broad jump, shuttle run, forward bend, grass hopper, pull-ups for boys and bend arm hand for girls and 50 yard dash. Anthropometric measurements were taken in height, weight, knee-finger length and leg length. It was concluded that Iowa children were heavier, taller and had longer legs than Tokyo children, but Tokyo children scored better in all the motor performance tests except sit-ups.

59. Jim Dinucci, et al. "Reliability of a Modification of the Health Related Physical Fitness Test for Use with Physical Education Majors." *Research Quarterly* 61:1 (1990): 20.

60. Namik Ikeda. "A Comparison of Physical Fitness of Children in Iowa, USA and Japan," *Research Quarterly* 33:4 (December 1962): 541-552.

Lorikay conducted a study to determine the impact of participation selected physical education activities on the Health Related Physical Fitness of college students. In addition, it had also to determine whether significant differences exist among activities holding little components of health related physical fitness and if there exists any significant interaction between gender and type of activity. The subjects consisted of 228 University students enrolled in aerobic dance, archery, swimming, weight training etc. The study concluded that improvements in the components of Health Related Physical Fitness would vary dependent on the selected activities.

Huff, Nancy Hasbin⁶¹ conducted a study on comparison of physical fitness levels of home school and public school students in south Alabama. The differences in the physical fitness levels between home school students and public school students were investigated. The President's Challenge Physical Fitness and Sports Test Battery was used to measure the physical fitness levels. The statistics analyzed indicated that the home school students were significantly more physically fit than the public school students in the area of upper body strength and endurance, flexibility and cardiovascular endurance. There was no significant difference in abdominal

61. Huff, Nancy Hasbin, "A Comparison of Physical Fitness Levels of Home School and Public School Students in South Alabama," *Dissertation Abstracts International* 61 (August 2000): 544A.

strength and endurance between home school and public school students. Comparison made with the State scores revealed that the students from South Alabama scored higher than the public school students across the state of Alabama with the exception of upper body strength and endurance for male students and upper body strength and endurance, and cardiovascular endurance for female public school students. When data from this research were compared to the national norms, 56% of the female home school students, 48% of the male home school students, 39% of the male public school students, and 35% of the female public school students scored above the 50th percentiles. Since physical fitness assessment of home school students is a new field of research, there is a paucity of empirical evidence to support or reject these finding.

Bos⁶² prepared percentile norms tables for selected measures of strength, power, agility, flexibility, body composition and cardio-vascular and muscular endurance from data collected in five schools of Unity of Christian School System at Hudsonille.

62. David L.Bos. "Physical Ability Testing of Male Students in Grades Four through Twelve." *Complete Research in Health, Physical Education and Recreation* 9 (1967): 77.

Barrow and McGee⁶³ have reported that Glover constructed a physical fitness test battery for primary grade children. The battery included four items - Standing Board Jump (to measure power and leg strength), Shuttle Run (to measure leg strength, speed and endurance), Seal Crawl (to measure arm and shoulder girdle strength, endurance and speed), Sit-ups (to measure abdominal strength and endurance).

The test was meant for measuring status in physical fitness items. The percentile norms were prepared for four items and were also used for classifying the children into ability groups by assessing the physical fitness.

Physical fitness norms (Percentile norms) for Nigerian boys and girls of 11 to 18 years of age were constructed by Anyanwu.⁶⁴ The test items included were shuttle run, push-ups (for boys), chair push-ups (for girls), flexed knee sit-ups, 45 metre dash, standing long jump, pull-ups (for boys), flaxed arm hang (for girls), nine minute run for subjects 11 to 12 years and 12 minute run for subjects 13 to 18 years. A comparison of the mean score of the United States and the Nigerian Youth showed that at the upper age levels, the United State youth had better physical fitness status than their

63. Barrow and McGee, *Practical Approach to Measurement in Physical Education* pp. 228-229.

64. Samuel Uwazuruonye Anyanwu, "Physical Fitness of Nigerian Youth." *Dissertation Abstracts International* 38 (November 1977): 2646 A.

Nigerian counter parts, whereas at the lower age level there was not much difference.

Watson⁶⁵ conducted a study of construct norms for Nebraska boys and girls. The test items for the Neb ELE physical fitness test are standing long jump or vertical jump, 50 yard dash, sit-ups, stick jump and 300 yard distance run. The items for secondary test are pull-ups, or flexed arm hang, 50 yard dash, standing long jump, sit ups, or flexed arm hang, 50 yard dash, standing long jump, sit-ups, side step, and a mile or 9 minute or 12 minute run. A random sample of schools in Neb (1%) was selected to participate in the establishment of these norms. The norms were established for each test items for girls, boys and the groups according to the chronological age. The following recommendations were formulated on the basis of the result: (1) There should be a test item included in ELE test, grade 1 to 6, to evaluate shoulder girdle strength, (2) Norms need to be established for the 1½ mile or 12 minute run, (3) The secondary girls need to establish norms for the girls chin-ups.

65. Rick E. Watson, "The Establishment of Norms for Nebraska Physical Fitness Test." *Completed Research in Health, Physical Education and Recreation* 19 (1978): 103.

Hodgkins and Skubie⁶⁶ conducted a study on cardio-vascular efficiency. The Tests were obtained for 2360 college women, who were enrolled in 66 colleges and universities representing the six districts of the AAHPERD. The pulse rate was converted to cardio-vascular efficiency scores and national standards were established. These included six categories and ranged from excellent to vary poor. In addition, it was found that scores in the eastern districts were better than in other disciplines, that there is no correlation between height and scores on the step test, and those women who weighed 150 pounds and more did not score as well as those who weighed under that amount.

Philips and Summers⁶⁷ developed bowling norms and analysed learning curves for college women. Bowling scores were collected for 3634 students from 22 colleges and universities. Norms and curves based on these data were developed. After 25 lines bowled during class instructional period, the ability groups were significantly different from each other in regard to bowling skill. There were differences in the character of learning at the different levels of ability. The initial rise in the learning curve was much more pronounced at the lower skill levels, decreasing progressively as

66. Jean Hodgkins and Vera Skubie, "Cardio Vascular Efficiency Test Scores for College Women in the United States." *Research Quarterly*, 34:4 (Dec. 1963): 454.

67. MaNorie Philip and Dean Summers, "Bowling Norms and Learning Curves for College Women," *Research Quarterly*, 21:4 (December 1950), pp.381-382.

the skill level increased. Fluctuations in the curve appeared more frequently and were more pronounced at the high skill levels than at the low. Starting with one of the middle skill levels and becoming progressively more pronounced as the skill increased, a decline in the curve appeared at the fifth or sixth line.

Backford⁶⁸ conducted a research to evaluate the physical fitness level of Navajo girls through AAHPER Youth Fitness Test. The Navajo girls of 14 to 16 years were selected from seven schools to measure physical fitness level. Also percentile norms were established on the basis of scores obtained from test results. These norms were compared to national norms found in the manual accompanying the AAHPER Youth Fitness Test. The results gave an indication of the overall fitness level of 14, 15 and 16 years old Navajo girls of the seven test items. The Navajo norms were found to be below the national norms on 5 items and above on the softball throw and 600 yard run/walk.

68. Patricia A. Backford, "A Normative Study of the Physical Fitness of 14, 15 and 16 years Old Navajo Girls Using AAHPER Youth Fitness Test." *Completed Research in Health, Physical Education and Recreation* 14 (1976): 159.

Hardayal Singh⁶⁹ and his associates defined norm of physical fitness are essential for formulation, control and assessment of training of sportsmen. The norms serve the following purpose:

- 1) Determination of the level of various motor abilities.
- 2) Determination of the effectiveness of various mean and method training and
- 3) Selection talent.

The norm scales to be accepted as valid and practical criteria for evaluating the individual physical fitness. Tests must be accompanied by norm when norm scales are being constructed, one must consider the following, practical statistical and educational principles:

- 1) Sampling techniques, 2) equivalency 3) Progressivity, 4) Sensitiveness.

Percentage correct score are preferably more useful for tests of motor skill than the written test. When a test is scored using the percentage correct method, the teacher usually decides upon a certain percentage score that reflects on adequate mastery of the material.

69. Hardayal Singh, et al. "Norms of Physical Fitness for Hockey Goal Keepers." *NIS Scientific Journal*, 10:3 (July, 1987), p. 3.

The Norm scales: To be accepted as valid and practical criteria for evaluating the individual physical fitness, tests must be accompanied by norms. When norm scales are being constructed, one must consider the following practical, statistical and educational principles.

1. Sampling technique
2. Equivalency
3. Progressivity
4. Sensitiveness.⁷⁰

Programmes of physical education for fitness must be set up in order to build a physically and socially strong nation. This type of programme should take place largely through the formal process of physical education, physical activity, health education and recreational programmes in each and every school and colleges. Health related physical fitness norm would be useful for assessing fitness level and to compare the level of fitness. Various scholars have conducted norm construction study and it is found to be useful to physical educators and students. It is obvious that physical fitness is an urgent need of our school and college programmes. To make the

70. Hardayal Singh et al., "Norms of Physical Fitness for Hockey Goal Keepers," *N.I.S. Scientific Journal*, 10:3 (July 1987), p. 3.

health of the students better off and prepare the pupil as physically fit, democratic and creative citizen, it is a dire need of today to introduce health and physical fitness programmes in all the levels of educational institutions.

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Chapter - III

Methodology

METHODOLOGY

In this chapter the procedure adopted for the selection of subjects, selection of variables, collection of data and statistical techniques applied for construction of norms have been presented.

1. SELECTION OF SUBJECTS

The study was designed to construct norms for the Health Related Physical Fitness of college men in the state of Kerala.

Six thousand three hundred and seventy five college men between the age group of eighteen to twenty three from fourteen districts of Kerala state (consisting three colleges from each district) were randomly selected for the purpose of the study.

2. SELECTION OF VARIABLES

At the college level, the AAHPERD Health Related Physical Fitness test battery was selected after taking into consideration the importance of measuring Health Related Physical Fitness of college men from 18 to 23 years of age.

The components and test items are¹:

- 1) Cardio respiratory function
 - a) One mile run

- 2) Body composition
 - a) Sum of triceps and sub scapular skin folds

- 2) Abdominal and low back -hamstring musculoskeletal function
 - a) Modified timed sit-ups
 - b) Sit and reach

Besides these tests BMI (body mass index) was computed by measuring height and weight.

3. RELIABILITY OF DATA

The reliability of the data was ensured by establishing the tester's competency, reliability of the test the subject reliability and the instrument reliability.

1. American Alliance for Health, Physical Education(1980). *Recreation and Dance, Health Related Physical Fitness Test Manual*, 1900, Association Drive, Reston, VA 22091, p. 5.

4. TESTER'S COMPETENCY

To determine the Testers Competency 10 subjects were selected at random and was first tested by the scholar and then by an expert under identical condition. Pearson's Product Moment correlation was computed between two measures of each variable separately and the correlation coefficient have been presented in Table I.

Table I

Table showing correlation between test and re-test

Sl No.	Test	Coefficient of Correlation
1	One mile run	0.90
2	Sit and reach	0.94
3	Sit-ups	0.83
4	Sum of skin folds	0.94
5	Height	0.98
6	Weight	0.95

The scholar had a number of practice sessions in the testing procedure and various authorized books were referred to, in order to acquire knowledge of the testing procedure. The tests were conducted by

the scholar with help of physical education teachers and well competent officials.

5. RELIABILITY OF TEST

To determine the reliability of the test ten subjects were selected at random and was tested by the research scholar and then by an expert under identical condition. Pearson's Product Moment correlation was computed between two measures of each variable separately and the correlation coefficient has been presented in Table II

Table II
Table showing reliability coefficient

Sl. No.	Test	Co-efficient of correlation
1	One mile run	0.90
2	Sit and reach	0.94
3	Sit-ups	0.83

It is evident from the above tests that for tester competency and reliability of the test values achieved having very high correlation.

6. SUBJECT RELIABILITY

Table III
Table showing Instrument Correlation

Sl No.	Test	Co- efficient of correlation
1	Height	0.98
2	Weight	0.95
3	Sum of skin folds	0.94

From the above test-retest method was also established that the subject reliability was significant as the same subjects were used under similar condition without any motivation techniques.

In order to get the co-operation from the subjects, the scholar explained the purpose of the study. Prior to the administration of the tests the procedure to be adopted was explained to the subjects in detail. Model tests by a few subjects were done in the presence of the students to make the subjects understand the AAHPERD to Health Related Physical Fitness Test.

7. INSTRUMENT RELIABILITY

The instrument used for the test were manufactured and supplied by recognized firms.

- 1) Stop watch : Casio Manually operated Digital stop watch
- 2) Skin fold caliper : Lange skin fold caliper supplied by Novel Products, Inc. USA
- 3) Sit and reach : Flex tester supplied by Novel Products, Inc. USA
- 4) Stadio meter : Specially constructed Stadio meter (teak wood) with two meter height reading
- 5) Weighing machine : Avery platform balance.

8. COLLECTION OF DATA

The administration of the tests and the method of collecting the data are detailed below:

CARDIO RESPIRATORY FUNCTION

Test Objectives

The purpose of the distance run was to measure maximal functional capacity and endurance of the cardio respiratory function.

Description

Students were instructed to run a mile in the fastest possible pace. The students began the race on the signal 'ready start'. As they crossed the finish line, elapsed time was recorded. Walking was permitted but the

objective was to cover the distance in the shortest possible time. The run was scored in minutes and seconds. One mile run was administered on 200, 400 meters track and other flat measured area.²

Scoring

One mile run time was recorded into minutes and seconds.

BODY COMPOSITION (SUM OF SKIN FOLD FAT)

Test objective

The purpose was to evaluate the level of body fat in college men in the state of Kerala.

Test Description

Two skin fold fat sites (triceps and sub-scapular) have been chosen for this test because they are easily measured and are highly correlated to total body fat.³

Triceps skin-fold was measured over the triceps muscle of the right arm half way between elbow and the acromion process of the scapula with

2. *ibid.*, p.9.

3. *ibid.*, p. 12.

the skin fold parallel to the longitudinal axis of the upper arm. The sub scapular site (right side of the body) is 1 cm (1/2 inch) below the inferior angle of the scapula inline with the natural cleavage lines of the skin.⁴

Testing procedure

- 1) Firmly grasp the skin fold caliper between the thumb and the forefinger and lift up.
- 2) Place the contact surfaces of the caliper 1 cm (1/2 inch) above or below the finger.
- 3) Slowly release the grip on the calipers enabling them to exert their full tension on the skin fold.
- 4) Read skin fold to nearest 0.5 millimeter after needle stops (1 to 2 seconds after releasing grip on caliper).⁵

Lange skin fold caliper was used to measure the body composition. Characteristics of this skin fold caliper include accurate calibration capacity and a constant pressure of 10 gm/mm² throughout the range of skin fold thickness.

4. *ibid.*, p.12-13.

5. *ibid.*, p.13.

Scoring

The skin fold measurement was registered on the dial of the caliper. Each measurement was taken three consecutive times with recorded score being the median (middle) of the three scores. To illustrate. If the three readings were 18, 15, and 16 mm the score recorded was 16.⁶

MODIFIED SIT UPS

Test objective

The purpose of the sit-ups was to evaluate abdominal muscular strength endurance.

Description

To assume the starting position, the student lies on his back with knees flexed, feet on floor, with heels between 12 to 18 inches from the buttocks. The arms are crossed on the chest with hands on the opposite shoulders. The feet are held by a partner to keep them in touch with the testing surface. The student, by tightening his abdominal muscles, curls to the sitting position. Arm contact with the chest must be maintained. The chin should remain tucked on the chest. The sit-up is completed when the elbows touch

6. *ibid.*, p.13.

the thighs. To complete the sit -up the student returns to the down position until the mid back makes contact with the testing surface.

Scoring

The timer gives the signal “ready go” and the sit-up performance is started. Performance is stopped on the word “stop” The number of sit-ups performed in 60 seconds shall be the score. Rest between the sit-ups is allowed, and the student should be aware of this before initiating the test. However, the objective is to perform as many correctly executed sit-ups as possible in the 60 second period.⁷

Equipment

Mats are recommended for safety and comfort. Casio electronic manually operated stopwatch was used.

SIT AND REACH TEST

Test objective

The purpose of the sit and reach was to evaluate the flexibility (extensibility) of the low back and posterior thighs.

⁷. *ibid.*, p.17-18.

Description

To assume the starting position, student removes their shoes and sits down at the test apparatus with their knees fully extended and the feet shoulder width apart. The feet should be flat against the end board. The arms are extended forward with hands placed on top of each other to perform the test. The student reaches directly forward, palms down, along the measuring scale four times and hold the position of maximum reach on the fourth trial. The position of the maximum reach must be held for one second. The test apparatus consists of a specially constructed box with a measuring scale where 23 cm is at the level of the feet.

Scoring

The score is the most distant point reached on the fourth trial measured to the nearest centimeter. The test administrator should remain close to the scale and note the most distant line touched by the finger tips of both hands. If the hands reach unevenly, the test should be re-administered. The tester should place one hand on the subjects' knee to ensure that they remain extended.

Test area

Any plain area with sufficient floor space may be used.

Besides these, height and weight of the subjects were measured to compute the (BMI) Body Mass Index.

BODY MASS INDEX

BMI represents the relationship of the height to weight, yielding a single number; the more you weigh in relation to your height, the higher your BMI. Using BMI as the measure, "obese" or "over weight" is defined as a body mass index of 27 or higher. A desirable BMI is anything less, and the lower the better.⁸

$$\text{Formula for the calculation of the BMI} = \frac{\text{Weight in kilograms}}{\text{Height in meters squared}}$$

Weight

Avery platform balance was used to assess the body weight. The students stood inactive, erect without motion on the weighing machine with minimum clothing. The weight was measured to the nearest 1/2kg.

Height

Stadiometer was used to measure the height of the students. Students were made to stand erect on the platform of the stadiometer barefooted and

8. Ralph S. Paffenbarger, Jr. M.D. and Eric Olsen.(1996). *Life Fit*. Published by Ralph S. Paffenbarger, Jr. M.D. and Eric Olsen in Canada, p. 88.

the top of the stadiometer was brought down into contact with the head.
The height was measured to the nearest one centimeter.

9. STATISTICAL TECHNIQUES

To construct Health Related Physical Fitness Norms the following statistical procedure was used.

Mean and standard deviation of the scores on all the tests were calculated and the data was converted into percentile to construct norms.

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Chapter - IV

Analysis of Data and Results of the Study

ANALYSIS OF DATA AND RESULT OF THE STUDY

The purpose of the study was a construct a percentile norm on (AAHPERD) Health Related Physical Fitness of college men comprising 18 to 23 years of age in the state Kerala.

The Mean and Standard deviation were made and percentile scale was constructed to prepare the norms for each item. The percentile scale was calculated from 1st to 99th percentile. The best scores (time and fat percent) in the case of one mile run and body composition and maximum score (numbers and centimeters) in the case of sit- ups and sit and reach have been kept in 99th percentile, where as the least values were kept in the 1st percentile.

Table IV

Description Scores in One Mile Run for College Men
(in minutes and seconds)

Number of subjects	Mean	SD
6372	7:52	1:11

Figure I
Graph showing Percentile Scores for One Mile Run of College Men
(minutes and seconds)

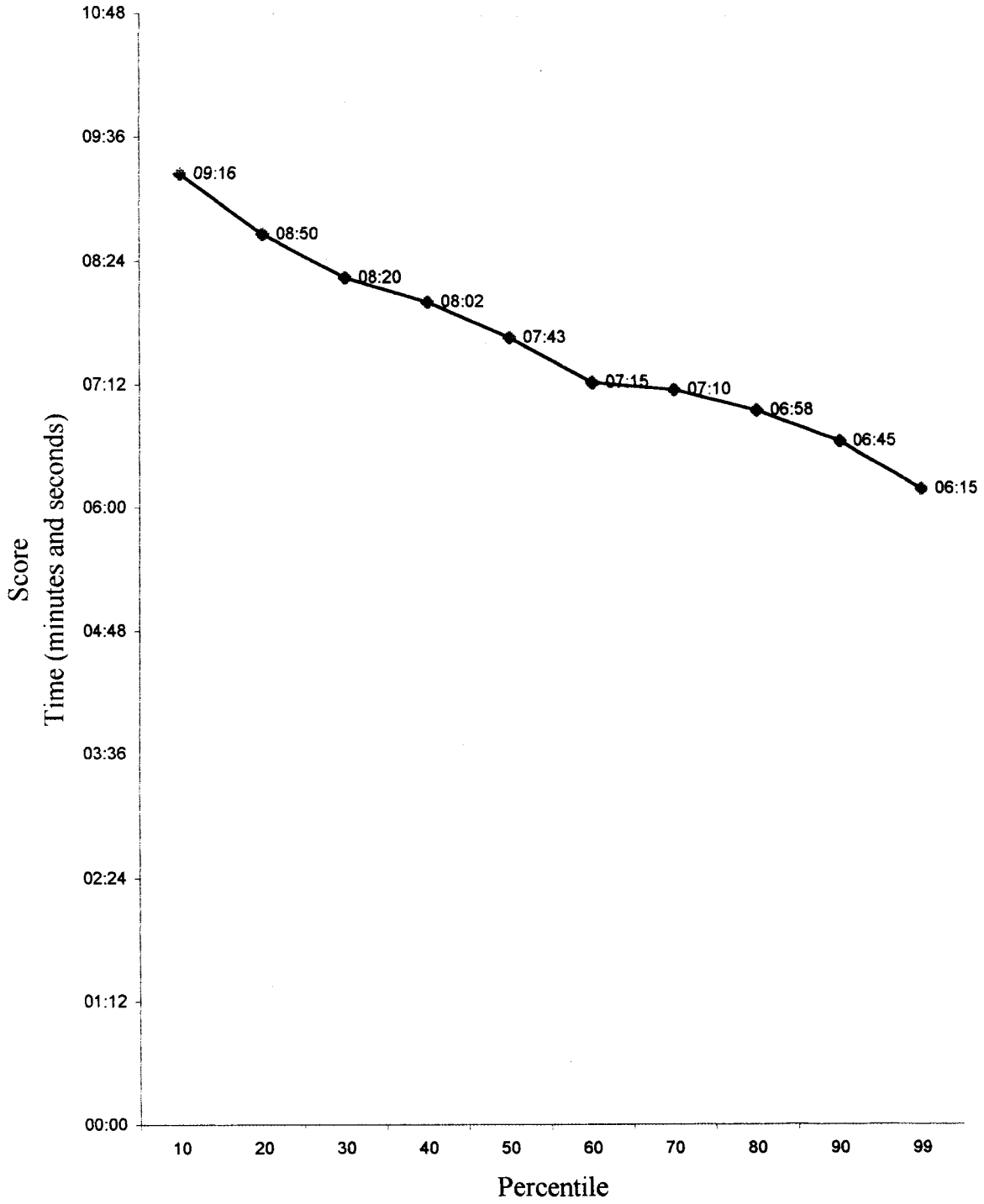


Table V

Percentile score for One Mile Run for College Men
(in minutes and seconds)

Percentile	One mile	Percentile	One mile
99	6:15	80	6:58
98	6:15	79	6:58
97	6:25	78	6:59
96	6:25	77	7:01
95	6:30	76	7:02
94	6:30	75	7:04
93	6:34	74	7:04
92	6:40	73	7:06
91	6:43	72	7:10
90	6:45	71	7:10
89	6:46	70	7:10
88	6:49	69	7:11
87	6:49	68	7:11
86	6:50	67	7:12
85	6:52	66	7:12
84	6:53	65	7:13
83	6:55	64	7:13
82	6:58	63	7:13
81	6:58	62	7:14

Percentile	One mile	Percentile	One mile
61	7:14	41	8:01
60	7:15	40	8:02
59	7:15	39	8:05
58	7:16	38	8:09
57	7:18	37	8:10
56	7:19	36	8:10
55	7:20	35	8:10
54	7:30	34	8:11
53	7:30	33	8:14
52	7:39	32	8:14
51	7:40	31	8:15
50	7:43	30	8:20
49	7:45	29	8:21
48	7:47	28	8:29
47	7:49	27	8:30
46	7:50	26	8:31
45	7:50	25	8:32
44	7:51	24	8:32
43	7:57	23	8:37
42	8:01	22	8:38

Percentile	One mile	Percentile	One mile
21	8:40	10	9:16
20	8:50	9	9:38
19	8:52	8	10:00
18	9:00	7	10:01
17	9:01	6	10:06
16	9:06	5	10:10
15	9:10	4	10:23
14	9:10	3	10:31
13	9:13	2	10:47
12	9:14	1	10:47
11	9:15		

Table VI
Description score on sit-ups for college men

Number of Subjects	Mean	SD
6372	32.68	9.12

Figure 2
Graph showing Percentile Scores of Sit Ups for College Men

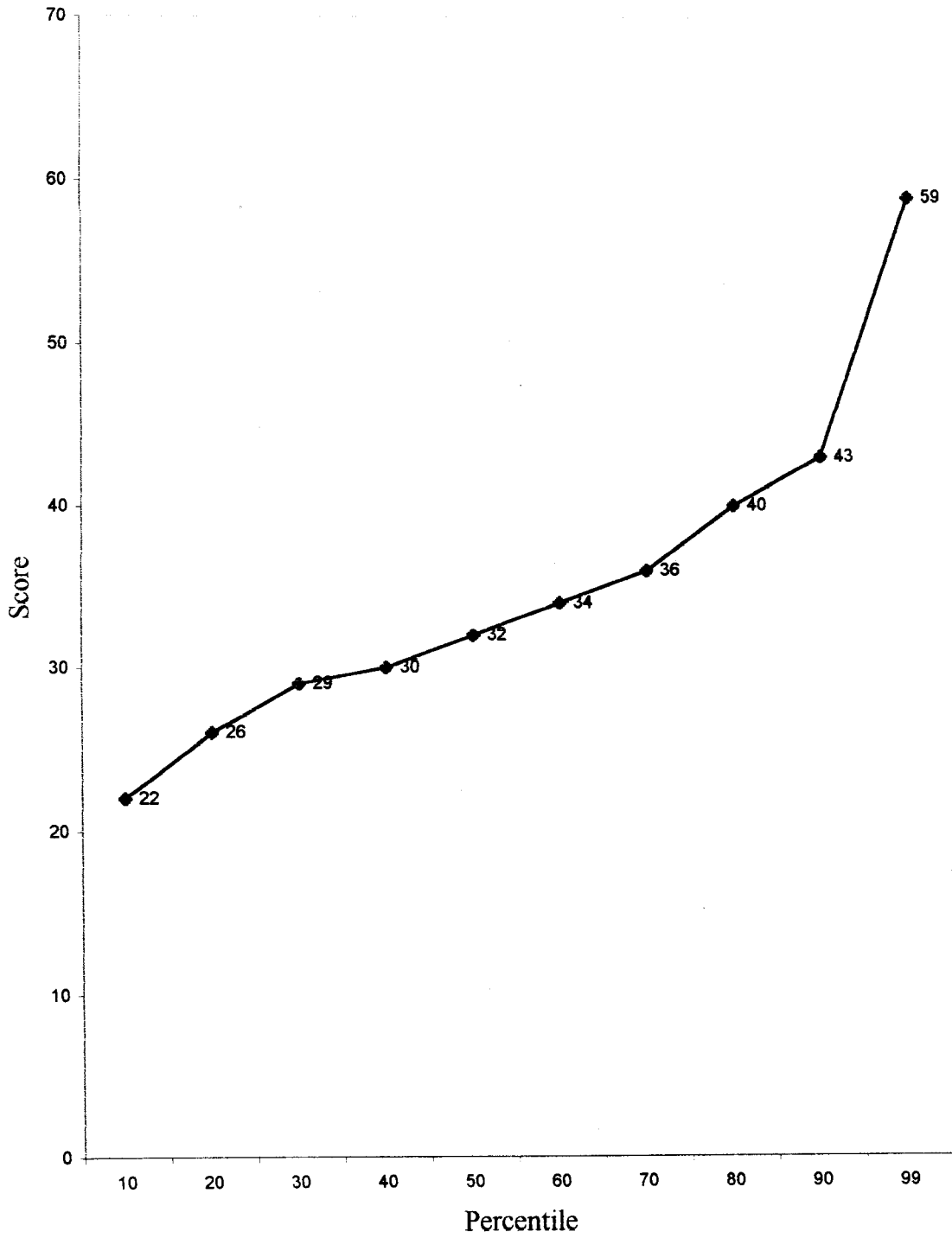


Table VII
Percentile Scores for the Sit Ups Test for College Men

Percentile	Sit-ups	Percentile	Sit-ups
99	59	82	40
98	56	81	40
97	52	80	40
96	50	79	40
95	48	78	40
94	47	77	39
93	46	76	39
92	45	75	38
91	44	74	38
90	43	73	38
89	43	72	37
88	43	71	37
87	42	70	36
86	42	69	36
85	41	68	36
84	41	67	35
83	40	66	35

Percentile	Sit-ups	Percentile	Sit-ups
65	35	45	31
64	35	44	31
63	35	43	31
62	35	42	30
61	34	41	30
60	34	40	30
59	34	39	30
58	34	38	30
57	33	37	30
56	33	36	30
55	33	35	30
54	33	34	30
53	33	33	29
52	32	32	29
51	32	31	29
50	32	30	29
49	32	29	29
48	32	28	28
47	31	27	28
46	31	26	28

Percentile	Sit-ups	Percentile	Sit-ups
25	27	12	23
24	27	11	22
23	27	10	22
22	26	9	21
21	26	8	20
20	26	7	20
19	25	6	19
18	25	5	19
17	25	4	18
16	24	3	16
15	24	2	14
14	24	1	12
13	24		

Table VIII
 Descriptions of Score in Sit And Reach for College Men (in cms)

No of Subjects	Mean	SD
6372	27.90	7.31

Figure 3
Graph showing Percentile Scores of Sit and Reach of College Men (in cms)

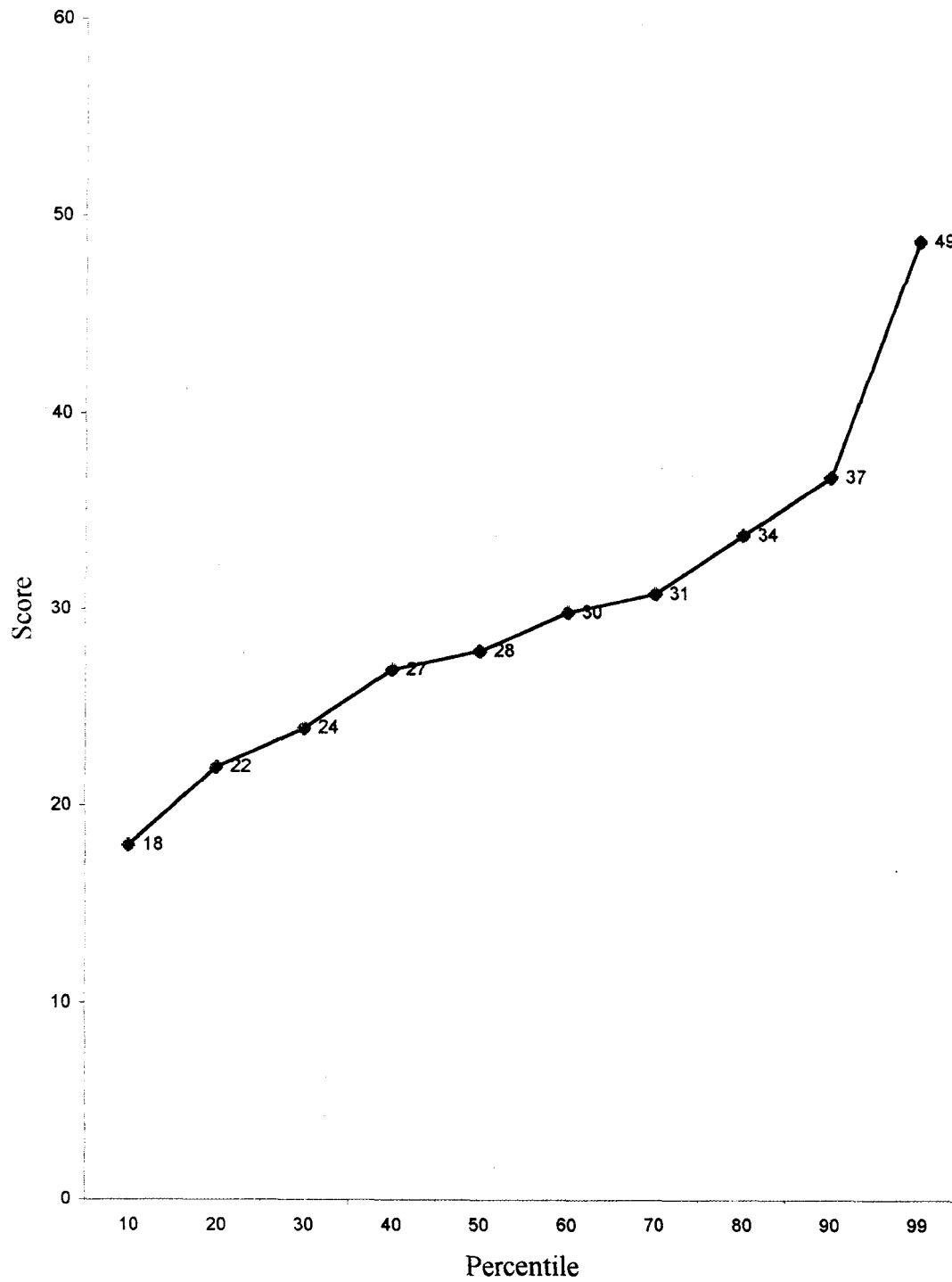


Table IX

Percentile scores for the Sit and Reach for College Men (in cms.)

Percentile	sit and reach	Percentile	sit and reach
99	49	82	34
98	44	81	34
97	41	80	34
96	40	79	33
95	39	78	33
94	38	77	33
93	38	76	33
92	37	75	32
91	37	74	32
90	37	73	32
89	36	72	32
88	36	71	32
87	36	70	31
86	35	69	31
85	35	68	31
84	35	67	31
83	34	66	31

Percentile	Sit and Reach	Percentile	Sit and Reach
65	31	45	27
64	30	44	27
63	30	43	27
62	30	42	27
61	30	41	27
60	30	40	27
59	30	39	26
58	29	38	26
57	29	37	26
56	29	36	26
55	29	35	25
54	29	34	25
53	29	33	25
52	28	32	25
51	28	31	24
50	28	30	24
49	28	29	24
48	28	28	24
47	28	27	24
46	28	26	24

Percentile	Sit and Reach	Percentile	Sit and Reach
25	23	12	19
24	23	11	19
23	23	10	18
22	22	9	18
21	22	8	18
20	22	7	17
19	22	6	17
18	22	5	16
17	22	4	15
16	21	3	13
15	21	2	11
14	21	1	9
13	20		

Table X
Description of score on Body Fat of College Men

Number of Subjects	Mean	SD
6372	29.44	8.53

Fig. 4
Graph showing Percentile Scores Body Fat of College Men
(in millimeters)

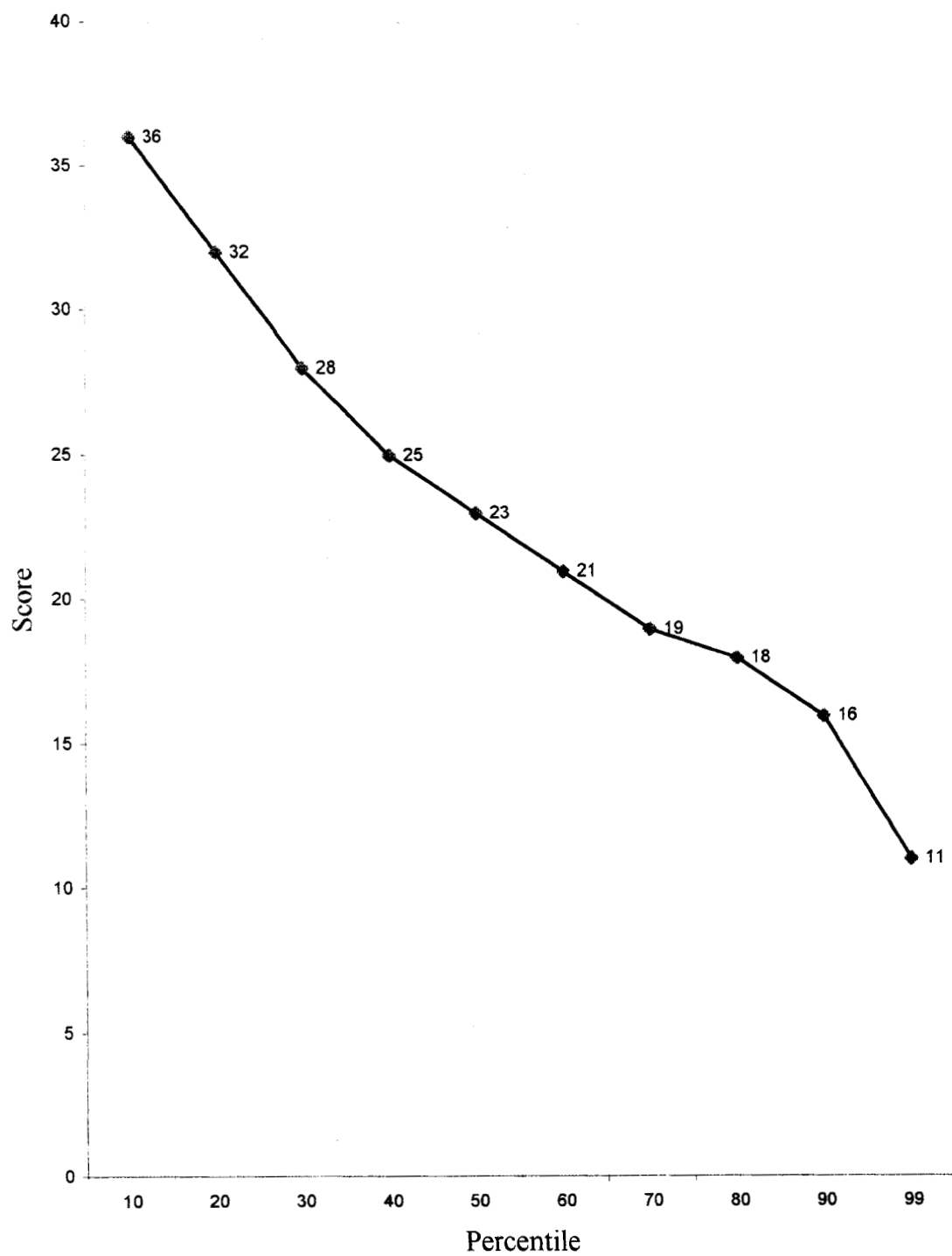


Table XI

Percentile scores for Triceps + Sub Scapular for College Men (millimeters)

Percentile	Triceps + Sub Scapular	Percentile	Triceps + Sub Scapular
99	11.00	82	17.00
98	13.00	81	18.00
97	13.00	80	18.00
96	14.00	79	18.00
95	14.00	78	18.00
94	14.00	77	18.00
93	15.00	76	19.00
92	15.00	75	19.00
91	15.00	74	19.00
90	16.00	73	19.00
89	16.00	72	19.00
88	16.00	71	19.00
87	16.00	70	19.00
86	16.00	69	20.00
85	17.00	68	20.00
84	17.00	67	20.00
83	17.00	66	20.00

Percentile	Triceps + Sub scapular	Percentile	Triceps + Sub Scapular
65	20	45	24
64	21	44	24
63	21	43	24
62	21	42	25
61	21	41	25
60	21	40	25
59	21	39	26
58	22	38	26
57	22	37	26
56	22	36	26
55	22	35	27
54	22	34	27
53	22	33	27
52	23	32	27
51	23	31	28
50	23	30	28
49	23	29	28
48	24	28	28
47	24	27	29
46	24	26	29

Percentile	Triceps + sub Scapular	Percentile	Triceps + Sub Scapular
25	29	12	34
24	30	11	35
23	30	10	36
22	31	9	37
21	31	8	38
20	32	7	39
19	32	6	40
18	32	5	41
17	33	4	42
16	33	3	46
15	33	2	49
14	33	1	60
13	34		

Table XII

Descriptive score on body mass index

Number of Subjects	Mean	SD
6375	21.71	2.56

Figure 5
Graph showing Percentile of BMI Scores of College Men

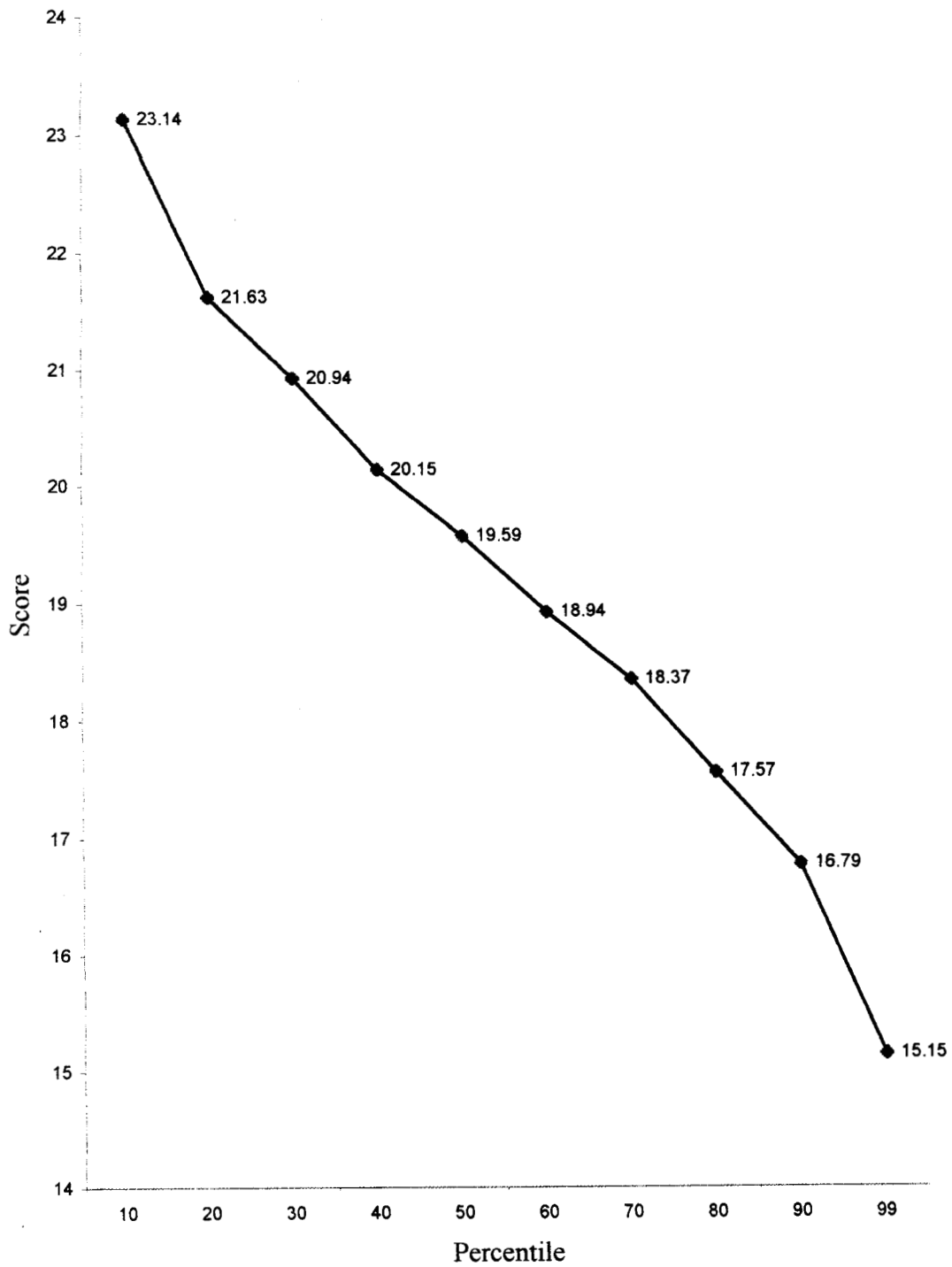


Table XIII

Percentile scores for body mass index for college men

Percentile	Body Mass Index	Percentile	Body Mass Index
99	15.15	82	17.44
98	15.24	81	17.53
97	15.67	80	17.57
96	15.92	79	17.65
95	16.13	78	17.74
94	16.35	77	17.84
93	16.50	76	17.91
92	16.56	75	17.99
91	16.73	74	18.04
90	16.79	73	18.08
89	16.90	72	18.22
88	17.01	71	18.25
87	17.10	70	18.37
86	17.18	69	18.38
85	17.26	68	18.44
84	17.36	67	18.47
83	17.37	66	18.51

Percentile	Body Mass Index	Percentile	Body Mass Index
65	18.59	45	19.84
64	18.72	44	19.92
63	18.75	43	19.95
62	18.82	42	20.05
61	18.90	41	20.08
60	18.94	40	20.15
59	19.03	39	20.20
58	19.05	38	20.31
57	19.05	37	20.38
56	19.15	36	20.52
55	19.23	35	20.53
54	19.31	34	20.66
53	19.43	33	20.72
52	19.49	32	20.83
51	19.53	31	20.86
50	19.59	30	20.94
49	19.61	29	21.01
48	19.69	28	21.07
47	19.72	27	21.15
46	19.82	26	21.22

Percentile	Body Mass Index	Percentile	Body Mass Index
25	21.30	12	22.86
24	21.39	11	22.99
23	21.47	10	23.14
22	21.53	9	23.33
21	21.60	8	23.67
20	21.63	7	23.94
19	21.72	6	24.16
18	21.88	5	24.38
17	21.97	4	24.91
16	22.19	3	26.08
15	22.34	2	26.95
14	22.46	1	29.04
13	22.66		

Table XIV

Percentile score of Health Related Physical Fitness for College Men of Kerala State

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
99	11	49	6:15	59
90	16	37	6:45	43
80	18	34	6:58	40
70	19	31	7:10	36
60	21	30	7:15	34
50	23	28	7:43	32
40	25	27	8:02	30
30	28	24	8:20	29
20	32	22	8:50	26
10	36	18	9:16	22

1. DISCUSSION OF FINDINGS

Fitness testing serves several purposes including educating students about the various components of physical fitness, tracking changes in fitness levels over the time, providing students, parents and teachers with information concerning the fitness of children and youth, providing a basis

for the development of personal exercise programme and motivating students to improve their fitness levels and exercise habits.

Health Related Physical Fitness of college men is significantly associated with certain physical activity behaviors of their childhood and their parent's attitude towards physical activity. Results of the test items included in this study can be a significant aid in the prescription of exercise for the development of physical fitness. Attained scores on various items of HRPF test can be used to identify strength and weakness within students. Those who score below 25th percentile on each test item should receive special attention and be strongly encouraged to improve the specific components. These students require counseling along with guidance in selecting appropriate procedures for improvement. Every physical education programme should have an established set of reasonable fitness objectives for the students. Test result can help to determine the degree to which those objectives are being met.

The very process of administering a fitness test to students communicates the nature of important components of health and fitness. The components are measured and emphasized as being worthy of special

consideration on individual's life style. The testing process should be an integral part of the student's educational experience in health and fitness. It should never be allowed to become a separate entity. The test result can also be used to determine whether physical education programmes are achieving the desired goals.

By one mile run test for the cardio respiratory endurance, the students can be compared with those of the same age based on the developed norms in the state of Kerala. Those who scored the 25th percentile should receive special attention and must be strongly encouraged to improve their distance run time so as to improve the cardio respiratory function. The students scored below 50th percentile should be encouraged to perform up to the median as a minimum level of cardio respiratory function. Low cardio respiratory function has been identified as significant risk factor in the development of coronary heart diseases. The score above the 75th percentile is considered at optimum level and these students may be motivated to keep the already achieved level.

Many individuals with low cardio respiratory fitness also have excessive body fat. Suitable levels of body composition are also important

for athletic competition. Excess body fat lowers aerobic fitness and reduces the ability to perform many activities requiring jumping and moving quickly. However, being too thin is not desirable either. Body composition is also considered to be an important measure of health fitness. A high percentage of body fat relative to bone and muscle has been shown as repeatedly a predictor of risk of a wide range of hypo kinetic diseases.

The exact relation of skin fold fat to body fatness in children and youth has not been fully documented. Therefore, while skin folds are known to be related to body fatness, the absolute amount of body fat cannot be determined with certainty. The criterion for a desired degree of fatness for college men is above the 50th percentile. That means the scores from 23 to 19 will be the most desirable range. When the students are below 50th percentile but above the 25th percentile (23 -33), it is recommended that their weight be maintained at the same level. For those below 25th percentile (<33) strong encouragement needs to be given to reduce body fatness until their skin fold fat data reaches a more desired level.¹

Skin fold measurements greater than 90th percentile that is the sum of skin fold is less than 16mm represent exceptional leanness. Above this level

reduction in weight may involve tissues other than fat eg: muscle, and may have both short and long range undesirable consequences for health, performance, growth and development. To attempt further weight reduction in students who are already at the 90th percentile is not a desirable goal..

Adequate development of abdominal strength - endurance and low back posterior thigh flexibility is important for the prevention and rehabilitation of low back disorders. The purpose of the sit up test was to evaluate abdominal muscular strength and endurance.

The Table VII provides the norms for the sit- up test. This was based on the data secured from six thousand three hundred and seventy five college men from fourteen districts of Kerala state.

Weak abdominal muscles are a contributing factor in the development of low back pain and associated problems. Students who scored below 50th percentile on this test be encouraged to improve their abdominal strength and endurance along with low back, hip and posterior thigh flexibility.

1. AAHPERD HRPF Test Manual, p 17.

According to the AAHPRED those who score below the 25th percentile score (36 numbers / min.) their abdominal strength endurance is critical and recommended for an individualized remedial programme. The data on sit-up scores shows that, 70.2% of the sample tested scored below the 36 which means that 70.2% of the population required an individualized remedial programme according to the AAPHERD norms. Many research data on the Indian population also shows that, back pain and related problems are higher in Indian population.

The sit and reach test was used to evaluate the flexibility of the low back and posterior thighs. A score above the 50th percentile on this test item is considered normal level of flexibility. As per the present data, the 50th percentile score was 28, which were far below when compared with AAHPERD norm that is 38 cm. Moreover, according to AAHPERD HRPF test manual, those who score below 25th percentile that is 33 cm have critical lack of flexibility, and they should be provided with remedial programme of exercise. As per this direction, 79.5 % of the sample were scored below 33 cm that is 25th percentile score according to AAHPERD norms.

As discussed in the case of abdominal strength, this lack also may be due to the genetic reasons. The AAHPERD data, primarily based on the Caucasian and African origin samples, shows that structurally they are much taller when compared to the Asian counter parts.

To summerise, the performance of Indians in the international level has been obviously a topic of heated discussion in many an avenue. One probable conclusion unanimously agreed is the grass root level development. But for this we need authentic data based on which we can progressively walk upon. One among is the development of proper norms to get a clear cut idea of what and when to walk upon.

Unless there was a Taj Mahal no one would have related any other monument to it, substantially proving its greatness. Fitness is no different. We need something to look upon, to depend upon and so this study has treaded into paths to create a criterion on which to depend upon.

Chapter - V

Summary, Conclusion and Recommendations

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Over the years, physical fitness has become the well-built foundation of a structure that supports the many concrete blocks on it which represents all the activities that makes life worth living: intellectual life, spiritual life, love life and social life.

In the modern era, considerable interests has been shown in both public and private sectors to develop physical efficiency and physical fitness by making physical education programme compulsory in many educational and social service institutions.

The concept of wellness has taken a mode of broader, more holistic, and more proactive view of health. The factors that define wellness include not only traditional criteria, of freedom from disease, but also a number of positive criteria, such as adaptability to cope up with everyday stress, feeling of accomplishment and personal growth, ability to express a positive and creative life style and a feeling of contentment and happiness. To be well in a more holistic sense, a person needs to be active, good in spirits, and must be free from disease and pain, to an extent.

Fitness and wellness have been approached primarily as if they were personal and individual issues. More recently, however, health has become

a national- issue; for no other reason than that an increasingly large part of our national wealth goes for health care.

Physical fitness tends to vary from one individual to another. Apparently, it varies in accordance with the nature of a person, depending on whether he is sedentary or dynamic.

Regular exercise is a pre-requisite for physical fitness, which leads to healthy life. Physical fitness can be classified into two - those pertaining to health and those pertaining to motor skill performance. Health related fitness is concerned with the development of those qualities that offer protection against diseases that is associated with physical activity. Performance related physical fitness on the other hand is associated with those qualities which are conducive to better performance in sports and other physical activities such as those requiring speed, strength, endurance, and co -ordinative abilities.

Physical education emphasizes the importance of physical activities as they are directly related to growth and development. Physical fitness movement is another area of development, which is receiving more attention nowadays among all segments of the society. People are striving to improve their fitness and are engaged in activities like jogging, brisk walking, cycling, yoga, aerobic dancing etc. AAHPERD give thrust to health

related physical fitness as it is very important for every one through out their life span. Cardio - vascular endurance, muscular strength /endurance, body composition and flexibility are the components stressed for in health related physical fitness

Health related physical fitness is important for all individuals throughout their life span. Motor performance fitness emphasis the development of the qualities that improve sports performance. Participation in exercise regularly increases physical fitness. Individual with regular exercise has an improved sense of general well being and has an enhanced self-image. Physical fitness is the best investment one can make for a long and healthy life.

Components of physical fitness are speed, strength, endurance flexibility and co-ordinative abilities.

One of the prominent tests to measure the health related physical fitness is AAHPERD Health Related Physical Fitness. AAHPERD Health Related Physical Fitness refers to the aspects of physiological functioning, which are believed to offer the individual, some protection against degenerative diseases such as coronary heart disease, obesity and various muscle skeletal disorders.

In 1980 American Alliance to Health, physical Education, Recreation and Dance (AAHPERD) developed a new fitness test to emphasis Health Related Physical Fitness instead of motor/Athletic fitness. The new test measures cardio-respiratory fitness, body composition, and low back and hamstring strength and flexibility.

The components of health related and performance related fitness are similar. For example both carry components as cardio-vascular function, body composition, strength and flexibility.

The qualities essential for health related and performance related fitness are cardio respiratory fitness, body composition, strength and flexibility.

The present study is significant in the following ways.

This study will enable the students to be aware of their fitness, to compare the fitness with the students of different age groups, to understand the fitness level of the college men in Kerala, to understand the present condition of physical education Programmes in college curriculum, preference for physical education in professional area, and also various plans of the government for the upliftment of health and fitness among citizens, to compare student's health fitness standards, based on public

health research, to find out the relationship between age, weight and height with respect to physical fitness, it may also throw light on the field of measurement highlighting the need for and direction of further research, to motivate students to improve their level of fitness status and to educate students about health related fitness. As no one has attempted to construct norms for health related physical fitness for college men in Kerala, the study will enable us to realise the need for physical fitness and may be used as criterion for the selection of teams and athletes. The norms developed will be of immense help to the physical education teachers and the coaches in identifying the talented youth, who could be trained further for elite level competitions.

At the college level, the AAHPERD Health Related Physical Fitness test battery was selected after taking into consideration the importance of measuring Health Related Physical Fitness of college men from 18 to 23 years of age.

Six thousand three hundred and seventy five college men between the age group of 18 to 23 from 14 districts of Kerala state (consisting three colleges from each district) were randomly selected for the purpose of the study. It enables the teachers to recognize that fitness test scores are influenced not only by exercise habit but also by genetic ability, maturation

and skill. Since there were no standard norms for the college men between the age group of 18 and 23 years in the state of kerala, on the AAPHERD Health Related Physical Fitness Test Battery, a need for it was felt and hence the investigator took up this study.

The following components were tested:

Cardio respiratory function (one mile run), Body composition (sum of triceps and sub scapular skin folds) and Abdominal and low back - hamstring musculoskeletal function (modified timed sit-ups and sit and reach)

Besides these tests BMI (body mass index) was computed by measuring height and weight.

Percentile norms were constructed on all the four test items of the AAPHERD Health Related Physical Fitness Test battery on college men in the state of Kerala. Besides this BMI (body mass index) percentile was also constructed.

To construct Health Related Physical Fitness Norms Mean and standard deviation of the scores on all the tests were calculated and the data was converted into percentile to construct norms.

1. CONCLUSION

The following conclusions were drawn from the result of the study.

- 1) The data from this study will contribute greatly in providing needed baseline information to set exercise and health objective for the students.
- 2) The results of this study will also allow comparison of students with population in the other states and developed countries like US.
- 3) The information gathered suggests that the current programme is be inadequate to promote physical fitness.
- 4) Findings of the study show that, our population is much lower in abdominal strength, and recommended developing some special programmes or special attention for development of abdominal strength /endurance in college men.
- 5) Subjects who scored below the 50th percentile should be encouraged to improve the particular variable.
- 6) In skin fold test, those who scored 90th percentile, additional weight loss should not be encouraged as this will result in the loss of muscle tissue.

Table XV

Percentile scores of Health Related Physical Fitness of College Men

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
99	11	49	6:15	59
95	14	39	6:30	48
90	16	37	6:45	43
85	17	35	6:52	41
80	18	34	6:58	40
75	19	32	7:04	38
70	19	31	7:10	36
65	20	31	7:13	35
60	21	30	7:15	34
55	22	29	7:20	33
50	23	28	7:43	32
45	24	27	7:50	31
40	25	27	8:02	30
35	27	25	8:10	30
30	28	24	8:20	29
25	29	23	8:32	27
20	32	22	8:50	26
15	33	21	9:10	24
10	36	18	9:16	22
5	41	16	10:10	19

2. RECOMMENDATIONS

- 1) The norms may be used as a reference standard to assess the health related physical fitness of college men.
- 2) Advanced analysis by the research community to develop further insights into to improve the health and fitness of the college men.
- 3) The Physical Education teachers and fitness experts can conduct frequent evaluation of students based on the percentile scales.
- 4) Individualized remedial programme should be given to those subjects who scored below the 25th percentile.
- 5) Further research in various age groups in different state may be conducted.
- 6) A National norm in Health Related Physical Education may be constructed.
- 7) More research is required to find out what is needed to foster a national commitment to life time fitness.
- 8) The physical education programmes to provide support for life time fitness should be developed.

- 9) Further research is needed to verify and further define such apparent changes and to interpret their implications for health of today's youth.
- 10) Study findings challenge policy makers, researchers, teachers and members of the general community to make informed decisions about actions needed to enhance the future fitness and physical activity habits of college men.

Appendices

Appendix - I

NORMATIVE DATA:
THE NATIONAL CHILDREN AND YOUTH FITNESS STUDIES II

Percentile	Sit-ups	Sum of skin folds	Sit and reach (inches)	One mile
90	54	13	19.5	6:10
75	50	15	17.5	6:42
50	43	18	15.0	7:35
25	36	24	13.0	8:34
10	31	30	10.0	10:50

1. NCYFS II Ross, Pate, Gold, and Silver, 1987. New HRPF Norms JOPERED 66:pp.18-22.

Appendix - II

**BODY COMPOSITION CLASSIFICATION
ACCORDING TO PERCENT BODY FAT¹**

MEN

Age	excellent*	Good*	Moderate**	Overweight	Obese
19	12.0	12.1-17.0	17.1-22.0	22.1-27.0	>27.1
20-29	13.0	13.1-18.0	18.1-23.0	23.1-28.0	>28.1
30-39	14.0	14.1-19.0	19.1-24.0	24.1-29.0	>29.1
40-49	15.0	15.1-20.0	20.1-25.0	25.1-30.0	>30.1
>50	16.0	16.1-21.5	21.1-26.0	26.1-31.0	>31.1

WOMEN

Age	excellent*	Good*	Moderate**	Overweight	Obese
19	17.0	17.1-22.0	22.1-27.0	27.1-32.0	>32.1
20-29	18.0	18.1-23.0	23.1-28.0	28.1-33.0	>33.1
30-39	19.0	19.1-24.0	24.1-29.0	29.1-34.0	>34.1
40-49	20.0	20.1-25.0	25.1-30.0	30.1-35.0	>35.1
>50	21.0	21.1-26.5	26.1-31.0	31.1-36.0	>36.1

* High Physical Fitness Standard

** Health Fitness Standard

¹. From Hoeger, W.K. and Hoeger, S. 1994. Principles and Labs for Physical Fitness and Wellness. Morton Publishing Company, Englewood, Colorado, in Fat-O-Meter by Novel Products, Inc. USA p.13.

Appendix III

Percentile score of Health Related Physical Fitness
for College Men of Kerala

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
99	11	49	6:15	59
98	13	44	6:15	56
97	13	41	6:25	52
96	14	40	6:25	50
95	14	39	6:30	48
94	14	38	6:30	47
93	15	38	6:34	46
92	15	37	6:40	45
91	15	37	6:43	44
90	16	37	6:45	43
89	16	36	6:46	43
88	16	36	6:49	43
87	16	36	6:49	42
86	16	35	6:50	42
85	17	35	6:52	41
84	17	35	6:53	41
83	17	34	6:55	40
82	17	34	6:58	40
81	18	34	6:58	40
80	18	34	6:58	40
79	18	33	6:58	40
78	18	33	6:59	40

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
77	18	33	7:01	39
76	19	33	7:02	39
75	19	32	7:04	38
74	19	32	7:04	38
73	19	32	7:06	38
72	19	32	7:10	37
71	19	32	7:10	37
70	19	31	7:10	36
69	20	31	7:11	36
68	20	31	7:11	36
67	20	31	7:12	35
66	20	31	7:12	35
65	20	31	7:13	35
64	21	30	7:13	35
63	21	30	7:13	35
62	21	30	7:14	35
61	21	30	7:14	34
60	21	30	7:15	34
59	21	30	7:15	34
58	22	29	7:16	34
57	22	29	7:18	33
56	22	29	7:19	33
55	22	29	7:20	33
54	22	29	7:30	33
53	22	29	7:30	33
52	23	28	7:39	32

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
51	23	28	7:40	32
50	23	28	7:43	32
49	23	28	7:45	32
48	24	28	7:47	32
47	24	28	7:49	31
46	24	28	7:50	31
45	24	27	7:50	31
44	24	27	7:51	31
43	24	27	7:57	31
42	25	27	8:01	30
41	25	27	8:01	30
40	25	27	8:02	30
39	26	26	8:05	30
38	26	26	8:09	30
37	26	26	8:10	30
36	26	26	8:10	30
35	27	25	8:10	30
34	27	25	8:11	30
33	27	25	8:14	29
32	27	25	8:14	29
31	28	24	8:15	29
30	28	24	8:20	29
29	28	24	8:21	29
28	28	24	8:29	28
27	29	24	8:30	28
26	29	24	8:31	28

Percentile	Triceps and Sub scapular	Sit and reach	One mile	Sit-ups
25	29	23	8:32	27
24	30	23	8:32	27
23	30	23	8:37	27
22	31	22	8:38	26
21	31	22	8:40	26
20	32	22	8:50	26
19	32	22	8:52	25
18	32	22	9:00	25
17	33	22	9:01	25
16	33	21	9:06	24
15	33	21	9:10	24
14	33	21	9:10	24
13	34	20	9:13	24
12	34	19	9:14	23
11	35	19	9:15	22
10	36	18	9:16	22
9	37	18	9:38	21
8	38	18	10:00	20
7	39	17	10:01	20
6	40	17	10:06	19
5	41	16	10:10	19
4	42	15	10:23	18
3	46	13	10:31	16
2	49	11	10:47	14
1	60	9	10:47	12

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