CHAPTER I
INTRODUCTION

Physical Fitness

Physical fitness is being accepted as one of the vital objectives of physical education. The adaptive capacity of the individual to the rigors of work is determined by his physical fitness. Physical fitness has been defined "as 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 unusual situations and unforeseen emergencies." It is something more than "not being sick" or merely "being well". It is different from resistance to or immunity from disease. It is a positive quality, extending on a scale from death to "abundant life". All living individuals have some degree of physical fitness which varies considerably in different people and in the same person at different times. It is


not so broad in its meaning as 'total fitness'. It includes adequate degree of health, posture, physique, proper functioning of vital organs, nutrition, and good health habits along with an adequate amount of endurance, strength, stamina, and flexibility.\footnote{3}{Harold M. Barrow and Rosemary McGee, \textit{A Practical Approach to Measurement in Physical Education} (3rd ed.) (Philadelphia: Lea and Febiger, 1979), p.119.}

\textbf{Its Hoary Tradition}

Fitness has always been a great concern of mankind. Physical fitness from pre-historic to the present day has been equated with survival and power. The earliest human beings were dependent mainly on their own individual strength, vigour, and vitality for survival. For existence they had to acquire basic skills such as agility, balance, strength and endurance. Their physical activity was related first to survival activity. They had to run in search of food, clothing, shelter and protection from a hostile environment.\footnote{4}{Harold M. Barrow and Janie P. Brown, \textit{Man and Movement: Principles of Physical Education} (4th ed.) (Philadelphia: Lea and Febiger, 1988), p.64.} They had to prepare themselves to fight with the animals and other enemies.
From time immemorial, the most celebrated countries over the globe which have created glorious past and famous civilizations of Greeks, Spartan, Athenians, Romans have bestowed paramount importance to the concept of physical fitness of the human body. The great rulers and citizens of the olden times were quite aware of the fact that physically fit subjects constituted not only a fit country but a healthy one too.

It was the order of those days that physically fit man had survived in the life struggle and comparatively a weaker man could not succeed in his attempts to establish himself triumphantly. The old saying 'Fit or Perish' was present in Sparta and Athens - during the Golden Era of Greek history and again in the early centuries of the Roman Empire.

The world's renowned thinkers have emphasised the importance of physical fitness in human beings to ensure a productive and meaningful life. It is from Memorabilia of Xenophon, we come to know of Socrate's emphasis on the necessity of physical fitness and possession of a robust

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physique for the Greek citizens. "No citizen has any right to be an amateur in the matter of physical training, it is a part of his profession as a citizen to keep himself in good condition, ready to serve his State at a moment's notice." Plato, the disciple of Socrates and a great philosopher and also twice a winner at Isthmian games in his youths, observes in his "Republic", gymnastics as well as music should receive careful attention in childhood and continue throughout life. He also emphasized the importance of physical fitness for both men and women. Aristotle stresses that "body and mind" are closely interrelated and interdependent and opines that education of the body must precede the intellect.

History of mankind is full of evidences that physical fitness has always been an important and essential objective of various civilizations and governments. The English historian, Arnold Toynbee wrote that out of the twenty one great civilizations of the past, nineteen of them failed to survive because of the physical and moral decay from within.


8 Ibid., p.66.

9 Barrow and Brown, op.cit., p.91.
John Locke has also affirmed, "A sound mind in a sound body", is a short but full description of a happy state in the world. He that has these two, has a little more to wish for. The rewards of a rich and full life are closely related to physical capacity of the man.

People throughout the ages were staunch in the belief that the Nation's status, standard and destiny were to be decided not by the numerical strength of the people but by the 'Fit People'. Rudyard Kipling has aptly expressed:

Nation have passed away and left no traces,
And History gives the naked cause of it,
One single, simple reason in all cases,
They fell because their people were not fit.

Physical Fitness in Ancient India

The profound tradition of physical fitness in India could be traced back to thousands of years. It has been closely associated with the religious practices, traditions and culture of India. The then Indian Physical

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10 Cited in H.Harrison Clarke and David H.Clarke, op.cit., p.3.
11 Cited in Barrow and Brown, op.cit., p.91.
Education was nothing but contributing to physical fitness. The physical fitness programme was in the form of physical activities like Yogasanas, Pranayama, Dands, Baithaks, Malkhamb, Lezium, Lathi and so forth and the games like Kabaddi, Kho-kho, and Atyapatya have been in vogue from time immemorial, but the names of the inventor and the dates of their origin are not clearly known. Yet we are aware of the fact that a scientific system of physical fitness programme was in existence in India and it was practised by the people from time of yore. These physical fitness programmes were organised and practised in Parnashalas, Ashramas, Hermitages, and the Temples. The preceptors were the Ustads.12

The age-old Vedas have also sounded the strength as one of the components of the physical fitness programme. This could be assessed in the following words "Balana Vai Prithivi Tishtati, Balan Upaswa" (The world stands protected by strength, worship strength).13

Medical authorities of ancient India, such as Charaka and Susruta, recommended physical exercise (Vyayam), oil bath, and massage for maintaining and restoring health.

12 Tirunarayanan and Hariharasarma, op.cit., p.1.
13 Ibid., p.2.
Susruta defined Vyayam as movements of the body that produced sufficiently vigorous circulation of the blood and quick respiration to fatigue the individual. Charaka recommended various exercises to ward off disease, reduce weight, and activate digestion, present a pleasing appearance, and delay the encroachment of old age.14

Dance requires a great deal of physical fitness. It has a long and systematic history in India and is intimately associated with religion. The bronze figure of a dancing girl found in the ancient city of Mohenjo-Daro proves the antiquity of the art, and the early literature reveals the people's love of dancing and the important role played in their religion. In fact, Shiva, one of the trinity of Hindu Gods, was known as 'the Lord of Dance'.15

The development of physical fitness and motor skills was incorporated in the vocational aims of certain groups of people especially that of the Kshatriyas or military caste. Dancing girls were also trained to give expression to religious concepts and to provide recreation for spectators.16

15 Ibid., p.21.
16 Ibid.
The great epics the 'Ramayana' and 'Mahabharata' have considered physical fitness as an important factor in all warfare. It was promoted through participation of Indigenous system of physical activities.\textsuperscript{17} The great Nalanda and Takshasila universities prominent in Ancient and Medieval India, had physical fitness programmes for 10,000 students at one time in the form of Indigenous activities and gymnastics of Indian origin.

\textbf{Physical Fitness in Pre-independent India}

The responsibility of education in the year 1833, was in the hands of British rulers, and hence they never paid any attention to the inclusion of physical fitness system in the school education programme.\textsuperscript{18}

The war of Indian independence of 1857 had suppressed the physical fitness programme of Indigenous physical activities, and it was replaced by Westernised type because the whole country was under the control of the whites. The fire of patriotism was injected into the minds of strong and stout Indians to refuse the physical fitness

\textsuperscript{17} Tirunarayanan and Hariharasarma, \textit{op.cit.}, p.6.

programme of Westernised system of physical activities, but in vain. The then rulers themselves were lover of gymnasium work. They patronised several wrestlers - to develop strength and Malkhamb (wrestler's pillar) to develop flexibility as components of physical fitness.  

In 1870, the education was made a state subject retaining the supervisory power at the centre. Even then, physical fitness programme was given no place in the school programmes.

The alien rulers had the fascination of promoting Western games in schools and colleges and thus degraded the indigenous physical activities. To give more impetus, Britain had introduced in India, the Maclarens system of gymnastics adopted from the German system, Swedish drill, military drill as adapted by Ling system, Marching and rhythmic exercises adapted from the Danish system and the modern British games like Football, Cricket, Hockey, and so forth., to aim at fulfilling the desired components of physical fitness.

19. Tirunarayanan and Hariharasarma, op.cit., p.16.
The outstanding development of physical fitness programme in pre-independence days goes to YMCA college of physical education founded in 1920 by Mr. Harry Crow Buck at Madras. The network of physical fitness components such as strength, endurance, flexibility, speed, agility and so forth, were found a place in the games of Volleyball and Basketball introduced in India with the American influence through the YMCA. Afterwards several institutions, namely, Government College of Physical Education, Hyderabad (1931), Christian College of Physical Education, Lucknow (1932), Training Institute of Physical Education, Kandivali (Bombay) (1938) and so forth sprang up basically to serve the cause of the physical fitness programme in India.

The Olympic movement in India resorted to encourage participation in high level competition and also to create a sense of participation in games and sports among mass in general. It was in the year 1920 that six competitors were sent for the first time to represent India in Athletics and wrestling in the world Olympic games held at Antwerp (Belgium) after having made them physically fit and also fit in the skills for the high level performance.

With a view to feed players and athletes for the high level competitions, several physical fitness training
Programmes were launched in order to develop strength, endurance, and agility.

**Physical Fitness in Post-independent India**

The impact of World War II made to develop physical fitness in the youth of the nation. The need for the national programmes of physical fitness was felt by the then administrators of India because young people were not in sound physical condition for selective services and professional preparation programmes. Physical fitness programme was very much necessitated for rehabilitating the war victims and it was also used in the educational and training institutions in the form of physical therapy, occupational therapy and physical re-training.

After attainment of Independence, utmost importance was given by the Indian Government for the promotion of physical fitness programmes to keep the citizens fit, both in body and mind for the national security, individual welfare and efficiency in production. The Government launched various measures for the betterment of physical fitness among youths and improved performance of the Indian sportsmen at International competitions. The development of physical fitness programmes was started with the establishment of Rajkumari Sports Coaching Schemes
(1953), and the All India Council of Sports (1954) and National Discipline Scheme (1954). 22

Many programmes with an idea of improving the physical fitness at the grass roots level (that is, at the school level) were launched. Each student was given an opportunity to assess the physical fitness level as to develop skill and understanding that will enable him to enjoy productive presence and more meaningful existence in the school. The physical fitness programmes in schools were initially placed at the hands of retired army personnel. There were no special periods allotted for physical fitness; it was expected that students would develop a certain amount of physical fitness through participation in some physical activities.

The Central Advisory Board of Physical Education has made further progress with the existing programmes on scientific lines by introducing specific schemes like National Discipline Scheme, National Physical Efficiency Drive, Auxilliary Cadet Corps, Youth Services Camps, Scouts and Guides, National Cadet Corps and the like. 23

\[^{22}\text{i}b\text{id.}, \text{pp.29-31.}\]
\[^{23}\text{i}b\text{id.}, \text{p.28.}\]
A National Plan of Physical Education and Recreation sponsored by the Ministry of Education finalised in 1956 suggested norms for physical efficiency tests.\textsuperscript{24}

One of the programmes of National Physical Efficiency Drive as specified above, was sponsored from the year 1959-60 with a specific purpose to create consciousness and enthusiasm among the people of our country for physical fitness and to stimulate their interest for physical welfare, which would help them to attain a better healthful living and in turn, increase the efficiency of work and result in a prosperous life. The factors that normally contribute to the physical efficiency of an individual are nothing but physical fitness components namely strength, speed, agility and endurance. To assess these factors, batteries of tests in certain physical performances were framed. These are known as "Physical Efficiency Tests". These tests (100 metres run, 800 metres run, Long jump, High jump, and Shot-put) were based on certain standards and homogeneity to the age group and sex. There were three distinct standards viz., 1. One star standard, 2. Two star standard and 3. Three star standard.\textsuperscript{25}


\textsuperscript{25}Kamlesh and Sangral, op.cit., p.146.
The National level awards were also given to the participants after they qualify for the requisite battery of tests in their own age group.

In 1959, the tests were conducted in 10 States and Union Territories at 269 centres. The number of participants were 77,109, out of which 42,357 people received merit certificates and medals. In 1968-69 the tests were administered in 12 States and 10 Union territories at 5,500 centres and 10,50,000 people took part. Out of which 4,10,000 people were qualified for merit certificates and medals, 12 people won national awards. To make it more appropriate and specific, the nomenclature of National Physical Efficiency Drive had been changed as National Physical Fitness Scheme. This scheme was in operation for some years. While administering the batteries of test under this scheme, some difficulties were experienced such as (i) technical events involving considerable training which were to be given in mastering over the performance and (ii) over-emphasis of neuromuscular skills. Besides, there were other important factors like loose organisation, disinterestedness on the part of conductors, and Bureaucratic mismanagement in the matter of awarding prizes and medals. Therefore the
National Physical Efficiency Drive Scheme became gradually weak and extinct.\textsuperscript{26}

Education from the 'State list' was brought under 'concurrent list' by the 42nd Amendment to the Constitution of India in the year 1976.\textsuperscript{27} The role of education has become vital instrument on the part of the State and Union Governments. The Union Territory of Pondicherry, being a centrally administrative state, closely follows the central government's direction. The National Physical Fitness Scheme has become a failure because of the reasons as attributed "SUPRA", not only at the centre but also in the State and Union Territory. Though the programme of physical fitness is existing in the Union Territory of Pondicherry, it has no standard norms and follow-up actions. Therefore, the need for improving physical fitness and raising the performance standard in various games and sports have been considered very imperative. In order to assess the physical fitness, there is a need to establish norms on the basis of the standard test batteries. In this direction, a significant step has been taken by this research scholar to establish the norms and to assess the physical fitness of school-going boys of the Union Territory of Pondicherry.

\textsuperscript{26}Ibid., p.147.

\textsuperscript{27}The Constitution (Forty-Second) Amendment Act, 1976, Section 57(c).
Norms referred as standard is based on statistical procedure which are developed to judge the individuals' performance in relation to others in the same age group, sex and at particular ability level. Therefore, norms of physical fitness are quite necessary in order to interpret the test scores, results and to evolve a standard procedure.

The AAHPER (American Alliance for Health, Physical Education and Recreation) youth fitness test battery is very popular in this region because of its comprehensiveness, simplicity, easy accessibility, and availability of the most of the physical fitness components. These components are strength, endurance, agility speed, power, and cardiovascular endurance. The problem for investigation in this test battery is undertaken by the research scholar with a view to establish a valid and reliable physical fitness norms for school boys in the Union Territory of Pondicherry.

Statement of the Problem

At some periods of human history and in some premature society, physical fitness was a necessity for getting livelihood and even to remain alive. The Physical fitness is to be desired, because life cannot be full, pleasant or better balanced without it. A boy or a girl enters the period of youth ranging from 13 to 16 years, with
a good allowance of physical fitness. The individual differences in physical fitness are common. These differences depend on heredity and numerous other factors.

The Government of Pondicherry has been well known for the sound educational system for more than twenty nine years, but no requisite importance has been given for physical fitness programmes since 1st July 1963 fully making the territory 'de facto' and 'de jure' a part of the Union of India.

It is true that the number of educational institutions have been established larger in number phenomenally, yet there is a widespread dissatisfaction that many of the institutions lack in the infrastructure facilities like playgrounds and other related amenities. If the promotion and interest are evinced on physical fitness programmes, then the realisation of facilities to be provided will come into operation as a measure of quick means. Even though the expenditure on physical fitness programme have been phenomenally increasing year by year virtually there was no system of physical fitness programmes in schools. Therefore, a plan of action is to be developed to measure the efficiency of the students in the physical fitness programmes.
Research has proved that there was no systematic implementation of physical fitness activities in the high and higher secondary schools and also participation of students in intramural and extramural competitions are below the expectation level. This is because of lack of mass participation and absence of their evaluation in physical fitness standards.

The system of physical fitness programme prevailed in the Union Territory of Pondicherry is said to be irrelevant to the need of the physical capacities of the students studying in schools. After the advent of the National Education Policy (1986),28 these defects of the existing system could be removed after fixing the standard norms for physical fitness for the students in the Union Territory of Pondicherry. The subject undertaken may give scope and direction. It may also give knowledge to augment the growth of physical fitness among the school boys of the Union Territory of Pondicherry. The general importance of

28 The National Policy on Education, 1986 has declared that "Sports and Physical Education are an integral part of the learning process, and will be included in the evaluation of performance", it will have appreciable impact on student's motivation to take part in sports activities. Therefore, however, certain irritant like the weightage to be assigned to sports activities in the curricula of school and college education and the criteria for marking sports performance, etc., which are yet to to sorted out.
physical fitness will be known to public, if scientific study on physical fitness is undertaken. The coaches and physical educationists working in the Union Territory of Pondicherry are also in need of knowledge regarding physical fitness prevailing among the school boys of their state. Thus, the study of "COMPUTATION OF NORMS FOR PHYSICAL FITNESS AMONG SCHOOL BOYS OF THE UNION TERRITORY OF PONDICHERY" would be practically fruitful and socially rewarding to enrich the policy of physical fitness of the Union Territory of Pondicherry.

**Significance of the Study**

Evaluation is an essential aspect of any educational venture and it is true in the case of physical education also. To determine the effectiveness of any physical activity, it is essential to evolve a standard procedure to measure the achievement level. No efforts so far have been made to formulate scientific evaluation procedures. For any evaluation procedure, where the performance can be obtained in terms of numerical scores, it is necessary that a standard scale be available to interpret, without which the scores may not convey much meaning. The present study, therefore, will be of a great significance as it will provide physical education teachers
and coaches the norms to grade their students on the basis of their performances in the physical fitness tests. It will also help the students to know their own level of achievement in relation to the group, thus to motivate the students, to raise themselves to higher performance levels in comparison with their fellow students.

Physical education teachers in various schools of the Union Territory of Pondicherry have been entrusted with the responsibility of looking after the development of youth. During their growth and development period, it is essential to know their physical fitness status before giving any physical education programme to them. This study would provide norms to determine the fitness status of the students and help the physical education teachers to plan physical education programmes accordingly.

No two individuals are alike. Individual differences make every physical education class a heterogeneous group. Therefore, no one programme of physical education can be ideal for all. Unless the strength and weakness of the individuals are known to the teachers, with the availability of norms, the coaches and physical education teachers in schools cannot determine the fitness status of the students and know the exact needs of
each individual. Thus, a norm serves the purpose of a parameter to indicate the state of affairs with respect to physical fitness of the students. The present study will be significant in the following ways.

1. The present study enables us to estimate the present physical fitness status for the school boys in the Union Territory of Pondicherry.

2. The computed physical fitness norms serves as a guide for the other schools to assess their physical fitness status.

3. On the basis of the results of this study, proper physical education programme can be planned effectively for the school boys.

4. The study provides an opportunity to physical education teachers and coaches, to spot-out the latent talents of the students and to select potential boys for different sports and games.

5. This study is more useful in planning our educational curriculum.

6. Through this study pupil can be encouraged to participate in physical fitness programme.
Delimitations

1. The study was delimited to the school boys studying from eighth standard to eleventh standard in the Union Territory of Pondicherry and they were of the age group from 13 to 16.

2. The study was considered 1683 school boys (both rural and urban) belonging to thirteen higher secondary schools and twelve high schools of the Union Territory of Pondicherry.

3. AAHPER Youth Fitness Test has been used as a measure of physical fitness variables.

Limitations

The study has the following limitations:

1. The study was conducted on sample drawn from different populations in different places. So the motivation level of the subjects at the time of testing was not controlled.

2. Certain factors like habits, life style, daily routine work, diet, etcetra, might have influenced the results which were not considered in this study.
3. The background of the previous training of the students was not considered.

4. The conditions of the school ground and environmental factors had not been taken into consideration.

5. The subjects for the study do not come from the same social, economical and cultural background.

**DEFINITION AND EXPLANATION OF THE TERMS**

**NORMS**

According to Chambers Dictionary, Norm is "an authoritative standard."  

According to Barrow and McGee, a norm is a scale that permits conversion from a raw score to a score capable of comparisons and interpretations.

Allen Phillips and Hornak define, Norms represent the achievement level of a particular group to which obtained scores can be compared.

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30 Barrow and McGee, *op.cit.*, p.45.

According to Ebel\textsuperscript{32}, "A Norm as the term is used in relation to test scores is the average of typical test scores (or other measure) for members of a specific group. Norms are often presented in tables giving the typical score values for a series of different homogeneous groups in a given grade or students of a given age."

Norms are standard point of differences to provide basis for judgement or for the determination of relations.\textsuperscript{33}

**PHYSICAL FITNESS**

Physical fitness has been defined "as the development and maintenance of a sound physique and a soundly functioning organs, to the end that the individual realizes in an optimum measure his capacity for physical activity as well as for mental accomplishment unhampered by physical drains or by a body lacking in physical strength and vitality".\textsuperscript{34}


\textsuperscript{33}Ibid., p.55.

\textsuperscript{34}Riedman, *op.cit.*, p.515.
Mathews defines physical fitness as the capacity of an individual to perform given physical takes involving muscular effort.\(^{35}\)

William defines physical fitness as the capacity of an individual to perform physical work.\(^{36}\)

In the words of Willgoose, Physical fitness is "The capacity for an activity which must be enough to perform the given task."\(^{37}\)

According to Hubert Dhanaraj,\(^{38}\) Physical fitness refers to the ability of the body to tolerate stress in all its kinds and maintenance manifestations.

**STRENGTH**

According to Barrow and McGee,\(^{39}\) Strength is the capacity of the whole body or of any of its parts to exert force.


\(^{38}\) V. Hubert Dhanaraj, "Skill Factors Involved in Fitness Testing", *Vayyam* 5 (May, 1974), p.55

\(^{39}\) Barrow and McGee, *op.cit.*, p.112.
According to Mathews,\textsuperscript{40} Muscular strength is the force that a muscle or group of muscles can exert against a resistance in one maximum effort.

According to Hockey,\textsuperscript{41} Strength may be defined as "The force, a muscle can exert against a resistance in one maximal effort". It is measured in units of pounds or kilograms.

**ENDURANCE**

Endurance is the capacity for protracted work and is a measure of the ability to stave off fatigue.\textsuperscript{42}

Barrow and McGee, define Endurance is the result of a physiologic capacity of the individual to sustain movement over a period of time.\textsuperscript{43}

**AGILITY**

Barrow and McGee,\textsuperscript{44} interprets Agility as the

\textsuperscript{40}Mathews, \textit{op.cit.}, p.5.


\textsuperscript{42}Riedman, \textit{op.cit.}, p.516.

\textsuperscript{43}Barrow and McGee, \textit{op.cit.}, p.113.

\textsuperscript{44}Ibid.
ability of the body or parts of the body to change directions rapidly and accurately.

According to Phillips and Hornak,\(^{45}\) the agility is the ability to change directions rapidly and accurately. It depends essentially on strength, speed of reaction and movement, and big muscle coordination.

Cratty and Hutton\(^{46}\) defines agility as the accuracy and speed with which an individual integrates his body parts in various ways.

Fleishman\(^{47}\) defines agility as the ability to change the direction of the body or of the parts of the body rapidly.

It is interrelated with speed, strength, balance and coordination. Agility, like speed, is partially innate; yet, it can also be improved through practice. The acquisition of agility is very important to success in game

\(^{45}\)Allen Phillips and Hornak, \textit{op.cit.}, p.241.


\(^{47}\)Fleishman, \textit{op.cit.}, p.75.
activities requiring dodging, changing of direction, and quick starts and stops.  

BARROW AND MCGEE, power is the capacity of the individual to bring into play maximum muscle contraction at the fastest rate of speed. Power is an explosive action and it is equal to the product of force times velocity, where force has to do with muscle strength and velocity with the speed with which strength is used in motor performance.

According to BOSCO and GUSTAFSON, power is "A function of force and time (Power = Work / Time) and is defined as the rate of performing work (Work = Force X distance). Since work is the product of force and distance over which the force is applied, power is that product divided by the time during which the force is applied.

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49 BARROW AND MCGEE, op.cit., p.112.

According to Jenson and Fisher, Power is the product of force and velocity, and the ability to apply force at a rapid rate.\textsuperscript{51}

According to Mathews\textsuperscript{52}, One's ability to get one's body mass moving in the shortest period of time is a measure of power. The physiologists refer to such events as being anaerobic (without oxygen) i.e., they are performed in such a short period of time that oxygen is not required in producing the necessary energy.

Power is the combination of strength with explosiveness (speed); maximum muscular force released at maximum speed. Power is a fundamental factor in jumping, throwing, kicking and striking. Power is improved through increase in strength and practice.\textsuperscript{53}

\textbf{SPEED}

Barrow and McGee\textsuperscript{54} define speed as the capacity of individual to perform successive movement of the same pattern at a fast rate.

\textsuperscript{52}Mathews, \textit{op.cit.}, p.
\textsuperscript{53}Elizabeth Le Blanc and Susan Lowy, \textit{op.cit.}, p.51.
\textsuperscript{54}Barrow and McGee, \textit{op.cit.}, p.113.
Johnson and Nelson define speed as the rate at which a person can propel his body, or parts of his body through space.

Speed is the ability to move from one place to another in the shortest possible time. It is primarily innate, yet it can be improved through practice for technique and movement efficiency.

**CARDIO-RESPIRATORY ENDURANCE**

According to Willgoose, Cardio-vascular endurance, also referred to as cardio-respiratory endurance and circulatory endurance, is a kind of physiological fitness demonstrated through an adjustment of the heart and lungs to prolonged physical exertion.

According to Jenson and Fisher, Cardio-vascular endurance -- the endurance of circulatory system, -- is the

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56 Carl Gabbard et al., *op.cit.*, p.50.


ability to carry on its functions efficiently under conditions of heavy work.

Cardio-respiratory endurance is the ability of the heart, lungs, and blood vessels to deliver essential nutrients, especially oxygen, to the working muscles and to remove waste materials from the body. It is identified as the most important component in health-related fitness, cardio-vascular endurance is the ability of the heart, lungs and vascular system to function efficiently for an extended period of time. Directly related to this function is physical working capacity. A heart and circulatory system that is functioning at a higher level, thus delivering more blood, is also making more $O_2$ available for working muscles. This process increases the child's ability to work at a greater intensity and over longer period of time without debilitating fatigue.

60 Elizabeth Le Blane and Susan Lowy, op.cit., p.52.