A DESCRIPTIVE STUDY OF CHANGES FOLLOWING A PHYSICAL FITNESS / PHYSICAL EDUCATION PROGRAM FOR MENTALLY RETARDED ADOLESCENTS

by

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Submitted to the Department of Health, Physical Education and Recreation and the Faculty of the University of Kansas in partial fulfillment of the requirements of Master of Science in Education.

8-22-84
Date Thesis Accepted

ABSTRACT

The purpose of this descriptive study was to analyze changes in twelve physical fitness parameters following a two school year physical fitness/physical education program for moderately mentally retarded adolescents. Laboratory pre- and post-test assessments were made of height, weight, resting heart rate, systolic and diastolic blood pressure, vital capacity, forced expiratory volume, hand steadiness, hand-eye coordination, flexibility, grip strength, triceps and abdominal skin-fold thicknesses, and aerobic capacity.

Forty-two subjects, aged 12 to 21, participated in the program which consisted of aerobic rhythms, dance, and track for physical fitness classes and basic sport skills and games for physical education classes. Group one, 21 subjects aged 12 to 18 participated in the combined program for two school years. Group two, 21 subjects aged 19 to 21, participated in the combined program the first school year and only the physical education program the second year.

Means and standard deviations were calculated to describe the data. For group one, health-related improvements were noted for resting heart rate, vital

capacity, hand steadiness, hand-eye coordination, flexibility, grip strength, and both triceps and abdominal skinfold thicknesses. Improvements were not demonstrated for forced expiratory volume or aerobic capacity. Increases for systolic and diastolic blood pressure, height, and weight were considered to be the result of growth and development. For group two, health-related improvements were noted for resting heart rate, vital capacity, forced expiratory volume, grip strength, hand steadiness, hand-eye coordination, flexibility, and triceps skinfold thickness. Increases for systolic and diastolic blood pressure were considered to be the result of growth and development. The slight increase for weight was considered to be a maintenance of the pre-test score. Improvements were not demonstrated for aerobic capacity and there was an increase for abdominal skinfold thickness.

ACKNOWLEDGEMENTS

The writer wishes to express her gratitude to the special persons who guided and encouraged her efforts in this endeavor. She sends a special thankyou to her advisor, Dr. Janet Fisher, who tirelessly gave of her knowledge and expertise of the mentally retarded. She is indebted to committee members Dr. Carole Zebas and Dr. Phil Huntsinger, whose guidance aided the completion of this investigation.

The writer wishes to express loving acknowledgement and thanks for the patience, encouragement, assistance, and devotion of her husband Bob, without whose love and support this study would not have been possible. Thanks also go to her children, Melanie and Eric, who lent their help and understanding. Finally, this thesis is dedicated to the memory of her mother, Marion Wilson Birch, who continues to be an inspiration.

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THE PROBLEM

Introduction

Two trends in the last thirty years have initiated positive changes for the mentally handicapped population. One trend has been the inception of the concept of "normalization" which has created an increased awareness of the needs and the rights of the handicapped and the subsequent beginning of programs designed to mainstream mentally retarded persons into the community (52, 5). The other trend has been the emphasis on the attainment of physical fitness which continues to become increasingly valued by greater numbers and ages of people (61).

Numerous researchers have shown that mentally retarded persons exhibit lower levels of physical fitness than do their peers having normal intellect (32, 43, 53, 58, 70). Because of impaired mental functioning and often underdeveloped physical abilities, mentally retarded individuals have been excluded from programs designed to increase levels of physical fitness (5, 24). Since this is an era of health and humanism, it is evident that increased attention needs to be directed towards research in assessing the parameters of physical fitness, developing appropriate activities, and devising successful instruct-

ional techniques to meet the challenge of assisting mentally retarded persons to achieve their potential (62).

Mentally retarded individuals can make gains on scores achieved on fitness parameters after being involved in programs which are systematic and progressive in nature (12, 14, 33). Ongoing programs are essential if the mentally retarded are to continue to develop and maintain acceptable levels of physical fitness. The results of many research studies have demonstrated positive results of short term physical fitness programs which ranged from four to fifteen weeks in length (5, 13, 14, 19, 80). Most researchers have utilized field tests for the assessment of physical fitness parameters (33, 51, 80). The investigator of this study evaluated the effectiveness of a two academic school year program of physical fitness and physical education for adolescent mentally retarded individuals, and utilized laboratory tests to pre- and post-test twelve parameters of physical fitness.

Purpose of Study

The purpose of this descriptive study was to descriptively analyze changes in the results of pre- and post-test assessments of twelve physical fitness parameters for 42 moderately mentally retarded adolescents who were involved in a physical fitness/physical

education program.

Specifically, the purpose was to administer laboratory tests to assess the following parameters: height, weight, resting heart rate, systolic and diastolic blood pressure, vital capacity, forced expiratory volume, hand steadiness, hand-eye coordination, grip strength, flexibility, triceps and abdominal skinfold measurements, and aerobic capacity. The investigator compared the means of the pre- and the post-test assessment scores of groups one and two individually to determine if changes had occurred in each parameter investigated.

Scope of the Study

Forty-two adolescents ranging in age from 12 to 21 years, 25 males and 17 females, participated in this study. All were students in the developmentally delayed program of the Shawnee Mission, Kansas School District #512 in Overland Park, Kansas. All subjects participated in a physical fitness program, which included fitness-oriented activities in aerobic rhythms, dance, and track. Group one participated for two academic school years, eight months per year, and group two participated for only one year. Both groups participated in the physical education program throughout the study. All subjects had physical education classes two times a week the first

year of the study. The second year, group one had physical education classes three times a week and group two, one to two times a week. Eight of this group participated twice a week, eleven, once a week, and one did not participate because of a scheduling conflict.

The data were collected for the pre-test in the fall of 1982 and for the post-test in the spring of 1984. All of the subjects were measured for height and weight and monitored for pulse and blood pressure. Laboratory tests were done to assess maximal oxygen uptake, vital capacity, forced expiratory volume, hand steadiness, hand-eye coordination, grip strength, flexibility, and skinfold thickness by staff from the Fitness Clinic at the University of Kansas.

Assumptions

The following assumptions were made regarding this study:

1. Each subject performed to the best of his/her ability.
2. The examiners encouraged each subject equally.
3. The order of administration of items of the post-test varied from that of the pre-test but did not affect results.
4. The subjects who participated in this study were representative of the moderately mentally retarded adolescent population.
5. Having different examiners administer the pre- and

post-tests did not adversely affect the results.

6. All subjects who were on prescribed medications had taken them regularly throughout the study.

Limitations

The researcher has recognized the following to be limitations of this study.

1. There was no control group.
2. Post-testing was not possible at the end of the first school year of the study to assess short term effects of the study.
3. The bicycle ergometer was used for testing in lieu of the treadmill because of portability.

Significance of Study

Research has proved that there is a positive relationship of planned physical fitness programs to gains in parameters of physical fitness. Studies have shown that mentally retarded persons do have deficits on scores of tests evaluating fitness parameters but that remediation programs positively influence gains in this area (5, 14, 15, 33). While there was controversy in the literature over whether or not I.Q. scores could be improved through better physical conditioning, there was a general agreement that scores achieved on fitness tests could be improved through systematic

physical fitness programming. (12, 13, 14, 19, 80)

The importance of this research was the examination of an ongoing program of physical fitness activities for mentally retarded adolescents. The focal point was the comparison of the means of pre- and post-test assessments after a two school term physical fitness/physical education program and the delineation of activities and effective instructional techniques to determine the program's effectiveness as suggested by Moon (62).

Due to a limited amount of information available of the types of effective activities appropriate for the adolescent mentally retarded population, the researcher was interested in evaluating an aerobic rhythms, dance, and track-oriented program for changes in physical fitness measurements. Research has proved that programs geared to the specific interests of normal adolescents show a positive correlation to gains in physical fitness parameters of adolescents with mental retardation. The ultimate goal of this physical fitness/physical education program was for the mentally retarded students to improve levels of physical fitness and to become involved with activities which promote and maintain lifetime fitness.

Definition of Terms

The investigator referred to the following terms

throughout this study:

Mental retardation (MR) is defined as intellectual functioning which is significantly below average (I.Q. 70 or below); which occurs along with the inability to successfully adapt to the environment; and which begins during the developmental period of life, which is prior to adulthood.

Physical fitness is the body's ability to incorporate the components of muscular strength, muscular endurance, flexibility, and cardiorespiratory endurance to perform tasks of daily living, participate in recreational activities, and have enough reserve energy to meet unforeseen emergencies.

Systolic blood pressure (or maximal blood pressure) is the pressure produced during the contraction of the heart called systole.

Diastolic blood pressure (or minimal blood pressure) is the pressure present during the rest period of the heart called diastole.

Vital capacity (V.C.) is the amount of air taken into the lungs with a single breath.

Forced expiratory volume (F.E.V.) is a measure taken the first second of one's maximal expiration and indicates the functionality of the muscles of expiration as well as the efficiency of the bronchopulmonary system.

Maximum oxygen intake (or aerobic capacity) is the summary of the efficiency of the oxygen transport system and the greatest amount of oxygen that one can utilize during the most strenuous exercise (68).

Astrand predicted max is the laboratory measurement of cardiorespiratory endurance which measures the amount of oxygen supplied per minute in maximal exercise (30).

Astrand recovery is a measure of how rapidly the heart beat returns to normal after exercise (30).

Grip strength is a measure of the strength of the hand and a rough screening device indicating overall body strength.

Eye-hand coordination is the ability to produce an efficient motor response by moving the hand when guided by information received by the eyes (56).

Flexibility is the range of motion of a joint of the body.

Skinfold thickness is a measurement of body fat.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Assisting the mentally retarded to achieve acceptable levels of physical fitness requires accurate knowledge and understanding of the characteristics of the population and the principles involved in the domain of physical fitness. It was the purpose of this review to study the mental, physical, and motor characteristics of mentally retarded individuals; to explore strategies for achieving physical fitness in the mentally retarded; and to investigate research studies that have referred to mental retardation and physical fitness.

Mental Retardation

The treatment of the mentally retarded population has grown from misunderstanding, neglect and abuse to a multifaceted branch of knowledge, attitudes, and programs. Changes in terminology over the years reflect the ongoing trend of an ever increasing knowledge base of the etiology, diagnosis, characteristics, and needs of this segment of the population. Krishef (50) has capsulized the derivation of terminology used by psychologists in delineating various degrees of mental retardation. In 1848, Samuel Howe used the term "feebleminded" to describe persons

ranging from his term "simpletons", or persons who could perform simple reasoning, to "fools", or persons who were not as capable of reasoning, to "idiots", persons he considered the least capable of reasoning. In 1877, W.W. Ireland utilized the terms "idiocy" and "imbecile" to describe varying degrees of mental retardation. Henry Goddard in 1914 also utilized the term "feeble-minded" and included as categories under this heading, "morons", who were found to have I.Q.'s ranging from 75 to 50; "imbeciles", who had I.Q.'s ranging from 49 to 25; and "idiots", who had I.Q.'s below 25.

Edgar Doll (27) in 1941 identified six components which had to be present for a person to be labeled "mentally retarded". They included "social incompetence, or an inability to manage one's own affairs; mental subnormality which occurs at birth or at an early age, and which is present at maturity; is of constitutional origin through heredity or disease and is essentially incurable."

A.F. Tredgold in 1947 identified the causative factors of mental retardation to be either intrinsic (primary amentia) or extrinsic (secondary amentia). The terminology continued in a positive vein in 1954 when the World Health Organization recommended that the term "mental subnormality" be utilized to include mental retardation, meaning those who were subnormal due to

educational or social incompetence, and mental deficiency, or meaning those who were subnormal due to physical or organic factors. Today, all three of these terms, mental subnormality, mental retardation, and mental deficiency are used because of the lack of universal acceptance of only one term. (50)

In 1983, the American Association on Mental Deficiency (AAMD) revised the definition to read:

> Mental retardation refers to significantly subaverage general intellectual functioning resulting in or associated with concurrent impairments in adaptive behavior, and manifested during the developmental period.

Specifically this means that to be classified as mentally retarded, the individual must have: 1) an I.Q. score which is greater than two standard deviations below the mean norm; 2) an impaired ability to adapt to his/her environment; and 3) become mentally retarded before adulthood as a result of brain damage, a degenerative condition of the central nervous system, or the result of cultural-familial retardation, now known as "retardation associated with sociocultural or psychosocial disadvantage", which refers to the importance of life with regard to the "nature-nurture equation". (38)

Vast insight has occurred in the last thirty-four years in the history of the mentally retarded. An advocate group, the National Association for Retarded Children was formed in 1950 which paved the way for

increased interest, research, programs, education and the laws. With the advent of the Congressional instigated public law P.L. 94-142, there has been an even greater involvement by educators, lawmakers, parents and communities to provide services to the mentally retarded to help them live as productive and enjoyable lives as possible. Each aspect of their lives has been studied to help accomplish this goal. Understanding the mental, physical, and motor characteristics of the mentally retarded provides a sound basis for planning and executing a successful program for achieving increased levels of physical fitness parameters.

Mental Characteristics of the Mentally Retarded

The mental characteristics of the mentally retarded (MR) population vary as widely as they do in the normal population. Considerations for educational programming need to include I.Q. scores and abilities, comprehension levels, learning strategies, and motivation levels.

I.Q. of the mentally retarded. Included in the AAMD definition of mental retardation is the clause "subaverage general intellectual functioning" (38) which refers to a significant deviation below the mean norm as assessed by one or more of the standardized tests which were developed for that purpose. A significant amount

is two standard deviations or more below the normal mean which, on the Stanford-Binet Intelligence Scale, is a score of 68 and which on the Wechsler Intelligence Scale (WISC-R), is a score of 70. (9) On the WISC-R, the mean norm is a score of 100 with the standard deviation being 15 and on the Stanford-Binet, the mean norm is also a score of 100 but the standard deviation is 16.

Approximately two and one-half to three percent of the population fall into the category of mental retardation which accounts for several million persons living in this country. To further help identify the characteristics and needs of persons with an I.Q. of below 70, this broad category, outlined by Fait (30) has been subdivided thus:

AAMD Classification:	Stanford-Binet I.Q.:	WISC-R I.Q.:
Mildly Retarded	68-52	69-55
Moderately "	51-36	54-40
Severely "	35-20	39-25
Profoundly "	19-0	24-0

Differing somewhat from the above categorization is one which is widely endorsed by state special education regulations: EMR, 75-50 I.Q.; TMR, 49-30 I.Q.; and Totally Dependent, 29 and below I.Q. (30). Each state has the option of establishing its own classification for educational placement purposes.

The State of Kansas follows the guidelines outlined by the AAMD when considering placement of students into EMR or TMR classrooms. Those individuals who are classified mildly mentally retarded are considered for semi-independent level placement and those classified moderately mentally retarded are considered for semi-dependent level placement. The goal for placement is to increase independent functioning and the amount of support services required depends upon the dependency levels which range from independent, semi-independent, dependent, to totally dependent. (81)

In the Shawnee Mission School District #512, a profile is drawn from the results of tests measuring intelligence, adaptive behavior, and language skills. The purpose of this is to depict an over-all range of functioning abilities for educational placement in one of the classrooms for the mentally retarded. Generally, the EMR classification includes those students having I.Q. scores ranging from 70 to 50; the TMR classification includes those with I.Q. scores ranging from 40 to 30; and the severe category includes those with I.Q. scores of 29 and below. (See Appendix A.)

The P.L. 94-142 allows flexibility in the educational placement of children and the categories serve as a suggested level and or type of services which are required (7). Individual needs and specificity should

be considered over planning for general needs of the group. Each student placed in the special education setting (which includes the categories of the gifted, learning disabled, personal and social adjustment, mentally retarded, multiply handicapped, severely multiply handicapped, speech disordered, deaf and blind) must have a yearly individualized education plan (I.E.P.). The written plan contains broad goals and specific objectives matched to students' weaknesses and serves as a guidepost to educators so that an appropriate educational program to meet individual needs can be developed.

Comprehension of the mentally retarded. Generally, several mental characteristics, based on comprehension ability, are evident in each of the educational categories. Mildly retarded individuals can usually achieve a maximum of a sixth grade education level and can be taught the basics of academic subjects. (74) The mental age expectancy ranges from eight to twelve years (16). Social adjustment can usually be made and the individual shows the potential for competitive employment in the community. The moderately to severely retarded persons need basic skills which concentrate in the areas of vocational and self-help skills. These persons can be expected to achieve at a second grade education level and

show success in social adjustment and progress towards economic usefulness. (74) The mental age expectancy ranges from three to seven years (16). The custodial or severely mentally retarded person most generally is totally dependent and requires supervision throughout life (74). The mental age expectancy ranges from zero to three years (16).

I.Q. scores are frequently converted into mental age (M.A.) scores to further facilitate understanding mental abilities. Piaget, as cited by Payne (65), suggested that all individuals progressed through certain stages as he or she developed and added or expanded to a repertoire of skills. He identified four stages with the corresponding mental age and characteristics of that stage.

> The sensorimotor stage (M.A.=0-2 years) is concerned with perceptual organization, the origins of intelligence and the infant's methods of dealing with simple behavior.
> The pre-operational stage (M.A.=2-7 years) is when the child begins to develop the ability to use symbols first as objects in his world and later to use words and numbers.
> The age of concrete operations (M.A.=7-11 years) furthers the child's abilities to order and classify things and is generally limited to the learning of a concrete, non-abstract nature.
> The stage of formal thought (M.A.=11 or 12 and older) encompasses the abilities needed to deal with the abstract, with hypothetical thought.

Knowing the M.A. level of the EMR-TMR students enables the educator to understand the comprehension ability of each student. Inhelder in 1968 reported that

EMR students do not reach the level of concrete operations until mid-adolescence and that the mentally retarded do not go beyond the stage of concrete operations. It is also likely that the mentally retarded person retains traces from earlier stages and will be more prone to return to earlier levels of thought. (65)

Learning of the mentally retarded. According to Seaman (74), the mentally retarded child exhibits a decreased learning ability, has a short attention span, poor short term memory, and is delayed with regard to mastering tasks. Language skills are delayed, often are deficient, and may be depressed. The severity of the retardation influences all areas of learning abilities that the retarded individual displays.

Normal learners and retarded learners have been compared as to their performance differences. Significant discrepancies in the areas of long term memory, incidental learning, operant conditioning, imitation, and learning of the attention process have not been shown. Appropriate programming for the retarded can improve short term memory, attention, and learning set. Although the retarded display deficiencies in the Piagetian stages of cognitive development, careful planning and instruction can help minimize these. (65)

The three laws of learning as stated by E.L.

Thorndike in 1928 apply to all learners. They are: 1) the law of effect, 2) the law of frequency, and 3) the law of readiness. (65) It is important that the educator interpret and implement the theory specifically for the abilities of the learners. Retarded children require more opportunities than normal children as a general rule but both groups require readiness and both will benefit if they are aware of the success of their prior accomplishments in learning which is the effect factor. Other factors have great influence in facilitating the learning of the retarded, including the amount and type of practice, the meaningfulness of the activity, and the active or passive nature of the task. (74)

Motivation of the mentally retarded. It is important to the mentally retarded as well as the normal learner to be motivated in order for maximum learning to take place in any given situation. Motivation goes beyond cognitive abilities and is a universal factor in influencing success or failure. Retarded individuals tend to be motivated more by the fear of failure than by the achievement of success and will attempt to go for smaller steps of success than will the normal learner. They are more motivated by experiencing the meaning of success and will be more likely to attempt increasingly difficult tasks if given the opportunity to re-experience

the last previous success just prior to going on to the task at hand. (65)

Another area which should be considered is the tendency of the mentally retarded individual towards being outerdirected, relying on cues and judgments of others. Educators who provide frequent experiences with successes among their retarded students will assist them in achieving more success, motivation, self-reliance, trust in their own judgments and a desire to accomplish more. (65)

The label for the satisfaction derived from the successful experience is "effectance". Educational programming which plans for increments commensurate with the retarded student's abilities will avoid the frustration and failure outcomes when the labor of the task is unrealistic. Individuals who are pushed beyond their abilities exhibit lack of motivation and lowered levels of effectance. Since there is a lack of success, the individual finds little cause to continue on since the pleasure of success was absent. (73)

Adaptive behavior of the mentally retarded. The AAMD definition of mental retardation includes the reference of the individual exhibiting deficits in adaptive behavior. This is the extent to which a person is able to adapt socially and function independently. How the

individual copes with his or her immediate environment is critical. (73)

There are three facets which are considered important when assessing strengths and weaknesses in the range of adaptive behavior. First is independent functioning which is an individual's ability to successfully perform tasks commensurate with his abilities and anticipated by the community. Second is personal responsibility which is considered to be the ability by the individual to take charge of his own behavior and assume the responsibility for the results of his or her actions. It also includes wanting to involve one's self in those activities for which he or she is capable. Third is social responsibility which dictates adherence to social norms of his or her peer group. Other expectations are social adjustment, a measure of emotional maturity, and a responsibility to the civic community. All of these are important for the individual to possess to progress towards independence financially. (73)

Inadequacies in adaptive behavior may be the result of developmental delays, environmental or learning deprivation or deficits in social skills. Since adaptive behaviors include motor skills, improving motor and physical fitness skills facilitates the individual's ability to interact with the environment. (21)

Physical Characteristics of the Mentally Retarded

It is obvious that many mentally retarded persons differ from the normal population in appearance and mannerisms associated with movement. Educators need to be cognizant of the common characteristics but search for the individual qualities this population presents. (30)

Appearance of the mentally retarded. Physically, there are a wide variety of characteristics displayed by the mentally retarded individual. Retarded persons do not necessarily have all of the following descriptions but the composite is representative and applicable to the majority of the population. Height is usually less than normal; many retardates tend to be overweight; there are more visual and auditory impairments; there is a higher incidence than in the normal population of multihandicapping conditions because of the organic etiology of the retardation in a vast majority of cases; posture is often poor; and some are prone to being easily fatigued. (52)

Many of the syndromes associated with mental retardation include unique physical characteristics. One example is Down's Syndrome in which the individuals have such characteristics as eyes which appear to slant upwards; a nose which tends to have a flat look; a smaller ear and head size; a protruding tongue; a small mouth; abnormal teeth; small, square hands; hair that is

straight and fine; and speech which is often impaired. In addition, these individuals have a tendency to be overweight. (30)

Medical conditions or impairments of the mentally retarded. The association of sensory and physical impairment along with the retardation increases in prevalence with moderately, severely, and profoundly retarded individuals when they are compared to those persons who are mildly retarded. Speech or communication disorders occur in approximately one-half of the retarded population and concurrent emotional problems are prevalent in a third of the group. These conditions increase the lowered ability to adapt to the environment, making it extremely important that appropriate medical care be sought for each deficit area that the individual presents so that he or she can be assisted to function to the best of his or her ability. (38) (60)

Many mentally retarded individuals display altered physical characteristics which have resulted from a genetic cause of the retardation or a medically handicapping condition. Damage to the nervous, muscular, or skeletal systems either intrinsically or extrinsically can cause a variety of abnormal characteristics. (74)

Down's Syndrome individuals are prone to upper respiratory infections and frequently have associated

heart anomalies (30). Concomitant medical conditions also occasionally include gastrointestinal defects and hearing impairments. Other medically handicapping conditions are associated with this and other syndromes and deem it necessary for the physical educator to be aware of them and adapt instruction when necessary. Medical primers are a valuable resource for reference and planning for individual health concerns. (6) (59)

The legal classification of multihandicapped or severely handicapped is defined by P.L. 94-142 as:

> Multihandicapped means concomitant impairments (such as mentally retarded-blind, mentally retarded-orthopedically impaired), the combination of which causes such severe educational problems that they cannot be accommodated in special education programs solely for one of the impairments. The term does not include deaf-blind children. (74)

The challenge for educators to assist the multihandicapped student is great due to the extent of physical and mental impairment. These students have the same rights and needs as all citizens but require unique instructional methods and programs to meet these needs (30). Individualized activities which are matched to physical deficits and which are appropriate to intellectual functioning are necessary (62).

Motor Characteristics of the Mentally Retarded

Motor characteristics of retarded children are coupled with physical characteristics. Retardates show

awkward movement ability; are clumsy; have difficulty in movement control; have slow reaction time; poor muscle tone, fine motor control, balance, body awareness, and spatial, temporal awareness. (60) (74) Many retarded persons are poorly coordinated and exhibit an awkward, shuffling gait. There is a great need to improve motor abilities, body mechanics, and physical fitness. According to studies by Dobbins (25) (26), EMR and TMR students lag two to four years behind their normal peers in motor performance tasks. (30) Litton identified a lag of two to five years in motor performance abilities when compared to a normal individual; deficits in perceptual-motor abilities; similar motor organization abilities of retardates and normals; and a significant relationship between I.Q. scores and levels of physical fitness (52).

Mentally retarded individuals exhibit a delay in developing motor patterns and movement abilities. The skill levels they attain are often less than those of the normal individual but the capabilities are present. (74) The problem of delayed physical and motor development is an ongoing concern of physical educators. Handicapped children need to improve motor fitness abilities to enjoy success in meeting the requirements of movement activities necessary for everyday living and for participating in sport skills. They need the strength, flexibility, and endurance which is necessary to effectively and efficiently

perform movement activities. The challenge to educators is to help the handicapped meet these prerequisites to adapt to the muscular demands. (21)

Adaptive physical education which teaches physical fitness to special populations, encourages the successful participation in sports and recreational activities and encourages movement confidence. (4) (37) It makes possible the implementation of the individualized education programs required by P.L. 94-142 in the area of movement experiences for handicapped students. The new term "special physical education" stresses the value of modifying activities while individualizing them to match the special needs of handicapped individuals. (30)

Physical Fitness

Physical fitness may be defined as a balance of adequate performance levels of muscular strength and endurance, power, cardiorespiratory endurance, flexibility, and body composition to create a state of dynamic health (39). The inclusion of good nutrition, adequate rest, relaxation activities, tension control, and physical fitness activities in an individual's lifestyle are the basics of wellness. The emphasis on physical fitness is strong as was shown by a survey which indicated that 90% of Americans believed that involvement in physical activity on a regular basis is important. Many individ-

uals have become aware that it is important at every age to be active and in good shape. (18) Physical fitness has become a sought-after value and even considered to be a status symbol.

History of Physical Fitness

For centuries, tests have been performed to evaluate physical fitness. Testing done in the United States dates back to 1880 but it was not until 1954 when the testing results of Kraus and Hirshland (49) were published that the great concern developed for the fitness status of American children and youth. Dwight David Eisenhower formed the President's Council of Youth Fitness in an attempt to assess fitness parameters and increase levels of physical fitness. (18)

Physical fitness boom. Knowledge of the importance of physical fitness began centuries ago but has made a phenomenal growth in the last thirty years. The formation of the President's Council of Youth Fitness began the sports boom. In 1961, approximately 28 million persons in America reported that they exercised daily and by 1977, the Gallup poll reported that the figure jumped to 55 million which was almost half of the adult population. (61) The upper age of the post-World War II "baby boom" was fifteen years of age in 1961 and a large proportion of today's population was educated to value

fitness through the President's Council on Fitness. This continues to grow as more and more research is conducted proving the beneficial aspects of physical fitness and as more and more segments of society become involved.

Businesses recognized the positive financial prospects of having employees who were physically fit which rendered them to be more productive, happier, and healthier. By 1978, at least three hundred of the largest U.S. corporations had instituted their own fitness programs for employees. (61)

Medical researchers reported improvements in the physiological parameters of heart rates, blood pressure, body fat percentage, levels of stress, and blood levels of lipids and cholesterol, all of which were lowered through fitness. Exercise improves cardiac and respiratory functions, improves muscle strength which benefits the skeletal structure and usually reduces joint stiffness through increased flexibility. The appestat mechanism was said to operate more effectively to suppress the appetite due to the energy output required to strengthen muscles. Other improvements have been noted in the treatment of the disorders of stomach acidity, mental depression, diabetes, and glaucoma. (3)

Wellness characteristics are found in persons committed to physical fitness and include stress management, increased self-confidence, effective interpersonal

communication, better nutrition, and decreased risk behaviors (3). For those individuals who honestly strive for them, "fulfillment, pleasure, recognition, a sense of personal value, a sense of worth, the enjoyment of loving and being loved are not optional, they are the facts of life" (36).

The physical fitness boom has influenced the lives of most Americans. Research has proved that the quality of life is vastly improved with the inclusion of a physical fitness program in the lives of every individual. Most Americans have the opportunity to learn of this importance in school physical education programs and voluntarily participate in the program of his or her choice to improve fitness parameters and become physically fit. Mentally retarded persons need and deserve to comprehend the values of physical fitness and to develop the same levels of physical fitness in order to enjoy health and wellness. (52)

History of adapted physical fitness. Physical activity programs for handicapped individuals date back to 2700 B.C. when Chinese cultures utilized therapeutic and preventive exercise and medical gymnastics to treat illnesses and physical disorders. The development of adaptive physical education was influenced by European cultures through the use of medical gymnastics. (74) In Sweden, Per Henrick Ling in 1804 introduced a system of

calisthenics which included specific body movements designed to improve posture and create a healthier body (30). He emphasized the importance of individualizing exercises and stressed that educators should acquire an accurate knowledge of anatomy and the physiology of exercise and to achieve the aim of "physical harmony and perfection, the oneness of the human organism, and the harmony between the mind and the body" (72).

In the United States, the Swedish pedagogical gymnastics was promoted by Hartvig Nissen, who introduced the concept in the Franklin School in Washington, D.C. and at Johns Hopkins University. His preparation and efforts paved the way for an even greater impetus in the field of medical gymnastics, the work of Baron Nils Posse. He expanded the educational effort to medical circles, hundreds of teachers and integrated the public schools of Boston with the method. (72) This movement continued to grow and public schools used these programs extensively because of the beneficial effects of calisthenics (30). This continued until after World War I when the needs of the returning war veterans led to a change of programming. Along with successful physical and corrective therapy evolved the pleasure associated with physical activities and handicapped individuals. This era lasted from the 1920's to the 1950's and the corrective physical education developed separately from physical education. (74)

In 1952, the American Alliance of Physical Education and Recreation (AAPER) clarified the scope of adaptive education and defined it as:

> A diversified program of developmental activities, games, sports and rhythms, suited to the interests, capabilities, and limitations of students with disabilities who may not safely or successfully engage in unrestricted participation in the vigorous activities of the general physical education program. (74)

The important emphases were that programming for the handicapped should reflect the curriculum and philosophy of physical education for the non-handicapped and that the inclusive activities be diversified. To be included were developmental activities designed to improve movement patterns, muscular strength, flexibility, motor ability, muscular endurance, and perceptual-motor skills. (74)

Fitness Goals for the Nation

Inherent in the widespread interest and research in the field of physical fitness was an ongoing concern by experts that Americans of all ages could make considerable gains in health if appropriate action was initiated. In 1979, the first U.S. Surgeon General's Report on Health Promotion, Healthy People, targeted fifteen priority areas, including physical fitness and exercise, for which goals were to be developed to be met by 1990. Committees were established to study the nature and scope of each problem area; recommend dissemination of the information;

observe and monitor the progress; formulate objectives; and collect the data. (83)

The Work Group on Physical Fitness and Exercise determined that, while Americans had increased their knowledge and participation in appropriate fitness programs, the trend needed to be increased. The 1977 Gallup Poll which had reported that 50% of Americans exercised regularly was estimated by the Work Group to be closer to 35% of adults aged 18 to 65. For those adults over 65, 36% reported in 1975 that they took regular walks. Only about one-third of children from the ages of ten to seventeen were reported to be involved in daily school physical education programs. Businesses which offered in-house physical fitness programs totaled only two and a half percent of those companies with 500 employees or more. In addition, several groups were shown to demonstrate little participation in activities of physical fitness including the physically and mentally handicapped. (83)

The nature of the problem and objectives written by the Work Group of Physical Fitness and Exercise to improve the health status of the nation included:

> 1. Improve health status.
> Increased levels of physical fitness may contribute to reduced heart and lung disease, possibly reduced injuries among the elderly, and more broadly an enhanced sense of well-being which may reinforce positive health behaviors in other areas.

2. Reduced risk factors.
By 1990, the proportion of children and adolescents participating in appropriate physical activities should be greater than 90%.
By 1990, the proportion of adults 18-65 participating regularly in vigorous exercise should be greater than 60%.
By 1990, 50% of the adults over 65 should be engaging in appropriate physical activities.

3. Increased public and professional awareness.

4. Improved services and protection.
By 1990, the percentage of companies of 500 or more employees offering in-house fitness programs should increase to greater than 25%.

5. Improve surveillance and evaluation systems. (83)

The implication for educators is to work towards achieving the above goals both personally and professionally. It is important to understand both the population of students and fitness clients and all of the parameters of physical fitness to do so.

Components of Physical Fitness

Whereas the exact definition of physical fitness varies from author to author in the literature, there is a consensus of opinion as to the components included. According to Seaman, Fait, and Auxter, the physiological components of muscular strength, muscular endurance, flexibility, and cardiorespiratory endurance are those associated with physical fitness (5, 30, 74). One definition describes physical fitness as "the functional capacity of the various systems of the body that support exercise, specifically muscular strength, muscular

endurance, flexibility, and cardiorespiratory endurance." Ideally, the four components of physical fitness are positively correlated to the body in health and wellness which enables the individual to achieve his potential. (30) The development of minimum levels of all of these components is an important prerequisite for the performance of activities associated with daily living, school, work, sports, and recreation (18). The continued development of all of the components of physical fitness results in an increased work capacity, an improved ability to participate in recreational or sports activities, and increased self-esteem and movement confidence (4, 5).

Muscular strength. This is defined as the ability of an individual to exert his or her muscles to effectively overcome or withstand resistance. The development of isotonic strength is particularly important for handicapped children as it relates to the activities of daily living such as moving the body, raising objects or transfering items from place to place. (18, 21)

Muscular endurance. This applies to the individual's ability to participate in uninterrupted muscle activity at an even performance level. Endurance is critical for the support of good posture basically and then for the ability to perform motor skills and sports-

related skills. (18, 21) Improving this component of physical fitness is especially important for handicapped individuals to enable them to perform efficiently when numerous repetitions of a task are required. Endurance is necessary for operating a wheelchair, using a walker, performing a job at a sheltered workshop, or attending to personal care needs.

Cardiovascular endurance. This concerns the ability of the individual to consume oxygen during physical activity with numerous repetitions. It is a requirement for the participation in sports and recreational activities. (18, 28) Characteristics of improved cardiorespiratory endurance include: 1) the ability to continue tasks which are physically demanding; 2) a decrease in the heart recovery time after exercise; 3) a lowered heart rate during exercise; 4) a decreased resting heart rate; 5) a faster return to a normal blood pressure after exercise; 6) the ability to perform more work prior to becoming exhausted; and 7) a higher maximal oxygen consumption. Improvement in these areas would benefit any individual, handicapped or normal. (30, 64)

Flexibility. This is defined as the ability to move the joints of the body through a full range of motion or how body parts move in relationship to other

body parts. It is essential for efficient movement, for the performance of tasks of daily living, for the execution of motor skills, and for the maintenance of posture and body alignment. (18, 21)

When a handicapped individual presents a condition in which the potential for total body movement is restricted, it would be advantageous to develop a full range of motion in each functional joint. Since occasional concomitant neuromuscular diseases often interfere with movement potential, flexibility exercises may retard this loss in range of motion. (30)

Testing for Physical Fitness

To assess physical fitness, a comprehensive evaluation should be completed. All components should be tested to establish a current level of functioning, the results of tests analyzed, and activity prescriptions written to remediate specific deficiencies. (4, 67) Included in the exercise prescription should be the type of activity needed, the frequency, the duration, and the intensity that the exercise should be performed to be beneficial (30, 67).

Considerations for choosing a fitness test. Physical educators can choose between laboratory measurements and field tests to assess physical fitness parameters. There are advantages and disadvantages to

each and all of them are considerations for the selection of a method for testing.

Laboratory tests provide the most accurate measures of physical fitness. Subjects tend to try harder and perform better due to the sophistication of the equipment and the nature of the setting. The measurement is objective. However, it is more costly; it is more time-consuming as testing must be done on an individual basis; and at this time, there are virtually no norms on mentally retarded individuals with most of the laboratory measurements. Norms must be established within the group itself for most tests.

According to Seaman (74), there are several advantages and similarities of the field type of physical fitness tests, including test-retest reliability; the objectivity of scoring the results; the inclusion of only a few items to measure the components which are considered to be defined as physical fitness; these tests tend to be normed on large numbers of subjects; they are group tests and therefore time-efficient; and they expect a concerted effort by the subjects because they assume that the students understand the expectation. Field tests are very low in cost and do not require expensive equipment. Some have excellent guidelines for reinforcing performance and offer incentives to students for improving physical fitness (53).

Tests should be selected which are appropriate to the physical and mental abilities of the subjects and should include all of the parameters considered essential to physical fitness. In addition, there are tests available which assess parameters other than physical fitness including perceptual motor abilities and motor fitness (21, 30).

Tests appropriate for the mentally retarded. Included in the available instruments for testing the parameters of physical fitness in mentally retarded children and adolescents are the following instruments and the components they test:

1. The AAHPER Special Fitness Test for Mildly Retarded Persons (1)

Arm and shoulder girdle strength: flexed arm hang

Efficiency of abdominal and hip flexor muscles: sit-ups

Speed and agility: shuttle run

Explosive muscular power: standing long jump

Speed: 50-yard dash

Skill and coordination: softball throw for distance

Cardiovascular efficiency: 300-yard walk-run

2. The Motor Fitness Test for the Moderately Mentally Retarded (45)

Arm and shoulder girdle strength: flexed arm hang

Efficiency of abdominal and hip flexor muscles: sit-ups in 30-seconds

Muscular power: standing long jump

Muscular power and coordination: softball throw for distance

Speed: 50-yard dash

Flexibility: sitting bob and reach

Developmental skill: hopping, skipping, tumbling progression, target throw

Cardiovascular efficiency: 300-yard walk-run

3. The Fait Physical Fitness Battery for Mentally Retarded Children (84)

Speed: 25-yard run

Static muscular endurance: bent-arm hang

Dynamic muscular endurance: leg lift

Static balance: balance

Agility: thrusts

Cardiorespiratory endurance: 300-yard run-walk

4. Hayden Physical Fitness Test for the Mentally Retarded (84)

Strength and endurance: hang for time

Power, strength and coordination: medicine ball throw

Flexibility and strength: back extension flexibility

Power: vertical jump

Flexibility: floor touch

Organic fitness: 300-yard run

Strategies for Improving Physical Fitness

Teaching physical fitness to mentally retarded adolescents requires careful planning and execution. Physical educators must use instructional techniques geared for the cognitive abilities of the students and address all of the accompanying physical limitations. Considerations need to be made for including appropriate and enjoyable activities, utilizing effective teaching methods, and providing incentives for the desired outcome of improved fitness levels. (30, 74)

Planning Activities for the Mentally Retarded

Once fitness parameter deficiencies have been delineated, activities can be initiated for remediation. Activities which are designed to remediate any or all of the parameters of flexibility, muscular strength, endurance, or cardiovascular endurance are called horizontal skill sequences because they are considered independently for remediation. Vertical sequences are those activities which attempt to build upon skill attainment within a parameter domain. (62) Under each deficiency listed in the horizontal skill sequences, the educational plan should list activities which are specifically designed to remediate that particular area.

Developmental activities to improve all of the parameters of physical fitness, movement activities, perceptual-motor function, and motor skills is a goal of adaptive physical education (74). There is a wide variety of activities to choose from to develop and enhance all of the parameters.

Flexibility activities for the mentally retarded. Included in the wide array of activities which could be utilized to improve the flexibility component are aerobic dance (5, 22), static stretching (53), floor exercises (74), and combinations of the above. Exercises should be performed just to the point of discomfort but not beyond. This is important for the activity to be beneficial but not harmful. (63) Mentally retarded individuals need to be shown exactly how to do the exercise, guided through it step by step, given constant feedback as to the accuracy of performance, and frequent encouragement to continue and to develop movement confidence.

Specific exercises for increasing flexibility should be performed routinely as a part of physical education or recreational activities. It is common for handicapped individuals, who tend to lead a sedentary existence, to suffer flexibility losses which leads to risk of injury; discomfort in performing his or her

daily routine; and an inability to be successful in sports or recreational activities. (63) Flexibility exercises should involve all of the major joints of the body and should be done in a static nature. A sequence starting from the head and progressing to the feet is simple, sequential, and can be a fun activity when accompanied by music the individuals enjoy.

Muscular strength activities for the mentally retarded. Activities which will improve this component include push-ups, pull-ups, sit-ups, the shuttle run, the softball throw, and the long jump (62). Strength activities concentrate on a particular body part. Isometric exercises which are static in nature use muscles against one another or against a moveable object to build strength (3). Specific exercises can be taught which can strengthen all of the major muscle groups of the body. Weight-lifting using manufactured or improvised weights is an example (75). Combined activities can be planned to provide an opportunity to build strength and endurance as well as to enhance cardiovascular endurance. A circuit training exercise which includes the performance of strength-building push-ups or sit-ups done in rapid succession with a jogging activity between stations is one example. (20) This type of exercise is especially appropriate for mentally retarded children

because it is short in duration and matches the short attention span many exhibit. It is important to increase the intensity of the activity to increase strength levels and provide a cool-down or relaxation period at the end of the workout (20).

Care must be taken to provide individual planning and instruction to mentally retarded individuals. Consideration must be made for the number of repetitions, for example, that the student can tolerate and the length of recuperation time between exercises. Each aspect of the activity should be carefully modeled before the student is then taught step by step. Monitoring the activity is essential for safety reasons as well as providing feedback. (20)

Muscular endurance activities for the mentally retarded. Isotonics uses movement exercises for increasing endurance over a period of time (3). Any activities which can be continued for many repetitions will improve the endurance component such as exercises, pull-ups, sit-ups, chins (18). Specific muscle groups must be considered when planning increasing endurance. Activities which increase muscular endurance do not require an all-out effort but rather a continuing persistence on the part of the performer. For example, weight-lifting could be considered appropriate if the weight is

decreased so that many more repetitions could be performed before fatigue begins. (63) Particularly good for mentally retarded students are running or swimming for distance, or kicking for distance on kickboards. (20) As with any consideration of the mentally retarded population, it is essential to provide frequent verbal and/or non-verbal encouragement to continue the activity so that it will be beneficial. There is an overwhelming tendency on the part of retarded individuals to cease participating in anything that is mildly uncomfortable. The fear of failure, or the lack of self-confidence needs to be overcome, in addition. Physical educators can provide the encouragement for visible gains in students' performances with frequent, positive feedback. (30)

Cardiovascular endurance activities for the mentally retarded. The list of activities which improves cardiorespiratory function includes jogging (3, 17); running (29, 35), brisk walking (77); bicycling, racquetball, handball, and swimming (17). Aerobic dancing (5) and jumping rope are additional activities good for improving this parameter and are easy to incorporate in a fitness program.

This is considered by many to be the most important fitness component because it is an indication of over-all health (62). It is the adaption of the

circulatory system, heart, and lungs to the demands of an all-out effort of the body in physical exertion. (63) Mentally retarded students cannot conceptualize the extreme importance of this aspect and need the guidance of physical educators to reach a level of cardiovascular fitness. Any activity which raises the heart rate significantly for more than five minutes, three or more times a week is considered to be beneficial for cardiovascular development. (63) The key to successfully engaging students in an activity in excess of five minutes is to find one which is fun. This varies with regard to age and interests and the physical educator must be sensitive to these when choosing appropriate activities.

Program Considerations for the Mentally Retarded

It is important that mentally retarded persons be taught a wide variety of useful and age appropriate physical fitness activities so that they may participate in the community setting. Since the laws have changed and attitudes and policies towards the handicapped have moved towards normalization and deinstitutionalization, efforts are needed to develop the potential of mentally retarded persons. (62) The Special Olympics organization has been a forerunner in providing programming for mentally retarded persons in the community setting.

Fourteen different official sports are offered in an international program dedicated to competitive athletics, physical fitness and training for sports. (74)

Teaching Methods and Techniques for the Mentally Retarded

Individualized instruction is an important consideration in teaching the mentally retarded physical or motor fitness skills because of the nature of their physical and cognitive limitations. Retardates have difficulty, for example, with generalizing information, directionality, laterality, and kinesthesis and the individualized teaching technique helps students better understand what is expected. An individualized approach is also essential in meeting the mandate of the I.E.P. objective which requires matching instruction to deficit areas. (30, 34) It is through careful individual attention that specific strengths and weaknesses can be identified so that planning and instruction can be initiated. (60, 73)

Communication techniques. Communication is an extremely important facet of teaching retarded students. Commands should be clear, simple, and short to enhance understanding. A few key words should be repeated frequently and students should be given a reasonable length of time to react. The physical educator should

not give additional verbal or visual cues which would confuse the learner. Being clear and specific will help the learner comprehend the task at hand. (30, 34)

To increase comprehension, present the information in multiple ways. Along with specific verbal cues, give visual input which could include modeling, pictures, films, or diagrams. Having students imitate the modeled skill or motion can give the educator specific information about the student's understanding of the task and/or the ability to replicate it. Placing foot prints or handprints cut from a model of the student's own body parts or using colored lines for proper placement would aid location in space. Manual kinesthesis or guiding the body parts through a movement provides a physical feeling or understanding of the desired behavior. It is important for the instructor to face the same direction as the student so that image reversal isn't an additional burden. Tactile stimuli is another aid which further helps to identify the body part needed to execute the pattern or skill. (30, 34)

Sequencing activities. The physical educator should teach toward success by breaking down skills into a hierarchial sequence. It is important to build skills sequentially so that the retarded will feel and experience success. With a systematic and progressive approach, one which gradually increases in complexity, the mentally

retarded can master the skill, develop a more positive self-concept, and be ready to advance to the next step. (14, 34)

The sequence of activities should consider fatiguability of the students. Sessions should be short to match the attention span of mentally retarded students and should start with more complex skills to avoid fatigue which interferes with the enhancement of learning and predisposes injuries. (30, 34) Mentally retarded students perform skills the best the first few times they do them, so spreading practice sessions over a gradual period of time and scheduling short drills as a review is advisable (30).

Reinforcement. Another aspect of communication is giving frequent, sincere verbal praise as a way of offering encouragement and providing feedback on performance. It is conducive for an effective learning situation and enjoyment of the endeavor. (30, 34) In addition, if the emphasis is placed on the abilities of the student rather than the disabilities, a positive environment exists which encourages everyone (5).

Teacher participation in every activity increases the importance of the event because it is proof that it is a good activity for everyone. It provides an ongoing visual cue for the correct procedure and sequence and can be a perfect opportunity for the generation of enthusiasm

for the event. (30)

Evaluation techniques. The evaluation of students by charting progress needs to be done accurately and frequently. It is essential for communicating with professionals, informing parents, evaluating the effectiveness of instruction, and offering feedback to students. If it is done on a regular, systematic basis, alternate programming can be initiated or it can be intensified to meet the needs of the individual student without wasting valuable time or frustrating the student. (5, 30)

Evaluation techniques need to be selected by the individual educator to reflect the desired information. A formal "norm-referenced" test compares students scores against norms established by a randomly selected group of individuals. In a "criterion-referenced" test, the mastery of certain information or skill of the student is compared to the arbitrarily established mastery level of a particular skill or task. In a "domain-referenced" test, a domain, in P.E., a pattern of movement, is identified and the student is evaluated as to how well he or she executes a part or the whole of the domain. The "task analysis" method which is a break-down of the entire task into small sequential steps, measures whether or not the student masters the final, most difficult step of the task. In "observation", the student is observed to have performed or not performed

a task. This can be done by means of a checklist, film, or videotape. "Self-evaluation" could be effectively utilized if the student understands the objective and the procedure. The "interview" is another evaluation technique. It is primarily used with parents and students but could be used with many people to gather information about a student's performance. (30)

Incentives

Reinforcing the desired behavior with a point or token system may be the key to achieving and maintaining physical fitness (14). Daily, weekly, or monthly points which represent certain activities could be charted as visible feedback; groups could be formed to exercise together, to share and be reinforced by each other; and a schedule of awards could be initiated to reinforce attaining fitness goals or maintaining levels of fitness achieved (62). Incentives range from verbal praise, non-verbal gestures to a never-ending list of tangibles or activities which are meaningful to the recipient. The important consideration is to couple a meaningful appropriate reinforcer immediately with the desired behavior. (42, 71)

Goal-setting has been shown to be another incentive for mentally retarded adolescents. The work potential can be enhanced by personal and social motivational

factors. If a student can set a goal for himself or herself and expect to obtain that goal, having had the task modeled for him so that he clearly understands the task, he is in a better position to show success. (48)

Physical Fitness Research Studies of Mental Retardation

Research studies regarding the physical fitness status of mentally retarded individuals have concentrated on four major areas: 1) correlations between physical health and intelligence; 2) the physical fitness levels of the mentally retarded as compared to persons of normal intelligence; 3) improving the parameters of physical fitness through systematic programming; and 4) other variables affected by increasing physical fitness levels of mentally retarded persons. The inception of P.L. 94-142 and the humanitarian movement which includes normalization and continuing deinstitutionalization have caused the necessity of increased attention and programming for the retarded (62). The change from isolation to incorporation into community programs requires careful consideration and research into the ways that successful integration can occur (5).

Physical Fitness Levels of the Mentally Retarded

Several researchers have reported findings which indicate consistently that mentally retarded individuals have lower physical fitness levels than persons having

normal intelligence. Specifying motor proficiency, Howe (43) in 1959 compared 41 retarded children to 41 normal children on eleven motor tasks and found that the normal boys were superior on all tasks performed and that the normal girls were superior on nine of the eleven tasks. In a study similar to Howe's, Francis and Rarick (32) in 1960 studied the scores achieved by 284 retarded boys and girls on a battery of six gross motor tasks. They discovered that the results, compared to the norms expected of children with normal intelligence lagged below age norms two to four years. Stein and Pangle (82) in 1966 summarized research findings on motor proficiency of retarded children which indicated that they were inferior to normal children on most motor tasks. (13)

Other researchers who reported findings of low physical fitness levels among the mentally retarded were Hunsicker (1963), Hayden (1964), Cureton (1965), Sengstock (75) in 1966, Keough and Oliver (1968), and Rarick, Widdop and Broadhead (70) in 1970. Hayden (1964) found that on the average, mentally retarded children exhibit about half the strength of normal children and show fatigue thirty percent faster on tasks of endurance. (14)

Rarick, et al (70) in 1970 used a modified version of the AAHPER Youth Fitness Test and evaluated 4,235 EMR boys. Groups of all ages scored lower than the

national norms. Both the EMR and normal boys demonstrated the same relationship of change in level of fitness to age. The AAHPER Special Youth Fitness Test was developed in 1976 by Johnson and Londeree (45) as a result of this study. (62)

Physical Fitness and Other Variables

As early as 1920, Sandwick, as cited by Campbell, demonstrated a positive relationship of intelligence and health. A study by Brace in 1948 was one of the few on primarily women, as cited by Moon. Brace reported that there was a positive correlation between I.Q. and the capacity to acquire necessary motor skills associated with athletic activities. (62) In 1961, Brace compared the norms of the AAHPER Youth Fitness Test to scores of mentally retarded boys and found that 80% of all scores at each age level fell below the median (13). Maksud and Hamilton (57) in 1974 measured the aerobic capacity of EMR children and adolescents to be lower than normal children. The 1976 study by Londeree and Johnson (53) showed the fitness levels of both EMR and TMR children to be inferior to normal children. Results of their research indicated a curvilinear correlation of I.Q. to proficiency of motor skills. In studies by Campbell (13) in 1973, Francis and Rarick (32) in 1959, Howe (43) in 1959, and Stein (82) in 1964, levels of fitness

demonstrated by moderately and severely retarded persons fell below those of mildly retarded persons. (62)

In other studies, Sloan (79) in 1951, Malpass (58) in 1960, Howe (43) in 1959, and Brown (11) in 1967 all reported that TMR students were consistently poorer in balance items on fitness tests than were their peers of normal intellect (51).

Oliver (1958) demonstrated the positive correlation of physical fitness and I.Q. after a ten week program when all academic subjects except arithmetic and English were replaced by physical education activities. The results showed significant gains in emotional stability, medical evaluation, and personality adjustment. Oliver reported that the experimental group made a gain of 4.26 on I.Q. points. (13)

Corder (19) in 1966 studied the results of a 20-day intensive physical education program and reported significant improvement on scores on the Full Scale and Verbal Scales of the WISC. Campbell considered the improvement of the scores could have resulted from the close proximity of the dates of the pre- and post-tests. (13)

Higher than any of the other motor abilities, coordination and balance were reported to correlate with I.Q. by Ismail, Kane and Kirkendall (44) in 1969. A high differentiation between normal and mentally retarded children was reported by Guyette (40) in 1964

on balance items. Asmussen and Heebol-Nelson (1956) reported lesser motor capabilities in boys with low I.Q.'s as compared with those of higher intellect. They inferred that the quality changes in physical capacity that is expected with growth is dependent upon a normal mental development. Kirkendall and Gruber (47) in 1970 researched individuals with normal intelligence who achieved low academic scores and found a relationship between motor and intellectual domains. The research of Ismail and Gruber (1957) concurred. (51)

Improving Physical Fitness

The research which reported physical fitness levels of mentally retarded children and adolescents to be deficient indicated the need for remediation. Oliver (1958) reported gains in physical fitness, strength measures and athletic achievement from his ten week physical education program designed for English EMR boys. Howe (1954) demonstrated that retarded boys and girls improved significantly in physical proficiency after just ten days of the program. Chasey (1970a, 1970b) developed an eight week clinical physical education program and showed motor fitness improvement in EMR boys. Hayden (1964), Carrol and Abshier (1966), Nunley (1965) and Stein (82) in 1966 reported that mentally retarded children involved in a physical education program increased strength and endurance measurements. Chasey (15) in 1971

conducted a fifteen week developmental physical education program and observed significant improvements in gross motor skills as assessed by the Oseretsky Tests.

Better fitness behaviors were achieved when participants were involved in a behavior management program, according to a study done in 1974 by Campbell. Fuller (1949), and Allen, Turner, and Everett (1970) reported that contingency management programs were successful for significantly improving motor skills. (14)

Funk (1971) observed the improvement in sit-up and shuttle run scores after a 30-minute, 58 consecutive school day planned physical education program. The researcher surmised that other fitness parameters involved were not improved because the nature of the programming had not been geared to increase proficiency in those areas. (33)

Some researchers have coupled other variables to physical fitness to determine if there was any correlation between them if the latter was improved. Campbell (13) in 1973 reported increases in I.Q., peer relations, and self-concept with gains in physical fitness. In 1979, Simpson and Meany (78) studied TMR adolescents and noted significant changes in success rates of learning to ski which was related positively to self-concept improvement. (62) Smith (1976),

Batten (1976), and Fisher (1977), reported by Barton, also reported improvements in self-concept in mentally retarded individuals involved in fitness programs. Barton in 1982 conducted an aerobic dance program for mentally retarded children who demonstrated a more positive self-concept with improved physical fitness. (5) Folkins (31) in 1981 studied the effects of physical fitness training to psychological variables including cognitive functioning, personality traits, and self-concept. He reported that while cognitive performance appeared improved during and after physical stress, that only self-concept and not personality traits improved with increased performance of physical fitness.

McDougall (55) in 1979 assessed mentally retarded children after a three-week or a six-week training period on a specially designed fitness trail which featured twelve exercise stations. More improvements were noted in the second group than the first on parameters which were directly related to specific exercise stations along the trail.

Summary

Mentally retarded persons differ significantly from their normal counterparts in intellectual functioning, physical characteristics and motor abilities (30, 38, 52, 60, 73). It is important to understand these differences

and to be knowledgeable about all of the characteristics of retarded individuals in order to assist them achieve potential and increase normalization (20, 38, 60, 62, 65, 73).

Physical fitness is a major goal for the citizens of our nation both individually and collectively (83). The needs of the mentally handicapped are receiving increasing attention and their right to achieve a state of physical fitness equals that of the remainder of the population (52, 62). Considering the nature of handicapping conditions, special research, methods, and programming are vital to accomplish the goal of fitness for special populations (5, 13, 30, 62).

Research has demonstrated that the mentally retarded do exhibit low levels of physical fitness but that motor training programs have a positive effect on improving motor abilities and parameters of physical fitness (5, 14, 15, 19, 33, 55, 80).

CHAPTER 3

PROCEDURE

Research Design

This descriptive study compared the mean scores of pre- and post-test assessments of twelve physical fitness parameters for 42 moderately mentally retarded adolescents who were involved in a physical fitness/physical education program. Group one was involved in fitness classes for two school years, eight months in each school term, and group two was involved in fitness classes for one school term. Both groups were involved in P.E. classes for the two years of the study. P.E. classes were held two times a week for each group the first year but three times a week the second year for group one and one to two times a week for group two. The investigator compared the means of the pre- and post-test assessment scores of groups one and two individually to determine if there was a difference between the mean scores.

Selection of the Sample

This study involved 42 moderately mentally retarded adolescents and young adults between the ages of 12 and 21 years. All were students in the developmentally delayed program of the Shawnee Mission, Kansas School

District, #512. Criteria for placement in the program included age and over-all functioning abilities as determined by measurements of cognitive abilities, adaptive behavior, and language skills. (See Appendix A for the population profile which shows ranges of scores of the subjects in tests administered to determine the appropriate placement in the school district.)

All 56 of the students enrolled in this educational setting during the 1982-83 and/or the 1983-84 school year were included in the physical fitness program, but only 42 of those students who were present at the inception of the study were determined to be eligible for participation in this study. Students in this program attended the North Developmental Center in Overland Park, Kansas.

This sample was considered to be an intact cluster of a stratified random sample according to the range of abilities demonstrated in the testing battery given to special education students in the school district. The students had I.Q. scores ranging from 30 to 68 and had deficits in adaptive behavior scale scores, indicating a semi-independent or a semi-dependent level of functioning. The group was considered to be a representative sample of the moderately mentally retarded adolescent population.

Group one included 21 subjects, eight females and

thirteen males, ages 12 to 18 years. Group two included 21 subjects, nine females and twelve males, aged 19 to 21 years. The older students were enrolled in "Community Living", a curriculum designed to prepare mentally retarded young adults for integration into community programs after graduation from school.

Equipment Used

Detecto Scales

This measured height and weight.

Tycos Sphygmomanometer

This measured systolic and diastolic blood pressure.

Propper Stethoscope

This was used to measure blood pressure.

Wedge Bellows Spirometer

This measured vital capacity and forced expiratory volume.

Layfette, Model 54030

This measured hand steadiness.

Layfette, Model 2Z03E Photoelectric Rotary Pursuit

This evaluated hand-eye coordination.

Health and Education Services Sit and Reach Box

This measured flexibility.

Quinton Grip Dynamometer

This measured grip strength.

Monark Bicycle Ergometer

This measured aerobic capacity.

Olympia Digital Stopwatch

Deacon Electronic Timer

Harpenden Skin Caliper

This measured body fatness.

Measurement Procedures

The investigator coordinated the pre- and post-testing situations which involved all of the 42 subjects and ten personnel from the University of Kansas Fitness Clinic. Subjects were measured for weight and height, resting heart rate and blood pressure and practiced riding the stationary bicycle for at least two five-minute sessions to practice riding the bicycle ergometer.

Letters were sent to the subjects' families explaining the focus and components of the physical fitness program and the testing parameters. Parents were requested to sign a permission form for pre-

testing and complete a health assessment evaluation for each subject. The identical procedure was followed nineteen months later for the post-testing to update information and communicate with parents about the status of the program. (See Appendixes B, C, and D for the consent, physical examination, and individual physiological report forms.)

Subjects were advised to wear comfortable clothing, such as warm-ups and tennis shoes for each testing session. Notes were sent home confirming and clarifying the request as a last minute reminder.

The testing equipment was brought to the North Developmental Center in Overland Park, Kansas for the pre- and post-tests by personnel from the Fitness Clinic at the University of Kansas. A classroom in the school was selected rather than the K.U. Fitness Clinic so that: 1) students would not be fatigued from the 60-minute bus ride from the school to Lawrence; 2) a long wait in unfamiliar surroundings would be avoided; 3) eating and toileting needs could be accommodated; and 4) there would be a minimal interruption in the school day.

The classroom was large, well-lighted and well-ventilated. Stations were situated so that subjects began the testing with vital capacity and ended with aerobic capacity. (See Appendix J for a room diagram with identified testing stations.)

The order of laboratory testing followed the sequence below beginning with vital capacity and forced expiratory volume. The testing took approximately 30 minutes per subject. The protocol used by the University of Kansas Fitness Clinic is described below. All directions to subjects were simple, clear, and unhurried, in an effort to maximize their understanding and performance.

Instrumentation

Pulse

A resting heart rate was obtained for each subject after he or she had been sitting for at least five minutes. The investigator placed two fingers, (the index and middle finger) on the radial artery (thumb side of the inside of the wrist) and counted the frequency of beats during a fifteen second interval and then multiplied that number by four to obtain beats per minute.

Blood Pressure

The systolic and diastolic blood pressure was ascertained by the ausculatory method. An aneroid sphygmomanometer and a stethoscope were utilized. The cuff was placed on the subject's arm above the elbow, at the level of the heart, with the arrows on the cuff pointing to the brachial artery located in the antecubital fossa (the inner aspect of the elbow). Palpitation identified the exact location and the stetho-

scope was placed on this site. All air had been squeezed from the cuff before placement. The cuff was inflated to approximately 180 mm. Hg. when the flow of blood through the artery was occluded. At the rate of two to three mm. Hg. per second, the cuff was slowly deflated. The appearance of the first sound was recorded as the systolic blood pressure and the disappearance of the sound was recorded as the diastolic blood pressure.

Measurement of Height

The subjects were asked to stand facing away from the scales on the center of the platform with shoes removed. The lever was lowered to touch the scalp and height was measured in inches and one-fourth inch increments.

Measurement of Weight

The subjects were weighed as they stood in the center of the scales platform with shoes removed. Weight was recorded in pounds and one-fourth increments of pounds.

Vital Capacity and Forced Expiratory Volume

The examiner placed a noseclip over the nose and confirmed that no air could escape from the nostrils during the trial. A cardboard mouthpiece was placed on the end of the tubing which was then handed to the

subject. A demonstration of the procedure followed, with the instructions that when directed, the subject was to take as big a breath as possible and then, when directed, the subject was to blow out all of the air as fast as possible.

Hand Steadiness

The measurement of hand steadiness was accomplished by the insertion of a stylus into holes of varying diameters (which decreased in size) while trying to avoid contact with the sides of the holes. A stop-clock was activated when contact was made. The higher the score, the poorer the performance. The subject sat in a chair in front of the machine and was instructed to hold the pen (stylus) in his or her dominant hand in the same manner as holding a writing instrument. The metal plate was positioned at a 45 degree angle, centered on the subject with the face of the plate pointed toward the dominant hand. The subject was then asked to place the stylus in a particular hole avoiding any contact with the table with any part of his or her arm, wrist, or hand. A practice session to get the feel of the exercise preceeded three 30-second trials which were timed by a stop-clock. Holes numbered one, two, and three were tested in order.

Hand-Eye Coordination

This test evaluated the ability to coordinate a moving light field and the subject by keeping a wand in contact with a light source moving along a pathway. The machine was turned on, the light source intensity set at ten, and the rotor speed set at 20 R.P.M. The subject stood in front of the machine holding the stylus in the dominant hand at a distance which allowed the arm to be bent at a 90 degree angle. A 20-second practice session was followed by two 30-second trials. The following directions were given:

1) "Your task will be to keep the wand (stylus) on the glass at all times and to catch the light and follow it.
2) For the practice session, put the wand on this spot (black area above the light pathway farthest away from the subject which was identified by the testor).
3) The light will go along the pathway once so that you can see its trail, then when I say go, catch the light and follow it until I say stop. Then return the wand to its original starting position. We will do this three times."

Sit and Reach

The subjects were asked to bend from the waist forward for 30 seconds to loosen the back and hamstring muscles. For the test, they were instructed to sit on the floor with their legs fully extended and their feet

flat against the testing device, shoes off. The subjects were then asked to place one hand on top of the other, palms down, and reach forward as far as possible while moving the slide device with their fingertips. The knees were held down by the examiner to keep them straight, and subjects were instructed to move forward slowly and evenly in a static stretch (to avoid a ballistic stretch). The best of three trials was recorded.

Hand Grip Dynamometer

A dynamometer measuring 100 kg. was used. The grip handle was adjusted to each subject's hand per specifications from the manufacturer. When correct placement had been established, the subject was instructed to hold his arm straight out, forearm parallel with the floor. The arrow was located on zero degrees by the examiner, and the subject was then instructed to grip the dynamometer as hard as possible in one squeeze and then release. Two trials were performed and the better score of the two was recorded, in kilograms.

Skinfold Thickness

The skin and subcutaneous fat were grasped between the forefinger and thumb and the thickness was measured with the skinfold caliper. Measurements were obtained at the triceps and abdominal locations on both males and females.

Aerobic Capacity

The submaximal test called the Astrand-Rhyming Bicycle Test was used to predict maximal oxygen uptake. For this test, the apparatus used included the Monark bicycle ergometer, an electric timer, a stopwatch, a stethoscope, a heart rate conversion chart, and an age correction factor chart.

The bicycle ergometer was calibrated and set to read zero load with zero tension. The subject's height and weight were recorded on the form as well as the age correction factor for his or her predicted maximal heart rate. The height of the bicycle seat was adjusted so that with the pedal in the middle of the subject's foot in the "down" position, the knee was only slightly bent.

Directions to each subject were as follows:
1) "You will be asked to pedal the bicycle for about two minutes while I listen to your heart beat.
2) Keep pedaling until I say stop. You will pedal about two minutes. When I say stop, put your feet on these foot rests. Then I will check your pulse rate for two minutes (recovery heart rate).
3) Sit very quietly while your pulse is being taken so that I can hear it. It is important not to talk."

After these instructions were given, the signal was given to the subject to start pedaling. The

tension was increased from zero until a submaximal heart rate was obtained.

The testors frequently asked the subjects how they were feeling during the test and observed their reactions to the task. The subjects were advised to inform the testor of any undue discomfort.

After 30-60 seconds of exercise, the work load was adjusted and recorded if the heart rate was too low or too high for the desired target rate. The test workload was recorded on the data sheet.

Personnel Used

Ten qualified graduate students, five for each testing session, who had received special training in stress physiology measurement procedures in the University of Kansas Fitness Clinic and Dr. Wayne Osness, department chairman, administered the battery of pre- and post-assessments of twelve physical fitness parameters. They followed the standard protocol as recommended by the manufacturer and written by the University of Kansas, Department of Health, Physical Education, and Recreation. Additional instructions and clarity for the comprehension level of the subjects were provided by the key investigator.

Personnel from the University of Kansas Fitness Clinic performed the same testing on all subjects using the standard protocol on the laboratory equipment.

They practiced their evaluative tasks regularly in the Fitness Clinic and were considered experts.

Treatment Program

The treatment program was initiated after the pre-test assessments had been completed. Activity prescriptions were written to remediate deficiencies in muscular strength, muscular endurance, flexibility, and cardiovascular endurance. (See Appendixes E and F for exercise log and activity prescription.)

Fitness classes met two times a week for 60 minutes during the first academic year for an eight-month period of time and included both groups of subjects. Scheduling conflicts and an administrative decision necessitated reducing physical fitness classes to 30-minute sessions which met twice a week for an eight-month period of time for the second academic school year and included group one only. Both groups participated in the physical education program which met two times a week for 60 minutes each session the first year of the study. For the second year, group one had three 60-minute P.E. sessions per week and group two had P.E. one to two times a week for 60 minutes each session.

Activities designed to increase the parameters of physical fitness included aerobic rhythms, dance, and the track activities of running and walking. Flexibility

exercises were used which incorporated all of the major joints of the body and were combined with exercises designed to increase muscular strength and endurance. Dance aerobics began with a warm-up period and ended with a cool-down period, both of which used stretching and flexibility exercises. The dance routines were combinations of basic motor skills which were familiar to the subjects, and more complex steps which were taught by a task analysis approach. Track events consisted of walking, jogging, and running.

Motivation techniques included involving the students in selecting the name for the program (Fun 'n Fitness), as well as the logo; continuous teacher and paraprofessional participation; family participation (log sheets were sent home); frequent verbal praise and encouragement; tactile reinforcement; scheduled intermittant rewards which included small paper tennis shoes representing a mile walked or run (these were lined up toe-to-heel for display in the hall of the school), stars on larger tennis shoes (also represented a mile), T-shirts with an embossed logo which represented a year of fitness participation, achievements printed in "Footnotes", the project newsletter, a fitness award, stars and notes to families on daily point cards. (See Appendixes G, H, and I for examples of motivation techniques.)

Special events included a "Walk for Fitness" which was planned for an enjoyable, fitness-oriented activity to raise money for the project. (Eighty students and twenty staff members and parents walked 500 miles and raised over $500.00 in the two and one-half hour event.) Students participated for two years in the American Heart Association event "Jump Rope for Heart" which was adapted to match the physical capabilities of the population. A walk to a park a half-mile distant from the school was a year end celebration. An aerobic presentation for parents at an awards dinner was highly reinforcing and was a motivating factor to increase the accuracy of the performance. These events became a yearly tradition because of the success and enthusiasm they generated.

Teaching techniques included continuous role-modeling by the key investigator who encouraged enthusiasm and participation for each activity. Other teachers and paraprofessionals also provided enthusiasm and encouraged participation by assisting those students who needed it by offering individual instruction, tactile stimulus, and/or manual kinesthesis.

Music which students requested had a positive correlation to the amount of involvement in the activity. It was observed that with the more popular songs,

students participated for a longer duration and with greater intensity and enthusiasm than with songs not considered "in" with the adolescent age group.

Collection and Treatment of Data

The data from the twelve physical fitness parameters were collected for the pre-test in the fall of 1982 and for the post-test in the spring of 1984 for all 42 subjects. A preliminary treatment of the raw data collected in the pre- and post-test assessments included the assembly of scores in a computerized program by the University of Kansas Fitness Clinic personnel. Computerized data were sent to the key researcher who analyzed the results.

Analysis of Data

Data were collected and compiled from the pre- and post-treatment assessments of twelve parameters of physical fitness for two groups of moderately mentally retarded adolescents. Descriptive statistics were employed to describe the distribution of the scores. Means and standard deviations for each of the twelve parameters were calculated. The results of the pre-test assessments were compared to the post-test assessments to determine if changes had occurred following the two school year physical fitness/physical education program for each of the two groups of subjects.

CHAPTER 4

RESULTS AND DISCUSSION

Introduction

The purpose of the descriptive study was to descriptively analyze changes in the results of pre- and post-test assessments of twelve physical fitness parameters for 42 moderately mentally retarded adolescents, aged 12 to 21 years, who were involved in a physical fitness/physical education program. Laboratory tests were administered to assess height, weight, resting heart rate, systolic and diastolic blood pressure, vital capacity, forced expiratory volume, grip strength, hand steadiness, hand-eye coordination, flexibility, triceps and abdominal skinfold thicknesses, and aerobic capacity.

Group one was involved for two school years, eight months in each term in the physical fitness/physical education program. Group two was involved for the first school year in the combined program but only the physical education program for the second school year.

The investigator compared the pre- and post-test assessment scores of groups one and two individually to determine if changes had occurred in the means of the scores of each of the twelve physical fitness parameters.

The presentation of the results of the study is coupled with a discussion of each of the parameters of physical fitness which were investigated.

Results and Discussion

Subjects were tested and scores evaluated for the following parameters of physical fitness: height, weight, resting heart rate, systolic and diastolic blood pressure, vital capacity, forced expiratory volume, grip strength, hand steadiness, hand-eye coordination, flexibility, triceps and abdominal skinfold thicknesses, and aerobic capacity. Means and standard deviations were computed for pre- and post-test scores to determine if changes had occurred after a two-year physical fitness/physical education program for mentally retarded adolescents, aged 12 to 21 years. Group one had participated in the combined program for two school years, eight months in each term, and group two had participated in the combined program the first school year and only the physical education program the second school term. (See Appendix K for the raw data comparison of pre- and post-test individual assessment scores of the 12 physical fitness parameters.)

As the findings of each of the twelve parameters of physical fitness are presented, a discussion follows immediately interpreting the mean scores and citing

possible reasons for changes, differences, or maintenance of scores. The mean scores will be compared to available norms established for the mentally retarded population and/or norms established and utilized by the University of Kansas Fitness Clinic for the normal population and/or national norms.

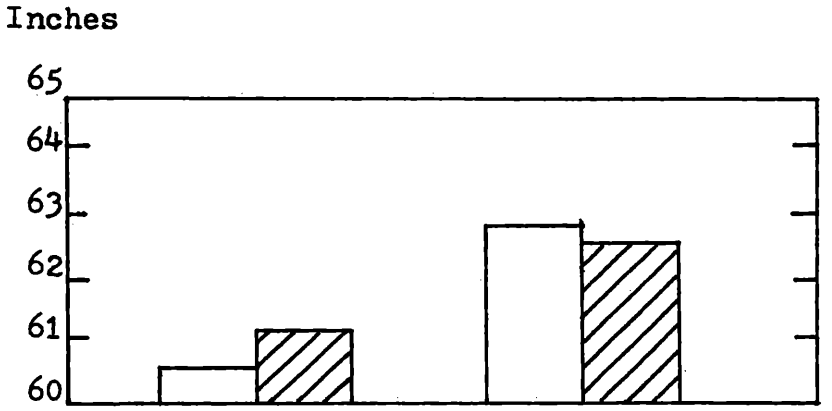
Height

The pre-test mean score for height for group one was 60.56" and the post-test mean score was 61.13" which demonstrated a growth of 0.57" or a 0.94% increase in height from the pre- to the post-test measurement. For group two, the pre-test mean score was 62.83" and the post-test mean score was 62.53" which demonstrated a 0.30" difference or a 0.48% decrease in height from the pre- to the post-test measurement.

Citations in the literature consistently show that mentally retarded persons are appreciably shorter than non-retarded age mates (52, 60, 68, 84, 85). Growth proceeds more slowly and for a longer period of time (30, 69). When compared to national norms established for normal adolescents, the subjects in group one demonstrated post-test mean scores which fell below the 25th percentile with the exception of one 17 year old male. These results were consistent with findings by Meyen (60) and Rarick (69) which indicated that normal

subjects are taller than mentally retarded subjects at all ages. (See Appendix L for a figure comparing the post-test mean scores of the mentally retarded adolescents in group one of this study to the mean scores of normal adolescents having the same chronological age (85). See Appendix M for a figure comparing the mean scores to national norms established for mentally retarded adolescents (2).)

The increase in height for group one was attributed to normal growth and maturation. The decrease for group two was considered to be a lack of consistency in the measurement procedure or from recording errors caused by misunderstanding dictated scores.



	Group One		Group Two	
$\bar{X}$	60.56	61.13	62.83	62.53
S	4.79	4.51	4.23	4.22
N	21	21	18	18

○ = Pre-test

⊘ = Post-test

Figure 1

Pre- and Post-test Means of Height

Weight

The pre-test mean score for weight for group one was 112.54 pounds and the post-test mean was 122.31 pounds which demonstrated an increase of 9.77 pounds or 8.68% from the pre- to post-test measurement. The pre-test mean score for group two was 129.40 pounds and the post-test mean score was 134.13 pounds which demonstrated a gain of 4.73 pounds or an increase of 3.66% from the pre- to the post-test measurement.

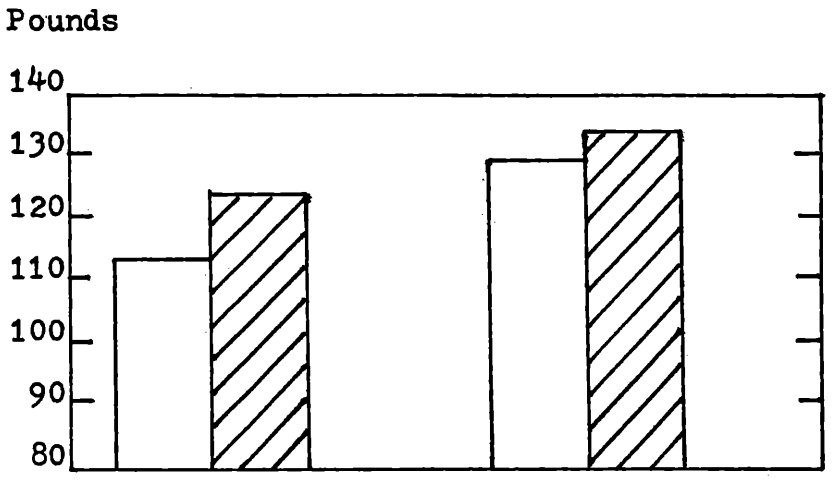
There was controversy in the literature about the weight of mentally retarded individuals. One author generalized that many retardates are overweight (52), and one related the tendency towards obesity demonstrated by Down's Syndrome individuals (30). Contrasted with this were citations by Meyen (60) and Rarick (69) who indicated that the weights of mentally retarded children are appreciably below standards for weight. A study by Rarick, as reported by Winnick (84), demonstrated that EMR subjects were heavier than TMR subjects in the six to nine and ten to thirteen year age ranges.

When the mean scores of the adolescents in group one of this study were compared to percentile norms for weight for non-retarded age mates, three scores appeared above the 50th percentile, three at the 51st percentile, and thirteen below the 35th percentile. (See Appendix N.) When the mean scores were compared to norms established

for mentally retarded adolescents, six were above the 50th percentile, and fifteen were below the 50th percentile. (See Appendix O.) The findings of this study concurred with the references that generally, mentally retarded children are lighter in weight than normal children.

The weight gain for group one reflected a normal maturation gain in body weight with the younger of the 12 to 18 year age group demonstrating the most significant weight gain. The slight weight gain for group two appeared to be evenly divided among those with positively-judged weight losses, negatively-judged weight gains, and subjects who maintained their weights. At this age, weights normally tend to be maintained with only a slight variation above or below. This score was thus considered to be maintained.

Several subjects in both groups in the study would be assessed as being overweight but the mean scores for the groups indicated that they were below average. Nutrition and weight control were not stressed in the treatment program other than references to controlling weight through exercise which may have been a factor in the decrease of some weights in groups one and two. Subjects were encouraged to continue exercising at home which may have contributed to weight losses and/or weight maintenance, also.



	Group One		Group Two	
$\bar{X}$	112.54	122.31	129.40	134.13
S	29.16	27.48	19.51	21.00
N	21	21	18	18

○ = Pre-test

⊘ = Post-test

Figure 2

Pre- and Post-test Means of Weight

Resting Heart Rate

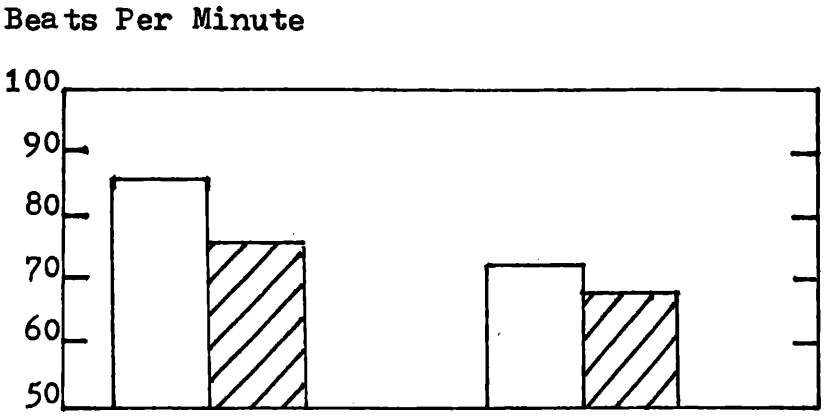
The pre-test mean score for resting heart rate for group one was 85.62 beats per minute (BPM) and the post-test mean score was 75.71 BPM which demonstrated a 9.91 BPM or a decrease of 11.57% in resting heart rate. The pre-test mean score for group two was 71.33 BPM and the post-test mean score was 68.57 BPM which demonstrated a decrease of 2.76 BPM or 3.87% from pre- to post-test measurements.

Research has proved that aerobic training programs result in decreased resting heart rates which indicate a healthier, stronger organ (3, 23, 76). Appropriate exercise introduced into an individual's training program will produce the greatest improvements in performance and a decreased resting heart rate change demonstrates training improvement (23, 54).

deVries (23) reported that there is a variation from individual to individual regarding a normal heart rate, but that the average is 78 BPM. The University of Kansas Fitness Clinic considers 76-78 BPM as the norm for this parameter and both groups one and two fall below this figure.

The dramatic decrease for group one and the continued decrease for group two was attributed to better physical conditioning. A decreased resting heart rate

is considered by Dr. Karl D. Pfuetze, an Overland Park, Kansas cardiologist (66), to be the most reliable sign of cardiovascular improvement because the heart pumps more blood, extracts oxygen better and doesn't have to pump as hard. Since group one had a longer period of physical fitness/physical education training, there was a greater decrease in resting heart rate. This is consistent with findings that indicate that continued and appropriate exercise results in a decreased resting heart rate (17, 23, 54, 76). The decrease for group two could have resulted from an effective learning of the conditioning training or from a maintenance of this aspect of physical fitness.



	Group One		Group Two	
$\bar{X}$	85.62	75.71	71.33	68.57
S	14.90	12.38	11.73	9.82
N	21	21	21	21

○ = Pre-test

⊘ = Post-test

Figure 3

Pre- and Post-test Means of Resting Heart Rate

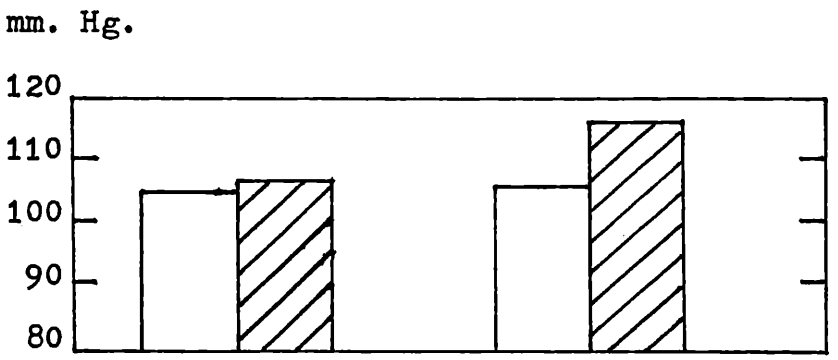
Systolic Blood Pressure

The pre-test systolic blood pressure mean score for group one was 106.10 mm. Hg. and the post-test mean score was 106.96 mm. Hg. which reflected a gain of 0.76 mm. Hg. or an increase of 0.72% from pre- to post-test measurements. The pre-test systolic blood pressure mean score for group two was 106.48 mm. Hg. and the post-test mean score was 110.67 mm. Hg. which reflected an increase of 4.19 mm. Hg. or 3.94% from pre- to post-test measurements.

Cardiovascular adaptations which result from endurance training include a decreased systolic blood pressure (10, 54). Generally, significant decreases in systolic blood pressure are noted in hypertensive individuals who engage in conditioning programs, according to Dr. Bruce Pfeutze, local cardiologist. Average systolic blood pressure is 113 mm. Hg. for women under 30 years and 124 mm. Hg. for men under 30 years (17). Both groups one and two demonstrated pre- and post-test mean scores considerably below 140 mm. Hg. which is considered to be the upper range of normal blood pressure, above which is considered to be a sign of hypertension (3, 10, 54).

There was a slight increase for both groups of subjects in systolic blood pressure. According to Dr. Pfuetze (66), there is a general trend for blood pres-

sure to increase slightly during childhood and adolescence. Since the time interval between pre- and post-testing was two years, it was considered that the increase in mean scores for systolic blood pressure was due to growth and development.



	Group One		Group Two	
$\bar{X}$	106.10	106.86	106.48	110.67
S	12.95	11.26	11.74	11.78
N	21	21	21	21

○ = Pre-test

▨ = Post-test

Figure 4

Pre- and Post-test Means of Systolic Blood Pressure

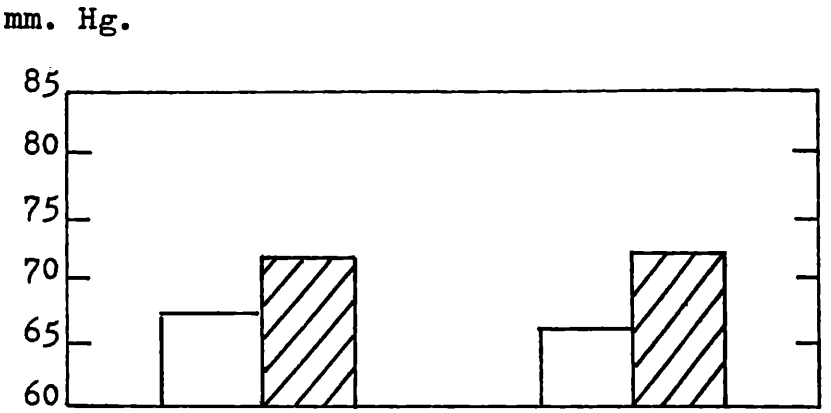
Diastolic Blood Pressure

The pre-test diastolic blood pressure mean score for group one was 67.33 mm. Hg. and the post-test mean score was 72.10 mm. Hg. which reflected an increase of 4.77 mm. Hg. or 7.08% from pre- to post-test measurements. The pre-test mean score for group two was 66.86 mm. Hg. and the post-test mean score was 72.19 mm. Hg. which reflected an increase of 5.33 mm. Hg. or 7.97% from pre- to post-test measurements.

As with systolic blood pressure, diastolic blood pressure is decreased because of cardiovascular adaptations resulting from endurance training (10, 54). According to Dr. Pfeutze (66), local cardiologist, significant decreases are noted in hypertensive individuals who engage in conditioning programs. The average diastolic blood pressure for women under 30 years is 75 mm. Hg. and for men under 30 years, it is 80 mm. Hg. (17). Above 90 mm. Hg. is considered to be a sign of hypertension and that figure is considered to be the upper range of normal diastolic blood pressure (3, 10, 54).

Groups one and two of this study demonstrated pre-test and post-test mean scores significantly below the 90 mm. Hg. level which is the upper range of normal diastolic blood pressure. Since blood pressure generally increases slightly during childhood and adolescence, the

increase in the mean scores for both groups was attributed to growth and development.



	Group One		Group Two	
$\bar{X}$	67.33	72.10	66.86	72.19
S	7.64	7.13	9.29	10.58
N	21	21	21	21

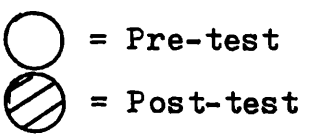


Figure 5

Pre- and Post-test Means of Diastolic Blood Pressure

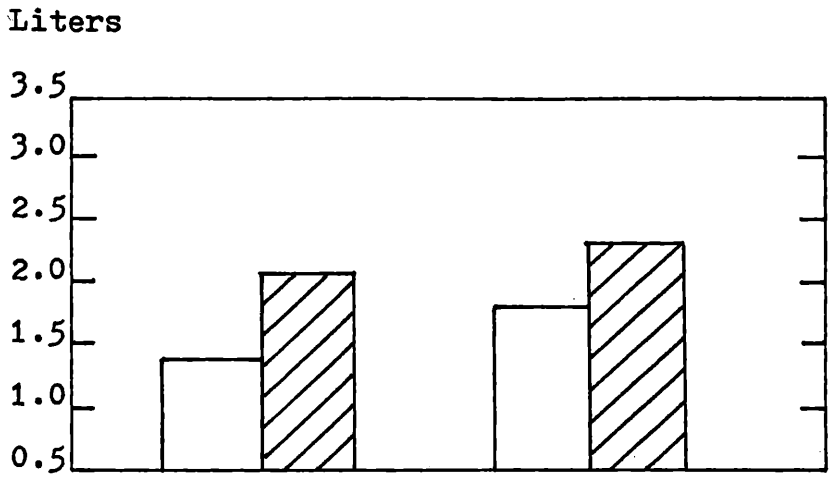
Vital Capacity

The pre-test mean score for vital capacity for group one was 1.42 liters (L.) and the post-test mean score was 2.05 L. which demonstrated an increase of 0.61 L. or 42.96% from the pre-test to the post-test mean scores. The pre-test mean score for group two was 1.79 L. and the post-test mean score was 2.36 L. which demonstrated an increase of 0.82 L. or a 47.40% increase from the pre-test to the post-test mean score.

According to Guyton (41), a normal vital capacity for a small female may be 3.0 L., a trained male athlete, 6.5 L., and a normal person, 4.5 L. The University of Kansas Fitness Clinic used a range of 3.0 to 3.5 L. as a norm when evaluating vital capacity. With improvements in aerobic capacity, increased breathing volumes result which are demonstrated in increased vital capacity (54). Both groups of subjects demonstrated increases in this parameter of physical fitness but compared with the normal values were below the lower limit which is 3.0 L. Group one had a post-test mean score which was 68% of the 3.0 L. value and group two had a post-test mean score which was 85% of that level. While fitness in this parameter improved, it was another indication of lower fitness levels presented by the mentally retarded.

The increases in mean scores for vital capacity were attributed to aerobic dance activities and track

events incorporated into the training program and to physiological and structural changes associated with maturation. Since group one participated for the longer period of time, it was expected that they would show greater improvement than group two, but group two demonstrated a greater percentage of increase in the post-test mean score than did group one. The reason was attributed to the older group better understanding the testing task, being slightly taller and heavier, and the greater aerobic capacity as demonstrated in the Astrand Rhyming Bicycle Ergometer Test.



	Group One		Group Two	
$\bar{X}$	1.42	2.03	1.79	2.36
S	.87	1.12	.79	.78
N	21	20	20	20

○ = Pre-test

⊘ = Post-test

Figure 6

Pre- and Post-test Means of Vital Capacity

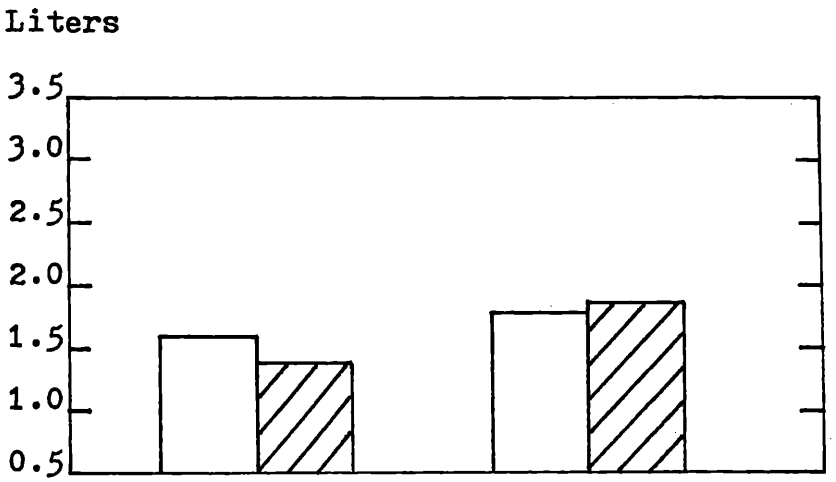
Forced Expiratory Volume

The pre-test mean score for forced expiratory volume for group one was 1.59 L. and the post-test mean score was 1.41 L. which demonstrated a decrease of 0.18 L. or a 11.32% lower post-test mean score as compared to the pre-test mean score. The pre-test mean score for group two was 1.76 L. and the post-test mean score was 1.87 L. which was an increase of 0.11 L. or 6.25% greater post-test mean score than the pre-test mean score.

Forced expiratory volume is a measurement of the efficiency of the bronchopulmonary system and the functionality of the muscles of expiration according to the definition used by the University of Kansas Fitness Clinic. The normal value used in testing forced expiratory volume is 2.0 - 2.5 L. When compared to this norm, the pre-test mean score for group one was 80% of the 2.0 L. value and the post-test mean score was 71% of that value. The pre-test mean score for group two was 88% of the normal score of 2.0 L. and the post-test score was 94% of that value. As aerobic capacity improves increased breathing volumes improve and results in increased ventilatory efficiency (54).

Group one did not demonstrate an improvement in this value which was an unexpected finding due to the great improvement in vital capacity. There was no

apparent reason for the failure to demonstrate improvement in forced expiratory volume. Group two did demonstrate an improved score which was attributed to increased respiratory efficiency which was demonstrated by an increase in vital capacity.



	Group One		Group Two	
$\bar{X}$	1.59	1.41	1.76	1.87
S	.81	.85	.64	.87
N	17	20	19	20

○ = Pre-test

⊘ = Post-test

Figure 7

Pre- and Post-test Means of Forced Expiratory Volume

Grip Strength

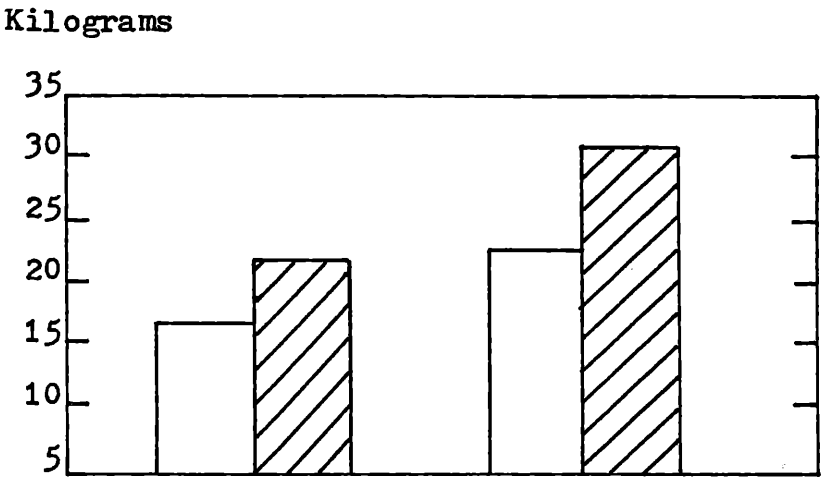
The pre-test mean score for grip strength for group one was 16.48 kg. and the post-test mean score was 22.86 kg. which demonstrated an increase of 6.38 kg. or 38.71% from the pre- to post-test measurement. The pre-test mean score for group two was 23.86 kg. and the post-test mean score was 30.57 kg. which demonstrated a 6.71 kg. or 28.12% increase from the pre- to post-test measurement.

Grip strength is a general screening device used as a general indicator of overall body strength since the hands are used in many physical tasks (30). In a study of eight to fourteen year old mentally retarded adolescents, Francis and Rarick, as reported by Winnick (84), tested grip strength as one indicator of performance levels when assessing the physical fitness status of this population. Fourteen year old boys demonstrated a mean grip strength of 26.4 kg. and girls a mean of 22.2 kg. compared to the mean scores in this study of 21.0 kg. for fourteen year old boys and 24.0 kg. for girls.

The normal value for grip strength is considered to be 20.67 kg. by the University of Kansas, and when compared to that norm, both groups of subjects performed above that score. Grip strength was shown to improve with age in the study by Rarick, with the greatest improvements

demonstrated in the nine to thirteen year age span (84).

Since both post-test mean scores showed a dramatic improvement, the cause was attributed to the physical fitness/physical education program which incorporated upper body strengthening exercises. From the results of this study, it appeared that grip strength increases with age. The pre-test score for group two was greater than the post-test score for group one and the greater increase for the post-test mean score indicated that this capacity was still improving.



	Group One		Group Two	
$\bar{X}$	16.48	22.86	23.86	30.57
S	6.14	8.68	7.11	10.39
N	21	21	21	21

○ = Pre-test

⊘ = Post-test

Figure 8

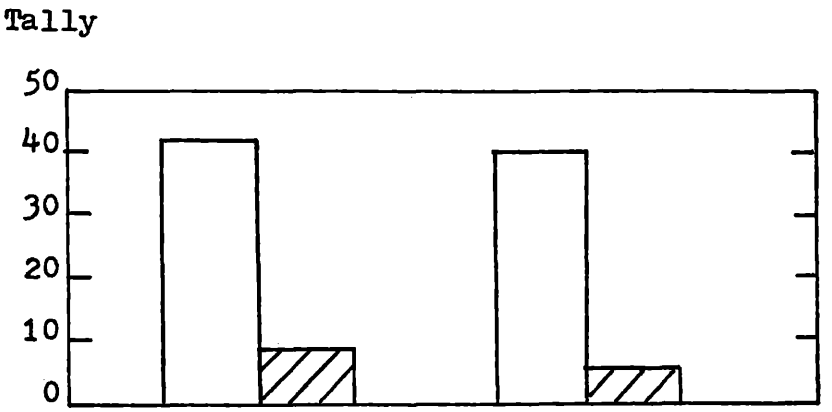
Pre- and Post-test Means of Grip Strength

Hand Steadiness

The pre-test mean score for hand steadiness for group one was 41.35 and the post-test mean score was 9.82 which was a decrease of 31.43 or 76.19% from the pre-test to the post-test score. The pre-test mean score for group two was 40.25 and the post-test mean score was 5.37 which was a decrease of 34.88 or 86.66% from the pre-test to the post-test score.

According to the University of Kansas Fitness Clinic, a low score is good and the closer the score is to zero, which is perfect, the better. No actual norms were established for this parameter but average scores for normals are close to zero.

It was considered that the contributing factors for the significant improvement in this parameter were increased upper body strength and range of motion; increased concentration or attention to task, and possibly, generalization to this parameter from writing or other fine motor tasks which had improved with practice. Subjects were observed to have more movement confidence and more self-confidence which may have had a positive effect on this score.



	Group One		Group Two	
$\bar{X}$	41.25	9.82	40.25	5.37
S	25.20	8.48	23.86	6.65
N	14	16	18	20

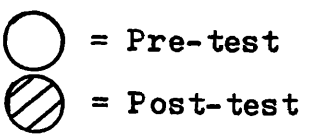


Figure 9

Pre- and Post-test Means of Hand Steadiness

Hand-Eye Coordination

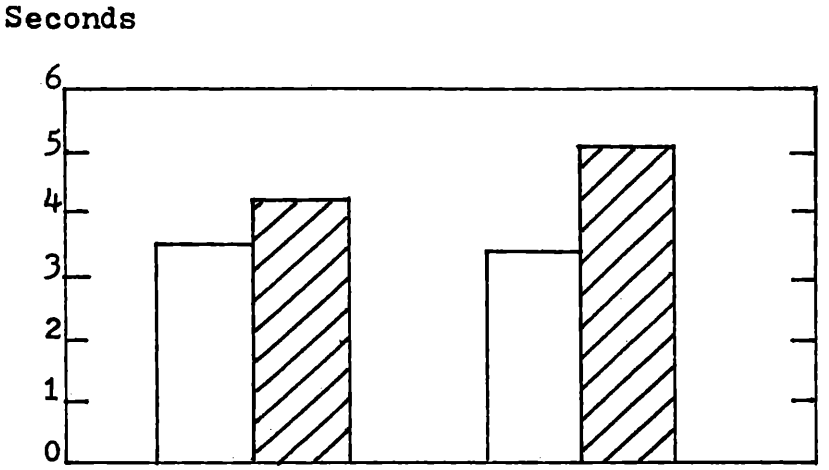
The pre-test mean score for hand-eye coordination for group one was 3.66 seconds and the post-test mean score was 4.11 seconds which was an increase of 0.45 seconds or 12.30%. The pre-test mean score for group two was 3.5 seconds and the post-test mean score was 5.16 seconds which was an increase of 1.66 seconds or 47.43% from the pre- to the post-test measurement.

According to the results of a study by Bruininks, as reported by Meyen (60), mentally retarded pupils had scores significantly below non-retarded pupils in all areas of motor proficiency. The greatest deficiency was shown to be skills requiring complex motor responses which required the coordination of visual and fine motor tasks. The pursuit rotor was a difficult test and the low scores compared to a normal score demonstrated Bruininks' findings in the present study.

The University of Kansas Fitness Clinic uses a norm of 10 when assessing hand-eye coordination. When compared to this figure, the post-test mean score was 41% of the value of 10 for group one and 52% of the value of 10 for group two. This indicated that the mentally retarded adolescents in this study were dramatically below the norm.

Improvements in this parameter were attributed to physical fitness/physical education training including

replicating numerous hand-body positions in aerobic dancing and stretching and flexibility exercises. It was concluded that the greater increase for group two was attributed to the specific activities they received in workshop training. For two hours a day, they attended to tasks requiring continuous eye-hand coordination compared to the thirty-minute requirement for students in group one. It would appear that practice improved this parameter.



	Group One		Group Two	
$\bar{X}$	3.66	4.11	3.50	5.16
S	3.36	4.50	2.06	4.01
N	19	18	21	21

○ = Pre-test

⊘ = Post-test

Figure 10

Pre- and Post-test Means of Hand-Eye Coordination

Flexibility

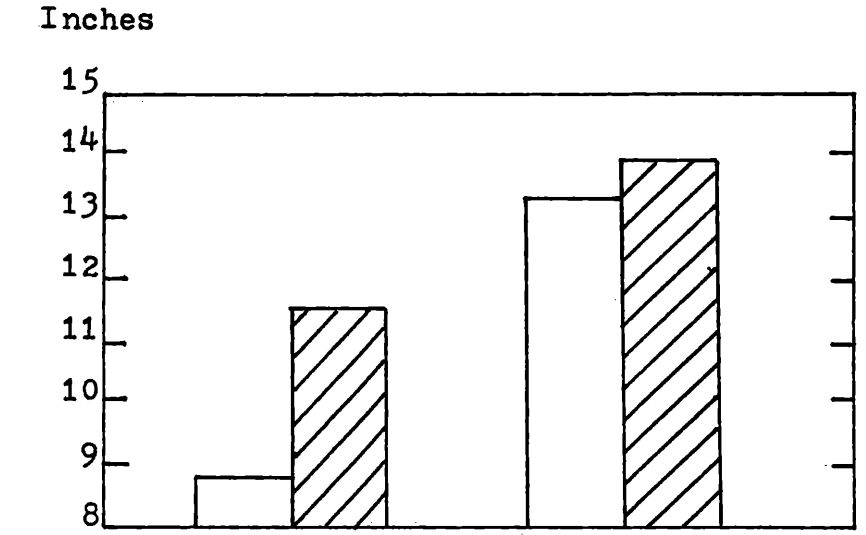
The pre-test mean score for flexibility for group one was 8.83" and the post-test mean score was 11.47" which was an increase of 2.64" or 29.9% from pre- to post-test measurement. The pre-test mean score for group two was 13.3" and the post-test mean score was 13.94" which was an increase of 0.64" or 4.81% from the pre- to the post-test measurement.

In a study of flexibility measures comparing normal and EMR children, Rarick, Dobbins, and Broadhead as cited by Winnick (84), found that the normal children were superior to the EMR children on all four tests and that the EMR boys were superior to the EMR girls. Rarick and McQuillan compared three flexibility tests to TMR boys and girls aged six to twenty-one and found that the differences between the sexes were mixed and that flexibility measures declined with increasing age. When EMR and TMR scores were compared, TMR subjects demonstrated greater flexibility. (84) (See Appendix P for a comparison of pre- and post-test mean scores to norms given for mentally retarded boys and girls.)

According to deVries, flexibility in children decreases with age reaching a low point between ten and twelve years of age. From this age, flexibility increases until young adulthood (23).

The improvement for group one was attributed to the major emphasis in the physical fitness/physical education program on stretching and flexibility. These activities were presented as warm-up and cool-down exercises four times a week the first school term and five times a week the second school term. Group two maintained levels of flexibility. The pre-test and post-test differences between demonstrated that flexibility increases with age to young adulthood, as reported by deVries, and indicated why the greater scores were evident for group two. The finding did not agree with findings by Rarick that showed that flexibility declines with age in TMR adolescents.

Additional causes for the improvement and maintenance of flexibility which were considered were the possibility of increased strength and control and an increased range of motion which may have resulted from the entire stretching program.



	Group One		Group Two	
$\bar{X}$	8.83	11.47	13.30	13.94
S	3.83	3.05	4.25	3.96
N	21	21	15	16

○ = Pre-test

⊘ = Post-test

Figure 11

Pre- and Post-test Means of Flexibility

Astrand Predicted Max
L./Min.

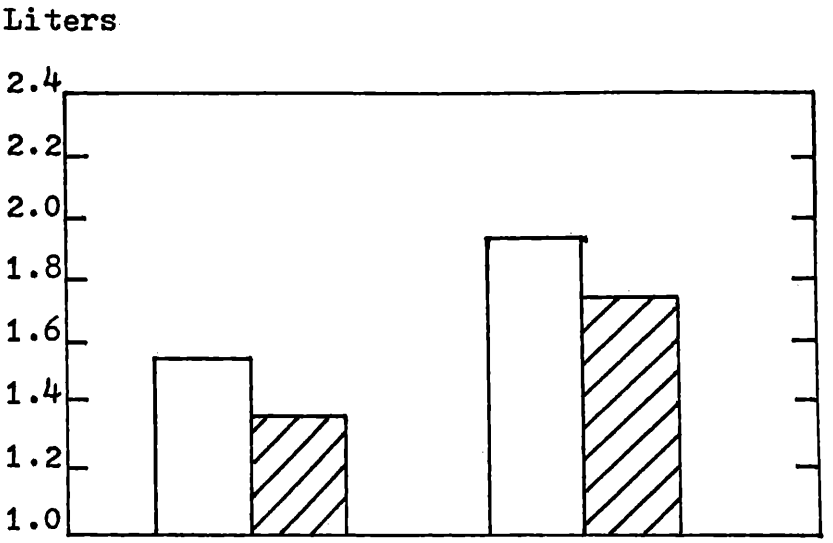
The pre-test mean score for Astrand Predicted Max, L./Min. for group one was 1.54 L. and the post-test mean score was 1.37 L. which was a decrease of 0.17 L. or 11.04% from the pre- to the post-test measurement. The pre-test mean score for group two was 1.93 L. and the post-test score was 1.73 L. which was a decrease of 0.20 L. or 10.36% from the pre- to the post-test measurement.

It is generally shown that mentally retarded individuals exhibit lower aerobic capacity, maximal oxygen uptake, physical work capacity, and exercise tolerance when compared to normal individuals (5, 12, 14, 57, 70). In a study similar to the present one, using a bicycle ergometer to assess cardiovascular fitness of EMR and TMR males, Coleman, et al, found that their fitness level was 20 to 30 percent lower than that of their normal peers (76). A normal score is considered to be 2.7 or 2.8 L. by the University of Kansas Fitness Clinic. When mean post-test scores of this study were compared to the 2.7 L. score, group one performed at 51% of this level and group two performed at 64% of this level. They were considered to be well below normal, healthy levels.

Astrand's study in 1952 showed a parallel increase

by both boys and girls of oxygen uptake until the age of 13 when both continue to increase but at a higher rate for boys than girls (18). (See Appendix Q for a comparison with mean scores from Astrand's 1952 study of maximum oxygen intake for children.)

Both groups one and two had post-test mean scores which were lower than their pre-test mean scores. The scores for group two were greater than for group one which indicated that the older subjects had increased aerobic capacity with age as suggested by Astrand. Scores were expected to increase following the training program for the subjects in this study but improvement was not demonstrated. Rationale will conclude the explanation of the Astrand recovery rate findings.



	Group One		Group Two	
$\bar{X}$	1.54	1.37	1.93	1.73
S	.53	.41	.53	.47
N	17	17	14	14

= Pre-test

= Post-test

Figure 12

Pre- and Post-test Means for Astrand Predicted Max - L./M.

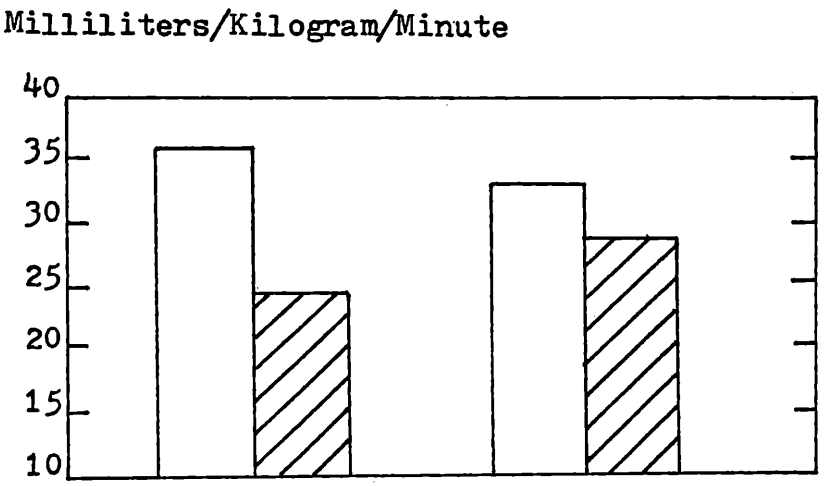
Astrand Predicted Max
ml./kg./min.

The pre-test mean score for Astrand Predicted Max, ml./kg./min. for group was 35.91 for group one and the post-test mean score was 24.29 which was a decrease of 11.62 or 32.36% from the pre- to the post-test measurement. The pre-test mean score for group two was 33.02 ml./kg./min. and the post-test mean score was 28.86 which was a decrease of 4.16 ml./kg./min. or 12.6% from pre- to post-test measurement.

McArdle reported findings from a study of ranges of scores with a range of 30-40 ml./kg./min. for untrained men and 65-80 ml./kg./min. for trained men (54). The normal value is considered to be 40 ml./kg./min. by the University of Kansas Fitness Clinic. When compared to this norm, the post-test mean scores were 61% of this value for group one and 72% of this value for group two. Coleman, et al, found the value to be 31.7 ml./kg./min. for adult EMR-TMR males (76). The results of the present study were closer to the findings of the study by Coleman of mentally retarded males, than of children and adults of normal intelligence.

Both groups decreased mean scores for Astrand Predicted Max, ml./kg./min. Since group two was the older of the two groups, it was expected that both pre- and post-test mean scores would be higher due to a

greater aerobic capacity but this was noted only with the post-test mean score. Following the training program, post-test scores had been expected to be increased from the pre-test level. Rationale will conclude the explanation of Astrand recovery rate findings.



	Group One		Group Two	
$\bar{X}$	35.91	24.29	33.02	28.86
S	16.62	7.31	9.71	8.84
N	17	17	14	14

○ = Pre-test

⊘ = Post-test

Figure 13

Pre- and Post-test Means of Astrand Predicted Max ml./kg./min.

Astrand Recovery Rate
One and Two Minutes

The pre-test mean score for Astrand Recovery Rate for one-minute for group one was 98.06% and the post-test mean score was 71.47% which was a decrease of 26.59 or 27.12% from the pre- to post-test measurement. The pre-test mean score for group two was 78.86% and the post-test mean score was 73.29% which was a decrease of 5.57 or 7.06% from the pre- to the post-test measurement.

The pre-test mean score for Astrand Recovery Rate for two minutes for group one was 101.24% and the post-test mean score was 80.59% which was a decrease of 20.65 or 20.4% from the pre- to the post-test measurement. The pre-test mean score for group two was 85.29% and the post-test mean score was 81.71% which was a decrease of 3.58 or 4.2% from the pre- to the post-test measurement.

The normal value used by the University of Kansas for one-minute recovery rate is 80% and for a two-minute recovery rate is 84-86%. Post-test mean scores for the one-minute recovery rate were 11% below the University of Kansas norm for group one and 8.4% below for group two. Post-test mean scores for the two-minute recovery rate were 4.1% below the norm of 84 in the range of 84-86% for group one and 2.8% below the 84% norm for group two. These findings were close to the norms used by the University of Kansas and an indication

that the subjects were functioning near the normal levels in this aspect of cardiovascular fitness.

A study by Bundschuh and Cureton (12) used a bicycle ergometer to test and condition mentally retarded adolescents. Gains were made in physical work capacity but scores of the experimental group were not significantly greater than the control group. Reasons cited for the results included habituation and a decline in motivation of subjects to improve.

Maksud and Hamilton (57) reported lower aerobic power results when scores from bicycle ergometer testing were compared to results obtained on a treadmill. They found that EMR children who rode bicycles at home had maximum heart rates that were ten beats higher per minute than those who did not. Reasons cited for lower aerobic power of EMR subjects were the type of exercise used, lack of motivation, and lack of strenuous daily activity.

(See Appendix R for individual subjects pre- and post-test recovery rates. One and two-minute rates are presented.)

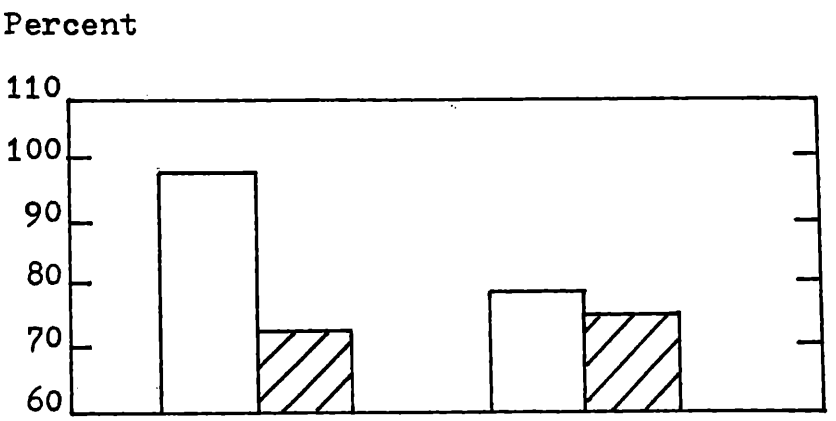
A difference in aerobic capacity was noted between groups one and two. Because of greater weight and height, group two demonstrated a greater aerobic capacity due to the structural and physiological advantages of an older age group.

There was no clear explanation for the decrease in the mean scores for aerobic capacity, but three possible explanations were cited. They included: 1) There may have been a lack of motivation by subjects to improve. 2) There may have been inadequate frequency and duration of training program activities considered, generally, to be 20 to 30 minutes of continuous aerobic capacity three to five times a week (67). 3) There may have been the selection of an inappropriate testing device for this particular TMR population, one which did not accurately test their aerobic capacity.

The task of riding the stationary bicycle proved to be very arduous for many of the subjects even after practice sessions prior to the testing situations. There were more practice sessions prior to the pre-test than the post-test and this may be one reason for the higher pre-test score. It was apparent that a testing instrument should have been selected which closely resembled training activities to adequately test cardiovascular fitness. Very few subjects rode bicycles for exercise or leisure so those muscles used for testing were not trained and they were not the same as those trained in the treatment program. Subjects appeared to fatigue and experience difficulty with pedaling.

Subjective observations of the students during

the final phase of the treatment program when compared to those of the initial phase noted considerable improvements in the areas of movement confidence, movement ability, laterality, directionality, endurance, and motivation. Subjects' fitness appeared to be improved but not demonstrated in this assessment of aerobic capacity.



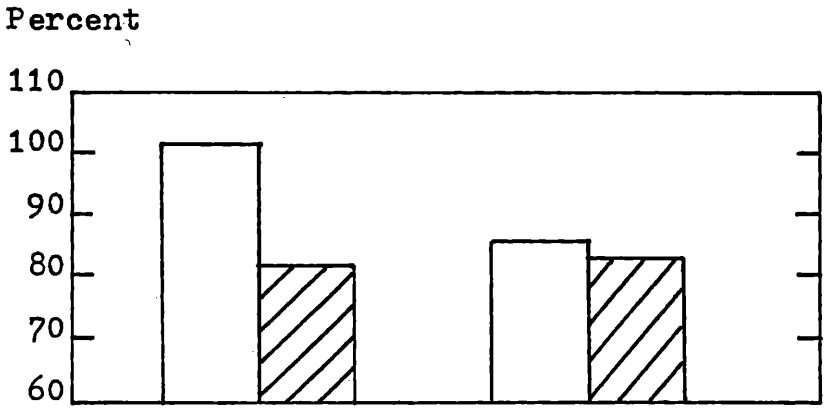
	Group One		Group Two	
$\bar{X}$	98.06	71.47	78.86	73.29
S	16.39	8.30	13.42	17.24
N	17	17	14	14

○ = Pre-test

⊘ = Post-test

Figure 14

Pre- and Post-test Means of Astrand Recovery Rate One Minute



	Group One		Group Two	
$\bar{X}$	101.24	80.59	85.29	81.71
S	18.09	9.25	12.35	19.08
N	17	17	14	14

○ = Pre-test

⊘ = Post-test

Figure 15

Pre- and Post-test Means of Astrand Recovery Rate
Two Minutes

Triceps Skinfold Measurement

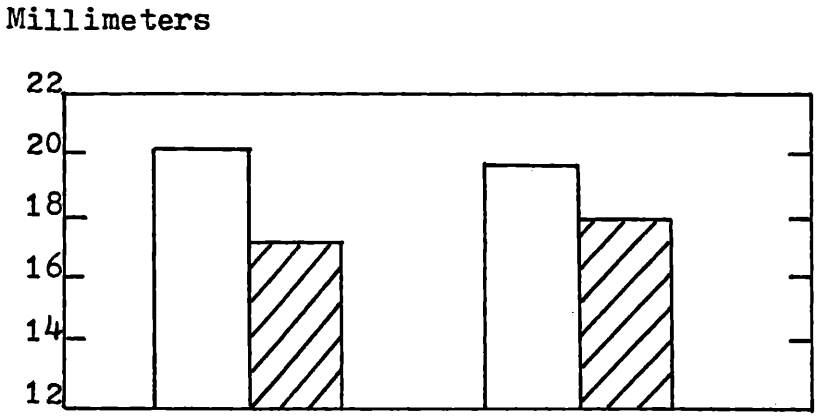
The pre-test mean score for triceps skinfold thickness for group one was 20.08 mm. and the post-test mean score was 16.6 mm. which was a decrease of 3.48 mm. or 17.3% from the pre- to post-test measurement. The pre-test mean score for group two was 19.68 mm. and the post-test mean score was 18.00 mm. which was a decrease of 1.68 mm. or 8.54% from the pre- to post-test measurement.

Rarick, Dobbins, and Broadhead compared abdominal, subscapular, and triceps skinfold measurements of normal and EMR thirteen year old subjects and found that the measures of all three sites were greater for the EMR population. In a study of TMR boys and girls, Rarick and McQuillan compared the same three skinfold measurements to those of the EMR study and found that the TMR measurements were greater. The girls' scores exceeded the boys' scores at all ages and the gap between the two sexes increased with age. From this and other research, it was determined that retarded subjects showed a greater percentage of body fat than did normal subjects at all ages. (84)

McArdle reported that body composition changes occur with regular endurance exercise. This exercise causes a reduction in body weight accompanied by a

decrease in body fat (54). Rarick reported on findings which indicated that increased physical activity changes the metabolic processes and results in decreased body fat values. The decreases in fatty tissues are in proportion to the intensity of the muscular activity. (69)

The decrease in the mean scores for the subjects in this study was attributed to the numerous repetitions of arm and upper body strengthening exercises presented frequently in physical fitness/physical education classes. Group one had a mean score which decreased more dramatically than group two due to the greater number and duration of training activities. (See Appendix S for figures comparing triceps skinfold mean scores to norms established for normal subjects.) From the size of the sample and the findings when the comparison was made, it was not possible to state that this population of mentally retarded adolescents generally had a greater percentage of body fat than the normal population.



	Group One		Group Two	
$\bar{X}$	20.08	16.60	19.68	18.00
S	10.03	7.79	9.32	9.30
N	21	21	16	16

○ = Pre-test

⊘ = Post-test

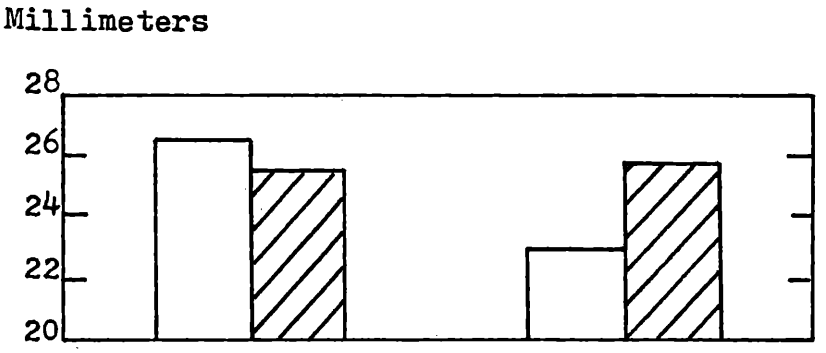
Figure 16

Pre- and Post-test Means of Triceps Skinfold Thickness

Abdominal Skinfold Measurement

The pre-test mean score for abdominal skinfold thickness for group one was 26.45 mm. and the post-test mean score was 25.52 mm. which was a decrease of 0.93 mm. or 3.52% from the pre- to the post-test measurement. The pre-test mean score for group two was 22.78 mm. and the post-test mean score was 25.81 mm. which was an increase of 3.03 mm. or 13.30% from the pre- to the post-test measurement.

Forty-three percent of the subjects in group one and nineteen percent of the subjects in group two lowered their scores for abdominal skinfold thickness. The decrease of the mean score for group one was attributed to the daily presentation of flexed-knee sit-ups in aerobic routines which were incorporated into the physical fitness/physical education program. Group two showed a slight gain in the mean score for weight at post-test and did not participate in the combined training program for the two year duration, both of which may have contributed to the gain in the mean score for abdominal skinfold thickness.



	Group One		Group Two	
$\bar{X}$	26.45	25.52	22.78	25.81
S	17.22	15.48	9.29	12.08
N	21	21	16	16

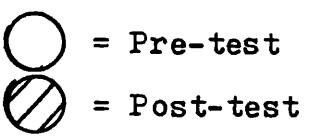


Figure 17

Pre- and Post-test Means of Abdominal Skinfold Thickness

Summary

This descriptive study was undertaken to observe and descriptively analyze changes which occurred following a two-year physical fitness/physical education program at the North Developmental Center in the Shawnee Mission, Kansas School District #512, located in Overland Park, Kansas. Twelve parameters of physical fitness were tested for observable changes.

The study included forty-two mentally retarded adolescents aged 12 to 21. The sample was considered to be an intact cluster of moderately mentally retarded adolescents. Group one included 21 subjects, eight females and thirteen males, ranging in age from 12 to 18 years. They participated in the physical fitness/physical education program for two school years, eight months in each term. The first term, physical fitness classes met twice weekly for 60 minutes and physical education classes met twice weekly for 60 minutes. The second term, physical fitness classes met twice weekly for thirty minutes and physical education classes met three times a week for sixty minutes. Group two included 21 subjects, nine females and twelve males, aged 19 to 21 years. They participated in the identical physical fitness/physical education program as group one the first school year but only physical education classes the second

year. Eight of these students participated in P.E. twice a week for 60 minutes; twelve participated once a week for 60 minutes; and one student had no P.E. because of a scheduling conflict.

Scores were obtained from pre- and post-test assessments of twelve parameters of physical fitness using laboratory equipment. Mean scores and standard deviations were calculated using a T.I.-55 calculator.

The results of this study showed changes in the mean scores of all of the variables tested. For group one, health-related improvements in mean scores were demonstrated for the following parameters of physical fitness: resting heart rate, vital capacity, grip strength, hand steadiness, hand-eye coordination, flexibility, triceps and abdominal skinfold thicknesses. Increases in the mean scores for height, weight, systolic and diastolic blood pressure were considered to be the result of growth and development. Changes in the mean scores for forced expiratory volume and aerobic capacity were decreases in scores and did not demonstrate improvement. For group two, health-related improvements in the mean scores were demonstrated for resting heart rate, vital capacity, forced expiratory volume, grip strength, hand steadiness, hand-eye coordination, flexibility, and triceps skinfold thickness. Increases in the mean scores for systolic and diastolic blood

pressure were considered to be due from growth and maturation. The slight increase in the mean score for weight was considered to have been a maintenance score. The decrease in height was considered to have been caused by an error in measurement or recording of scores which were dictated orally to an assistant. Decreases in the mean scores for aerobic capacity did not demonstrate improvement in this parameter.

Reasons cited for improvements included: 1) a two-year physical fitness/physical education program geared to improving fitness through the activities of aerobic rhythms, stretching and flexibility exercises and the track events of walking and running; and 2) the maturation and increased experiences of the subjects. Possible causes cited for a decline in the mean scores for health-related parameters included: 1) the testing device was inappropriate for this population of mentally retarded subjects because of inadequate training for the testing situation and did not use the same activity for testing as training, therefore was not an accurate indicator of actual capabilities; 2) a lack of motivation to improve scores by subjects; and 3) inadequate intensity and duration of training program activities to promote improvements in these parameters of physical fitness.

There was a 0.94% increase for group one for height and a 0.48% decrease for group two. There was

an 8.68% increase for group one for weight and a 3.66% increase for group two. The scores generally reflected developmental changes for group one as is expected of younger adolescents (30, 60). Group two was considered to have maintained weight and the decreased mean score for height was considered to be due to a measurement error.

A positive change was shown in the decrease of 11.57% for group one and 3.87% for group two for mean scores for resting heart rate. The improvement noted is consistent with research by Cooper (17) which indicated that aerobic training programs strengthen the heart muscle and result in a lowered resting heart rate.

Systolic blood pressure increased 0.72% for groups one and two respectively. The diastolic blood pressure increased 7.08% and 7.97% for groups one and two respectively. These changes were considered to have changed because of growth and development.

For vital capacity, there was in increase of 42.96% for group one and 47.40% for group two. Forced expiratory volume was increased by 6.25% for group two but decreased by 11.32% for group one. The demonstrated improvement for vital capacity for both groups and the improvement by group two for forced expiratory volume was an indicator of improved physical fitness.

Grip strength improved 38.71% for group one and

28.12% for group two. Hand steadiness mean scores decreased 79.19% for group one and 86.66% for group two, which demonstrated a significant improvement. Mean scores for hand-eye coordination increased 12.30% and 47.43% for groups one and two respectively. Flexibility improved 29.90% for group one and 4.81% for group two.

Group mean scores for aerobic capacity did not demonstrate improvement. For the Astrand Predicted Max, L./Min., there was a decrease of 11.04% and 10.36% for groups one and two respectively; for ml./kg./min., a decrease of 32.36% and 12.6% for groups one and two respectively was noted; for the Astrand Recovery Rate, 27.12% and 7.06% decreases were shown for groups one and two; and for the two-minute recovery, a 20.4% decrease for group one and a 4.2% decrease for group two was noted.

Triceps skinfold thickness improvements were shown for group one with a 17.3% decrease and an 8.54% decrease for group two. A decrease in abdominal skinfold thickness for group one was 3.52% but there was an increase of 13.30% for group two.

Physical fitness was demonstrated to be improved in most measures following a two-school year physical fitness/physical education program. This was consistent with studies which indicate that levels of physical fitness can be increased for mentally retarded persons through systematic programming (5, 14, 15, 33).

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This descriptive study was designed to descriptively analyze changes in twelve parameters of physical fitness following a two-school year physical fitness/physical education program for moderately mentally retarded adolescents. Two groups of subjects, aged 12 to 21 years participated in the study.

Pre- and post-test assessments were made for the following parameters: height, weight, resting heart rate, systolic and diastolic blood pressure, vital capacity, forced expiratory volume, hand steadiness, hand-eye coordination, grip strength, flexibility, triceps and abdominal skinfold thicknesses, and aerobic capacity. Means and standard deviations were calculated to determine the changes.

The results of this study revealed that the mean scores of all twelve assessments changed. For group one, health-related improvements were demonstrated for resting heart rate, vital capacity, grip strength, hand steadiness, hand-eye coordination, flexibility, and skinfold thicknesses. Increases in the mean scores for height, weight, diastolic and systolic blood pressure were considered

to be the result of growth and development. Decreases were shown for forced expiratory volume and aerobic capacity, the parameters in which improvement was not demonstrated. For group two, health-related improvements were demonstrated for resting heart rate, vital capacity, forced expiratory volume, grip strength, hand steadiness, hand-eye coordination, flexibility, and triceps skinfold thickness. The diastolic and systolic blood pressure increases were considered to have been the result of growth and development. The slight increase in the mean score for weight was considered to have been a maintenance of the pre-test score. Improvements were not demonstrated for aerobic capacity and triceps skinfold thickness. The decrease in the mean score for height was considered to be caused by a measurement or recording error.

Conclusions

Within the assumptions and limitations of this study, the following conclusions can be drawn:

1. It is possible for mentally retarded persons to make improvements in scores of parameters of physical fitness through systematic programming utilizing activities specifically designed to increase levels of physical fitness.
2. Specific health-related improvements were demonstrated by numerical changes in mean scores in the following areas:

resting heart rate - both groups

vital capacity - both groups

forced expiratory volume - group two

hand steadiness - both groups

hand-eye coordination - both groups

flexibility - both groups

triceps skinfold thickness - both groups

abdominal skinfold thickness - group one

3. Height and weight changes for group one were primarily considered to have occurred due to growth and maturation.

4. Systolic and diastolic blood pressure increases were considered to be the result of normal increases expected from maturation.

5. Aerobic capacity was not demonstrated to be improved using the bicycle ergometer to test this parameter of physical fitness with this population of mentally retarded adolescents.

6. It was not possible to conclude that improvements were noted solely from the results of the physical fitness/physical education program due to the influence of outside activities of the subjects which included Special Olympics and home living activities.

7. When comparisons were made of groups one and two, it was apparent that the following differences existed:

Because of age and maturation, group two had a greater aerobic capacity, and thus a greater vital capacity and forced expiratory volume; was taller and heavier; demonstrated a higher level of systolic and diastolic blood pressure; had greater grip strength; and had a higher percentage of body fat. Because of more experience and practice, group two exhibited more hand steadiness and had better hand-eye coordination.

Because of the longer, more intense training program, group one demonstrated a greater decrease in resting heart rate; had a higher percentage of increase in grip strength; had a greater percent increase in flexibility; and a greater decrease in percent body fat.

Recommendation

1. The investigator recommends changing the testing of aerobic capacity with the use of a treadmill instead of a bicycle ergometer as it did not appear to be effective in accurately evaluating this parameter of physical fitness due to the apparent difficulty of the task.
2. Using a post-test at the end of each school term would reveal changes that had occurred during the treatment phase that ended before the three-month summer break.
3. The use of a tighter regime of activities would facilitate the evaluation of the treatment program.

4. To increase levels of physical fitness, it is recommended that an intense, long-term conditioning program be continued for mentally retarded adolescents.

5. Further laboratory and field testing needs to be made for mentally retarded children and adolescents so that norms can be established from larger numbers of subjects, different I.Q. levels, different ages, and in more parameters of physical fitness.

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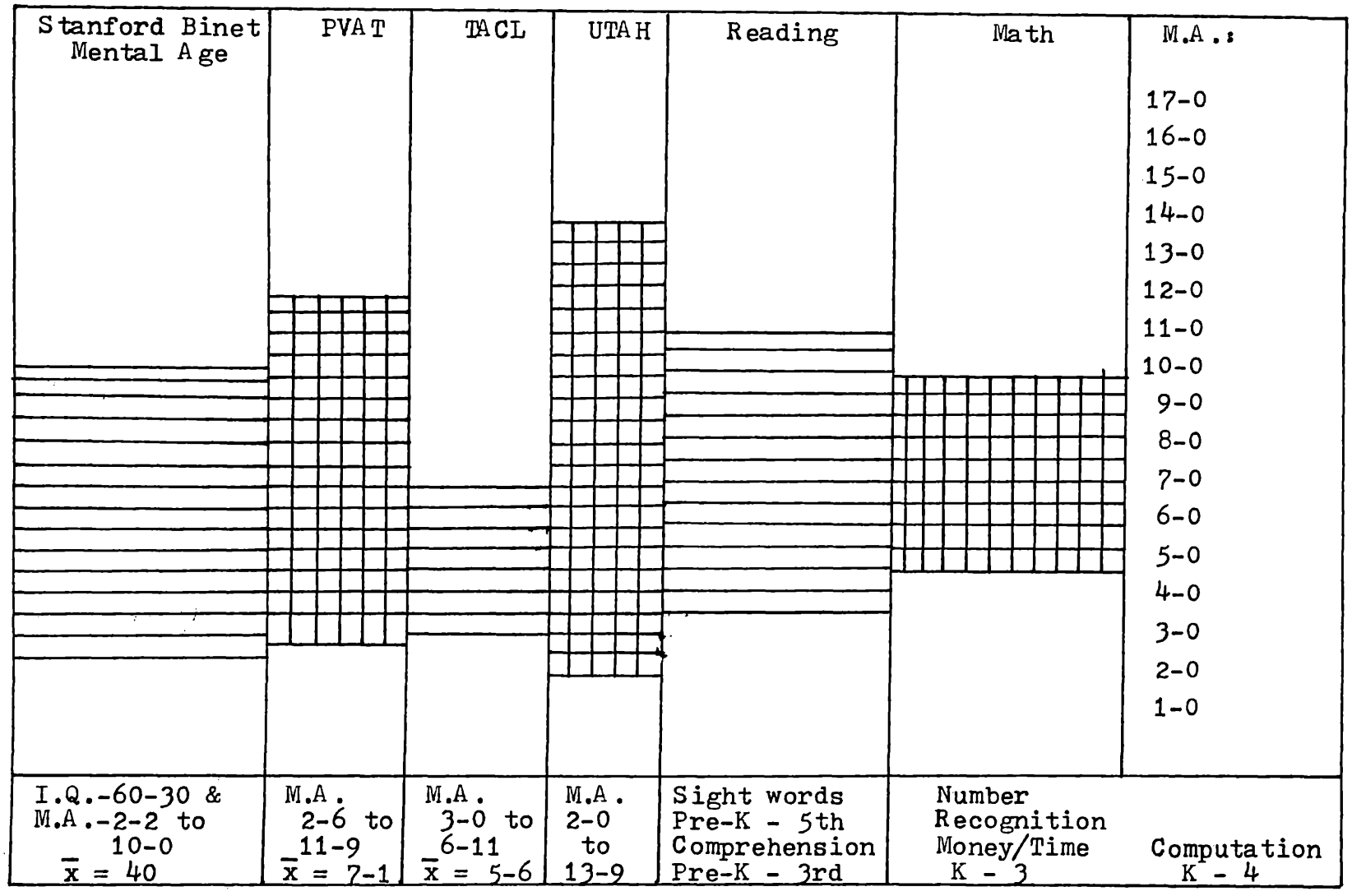
APPENDIX A

POPULATION PROFILE


Stanford Binet Mental Age
PVAT
TACL
UTAH
Reading
Math
M.A.:
17-0
16-0
15-0
14-0
13-0
12-0
11-0
10-0
9-0
8-0
7-0
6-0
5-0
4-0
3-0
2-0
1-0
I.Q.-60-30 & M.A.-2-2 to 10-0 x̄ = 40
M.A. 2-6 to 11-9 x̄ = 7-1
M.A. 3-0 to 6-11 x̄ = 5-6
M.A. 2-0 to 13-9
Sight words Pre-K - 5th Comprehension Pre-K - 3rd
Number Recognition Money/Time K - 3
Computation K - 4

APPENDIX B

CONSENT FORM

SHAWNEE MISSION PUBLIC SCHOOLS
STUDENT PERMISSION FORM

(Revised 10/8/74)

I consent to the enrollment and/or participation of: _____
in the following activity(s): (Student's Name)

Type or Name of Field Trip: Post-Test of Physical Fitness
(e.g. Choir, Debate, Football, Tennis, Track)

Authorized by: _____ _____
(Sponsor/Teacher Signature) (Administrator's Signature)

Time and Date of Activity: May 7, 1984

Trip Origination & Termination Points: _____

Location of Activity: North Developmental Center

Mode of Transportation: -

Cost per Student: -

Purpose: Post-testing assessment of physical fitness parameters.

Special Arrangements: Students should wear short-sleeved shirts, comfortable slacks and shoes.

Remarks: Battery of tests will take approximately 30 min.

It is understood that reasonable precautions will be taken to protect the safety and welfare of the student and that the District, Sponsor or Teacher can, under reasonable and limited conditions, alter plans of this activity.

We the undersigned do hereby consent to the above named student participating in the activity or activities above described, including his transportation to and from such activities: and for and in consideration of providing the undersigned and the above named student with additional extra-curricular activities, the undersigned hereby Covenant and agree for ourselves and on behalf of the student named above, not to sue the Unified School District No. 512, its officers, agents, servants and/or employees for any amount in excess of the valid and collectible insurance in force and effect protecting said Unified School District No. 512, its officers, agents, servants and employees, and the undersigned further indemnifies and agrees to save and hold said District, its officers, agents, servants and employees free and harmless from any and all liability in excess of the insurance coverage as aforesaid. Nothing herein is intended to, nor shall it be construed to release any insurance company from any obligations to pay under any liability insurance or other benefits.

_____ _____
(Date) (Signature of Parent or Guardian)

NOTE: If this student has reached the age of 18 years, please complete the following:

I, _____ have read the above and foregoing permit executed by my parents
(Student's Name)
and do hereby join with them in this release.

_____ _____
(Date) (Student's Signature)

APPENDIX C

PHYSICAL EXAMINATION FORM

SHAWNEE MISSION PUBLIC SCHOOLS
SUNFLOWER PROGRAM PHYSICAL FITNESS EXAMINATION FORM
DOCTOR'S PHYSICAL EXAMINATION REPORT

Name: _____ School: _____

Parents Names: _____ Address: _____

Sex: _____ Birthdate: _____ Age: _____

Type of handicap(s):

Vision L: R:

Hearing L: R:

B/P: Pulse:

Heart Condition:

Lungs:
Renal:
Orthopedic:
Emotional:
Neurological:
Seizures: Type Frequency:

Other:

Limitations:

Please note any contraindications for either vigorous physical (aerobic) exercise or dietary change:

Please list all medications, dosage, and time of administration:

Allergies:
Known drug reactions:
Special diet:
Over weight: Underweight:
Oral hygiene:

Date of physical exam:

Physician's Signature: _____

To be completed by parent.

I authorize school personnel to obtain emergency medical care for my child in the event that I cannot be reached. If transportation by ambulance is required, this service may be obtained.

Preferred Physician: _____

Address: _____

Phone _____

Parent of Guardian Signature: _____

Are there any additions to the examining physician's report which you think might affect your child's school experience or assist us in serving your child?

_____

_____

_____

APPENDIX D

INDIVIDUAL PHYSIOLOGICAL REPORT

Individual Physiological Report

Name_____

Birth Date_____

Sex_____

School_____

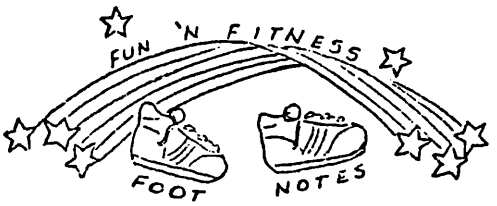
M.A./I.Q._____

	Pre-test	Post-test
Height		
Weight		
Resting Blood Pressure		
Resting Heart Rate		
Anthropometric		

Comments:

APPENDIX E

INTERIM EXERCISE LOG



Fun 'n Fitness Interim Exercise Log

Dates: _____

Location of exercise: (circle one)

A. Fitness Class B. P.E. Class C. Home D. Special Olympics

(Formal program to begin when testing results computed; evaluated; prescriptions written; all activities implemented)

Activity *	Names:	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
_____	1.							
_____	2.							
_____	3.							
_____	4.							
_____	5.							
_____	6.							
_____	7.							
_____	8.							
_____	9.							
_____	10.							
_____	11.							
_____	12.							
_____	13.							
_____	14.							
_____	15.							

*
Running, Walking, Bicycling, Swimming(distance): Record number of miles.

Aerobic dancing, Rebounding, Aerobic Floor Exercises, Jumping Rope: Record in minutes.

Signature: _____ Parent
Teacher

APPENDIX F

INDIVIDUAL EXERCISE PRESCRIPTION

INDIVIDUAL EXERCISE PRESCRIPTION

Student Name: _____

	School Activities					Home Activities	
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Aerobic-Vital Capacity							
1. Jogging on track							
2. Dancing-aerobic							
3. Floor exercises							
4. Jumping rope							
5. Rebounding							
Strength							
1. Jogging							
2. Sit-ups							
3. Push-ups							
4. Simple weight lifting							
5. Pull-ups							
6. Finger strengthening and dexterity exercises							
7. Upper and lower body strengthening activities (10 or more repetitions)							
Hand-Eye Coordination							
1. Ball bouncing							
2. Ball catching							
3. Ball throwing							
Flexibility							
1. Floor exercises							
2. Tumbling							

APPENDIX G

WALK FOR FITNESS PLEDGE SHEET

FUN 'N FITNESS PROJECT
WALK FOR FITNESS

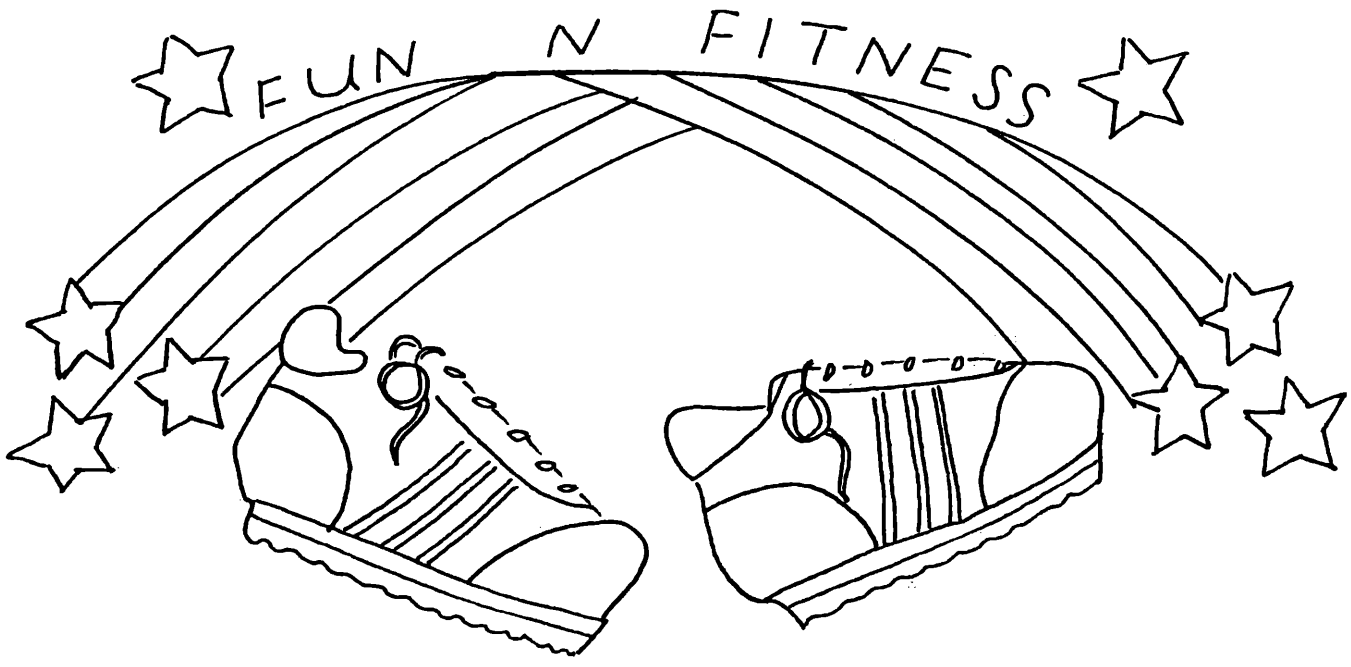
Name ______________________ Date ______________________

I would like to support this person as they raise money for their school fitness project.

Name	Address Phone	Amount Pledged	Miles Completed	Paid

APPENDIX H

FITNESS AWARD WITH LOGO



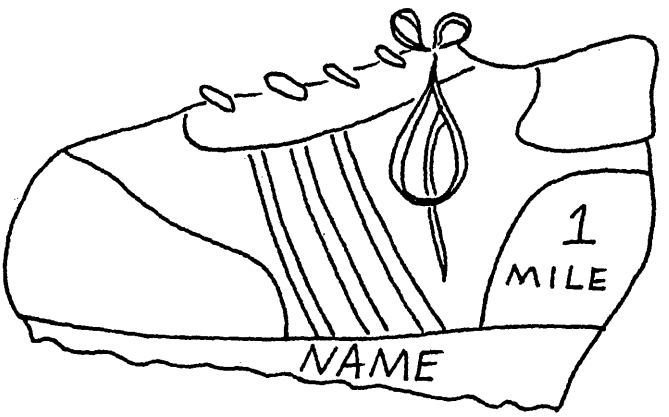
FITNESS AWARD

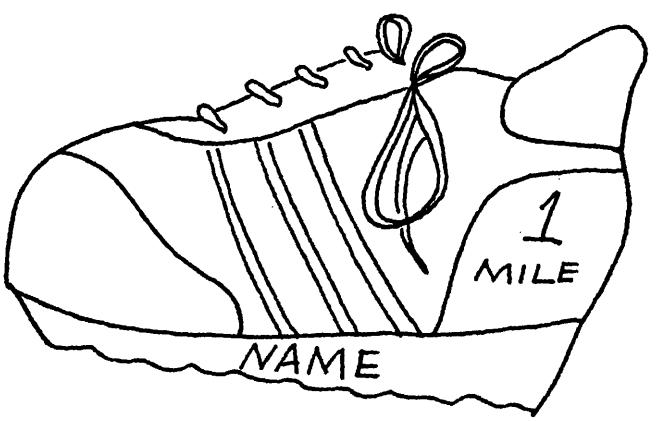
PRESENTED TO

_____

APPENDIX I

DISPLAY INCENTIVES
Tennis Shoes for Walking and Running
Bicycle for Cycling
Dolphin for Swimming
Wheelchair for Physically Disabled


1
MILE
NAME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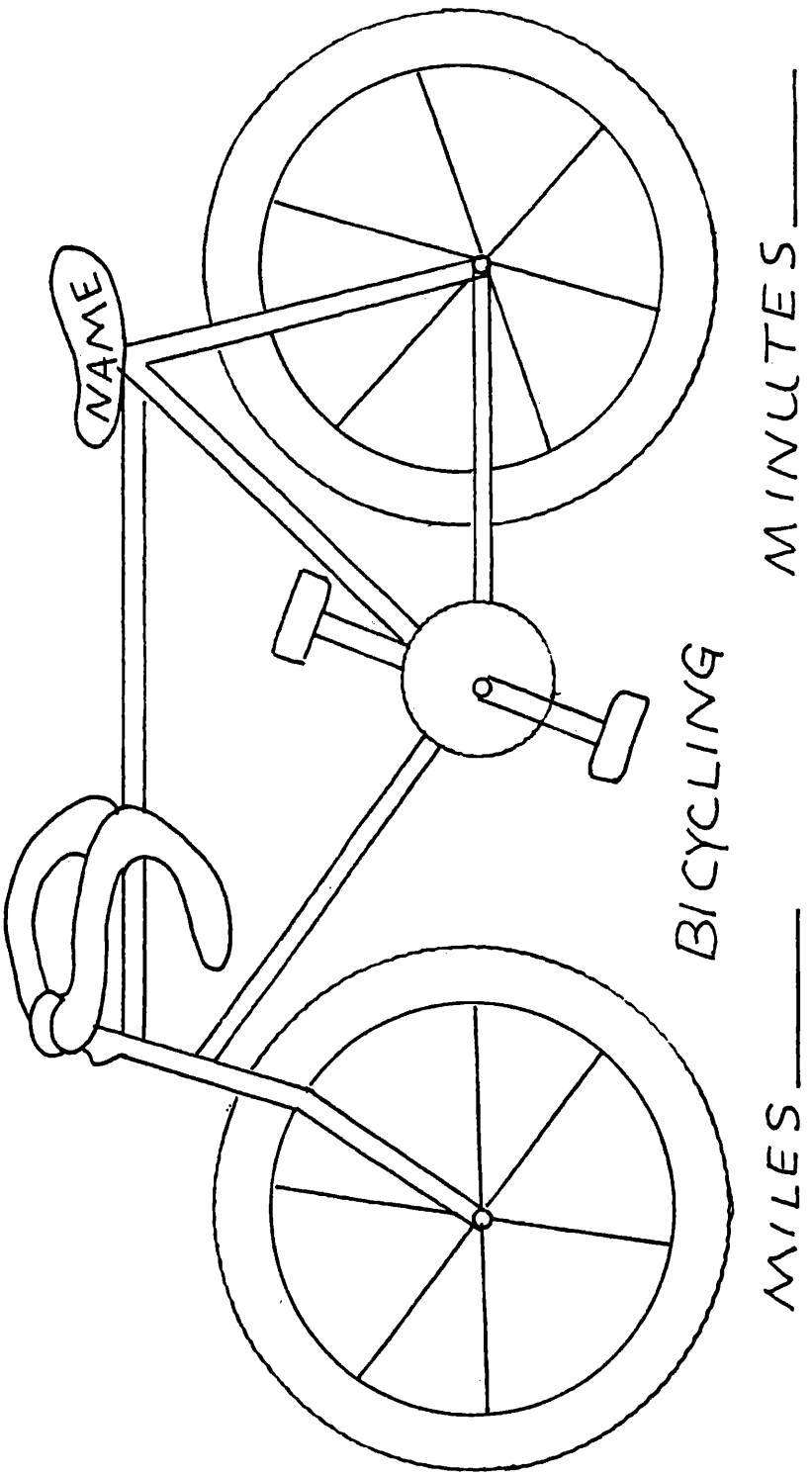
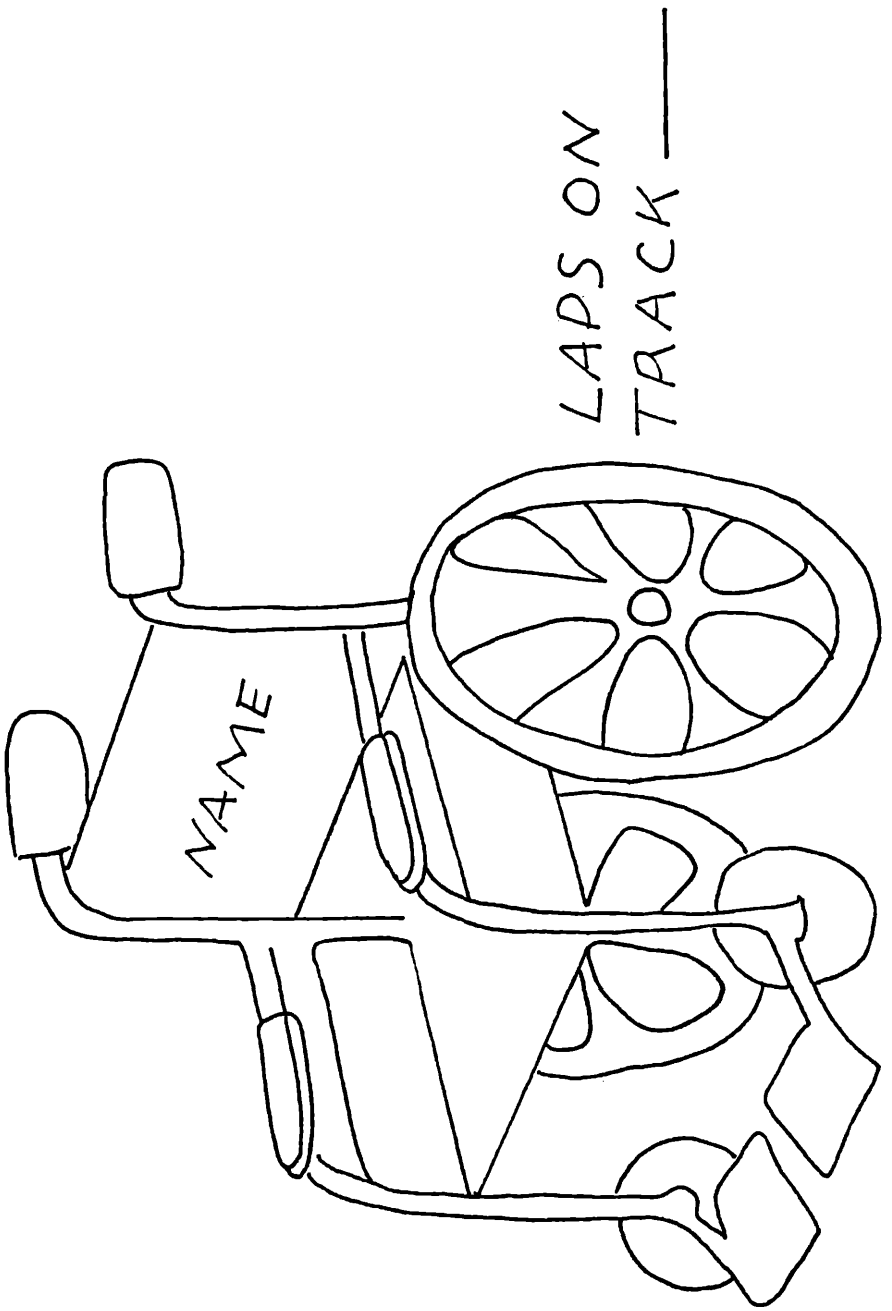
MILE
NAME

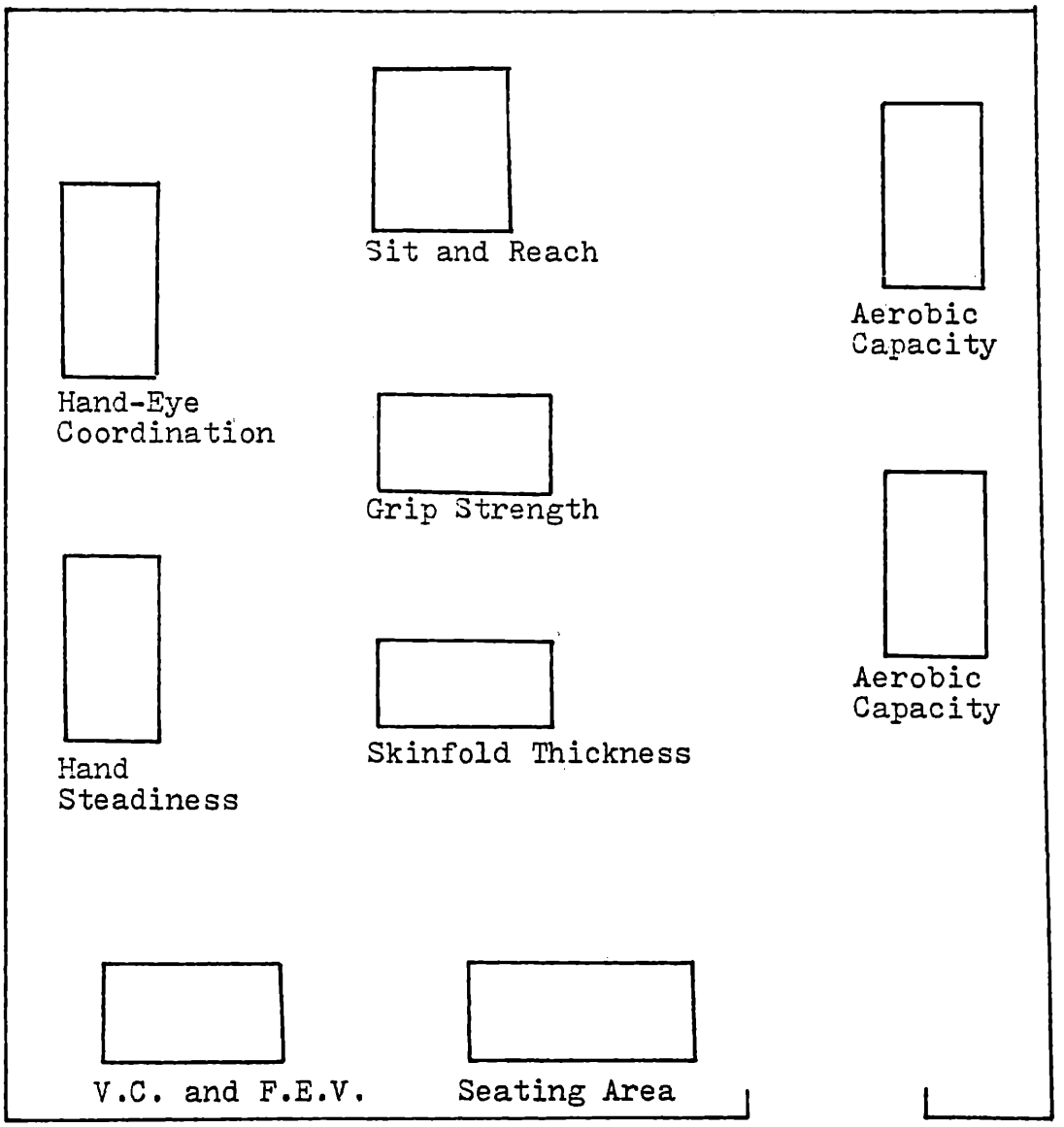

NAME
BICYCLING
MILES ____
MINUTES ____

NAME
1 MILE
72 LAPS - OLYMPIC POOL


LAPS ON TRACK ___
NAME

APPENDIX J

ROOM WITH IDENTIFIED TESTING STATIONS


Sit and Reach
Aerobic Capacity
Hand-Eye Coordination
Grip Strength
Aerobic Capacity
Hand Steadiness
Skinfold Thickness
V.C. and F.E.V.
Seating Area

APPENDIX K

COMPARISON OF PRE- AND POST-TEST INDIVIDUAL DATA FOR AGE, HANDICAPPING CONDITIONS, MEDICATIONS, AND ASSESSMENT SCORES OF PHYSICAL FITNESS PARAMETERS

Subject	Sex	Age Pre-	Age Post-	Handicap	Medications
A	F	15-3	16-10		
B	M	17-11	18-7	Vision	
C	M	12-7	14-1	Down's	
D	F	17-4	18-11		
E	M	16-3	17-10		
F	F	13-5	15-0	Hyperact-ivity	Impiramine Pre- Deaner Impiramine Post-
G	M	12-10	14-4	Down's	
H	F	14-4	16-0	Down's Vision	
I	M	16-8	18-3	Seizures	Tegretol
J	F	17-3	18-10	Seizures	Phenobarbital Depekene Zarontin
K	M	13-1	14-7		
L	M	15-3	16-10		Accutane Post-
M	M	12-7	14-1	Seizures	Phenobarbital Tegretol Tranxene
N	M	16-11	18-7		
O	M	16-8	18-3	Down's	
P	M	14-8	16-3	Down's	
Q	M	13-11	15-6	Down's	
R	F	13-2	14-9	Down's	
S	F	15-6	17-2		
T	F	13-10	15-5	Seizures C. Palsey	Dilantin Tegretol
U	M	15-4	16-11	Lowe's Vision	

Subject	Sex	Age Pre-	Age Post-	Handicap	Medications	
AA	F	18-1	19-8	Down's C. Palsey		
BB	M	19-3	20-10	Down's		
CC	M	18-2	19-9	Down's VSD		
DD	F	18-10	21-4	Autism		
EE	F	19-5	21-0	Down's		
FF	F	18-11	20-6	Seizures Hemiplegia	Depekene Valium	Both Post-
GG	M	18-3	19-10	Seizures	Mebaral Erythromycin	Both Pre-
HH	M	19-4	20-11	C. Palsey		
II	F	19-9	21-4	C. Palsey Hearing		
JJ	F	19-7	21-2	C. Palsey		
KK	M	19-11	21-6	Seizures Paraplegia	Depekene Dilantin	Pre- Post-
LL	M	19-7	21-2	Down's		
MM	M	18-1	19-8	Autism		
NN	M	20-0	21-7	Down's		
OO	F	18-7	20-3	Seizures	Dilantin Phenobarbital	
PP	F	17-1	18-8	Down's		
QQ	M	17-11	19-6	Down's Seizures	Dilantin	
RR	F	19-3	20-10	Down's		
SS	M	19-1	20-8	Hyperact- ivity	Ritalin	
TT	M	17-10	19-5	Down's		
UU	M	19-1	20-8	C. Palsey Hearing		

Subject	Height Pre-	Height Post-	Weight Pre-	Weight Post-
A	56.00	55.75	106.50	97.75
B	65.25	65.00	110.00	114.50
C	59.50	61.00	94.00	111.00
D	63.00	62.00	127.00	128.75
E	68.50	69.00	126.00	132.50
F	61.50	62.00	93.50	107.50
G	61.50	64.00	118.50	139.25
H	53.00	52.25	85.00	94.75
I	66.50	67.50	125.00	143.50
J	59.50	59.25	110.25	122.25
K	53.25	56.00	62.50	72.50
L	66.00	66.25	143.00	151.00
M	57.25	61.75	75.00	92.50
N	68.00	68.50	176.00	187.75
O	60.00	59.50	109.00	109.50
P	61.00	61.00	109.50	126.25
Q	55.00	55.50	98.50	106.25
R	52.00	55.50	64.00	80.50
S	64.50	62.00	157.00	159.00
T	61.50	61.00	161.00	153.00
U	59.00	60.00	112.00	138.50

Subject	Height Pre-	Height Post-	Weight Pre-	Weight Post-
AA	54.50	54.75	116.00	126.25
BB	63.25	62.00	109.00	111.75
CC	61.50	61.25	147.00	147.25
DD	63.25	63.50	123.25	120.00
EE	56.50	56.25	101.00	106.50
FF	62.00	62.75	107.00	131.00
GG	74.00	73.75	171.00	193.75
HH	-	-	-	-
II	60.00	59.00	105.00	111.00
JJ	63.00	62.75	142.00	140.25
KK	-	-	-	-
LL	65.00	65.00	146.00	155.50
MM	69.00	68.75	149.00	142.75
NN	62.25	62.00	131.00	127.75
OO	64.00	62.75	124.00	127.00
PP	57.50	57.00	109.00	118.25
QQ	64.00	63.50	143.00	143.50
RR	64.00	63.75	127.00	123.00
SS	64.00	63.75	122.00	124.25
TT	63.25	63.00	157.00	164.50
UU	-	-	-	-

Subject	Resting Ht. Rate Pre-	Resting Ht. Rate Post-	Flexibility Pre-	Flexibility Post-
A	80	96	-1.5	+1.5
B	88	72	-6.5	-3.0
C	96	76	+1.5	+6.3
D	86	80	-11.0	-4.5
E	80	68	+4.5	+5.0
F	108	100	-3.5	-3.7
G	94	68	-0.5	+1.5
H	84	68	-1.5	+2.0
I	76	64	+2.5	+2.3
J	84	84	-5.0	-0.5
K	106	76	-9.5	-4.7
L	84	68	-3.5	-1.0
M	88	92	-3.5	+0.5
N	68	80	-3.0	-2.0
O	60	60	-4.5	-0.5
P	60	64	+4.5	+5.3
Q	112	66	-3.5	-1.2
R	100	76	+0.5	+0.5
S	60	52	-2.5	+0.3
T	84	92	-7.5	-4.0
U	100	88	-0.5	-0.7

Subject	Resting Ht. Rate Pre-	Resting Ht. Rate Post-	Flexibility Pre-	Flexibility Post-
AA	88	68	+7.5	+5.5
BB	68	64	+7.5	+7.0
CC	68	68	-2.5	-1.0
DD	78	68	-3.5	-2.7
EE	66	68	+4.0	+5.8
FF	86	72	-11.5	-5.0
GG	64	76	-4.5	-1.7
HH	88	84	-	-
II	86	60	-0.5	+1.5
JJ	84	84	-3.5	+0.5
KK	66	64	-	-
LL	56	76	-1.5	+2.3
MM	76	80	-	-
NN	60	56	+4.5	+4.8
OO	64	76	-	-
PP	58	56	+3.5	+3.5
QQ	46	52	+6.5	+6.3
RR	70	68	+2.5	+2.8
SS	72	64	-0.5	+0.3
TT	66	52	+7.5	+9.0
UU	88	84	-	-

Subject	Systolic B/P Pre-	Systolic B/P Post-	Diastolic B/P Pre-	Diastolic B/P Post-
A	90	89	64	70
B	124	108	74	78
C	110	118	64	78
D	98	108	64	74
E	114	100	74	70
F	96	98	68	68
G	110	118	52	78
H	104	110	62	68
I	118	122	64	80
J	100	118	64	72
K	120	82	70	56
L	120	108	78	70
M	104	104	78	80
N	128	132	80	88
O	90	100	60	74
P	102	96	60	60
Q	98	98	60	78
R	78	98	58	68
S	90	98	70	64
T	116	110	80	70
U	118	120	70	70

Subject	Systolic B/P Pre-	Systolic B/P Post-	Diastolic B/P Pre-	Diastolic B/P Post-
AA	98	102	60	76
BB	96	98	60	68
CC	118	106	60	84
DD	120	110	70	68
EE	112	110	80	64
FF	100	100	76	78
GG	120	110	72	76
HH	96	120	56	76
II	110	120	58	80
JJ	124	128	80	62
KK	118	106	66	64
LL	102	106	64	76
MM	100	118	72	76
NN	108	104	70	66
OO	90	104	64	66
PP	100	108	68	58
QQ	98	100	60	70
RR	80	104	58	58
SS	122	152	70	72
TT	104	108	50	108
UU	120	110	90	70

Subject	V.C. Pre-	V.C. Post-	F.E.V. Pre-	F.E.V. Post-	Grip Pre-	Grip Post-
A	1.05	0.95	1.05	0.75	10	11
B	1.45	1.30	1.45	0.80	18	23
C	2.00	3.55	1.90	2.75	12	21
D	1.40	0.65	1.40	0.55	10	9
E	2.85	3.65	2.45	1.85	27	36
F	1.25	2.20	1.25	1.50	20	18
G	1.40	2.70	1.40	2.40	15	22
H	1.10	0.70	1.10	0.50	6	10
I	2.70	2.95	2.70	2.40	24	38
J	0.10	0.35	0	0.30	15	20
K	0.45	0.75	0.45	0.60	13	20
L	3.85	4.15	3.85	3.40	29	37
M	0.75	0.80	0.75	0.40	13	21
N	2.00	3.25	2.00	0.75	28	35
O	1.50	2.30	1.50	1.80	17	24
P	0.80	2.25	0	1.55	15	36
Q	1.55	1.45	1.50	1.35	13	21
R	0.65	1.55	0.60	1.40	11	24
S	1.65	2.75	1.65	2.20	21	23
T	0.40	0	0	0	16	16
U	0.90	2.30	0	1.00	13	15

Subject	V.C. Pre-	V.C. Post-	F.E.V. Pre-	F.E.V. Post-	Grip Pre-	Grip Post-
AA	0.30	1.75	0	0.90	16	20
BB	1.80	1.80	1.55	1.45	23	33
CC	1.00	1.70	1.00	1.60	22	29
DD	0.80	1.30	0	0	12	21
EE	2.20	2.60	2.20	1.95	22	26
FF	0	0	0.50	2.50	23	27
GG	1.70	3.45	1.70	2.95	25	41
HH	1.25	2.50	1.25	0.50	20	20
II	2.20	2.75	1.85	2.25	23	24
JJ	1.25	2.60	1.25	2.35	24	27
KK	2.80	2.85	2.55	2.80	40	56
LL	2.35	3.60	2.80	2.50	33	50
MM	1.45	1.45	1.45	0.80	23	24
NN	2.15	3.50	2.15	3.00	25	35
OO	0.60	1.25	0.60	0.20	18	21
PP	2.25	2.10	2.25	1.60	20	27
QQ	2.00	2.35	2.00	2.15	35	43
RR	1.60	1.80	1.60	1.40	20	25
SS	2.10	2.75	2.10	2.70	27	30
TT	3.25	3.75	2.80	3.10	37	45
UU	1.80	1.40	1.80	0.75	13	18

Subject	Hand Stead. Pre-	Hand Stead. Post-	Hand-Eye Pre-	Hand-Eye Post-	Astrand L/Min. Pre-	Astrand L/Min. Post-
A	28.10	1.13	4.41	3.00	2.02	1.09
B	87.00	22.75	.72	.62	1.10	1.27
C	37.70	6.54	.75	1.67	1.12	.89
D	0	0	1.76	.49	0	0
E	34.20	8.90	9.07	9.45	2.50	1.82
F	59.50	.78	3.12	4.82	1.80	1.54
G	31.50	19.70	2.52	1.47	1.12	.77
H	0	0	0	0	0	0
I	12.70	1.34	12.58	15.95	2.24	1.71
J	0	0	1.12	.30	1.73	1.61
K	0	16.52	2.26	2.15	1.98	.67
L	1.13	.32	7.45	12.35	2.20	1.85
M	45.00	22.78	.20	.29	.77	.78
N	78.00	3.24	2.60	6.34	.99	1.71
O	68.00	8.95	1.59	.24	1.10	1.71
P	44.70	7.20	1.18	2.38	.99	1.96
Q	0	12.82	3.39	2.19	1.00	1.10
R	48.30	23.70	1.09	1.57	1.87	1.33
S	1.70	.37	9.01	8.71	1.65	1.40
T	0	0	0	0	0	0
U	0	0	4.71	0	0	0

Subject	Hand Stead. Pre-	Hand Stead. Post-	Hand-Eye Pre-	Hand-Eye Post-	Astrand L/Min. Pre-	Astrand L/Min. Post-
AA	23.10	.22	4.18	5.17	0	0
BB	9.80	1.71	2.54	9.32	2.40	1.77
CC	37.90	.06	1.06	.28	1.32	2.10
DD	0	0	2.56	3.77	0	0
EE	35.10	.23	4.01	6.43	1.80	1.25
FF	0	1.72	.39	1.03	0	0
GG	76.00	19.17	.55	.82	2.20	1.89
HH	73.40	9.86	1.42	2.10	0	0
II	10.50	4.18	4.44	14.93	1.00	1.04
JJ	61.00	21.40	2.76	2.79	2.30	1.46
KK	28.60	1.28	3.80	11.24	0	0
LL	13.25	1.58	7.51	5.23	2.20	.83
MM	64.10	7.02	5.70	8.09	0	0
NN	22.70	.49	7.30	11.41	2.00	2.60
OO	78.00	15.42	1.85	8.08	2.60	1.89
PP	32.80	3.45	4.40	6.91	1.50	1.27
QQ	0	3.41	6.78	2.08	.90	2.21
RR	27.50	1.02	3.02	.84	2.50	2.00
SS	76.00	14.05	1.26	1.41	2.10	2.04
TT	14.90	.70	4.58	3.30	2.20	1.80
UU	39.90	.46	3.37	3.10	0	0

Subject	Astrand ml/kg/m Pre-	Astrand ml/kg/m Post-	Astrand Rec - 1 Pre-	Astrand Rec - 1 Post-
A	41.70	25.00	83	82
B	35.30	23.00	88	65
C	26.30	18.00	113	67
D	0	0	0	0
E	43.70	30.00	96	87
F	42.30	31.00	96	61
G	20.80	8.00	90	63
H	0	0	0	0
I	39.50	26.00	103	68
J	34.50	29.00	82	71
K	69.90	12.00	139	72
L	64.80	28.00	95	72
M	22.60	19.00	99	84
N	12.40	20.00	86	72
O	22.30	34.00	79	68
P	19.90	35.00	88	85
Q	26.80	23.00	122	62
R	64.50	32.00	123	75
S	23.20	20.00	85	61
T	0	0	0	0

Subject	Astrand ml/kg/m Pre-	Astrand ml/kg/m Post-	Astrand Rec - 1 Pre-	Astrand Rec - 1 Post-
AA	0	0	0	0
BB	48.60	36.00	78	65
CC	19.80	32.00	74	59
DD	0	0	0	0
EE	39.30	25.00	72	65
FF	0	0	0	0
GG	28.40	22.00	80	84
HH	0	0	0	0
II	21.00	20.00	83	65
JJ	35.70	23.00	102	104
KK	0	0	0	0
LL	33.20	11.00	61	103
MM	0	0	0	0
NN	33.70	46.00	59	69
OO	46.30	34.00	76	89
PP	30.30	24.00	65	60
QQ	13.80	34.00	84	55
RR	43.40	36.00	106	94
SS	37.90	38.00	92	63
TT	30.90	23.00	72	51
UU	0	0	0	0

Subject	Astrand Rec - 2 Pre-	Astrand Rec - 2 Post-	Tricep Skin Pre-	Tricep Skin Post-	Abdom. Skin Pre-	Abdom. Skin Post-
A	82	91	18.00	17.20	22.20	13.20
B	91	72	8.20	7.20	9.00	10.40
C	113	77	6.40	9.20	6.20	7.00
D	0	0	34.00	33.60	36.20	32.00
E	92	92	9.20	8.00	9.60	8.20
F	96	70	14.20	18.60	8.40	16.00
G	89	68	23.00	19.40	39.80	33.00
H	0	0	27.20	22.00	24.80	24.50
I	106	75	9.20	9.80	11.20	17.20
J	83	90	29.20	15.80	36.60	50.00
K	139	75	11.40	7.60	6.80	7.40
L	93	82	22.40	12.60	41.60	46.00
M	102	94	9.40	6.60	5.60	6.40
N	87	75	34.60	21.00	59.80	27.60
O	95	81	22.40	17.80	22.60	22.00
P	103	100	16.80	13.00	26.40	29.80
Q	124	70	22.00	16.80	34.80	34.60
R	143	78	14.40	9.20	7.40	11.60
S	83	80	39.00	30.60	45.40	48.00
T	0	0	38.20	28.60	59.00	60.00
U	0	0	13.40	24.00	42.00	31.00

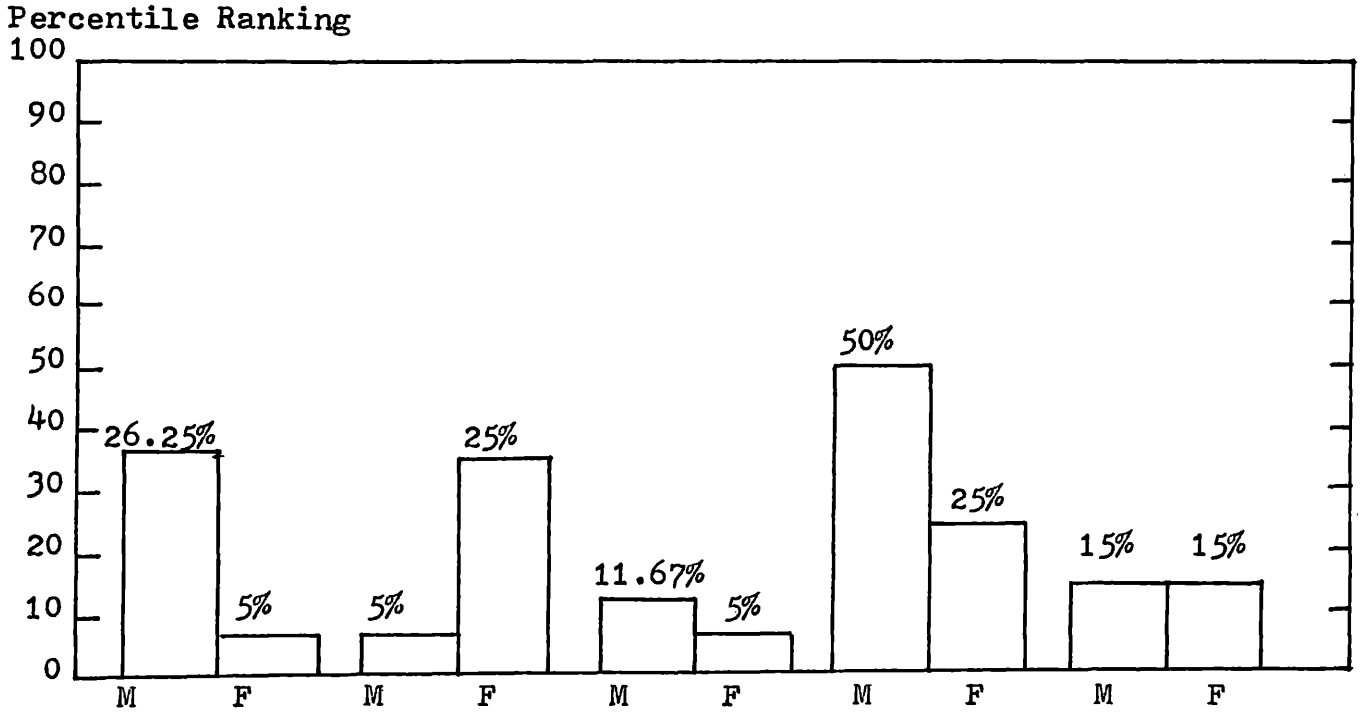
Subject	Astrand Rec - 2 Pre-	Astrand Rec - 2 Post-	Tricep Skin Pre-	Tricep Skin Post-	Abdom. Skin Pre-	Abdom. Skin Post-
AA	0	0	22.00	18.40	22.00	26.00
BB	94	68	7.60	7.40	9.40	11.40
CC	72	72	20.60	16.00	26.40	32.40
DD	0	0	0	0	0	0
EE	77	79	19.60	18.20	15.40	19.40
FF	0	0	0	0	0	0
GG	90	86	7.00	6.25	17.00	22.40
HH	0	0	0	0	0	0
II	88	74	13.80	13.20	14.00	12.60
JJ	108	118	43.40	36.80	30.20	36.60
KK	0	0	0	0	0	0
LL	76	117	18.20	19.00	27.20	26.40
MM	0	0	0	0	0	0
NN	71	80	20.40	9.80	23.00	9.80
OO	76	92	26.80	14.60	25.20	26.70
PP	73	62	26.20	27.80	31.00	34.00
QQ	92	57	30.20	31.40	26.40	28.00
RR	108	106	11.00	14.00	17.60	16.80
SS	94	68	5.80	5.00	11.00	12.00
TT	75	65	22.00	17.60	49.00	54.00
UU	0	0	0	0	0	0

APPENDIX L

COMPARISON OF MEAN SCORES TO NATIONAL NORMS OF HEIGHT FOR NORMAL ADOLESCENTS

APPENDIX L

Comparison of Mean Scores to National Norms of Height for Normal Adolescents



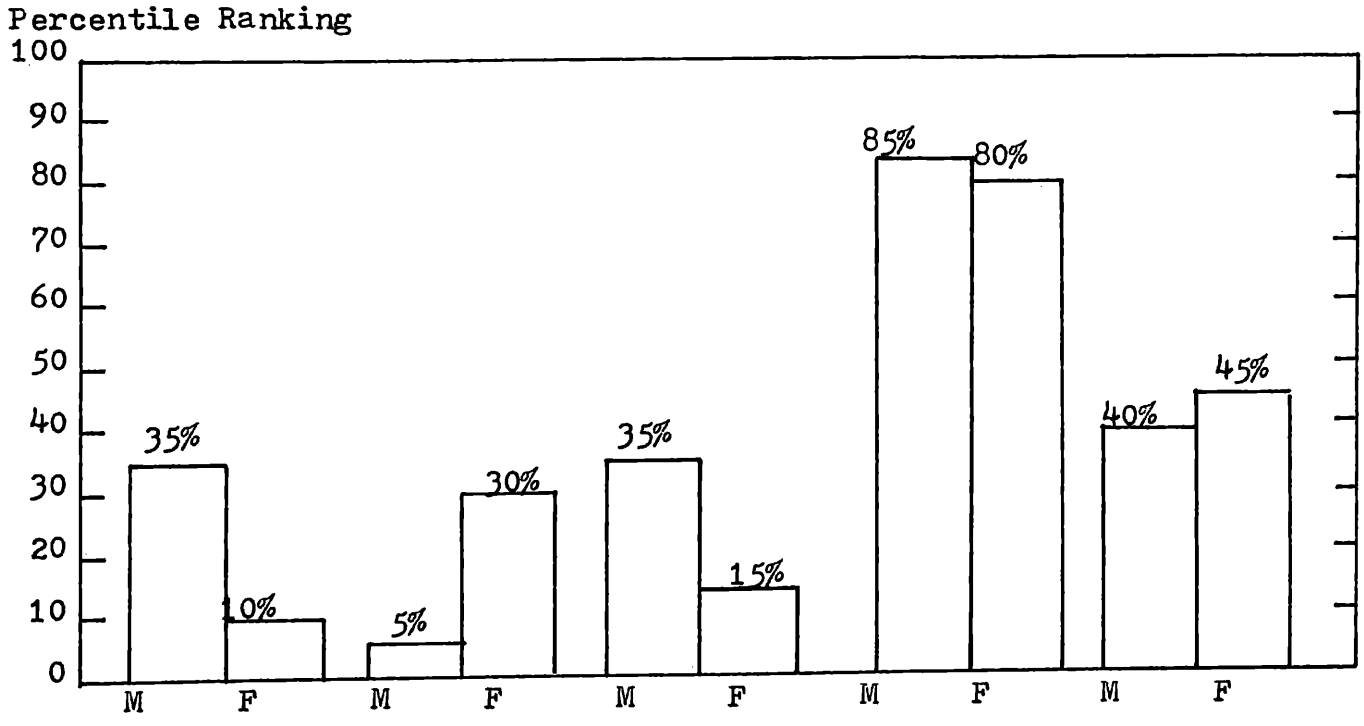
Sexes		M	F	M	F	M	F	M	F	M	F
Ages		14		15		16		17		18	
Norm $\bar{X}$		64.00	63.25	66.50	63.75	68.50	64.00	69.50	64.50	69.75	64.50
M.R. $\bar{X}$		60.69	54.50	55.50	58.42	63.06	55.75	60.00	62.00	65.17	60.63
N		4	1	1	2	3	2	1	1	4	2

APPENDIX M

COMPARISON OF MEAN SCORES TO NATIONAL NORMS OF HEIGHT FOR MENTALLY RETARDED ADOLESCENTS

APPENDIX M

Comparison of Mean Scores to National
Norms of Height for Mentally Retarded Adolescents



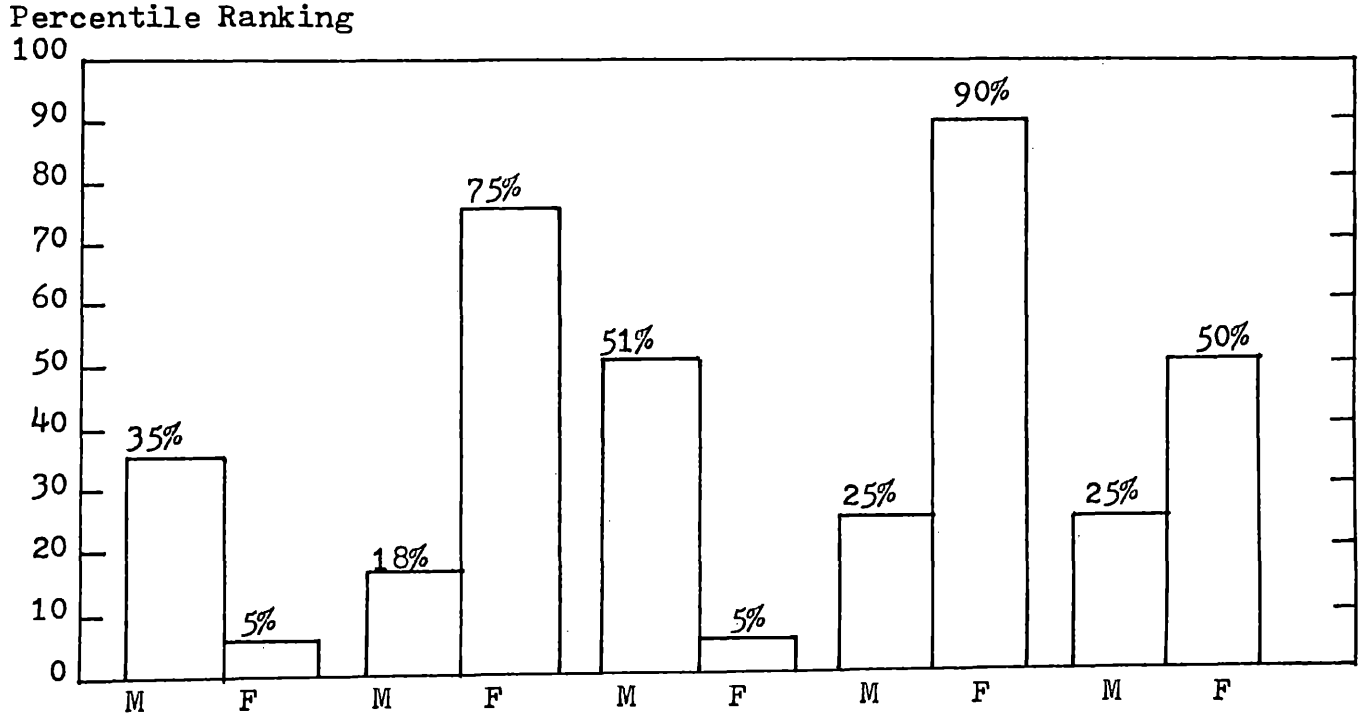
Sexes										
Ages	14		15		16		17		18	
Norm $\bar{X}$	62.50	60.00	64.50	60.50	64.75	60.50	65.50	59.75	66.00	62.25
M.R. $\bar{X}$	60.60	54.50	55.50	58.42	63.06	55.75	69.00	62.00	65.17	60.63
N	4	1	1	2	3	2	1	1	4	2

APPENDIX N

COMPARISON OF MEAN SCORES TO NATIONAL NORMS OF WEIGHT FOR NORMAL ADOLESCENTS

APPENDIX N

Comparison of Mean Scores to National Norms of Weight for Normal Adolescents



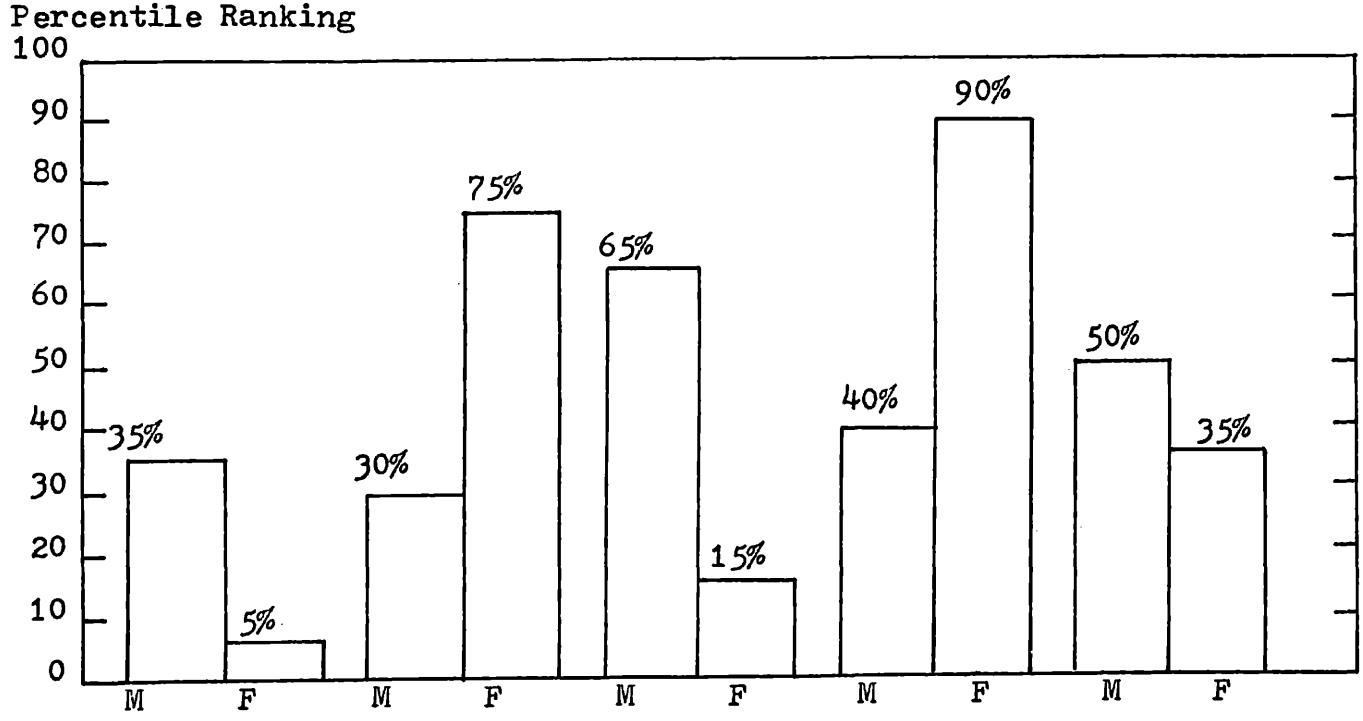
Sexes										
Ages	14		15		16		17		18	
Normal $\bar{X}$	112	110	124	118	136	124	146	125	152	125
M.R. $\bar{X}$	104	81	106	130	138	96	133	159	139	126
N	4	1	1	2	3	2	1	1	4	2

APPENDIX O

COMPARISON OF MEAN SCORES TO NATIONAL NORMS FOR WEIGHT FOR MENTALLY RETARDED ADOLESCENTS

APPENDIX O

Comparison of Mean Scores to National
Norms for Weight for Mentally Retarded Adolescents



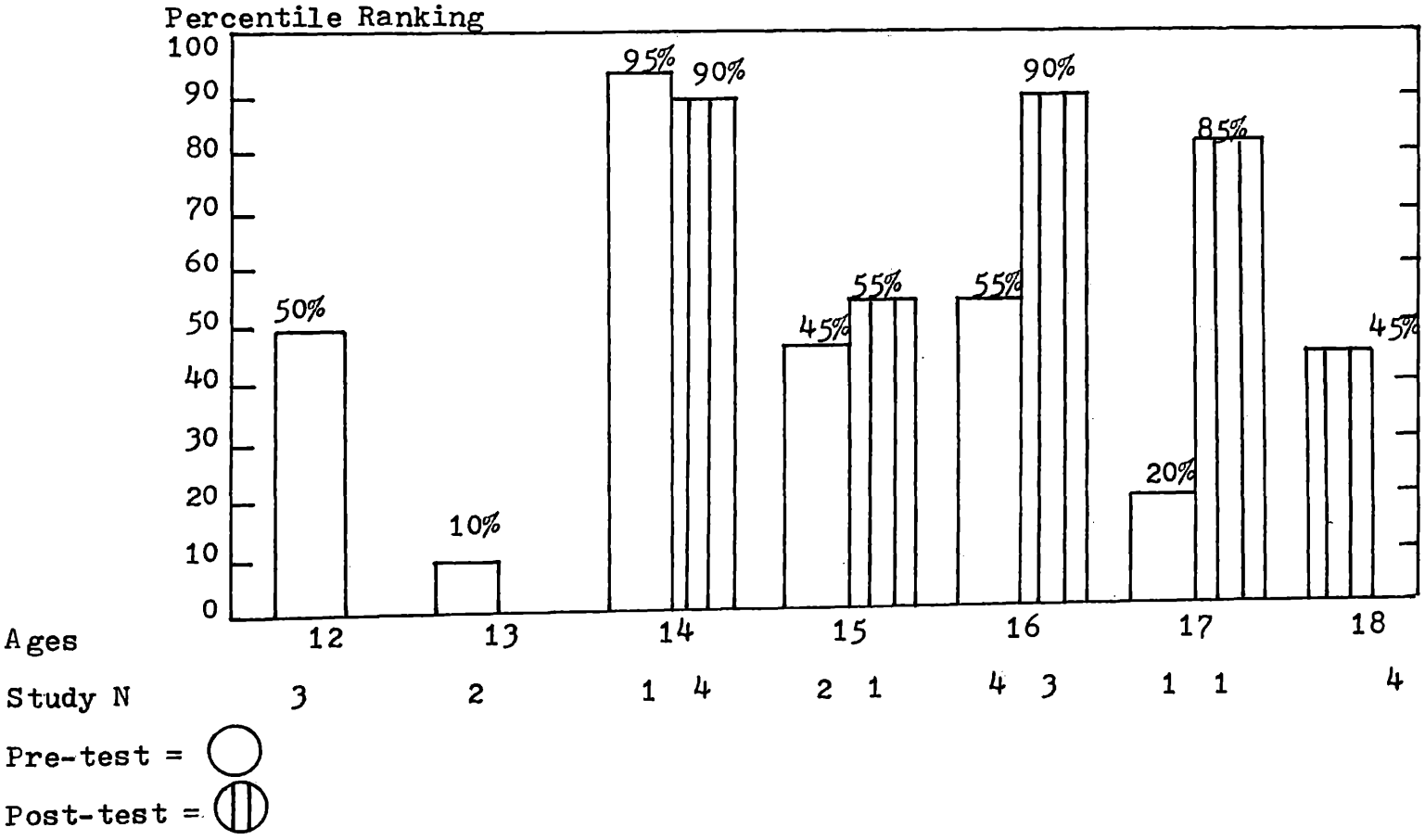
Ages	14		15		16		17		18	
Nat. M.R. $\bar{X}$	114	117	127	119	128	120	140	110	140	153
Study $\bar{X}$	104	86	106	130	139	96	133	159	139	126
N	4	1	1	2	3	2	1	1	4	2

APPENDIX P

COMPARISON OF MEAN SCORES TO NATIONAL NORMS OF FLEXIBILITY FOR MENTALLY RETARDED MALES AND FEMALES

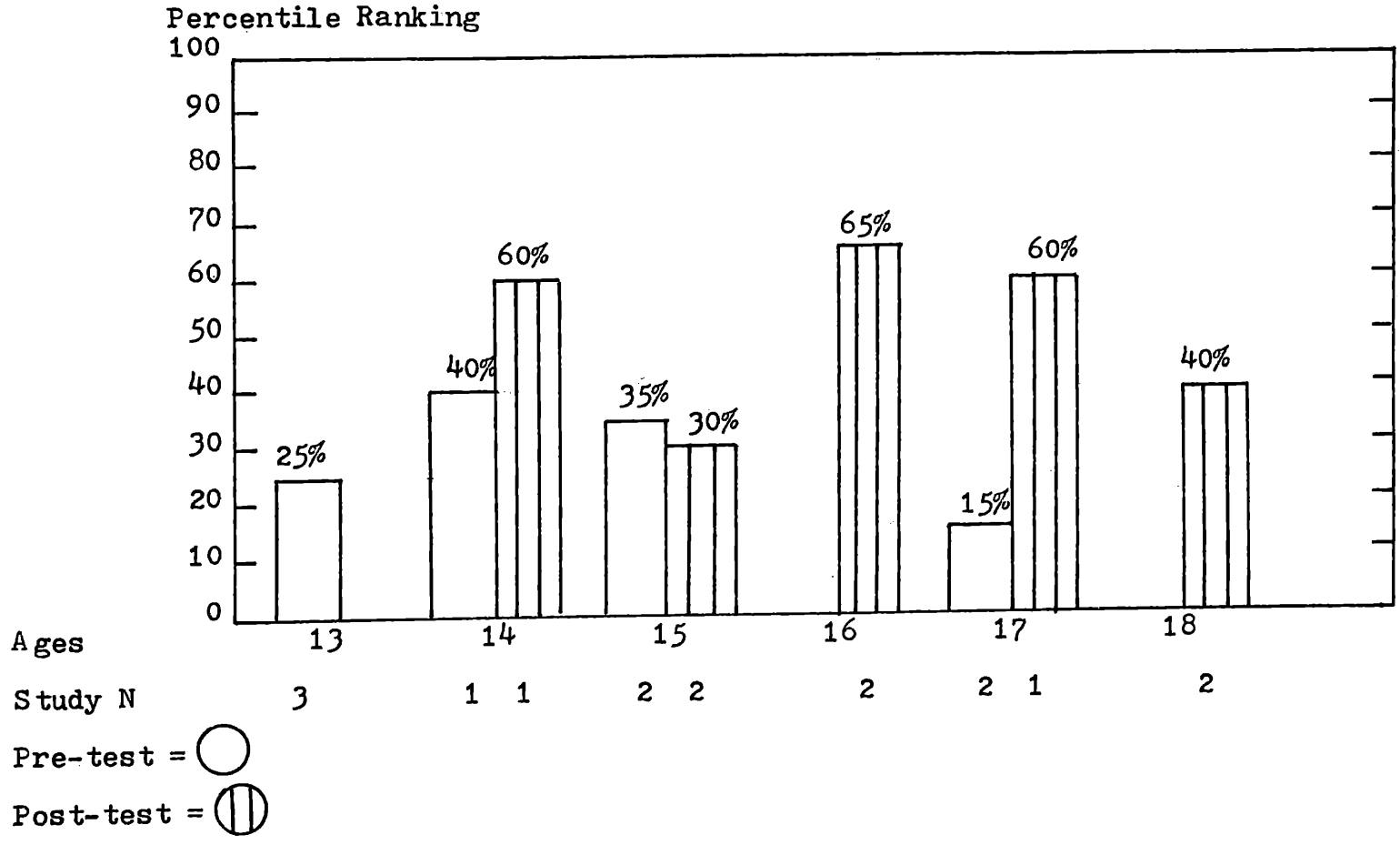
APPENDIX P

Comparison of Mean Scores to National
Norms of Flexibility for Mentally Retarded Males



APPENDIX P
continued

Comparison of Mean Scores to National
Norms of Flexibility for Mentally Retarded Females



APPENDIX Q

COMPARISON OF MEAN SCORES TO NORMS ESTABLISHED BY ASTRAND FOR MAXIMUM O_2 INTAKE FOR NORMAL CHILDREN

Pre-test - L./Min.

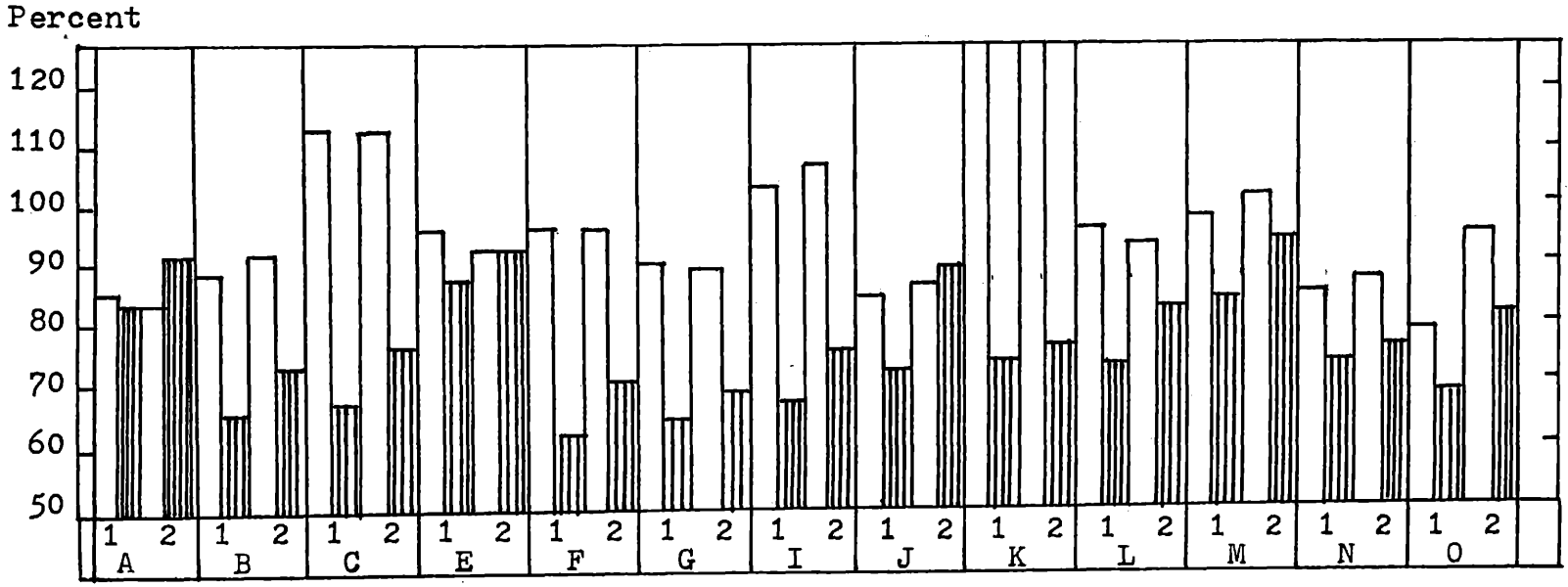
Females			Males		
Ages	Astrand $\bar{X}$	Study $\bar{X}$	Ages	Astrand $\bar{X}$	Study $\bar{X}$
12-13	2.31	1.84	12-13	2.46	1.20
14-15	2.58	1.84	14-15	2.53	1.60
16-17	2.71	1.73	16-18	3.68	1.59
		Post-test - L./Min.			
14-15	2.31	1.44	14-15	3.53	.78
16-17	2.58	1.25	16-18	3.68	1.72
		Pre-test - ml./kg./min.			
12-13	49.8	53.40	12-13	56.5	33.28
14-15	46.0	32.45	14-15	59.5	42.35
16-17	47.2	34.50	16-17	57.6	30.64
		Post-test - ml./kg./min.			
14-15	49.8	31.5	14-15	59.5	14.0
16-17	46.0	22.5	16-18	57.6	28.0
18	47.2	29.0			

APPENDIX R

COMPARISON OF PRE- AND POST-TEST INDIVIDUAL ASSESSMENT OF ASTRAND RECOVERY RATE FOR ONE AND TWO MINUTES

APPENDIX R

Comparison of Pre- and Post-test
Individual Assessment of Astrand Recovery
Rates for One and Two Minutes



1 = One Minute Recovery Rate

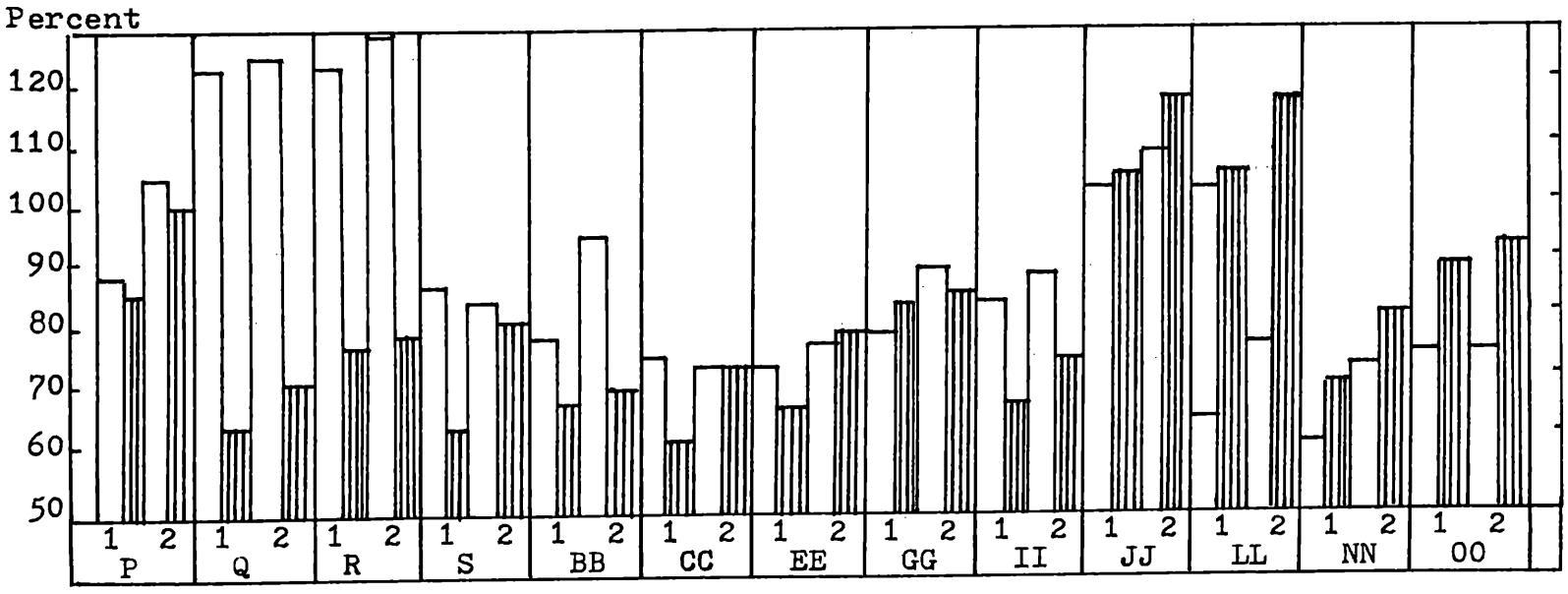
2 = Two Minute Recovery Rate

Letter = Subjects

Pre-test = ○

Post-test = ▨

APPENDIX R
continued



1 = One Minute Recovery Rate

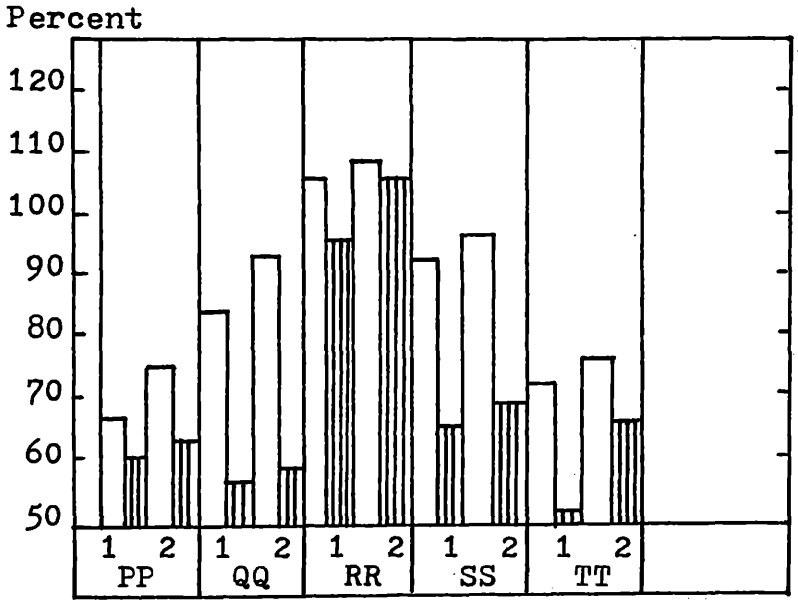
2 = Two Minute Recovery Rate

Letter = Subjects

Pre-test = ○

Post-test = ▨

APPENDIX R
continued



1 = One Minute Recovery Rate

2 = Two Minute Recovery Rate

Letter = Subjects

Pre-test =

Post-test =

APPENDIX S

COMPARISON OF MEAN SCORES TO NORMS OF TRICEPS SKINFOLD MEASUREMENTS FOR NORMAL SUBJECTS

APPENDIX S

Comparison of Mean Scores to Norms of Triceps Skinfold Measurements for Normal Subjects