The Effects of Participating in a Cross-Country Ski/Exercise Program Upon the Development of Physical and Motor Fitness in Mentally Retarded Adults

James T. Decker

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THE EFFECTS OF PARTICIPATING IN A CROSS-COUNTRY SKI/EXERCISE PROGRAM
UPON THE DEVELOPMENT OF PHYSICAL AND MOTOR FITNESS
IN MENTALLY RETARDED ADULTS

A Thesis
Presented to the Professional Studies Graduate Unit
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James T. Decker

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THE EFFECTS OF PARTICIPATING IN A CROSS-COUNTRY SKI/EXERCISE PROGRAM UPON THE DEVELOPMENT OF PHYSICAL AND MOTOR FITNESS IN MENTALLY RETARDED ADULTS

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This study compared the development of elements of physical and motor fitness in MR adults who participated in an eight week cross-country ski/exercise program with MR adults who did not participate in such a program. The subjects were 36 MR men and women ranging in age from 18 to 36 years and in IQ from 31 to 82. The subjects were pre- and post- tested using a modified version of the AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons. The data were analyzed using a repeated measures ANOVA for each variable and graphic post hoc analyses were calculated when interactions were significant in any of the ANOVAs. Results of the univariate analyses showed participation in the cross-country ski/exercise program did not significantly improve physical and motor fitness. On five of the seven test items (9-minute run, arm-hanging, shuttle run, long jump, and sit and reach) significant trial by group interaction effects provided evidence that the cross-country ski/exercise program was superior to the control group program (no adapted physical education) in maintaining physical and motor fitness levels. Results of this study are in accord with previous research which has indicated that MR individuals who are given programs of physical education benefit from such programs, and demonstrate a better rate of improvement than MR individuals who do not participate in physical education programs.
This Thesis is dedicated to the students of
the School of the Holy Childhood
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CHAPTER I

INTRODUCTION

Research over the past thirty years has demonstrated that mentally retarded individuals have led sheltered, unchallenged lives. In fact, it has been demonstrated that mentally retarded individuals have potential for growth in many areas which have been relatively untapped.

It has been well documented, (Howe, 1959; Francis and Rarick, 1959; Brace, 1961; Stein, 1965; Sengstock, 1966) that mentally retarded children fall significantly below normal children in tests of physical and motor fitness. In reaction to this finding many studies have been conducted to examine the effects of physical education and recreational training on mentally retarded children and adults. An abundance of studies, (Oliver, 1958; Stein, 1963; Funk, 1964; Corder, 1966; Bratten, 1976) have demonstrated that the physical and motor fitness of mentally retarded individuals can be improved through programs of physical education. Positive fitness gains have been recorded in programs employing weight training (Debick, 1979), fitness trial (McDougal, 1979) and aerobic dance (Barton, 1979).

Cross-country skiing has become one of the most popular winter activities in the United States. In addition to being enjoyable and easy to learn, it involves all the major muscle groups of the body, arms, back, abdomen, and chest. It is generally considered an excellent all around muscle toner and aerobic conditioner (Odmark, 1978).
It would seem that a cross-country ski/exercise program conducted for mentally retarded individuals would promote increased physical and motor fitness. In addition, the skills developed in such a program could be used in Special Olympic competition and for individual recreation.

Statement of the Problem

The purpose of this study was to determine the effects of participation in a cross-country ski/exercise program on the development of physical and motor fitness in mentally retarded adults.

Hypothesis

It was hypothesized that there would be an increase in physical and motor fitness in those mentally retarded adults who participated in the cross-country ski/exercise program.

Delimitations

The study was delimited to 36 mentally retarded adults enrolled in the Adult Day Training Program of the School of the Holy Childhood in Rochester, New York. The cross-country ski/exercise program was conducted for eight weeks with the experimental group meeting four times a week for 60 minutes each session. The measurement of physical and motor fitness was delimited to the AAHPER/Kennedy Foundation Special Fitness Test of the Mildly Mentally Retarded, although modified by the investigator.
Definition of Terms

Mental retardation - refers to significantly sub-average general intellectual functioning existing concurrently with deficits in adaptive behavior, and manifested during the developmental period (Grossman, 1973).

Mildly mentally retarded children/adults - have IQ's between 50 and 75, the capacity to acquire basic academic skills, a moderate degree of social adjustment, and satisfactory ability for self support (Grossman, 1973).

Moderately or trainable mentally retarded children/adults - have IQ's between 30-50, acquire basic skills of self care, social adjustment to the home and neighborhood, oral communication and a degree of economic usefulness in sheltered situations (Grossman, 1973).

Physical and motor fitness - For the purpose of this study the following elements of physical and motor fitness are applicable:

muscular endurance - is the ability of muscles to perform work (Clarke, 1976).

circulatory-respiratory endurance - is characterized by moderate contractions of large muscle groups for relatively long periods of time, during which maximal adjustments of the circulatory-respiratory system to the activity are necessary, as in distance running and swimming (Clarke, 1976).

muscular power - is the ability to release maximum muscular force in an explosive manner, that is, in the shortest possible time (Clarke, 1976).

agility - is speed in changing body positions or in changing directions (Clarke, 1976).

flexibility - is range of movement in a joint or a sequence of joints (Clarke, 1976).

Cross-country ski/exercise program - consisted of 60 minute sessions four times per week for eight weeks. The sessions were comprised of:

A) good weather routine (outside)
   1. warm-up (bent leg stretch, foot swing, straight leg toe touch, run in place)
   2. warm-up track skiing - 200 to 400 meters
   3. cross-country skiing over even terrain at individual pace for approximately 35 minutes, (approximately 2000 to 6000 meters).
B) bad weather routine (indoors)

1. five minute individual stretching
2. dry land skiing exercises (10 repetitions)
   a) calf lift
   b) Z-lean
   c) $\frac{1}{2}$ knees bend
   d) leg circles
   e) ski squats
   f) squat jumps
   g) leg lifts
   h) leg scissors
   i) side double leg lifts
3. simulated cross-country skiing in hallway for approximately 25 minutes (approximately 500 to 1000 meters).

Limitations

The following limitations of this study may affect the generalizability of the results:

1. The subjects selected represented a small sample of the population.
2. The investigator had no control over physical activities outside of the experimental environment.
3. The investigator had no control over the weather conditions.
CHAPTER II

REVIEW OF LITERATURE

A review of literature related to this study of the effects of participation in a cross-country ski/exercise program on the development of physical and motor fitness is presented under the following topics: (a) historical background of physical education for mentally retarded individuals, (b) components of physical and motor fitness, (c) physical and motor fitness of mentally retarded individuals, (d) effects of physical education programs on the fitness of mentally retarded individuals, (e) assessment of the physical and motor fitness of mentally retarded individuals, (f) exercise prescription, and (g) cross-country skiing.

Historical Background of Physical Education for Mentally Retarded Individuals

For many years mentally retarded persons were excluded and isolated from our society; however, the present trend is to integrate the mentally retarded back into our society (Barton, 1979). New programs concerning mentally retarded persons structure the emphasis on their ability rather than their disability (Dunn, 1976).

President John F. Kennedy was responsible in part for shedding light on the plight of the retarded. He set a goal for helping the mentally retarded of the nation. The president charged his panel on mental
retardation with:

...the responsibility...to explore the possibilities and pathways to prevent and cure mental retardation. No relevant discipline and no fact that will help achieve this goal is to be neglected (Kennedy, 1962).

The results of a 1966 national survey of public school administrators and teachers in schools having mentally retarded pupils cited the need for physical education. The investigator found that: 1) mentally retarded pupils received little or no special attention with respect to instruction in physical education and recreation; 2) in primary schools reporting, 35 percent of the retarded pupils received no physical education, and in elementary schools, 20 percent received no physical education; 3) facilities were meager; 4) a balanced physical education program was atypical rather than usual in both elementary and secondary schools; 5) health services were inadequate and left much to be desired; 6) more physical education teachers with special preparation in teaching the mentally retarded were needed (Brace, 1968).

In 1967 investigators conducted an extensive study, testing 4,235 educable mentally retarded children from 241 American public schools to determine motor performance and physical fitness levels using a modified version of the AAHPER Youth Fitness Test. The investigators noted that retarded children of both sexes were two to four years behind performance levels of normal children of similar age (Rarick, Widdop and Broadhead, 1967).

Organizations have contributed to improving conditions for the mentally retarded. In the 1950's, the Joseph P. Kennedy, Jr., Foundation was established to search for ways to prevent and eliminate retardation in the United States. Physical education and recreation programs have been supported by the Kennedy Foundation in a number of ways. It has conducted
workshops, financed research, supported camp programs, developed a Special Olympics program to encourage sports participation by the retarded, and disseminated information about physical education and recreation programs for the retarded (Drowatzky, 1971).

The American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) has aided in developing physical fitness test and award programs for mentally retarded individuals. In addition AAHPERD has published materials concerning activities for the retarded and compiled information about the funding of physical education and research in this area.

One investigator (Stein, 1963) found that there was almost a complete absence of research in the organic fitness of the mentally retarded. He encouraged well planned, carefully controlled, and scientifically executed experimental research to be conducted. He emphasized that this research be conducted on the effects of different types of program placements and specific activities in improving the fitness of mentally retarded individuals. In citing implications for research AAHPERD suggested the exploration of various physiological parameters in terms of effects/contributions/values of certain programs, activities, and modalities for retarded participants at various functional levels (AAHPERD, 1975).

Components of Physical and Motor Fitness

Physical educators, physicians, and physiologists have attempted to define physical fitness for many years. The literature abounds with both similar and varying views.

The President's Council on Physical Fitness and Sports (Physical Fitness Research Digest, July, 1971) has adopted the following definition of physical fitness:
...The ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies. Thus, physical fitness is the ability to last, to bear up, to withstand stress, and to persevere under difficult circumstances where an unfit person would quit. It is the opposite to become fatigued from ordinary efforts, to lacking energy to enter zestfully into life's activities, and to becoming exhausted from unexpected, demanding physical exertion (Clarke, 1971).

Recent research has shown that physical inactivity is associated with higher levels of hypertension, heart disease, diabetes, and lower back problems. This link between exercise and disease has led to a health-related view of physical fitness (Jackson et al., 1976). The definition of health-related physical fitness adopted by the AAHPERD is as follows:

...Physical fitness is a multi-faceted continuum that is affected by physical activity, and ranges from death at one end to the other extreme of optimal functional abilities in all aspects of life. Between the two extremes are severely limiting diseases related to physical activity and low to high levels of different physical fitnesses (AAHPERD, 1980).

The terms physical fitness and motor fitness are often used interchangeably, but motor fitness is actually the broader concept, including both physical fitness and motor ability factors (Baumgartner and Jackson, 1982). Clarke (1971) lists seven components that are used most often to define motor fitness:

1) Muscular strength. Characterized by the contraction power of the muscles, this capacity involves the amount of force a muscle can exert.

2) Muscular endurance. Characterized by the ability to perform work, this capacity involves performing a task to exhaustion.

3) Circulatory-respiratory endurance. Characterized by the moderate contractions of large muscle groups over long periods of time, for example, in running long distances.

4) Muscular power. The ability to release maximum muscular force in the shortest possible time, as in executing a standing long jump.
5) Agility. The ability to change body position or direction rapidly.
6) Speed. Rapidity of movement.
7) Flexibility. The range of movement in a joint or joints.

Physical and Motor Fitness of Mentally Retarded Individuals

Several studies have indicated that mentally retarded individuals, as a general rule, achieve below normal individuals on tests of physical and motor fitness. Francis and Rarick (1959) compared the gross motor abilities of 284 normal and mentally retarded children (ages 7 to 14 years and IQ's between 50-90). A battery of 11 motor performance tasks measuring strength, power, balance, and agility was administered. For strength, the results showed that both groups followed similar slope curves, although the mentally retarded children were significantly lagging behind the normal children at all age levels. On the tests for power and agility (standing broad jump and squat thrusts) the mentally retarded children were behind the normal children by six years. In running speed, again the retarded fell behind the normal children four years for both sexes. The authors concluded that mentally retarded children generally are two to four years behind the normal children in motor performance and that the discrepancy between the groups tends to increase with age.

Supportive results for Francis and Rarick's work were found by Brace (1961) when he used the AAHPER Youth Fitness test to assess physical fitness of mentally retarded boys. The test items included strength, speed, agility, power, coordination, and endurance. The author matched the results from the group he treated to the national norms, founded by AAHPER, and the results indicated the mentally retarded children to be 80 percent below the median of the national scale.
Sengstock (1966) compared AAHPER Physical Fitness Test item scores of educable mentally retarded children with those obtained by normal children of either the same chronological age or the same mental age. Thirty EMR boys (CA 10-11 to 15-4; IQ 60-80, MA 7-5 to 12-3) were compared with 30 intellectually normal boys of comparable chronological age (old normal CA 10-9 to 15-2; IQ 92-107; MA 10-0 to 15-10), and with 30 intellectually normal boys of comparable mental age (young normal CA 6-11 to 11-7; IQ 91 to 110; MA 7-3 to 12-2). Pertinent findings included: 1) physical fitness scores of EMR boys were inferior to those of the old normal group—analyses resulted in significant differences for all test items except for raw and percentile comparisons of pull-ups and for percentile comparisons of the 50-yard dash, and 2) physical fitness scores of the EMR boys were superior to those of the young normal group—analyses resulted in significant differences for all test items except sit-ups in which young normals surpassed the EMR group, and for pull-ups. Generally, performance of the EMR group was almost midway between mean performances of old normal and young normal groups.

In a research review of psychomotor function of the retarded Stein and Pangle (1966) included the following guidelines based on scientific knowledge: 1) for a given age, and sex, normal children were superior to mentally retarded youngsters on most measures of motor proficiency, 2) in spite of underachievement with respect to motor function, mentally retarded children were much closer to the norm physically then mentally, and 3) physical proficiency was improved in retarded children as a result of planned and systematic programs of physical education.

Drowatzky (1967) administered the Kraus-Weber test of minimum muscular fitness to 72 female trainable mentally retarded subjects. He found that
90 percent of these subjects were not able to pass the test battery and that most subjects experienced multiple failures. In a second study using trainable mentally retarded male subjects, Drowatzky (1968) found that 72 percent of the subjects were unable to pass the Kraus-Weber test with 62 percent experiencing multiple failures.

In the study previously mentioned, Rarick, Widdop, and Broadhead (1967) hoped to motivate schools to improve physical fitness programs for the mentally retarded. The investigators administered a modified AAHPER Youth Fitness Test in 21 states to mentally retarded boys and girls between the ages of 8 and 18 years and IQ's of 50 to 80. A pilot test prior to the study resulted in the following modifications: flexed arm hand substituted for pull-ups, one-minute time limit for sit-ups, and the 600-yard run/walk was cut back to 300 yards which was considered by the investigators to be sufficiently long to measure endurance. An analysis of the data resulted findings similar to previous studies with educable mentally retarded subjects, namely that EMR subjects were inferior to intellectually normal subjects in all aspects of fitness, regardless of age.

Rarick, and Dobbins (1972) conducted a 30 month investigation to determine the basic components in the motor performance of educable mentally retarded children. The investigators tested 261 EMR boys and girls (CA 6 - 13, and IQ 41 to 95) and 145 normal children of the same age and sex. After considerable preliminary investigation, 61 tests were selected for the following basic components: static muscular strength, explosive muscular strength, muscular strength-endurance, gross body coordination, cardio-respiratory endurance, limb-eye coordination, manual dexterity, static balance, dynamic balance, kinesthesis, flexibility, speed and coordination of gross limb movements, body fat, and body size. The investigators concluded that
EMR children were considerably less able in motor tasks requiring elements of muscular strength and power, gross and fine motor control, flexibility and balance than intellectually normal children of the same age and sex.

Rarick (1973) made the following remarks regarding the physical fitness of mentally retarded individuals:

Mental retardation is almost invariably accompanied by substandard levels of performance in both fine and gross motor skills. It is now well established that on standardized tests of motor performance, educable mentally retarded children will perform well below the average of intellectually normal children of the same age and sex.

**Effects of Physical Education Programs on the Fitness of Mentally Retarded Individuals**

Several studies have been conducted to investigate the effects of physical education training on mentally retarded subjects. Numerous researchers have demonstrated that the physical and motor fitness of mentally retarded individuals can be improved significantly through participation in specialized physical training programs. Examples of such research are discussed below.

Oliver (1958) studied the effects of physical conditioning exercises and activities on fitness levels and mental characteristics of two matched groups of 20 EMR boys (CA 13 to 15, IQ 54 to 86). The experimental group participated for ten weeks in a physical conditioning program and the control group continued their normal physical education classes. The experimental group improved significantly in all measures of athletic achievement, physical fitness, and strength. Also, there were significant increases in the IQ's of 25 percent of the experimental group while no significant improvements in IQ were reported in the control group.
Funk (1964) studied the effects of participation in a 30-minute physical education class on physical fitness and motor development in 18 trainable mentally retarded subjects, with a matched group of 18 trainable retarded subjects. The physical education program was run for 58 consecutive days and included such activities as: balancing, running, jumping, crawling, throwing, catching, calisthenics, games and relays. The results showed that the experimental group improved significantly on sit-up and shuttle run tests, although significant improvement was not shown in tests on straight arm hang, standing long jump and medicine ball throw.

Solomon and Prangle (1967) devised a systematic 45-minute physical education program that was broken up into 15-minute segments. The lessons consisted of 15-minutes of warm-up activities, 15-minutes of self-testing dual and relay activities, 15-minutes of teaching skills and game participation. The physical education program was given to 24 educable mentally retarded boys, ages 13 to 17, with a matched group of EMR boys as a control group. All subjects were given three items from the AAHPER Youth Fitness Test, pull-ups, sit-ups, and 50-yard dash. As a result of post-test and follow-up data obtained six weeks after the experimental period ended, the investigators concluded: 1) levels of physical fitness were significantly improved so as to allow for favorable comparisons with non-retarded children, and 2) significant gains demonstrated at the end of the experiment remained significant over a six-week post experiment follow-up period.

Rarick and Broadhead (1968) investigated the role of educational physical activity programs in modifying motor, intellectual, social, and emotional behavior of educable mentally retarded children. Subjects were 275 EMR children and 206 minimally brain injured children. All subjects were 6 to 13 years old and were given the AAHPER Special Fitness Test and selected strength items. Subjects were randomly assigned by disability and age to one of four treatments: 1) individually oriented physical activity
activity programs, 2) group oriented physical activity program, 3) art
programs to assess the Hawthorne effect, and 4) usual instructional pro-
grams as an experimental control. The following summarizes findings of the
research: 1) children who participated in one of the three specially
planned experimental programs exhibited significantly greater positive
changes in motor, intellectual, and emotional behavior than children
denied these opportunities, 2) of the specially planned experimental programs,
physical education programs proved to be superior in modifying motor perfor-
mance, the art program superior in modifying emotional behavior, and each
program played an equal role in modifying intellectual behavior of the
children, 3) the individually oriented physical education program was more
successful in eliciting changes in motor, intellectual, and emotional
behavior than the group oriented program.

As educators learn more about, and employ the elements needed, in special
physical training programs for the mentally retarded, the physical and
motor fitness performance of this population should continue to improve.

Assessment of the Physical and Motor Fitness of Mentally Retarded Individuals

Researchers have employed a variety of tests and modified test items
to evaluate the physical and motor fitness of mentally retarded individuals.
Problems associated with such testing are: 1) retarded individuals do not
comprehend what is expected of them, 2) retarded individuals with very low
fitness are not able to properly perform the test items, and 3) tests are
not appropriate and administerable in a field setting. To combat these
problems several tests have been developed. These are discussed below.

The Kraus-Weber Test of Minimum Muscular Fitness (Kraus and Hirshland,
1954) was designed to evaluate minimum levels of strength and flexibility
for certain key muscle groups. Jenny (1957) and Drowatzky (1971) advocated the use of the Kraus-Weber test for initial fitness screening of mentally retarded children. The test involved the following items: straight leg sit-ups (abdominal muscles), bent leg sit-ups (abdominal muscles, supine leg lifts (hip flexors), chest raise (upper back muscles, prone leg lifts (lower leg muscles), standing toe touches (length of back and hamstring muscles).

Hayden (1964) developed a test battery for severely mentally retarded children. Norms were provided for boys and girls aged 8 to 17. The battery involved the following items: hang for time (muscular endurance), 300-yard run (cardiorespiratory endurance), back extension (flexibility), medicine ball throw (muscular strength), and vertical jump (muscular power).

AAHPER (1968) in conjunction with the Joseph P. Kennedy Jr. Foundation modified the AAHPER Youth Fitness Test (1965) with a version entitled the Special Fitness Test for Mildly Mentally Retarded Persons. Modifications were made in three of the seven test items: 1) pull-up test for boys was eliminated and both boys and girls performed the flexed arm hand(arm and shoulder girdle endurance), 2) sit-up test for both boys and girls was changed from number of sit-ups in an unlimited time to number executed in sixty seconds (efficiency of abdominal and hip flexor muscles), and 3) 600-yard run-walk was changed for both sexes to the 300-yard run-walk (cardiovascular efficiency). Remaining test items included: shuttle run (speed and agility), standing long jump (explosive muscular power), 50-yard dash (speed), and softball throw for distance (skill and coordination). Norms were provided for boys and girls aged 8 to 18. This test has been used widely in studies evaluating the physical fitness of mildly mentally retarded subjects.

Fait (1972) developed the Physical Fitness Battery for Mentally Retarded Children. Norms have been established for trainable and educable
retardates within the 9 to 12, 13 to 16, and 17 - 20 year age groups.
The battery involves the following items: 25-yard run (speed), bent-arm
hang (static muscular endurance), leg lift (hip flexors), balance (static
balance), thrusts (agility), and 300-yard run-walk (cardiorespiratory endu-
rance).

Johnson and Londeree (1976) developed the Motor Fitness Test for
the Moderately Mentally Retarded. This test determines the psychomotor
ability of moderately retarded individuals and includes norms for both
sexes aged 6 to 20. The test items included are: flexed-arm hang (arm and
shoulder girdle strength), sit-ups in 30 seconds (efficiency of abdominal
and hip flexor muscles), standing long jump (muscular power), softball
throw for distance (muscular power and coordination), 50-yard dash (speed),
sitting bob-and-reaching (flexibility), hopping, skipping, tumbling, target
throw (developmental skill), and height and weight. The test is administered
individually, requires approximately 45 to 60 minutes and equipment needs
are minimal.

Of particular concern in testing the physical and motor fitness of mentally
retarded subjects is the cardiorespiratory component. Peries (1973) found
that few investigations have been conducted to ascertain the maximal or
sub-maximal level of cardiorespiratory fitness of mentally retarded children.

Barton (1959) found that up until 1966 the assessment of one's cardiorespiratory fitness was made using maximum oxygen uptake. Of course, this method
causes many problems such as equipment, special knowledge and is usually not
applicable to field settings. Falls et al. (1966) proposed the use of
specific motor fitness items from the AAHPER Youth Fitness Test as a predicator
in estimating maximal oxygen uptake. A group of 87 males ranging in age from
23 to 58 years participated in a five-month fitness program. Data was
collected on the following items: pull-ups, standing broad jump, sit-ups, 50-yard dash, 600-yard run-walk, shuttle run, medicine ball put, and drop off index; and Maximal oxygen uptake using the bicycle ergometer with the testing procedures from the Balke and Taylor's protocol. The results showed ±11.5 percent standard error of prediction between the maximal oxygen uptake and AAHPER tests. Astrand and Phyming (1954) had found an error of ±10 percent with their nomogram of estimates from heart rate and oxygen uptake values measured during submaximal bench-stepping or bicycle riding. It was concluded that the AAHPER Youth Fitness Test was a favorable method to estimate maximal oxygen uptake per kilogram of body weight.

Cumming and Keynes (1967) studied the relationship between maximal oxygen uptake and the Canadian Association for Health, Physical Education, and Recreation (CAHPER) test with 700 children ages ranging between 6 to 17 years. The CAHPER Test consisted of similar items to the AAHPER Youth Fitness Test which were: speed of sit-ups, standing broad jump, shuttle run, flexed-arm hang, 50-yard dash and 300-yard run. All 700 subjects were laboratory tested for maximal oxygen uptake on a bicycle ergometer and 497 of these subjects were also administered the CAHPER Test. The investigators found the CAHPER Test to represent between 30 to 60 percent of the variability for working capacity for boys and only 10 to 20 percent for girls. The two tests were found to be indirectly related because they were both dependent on the subject's body size. The authors concluded from the low percent values that the CAHPER test was not an efficient test to measure endurance, and the 300-yard run should be longer in duration to assess endurance fitness in children.

In investigating the development of cardiovascular fitness measures in preschool normal and mentally retarded children, Black (1974) administered five tests to 107 preschool children. The tests were: the Balke Treadmill
Test, 100-yard dash, shuttle run, a step test, and bent-knee sit-ups. Black concluded that none of the tests were appropriate for administration to mentally retarded children. Black recommended that additional cardiovascular fitness measures be developed for mentally retarded children and children under the age of five.

Running performance tests are employed, for example, in the following physical fitness batteries: AAHPER Youth Fitness Test, AAHPER Health Related Fitness Test, Texas Physical Fitness/Motor Ability Test and the South Carolina Physical Fitness Test. All of these tests include a running test of 600 yards to 1.5 miles in distance or 9 to 12 minutes in duration.

Cuerton (1982) found favorable correlation between the use of running tests and physical fitness in children. He found that in studies that have used samples of at least 25 children or adolescents and distance runs of approximately one mile or more in distance or 9 minutes or more in duration, correlations between distance running performance and $V_{O_2}^{max}$ ($ml:kg^{BW^{-1}}.min^{-1}$) have ranged from approximately .6 to .8.

Exercise Prescription

In order to have an exercise program be beneficial it must be well planned. The key to improving function is the total work or energy cost of the exercise program, which is expressed as: energy cost = frequency X intensity X duration (Pollock and Blair, 1981).

The American College of Sports Medicine has recommended the following guidelines, which have been approved by the Research Consortium of AAHPERD for the average healthy adult:

1. Frequency of training: 3 to 5 days per week.

2. Intensity of training: 60% to 90% of maximum heart rate or, 50% to 85% of maximum oxygen uptake ($V_{O_2}^{max}$).
3. Duration of training: 15 to 60 minutes of continuous aerobic activity...

4. Mode of activity: Any activity that uses large muscle groups, that can be maintained continuously, and is rhytmical and aerobic in nature, e.g. running-jogging...cross-country skiing (American College of Sports Medicine, 1978).

Cross-Country Skiing

Cross-country skiing is not only an enjoyable recreational pursuit, but also an excellent all-around conditioner that can contribute to general health and fitness in many ways. Cross-country skiing involves all the major muscle groups of the body, arms, legs, back, abdomen, and chest. It is this activity that contributes to overall physical fitness (Odmark, 1978). All these qualities make cross-country skiing an excellent lifetime recreational activity for mentally retarded individuals.

Another attribute of cross-country skiing is that it is relatively easy to learn. As compared with alpine skiing, the skis are thinner and lighter. The boots are simple and fastened to the skis only at the toes; thus the heel is completely free to lift off the ski. Also unlike Alpine skiing which was meant exclusively for downhill movement, cross-country equipment and techniques are intended to be used for both uphill and downhill (Brady, 1970).

Competitive cross-country skiers have been tested as having highly developed cardiorespiratory systems (Bergh, 1982). In Switzerland they have a motto, "Langlaufer Leben Langer" which is translated, "cross-country skiers live longer" (Bennett, 1973).

The Special Olympics Sports Skills Instructional Program (Joseph P. Kennedy Jr., Foundation, 1981) has developed an exercise program to
prepare individual for cross-country skiing (See Appendix C).

Summary of Related Literature

Mentally retarded individuals have been historically unchallenged, particularly in the area of physical education. It is well documented that mentally retarded children score below normal children in tests of physical and motor fitness. It is also well documented that such individual's physical and motor fitness can be improved through organized programs of physical education. Cross-country skiing is an excellent aerobic exercise and recreational activity. Cross-country ski/exercise programs involve the major muscle groups of the body. It would seem that a cross-country ski/exercise program would: 1) serve to improve the physical and motor fitness of mentally retarded individuals, and 2) prepare them to participate in an excellent lifetime recreational activity.
CHAPTER III

PROCEDURES

The purpose of this study was to determine the effects of a cross-country ski/exercise program on the development of physical and motor fitness in mentally retarded adults. The procedures used in this study are presented in the following manner: 1) administrative approval, 2) selection of subjects, 3) selection of instrumentation, 4) cross-country ski/exercise program, 5) collection of data, and 6) treatment of data.

Administrative Approval

The investigator presented a human subjects research review proposal to the Institutional Review Board for the Protection of Human Subjects of the State University of New York College at Brockport. The proposal was approved unanimously on 12/13/82. Sister Seraphine Herbst, Director of the School of the Holy Childhood, granted approval for the study to take place in the Adult Day Training Program at Holy Childhood (see Appendix A).

Selection of Subjects

The 36 subjects for the study were 14 male and 22 female clients enrolled in the Adult Day Training Program of the School of the Holy Childhood in Rochester, New York. The chosen participants ranged in age from 18 to 36 years, and in IQ from 31 to 92. See table 1 for the age, height, weight, and IQ of the participating subjects.
Table 1. Age, Height, Weight, and IQ of Subjects

<table>
<thead>
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<th>Subject</th>
<th>Age (Years)</th>
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<th>Weight (Pounds)</th>
<th>IQ</th>
</tr>
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<td>22</td>
<td>62.5</td>
<td>172.5</td>
<td>64</td>
</tr>
</tbody>
</table>

**Experimental Group**

| Group Mean | 21.38 | 62.47 | 144.21 | 59.81 |

<table>
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<tr>
<th>Subject</th>
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<th>Weight (Pounds)</th>
<th>IQ</th>
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<td>36</td>
<td>23</td>
<td>62.5</td>
<td>159.5</td>
<td>64</td>
</tr>
</tbody>
</table>

**Control Group**

| Group Mean | 23.06 | 59.81 | 131.38 | 47.81 |

Subjects 12, 17, 20, and 30 did not complete the study
All subjects were classified as mentally retarded or as having subnormal intelligence. None of the subjects had any physical disabilities which would prohibit participation in a cross-country ski/exercise program. Permission to be involved in the study was obtained from the subject's parent or guardian. A copy of the Informed Consent Form used to obtain permission appears in Appendix A.

Clients in the Adult Day Training Program participated in instructional classes in workshop, food service, woodshop, personal hygiene, survival skills, and adapted physical education. For the purposes of the study, the subjects were divided equally into two groups A) experimental, and B) control. The experimental group underwent the pre- and post-testing and participated in an eight week cross-country ski/exercise program. The control group underwent the pre- and post-testing. Additionally, all students participated in a weekly recreational swim and gym program. The program consisting of the following: 20 minutes of swim technique instruction, 20 minutes of free swim, and 40 minutes of group recreational games.

**Selection of Instrumentation**

A modified version of the AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons was used to evaluate the physical and motor fitness of all subjects. For the purposes of this study the following modifications were made: 1) straight leg sit-ups were changed to bent leg sit-ups, 2) the 300-yard run-walk was changed to the 9 minute run-walk, 3) the 50-yard dash was eliminated, and 4) the sit and reach was added.
Cross-Country Ski/Exercise Program

The cross-country ski/exercise program was divided into two elements: A) Good Weather Routine, and B) Bad Weather Routine. These elements are described below.

A) Good Weather Routine

Subjects performed the following:

- Change into cross-country ski clothes
- Carry skis and ski poles outside to skiing area (approximately 20 meters)
- Get snapped into ski bindings and perform five repetitions of the following warm-up exercise: bent-leg stretch, foot swing, straight-leg toe touch, and run-in-place (see Appendix C)
- Ski on the warm-up track for 200 to 400 meters
- Ski over even terrain, using prepared tracks, at individual pace for approximately 35 minutes (approximately 2000 to 6000 meters)
- Remove skis, return to building and change out of ski clothes

B) Bad Weather Routine

Subjects performed the following:

- Change into T-shirts, shorts, gym socks, and gym shoes
- Warm-up individually for five minutes using a variety of exercises (arm circles, shoulder rounds, alternate toe touches, trunk twists, and V-sit stretch)
- Dry land exercises (10 repetitions each)
  a) calf lift
  b) Z-lean
  c) \(\frac{1}{2}\) knee bends
  d) leg circles
  e) ski squats
  f) squat jumps
  g) leg lifts
  h) leg scissors
  i) double leg circles
  j) side double leg lifts
  (see Appendix C)
- Change into ski boots, snap into ski bindings and poles
- Simulated cross-country skiing in carpeted hallway for approximately 25 minutes (approximately 500 to 1000 meters)
- Change out of ski equipment and gym clothes

Ski/exercise classes were 60 minutes each with 15 minutes being spent in changing clothes and 45 minutes being spent in ski/exercise participation.

The experimental group was divided into three classes of six subjects each.
The classes were scheduled four times per week, however, the good weather routine was performed a maximum of three times per week. Bad weather routine was performed if the subjects had already performed the good weather routine three times in one week or when weather was unsuitable for outdoor skiing. See Appendix E for Bad Weather Criteria.

Collection of Data

The investigator administered the modified AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons to all subjects during the week prior to the start of the experimental program. Post-tests were administered by the investigator during the week following the experimental program to determine if any changes had occurred in each subject. The procedures used in giving the post-test were as similar as possible to those used in the pre-test.

Treatment of the Data

Subprogram P2V of the Biomedical Computer Programs (Brown, et al., 1977) was used for repeated measures ANOVA of each variable of the modified AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons. Subprogram ONEWAY of the Statistical Package for the Social Sciences (Nie, et al., 1975) was used for the generation of confidence intervals used for post hoc graphic analysis when interactions were significant in any of the ANOVAs.

The .05 level of significance was used throughout this study.
CHAPTER IV
ANALYSIS AND DISCUSSION

The purpose of this study was to determine the effects of a cross-country ski/exercise program on the development of physical and motor fitness in mentally retarded adults. Data was collected through administration of a modified version of the AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons prior to and following the cross-country ski/exercise program. The statistical procedures used in the analysis of these data included subprogram P2V of the Biomedical Computer Programs (Brown, et al., 1977) for repeated measures ANOVA and subprogram ONEWAY of the statistical Package for the Social Sciences (Nie, et al., 1975) for the generation of 95% confidence intervals used for post hoc graphic analysis when interactions were significant in any of the ANOVAs. It should be noted that four subjects withdrew from the study, two from the experimental group and two from the control group. Three subjects withdrew due to unrelated physical concerns and one subject left the Adult Day Training Program. It should also be noted that one subject in the experimental group did not perform the softball throw and one subject in the control group did not perform the long jump, both due to temporary medical contraindications. This chapter is presented in the following manner: 1) analysis of the data, and 2) discussion of results.
Analysis of the Data

Means and standard deviations for each of the seven test items were computed using subprogram P2V of the Biomedical Computer Programs (Brown, et al., 1977). A summary of these data is presented in Table 2.

Table 2. Means and Standard Deviations for all Seven Test Items

<table>
<thead>
<tr>
<th>Tests</th>
<th>Experimental Group</th>
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<tr>
<td></td>
<td>$\bar{X}$</td>
<td>$S$</td>
<td>$\bar{X}$</td>
<td>$S$</td>
</tr>
<tr>
<td>9-Minute Run (Yards)</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Long Jump (Inches)</td>
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<tr>
<td>Sit and Reach (Centimeters)</td>
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<tr>
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<td>28.75</td>
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<td>20.06</td>
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<td>Softball Throw (Inches)</td>
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<td>602.93</td>
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<tr>
<td>Post-test</td>
<td>600.80</td>
<td>176.48</td>
<td>400.63</td>
<td>129.84</td>
</tr>
</tbody>
</table>
The data presented in Table 2 indicates that the experimental group generally made higher scores than the control group on the seven test items. This may be partially explained by the fact that the experimental group members all had experience in cross-country skiing in previous years and tended to be "higher functioning" than the members of the control group. The experimental group slightly increased their post-test performance on five items which were: arm-hang, sit-ups, shuttle run, long jump, and sit and reach. Post-test scores indicate that the control group performance declined in six test items with the only slight improvement occurring in the sit-up test.

Repeated measures analysis with one grouping factor (group membership) and one trial factor (pre- and post-tests) was performed separately for each of the seven test items. In the presence of significant group by trial interaction a graphic analysis was done post hoc to interpret the interaction. Means were plotted with 95% confidence intervals. In the absence of significant interaction, significant group and/or trial differences are discussed in light of the mean values presented in Table 1. ANOVA results for each of the seven items follows.
9-Minute Run

The results of the ANOVA for the 9-minute run are presented in Table 3.

Table 3. ANOVA of 9-Minute Run Test Scores

<table>
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<tr>
<th>Source of Variation</th>
<th>SS</th>
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<td>1</td>
<td>39700.56</td>
<td>6.27</td>
</tr>
<tr>
<td>Error</td>
<td>189841.19</td>
<td>30</td>
<td>6328.04</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 3 indicates that there was a significant trial by group interaction on the 9-minute run. In an effort to explain this interaction a graphic analysis was performed and is presented in Figure 1.
Figure 1. Graphic Representation of the Group by Trials Interaction on the 9-Minute Run.

Figure 1 indicates that pre-test scores were not significantly different between the groups (confidence intervals overlap). Both groups decreased in performance on the post-test, although not significantly. However, the control group did score significantly lower than the experimental group on the post-test. This is a combination of the control groups initial lower score than the experimental group, and it's decrease in performance. This indicated that the experimental group maintained more of their circulatory-respiratory endurance than did the control group.
Arm-Hang

The results of the ANOVA for the arm-hang are presented in Table 4.

Table 4. ANOVA of Arm-Hang Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>749.39</td>
<td>1</td>
<td>749.39</td>
<td>6.60*</td>
</tr>
<tr>
<td>Error</td>
<td>3406.97</td>
<td>30</td>
<td>113.57</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>50.77</td>
<td>1</td>
<td>50.77</td>
<td>8.62*</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>58.14</td>
<td>1</td>
<td>58.14</td>
<td>9.88*</td>
</tr>
<tr>
<td>Error</td>
<td>176.59</td>
<td>30</td>
<td>5.89</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 4 indicates that there was a significant trial by group interaction on the arm-hang. In an effort to explain this interaction a graphic analysis was performed and is presented in Figure 2.
Figure 2. Graphic Representation of the Group by Trials Interaction on the Arm-Hang.

Figure 2 indicates that there was not a significant difference between the experimental group and the control on the pre-test. The experimental group improved on the post-test and the control group decreased in performance on the post-test, although neither group did so significantly. However, the experimental group did significantly outperform the control group on the post-test. This is a combination of the control groups' initial low scores and the increase in performance of the experimental group.
Sit-up

The results of the ANOVA for the sit-up test are presented in Table 5.

Table 5. ANOVA of Sit-Up Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>1016.02</td>
<td>1</td>
<td>1016.02</td>
<td>5.88*</td>
</tr>
<tr>
<td>Error</td>
<td>5180.09</td>
<td>30</td>
<td>172.67</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>40.64</td>
<td>1</td>
<td>40.64</td>
<td>5.10*</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>6.89</td>
<td>1</td>
<td>6.89</td>
<td>.87</td>
</tr>
<tr>
<td>Error</td>
<td>238.97</td>
<td>30</td>
<td>7.97</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 5 indicates that the main effects of group membership and trials were significant on the sit-up test. According to this analysis the experimental group made significantly higher scores than the control group on both pre- and post-tests and both groups improved over time. However, since the improvement of the control group was less than 1 sit-up (.93), the significant trial effect observed may be due to a Type I error. The occurrence of a Type I error is possible especially in light of the relatively large number of comparisons necessary in seven univariate analyses.
Shuttle Run

The results of the ANOVA for the shuttle run are presented in Table 6.

Table 6. ANOVA of Shuttle Run Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>162.88</td>
<td>1</td>
<td>162.88</td>
<td>9.34*</td>
</tr>
<tr>
<td>Error</td>
<td>523.25</td>
<td>30</td>
<td>17.44</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>2.60</td>
<td>1</td>
<td>2.60</td>
<td>3.41</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>5.35</td>
<td>1</td>
<td>5.35</td>
<td>7.02*</td>
</tr>
<tr>
<td>Error</td>
<td>22.86</td>
<td>30</td>
<td>.76</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 6 indicates that there was a significant trial by group interaction on the shuttle run. In an effort to explain this interaction a graphic analysis was performed and is presented in Figure 3.
Figure 3. Graphic Representation of the Group by Trials Interaction on the Shuttle Run.

Figure 3 indicates that there was not a significant difference between the experimental group and the control group on the pre-test. The experimental group improved slightly and the control group's performance declined on the post-test, although neither change was significant. However, there was a significant difference between the groups on the post-test. This is a combination of the initial low score of the control group and the decline in performance. This indicates that members of the experimental group maintained more of their agility than members of the control group.
Long Jump

The results of the ANOVA of the long jump are presented in Table 7.

Table 7. ANOVA of Long Jump Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>2963.01</td>
<td>1</td>
<td>2963.01</td>
<td>8.77*</td>
</tr>
<tr>
<td>Error</td>
<td>9795.67</td>
<td>29</td>
<td>337.78</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>222.12</td>
<td>1</td>
<td>222.12</td>
<td>10.34*</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>325.86</td>
<td>1</td>
<td>325.86</td>
<td>15.17*</td>
</tr>
<tr>
<td>Error</td>
<td>623.08</td>
<td>29</td>
<td>21.49</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 7 indicates that there was a significant trial by group interaction on the long jump. In an effort to explain this interaction a graphic analysis was performed and is presented in Figure 4.
Figure 4. Graphic Representation of the Group by Trials Interaction on the Long Jump

Figure 4 indicates that there was not a significant difference between the experimental group and the control group on the pre-test. The experimental group improved in performance and the control group declined in performance on the post-test, although neither change was significant. However, the post-test scores show a significant difference between the groups. This can be accounted for by the initial difference in scores combined with the performance decrease in the control group and the performance increase in the experimental group. This indicates that the experimental group maintained better explosive muscular power than the control group.
Sit and Reach

The results of the ANOVA for the sit and reach are presented in Table 8.

Table 8. ANOVA of Sit and Reach Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>618.77</td>
<td>1</td>
<td>618.77</td>
<td>3.15</td>
</tr>
<tr>
<td>Error</td>
<td>5900.72</td>
<td>30</td>
<td>196.69</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>21.39</td>
<td>1</td>
<td>21.39</td>
<td>1.06</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>97.52</td>
<td>1</td>
<td>97.52</td>
<td>4.82*</td>
</tr>
<tr>
<td>Error</td>
<td>606.59</td>
<td>30</td>
<td>20.22</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Table 8 indicates that there was a significant trial by group interaction on the sit and reach test. In an effort to explain this interaction a graphic analysis was performed and is presented in Figure 5.
Figure 5. Graphic Representation of the Group by Trials Interaction on the Sit and Reach

Figure 5 indicates no significant differences between the groups of subjects on the test trials on the sit and reach. Apparently the significant interaction is due to the fact that the experimental group improved slightly and the control group declined slightly, so that the slopes of the lines are dissimilar. This pattern was also demonstrated in the arm-hang, shuttle run, and in the long jump, although on each of those items a significant difference emerged on the post-test.
Softball Throw

The results of the ANOVA for the softball throw are presented in Table 9.

Table 9. ANOVA of Softball Throw Test Scores

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group Membership</td>
<td>557816.08</td>
<td>1</td>
<td>557816.08</td>
<td>11.61*</td>
</tr>
<tr>
<td>Error</td>
<td>1393567.34</td>
<td>29</td>
<td>1393567.34</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>2420.97</td>
<td>1</td>
<td>2420.97</td>
<td>.70</td>
</tr>
<tr>
<td>Trials X Group</td>
<td>1665.36</td>
<td>1</td>
<td>1665.36</td>
<td>.48</td>
</tr>
<tr>
<td>Error</td>
<td>100055.74</td>
<td>29</td>
<td>3450.20</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level

Analysis of variance showed no significant interaction or trial effects on this sub-test. The performance of the experimental group was superior to that of the control group on both pre- and post-test measures as indicated by the significant main effect of group membership. Both groups decreased in performance on the post-test, although not significantly. This indicates that the cross-country ski/exercise program did not significantly improve the skill and coordination of the subjects.
Discussion of Results

The investigator's hypothesis, that the participants in the cross-country ski/exercise program would show significant improvement in physical and motor fitness test scores was generally not supported. The experimental group demonstrated a significant increase in only one test item, sit-ups, however, the control group also demonstrated a significant increase in this item. This result may be due in part to unseasonable weather conditions. The Rochester area experienced considerably less snowfall over the experimental period than had occurred during the same period in recent years (See Appendix F). Due to the lack of snow the good weather routine (outside) of the cross-country ski/exercise program was performed only six times over the eight week period. At all other times the bad weather routine (indoors) was followed. Table 10 presents the number of times each routine was performed.

Table 10. Exercise Routines Performed

<table>
<thead>
<tr>
<th>Number of Classes</th>
<th>Good Weather Routine</th>
<th>Bad Weather Routine</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Classes</td>
<td>6</td>
<td>26</td>
<td>32</td>
</tr>
<tr>
<td>Percentage of Classes</td>
<td>19%</td>
<td>81%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 10 indicates that the bad weather routine comprised over 80 percent of the cross-country ski/exercise program classes. It is the investigator's belief that had weather conditions allowed for more actual skiing the physical and motor fitness of the experiential group would have significantly improved.
Analysis of the data did reveal several patterns. In all seven test items the control group scored lower than the experimental group, although not significantly, in both pre- and post-test scores. This suggests that the control group as a whole was of lower physical and motor fitness initially and did not improve. In four items: the arm-hang, shuttle run, long jump, and sit and reach, the experimental group demonstrated a slight improvement in performance while the control group demonstrated a slight decrease in performance. In five of the test items: the 9-minute run, arm-hang, long jump, shuttle run, and sit and reach there was a trial by group interaction. In all but the sit and reach the interaction resulted in a significant difference in post-test scores between the groups. These interactions are a combination of: 1) the control group having lower scores than the experimental group initially, and 2) the experimental group having a slight increase in scores while the control group had a slight decrease in scores.

It should be noted that all subjects participated in a weekly recreational swim and gym program prior to and during the experimental period. It should also be noted that all subjects participated in Adapted Physical Education (A.P.E.) classes prior to the start of the study. During the experimental period the control group had no instruction in Adapted Physical Education while the cross-country ski/exercise program served as A.P.E. class for the experimental group.

Although the experimental group did not significantly improve in performance it did maintain better levels of physical and motor fitness than the control group. The significant interaction observed indicated that the slopes of the pre- and post-test performance lines were not equal. This is due to a combination of the following: 1) a slight increase or
maintenance in experimental group performance, and 2) a slight decrease in control group performance. This result supports the evidence in the literature that mentally retarded individuals who are given programs of physical education benefit from such programs (Oliver, 1958; Funk, 1964; Solomon and Pangle, 1967; and Rarick and Broadhead, 1968).

The results of the study also indicate that the rate of improvement for the experimental group was better than the control group. Possibly if the cross-country ski/exercise program had run longer, or been slightly more intense (possibly more outdoor skiing sessions) the post-test scores of the experimental group might have been significantly higher than their pre-test scores.

Another factor which possibly influenced the outcome of this study was the physical activities of the subjects outside of the experimental environment. This factor was neither controlled or surveyed.
CHAPTER V
SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The problem addressed by this study was to investigate the effects of a cross-country ski/exercise program on the development of physical and motor fitness of mentally retarded adults. This chapter is presented under the following topics: 1) summary of procedures, 2) summary of findings, 3) conclusions, 4) implications, 5) recommendations for further study.

Summary of Procedures

Thirty six mentally retarded adults, ranging in age from 18 to 36 years were assigned to two groups, one experimental (N=18) and one control (N=18). The experimental group underwent an eight week cross-country ski/exercise program and the control group received no program of physical education (all subjects participated in a weekly recreational swim and gym program). The cross-country ski/exercise program consisted of four 60 minute sessions per week of either actual skiing and exercise outdoors or exercise and simulated exercise (skiing) indoors.

A modified version of the AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons was used to determine physical and motor fitness. The physical and motor fitness test items included: 9-minute run, arm-hang, sit-ups, shuttle run, long jump, sit and reach, and softball throw. This test was administered to all subjects prior to and following the cross-country ski/exercise program to detect changes in levels of physical and motor fitness.

Subprogram P2V of the Biomedical Computer Programs was used for repeated ANOVA analysis of each test variable. Subprogram ONEWAY of the
Statistical Package for the Social Sciences was used for the generation of confidence intervals used for post hoc analysis when interactions were significant in any of the ANOVAs. The .05 level of significance was used throughout the study.

Summary of Findings

Based on the analysis of data in this study, and in light of the hypothesis tested, the following findings are present:

1. Results of the modified AAHPER/Kennedy Foundation Special Fitness Test for Mildly Mentally Retarded Persons indicated that the post-test scores of participants did not improve significantly over the pre-test scores on any of the seven test items. The hypothesis that the cross-country ski/exercise program would yield significant gains in physical and motor fitness was not supported.

2. On five of the seven test items (9-minute run, arm-hang, shuttle run, long jump, and sit and reach) significant trial by group interaction effects provided evidence that the cross-country ski/exercise program was superior to the control group program in maintaining physical and motor fitness levels.

Conclusions

Within the limitations of this study the following conclusions appear to be justifiable:

1. Participation in a cross-country ski/exercise program maintains levels of performance in elements of physical and motor fitness in mentally retarded adults.

2. The physical and motor fitness of mentally retarded adults who are accustomed to participation in an Adapted Physical Education
program tends to decline, although not significantly when participation in such a program is stopped.

Implications

The results of this study appear to have several implications for professionals in physical education working with mentally retarded individuals. This study demonstrated that a cross-country ski/exercise program can be conducted indoors when weather conditions are unfavorable for outdoor skiing. Further, it demonstrates that the physical and motor fitness of mentally retarded individuals can be maintained through a cross-country ski/exercise program held primarily indoors. It is also hypothesized that a cross-country ski/exercise program held in favorable weather conditions outdoors may prove to be more beneficial to such individuals.

The results of this study also indicate that when mentally retarded individuals who are accustomed to a program of Adapted Physical Education are removed from such a program their physical and motor fitness tends to decline. This supports the findings of several researchers that planned, systematic and progressive programs of physical education can improve the physical and motor fitness of mentally retarded individuals.

This study also demonstrated that the mentally retarded subjects involved in this study successfully and safely participated in the 9-minute run test. Currently most physical and motor fitness tests for mentally retarded individuals incorporate run-walk tests (cardiorespiratory endurance) of 300 yards. Possibly, mentally retarded individuals are able to withstand more rigorous running endurance tests without negative affects.

It is clearly demonstrated in this study that mentally retarded individuals can master the basic skills of cross-country skiing and that
this sport can become a lifetime recreational pursuit for such individuals.

Recommendations for Further Study

The following recommendations for further study were based on the findings of this study:

1. A similar study should be conducted under favorable weather conditions as to allow outdoor cross-country skiing.

2. A similar study should be conducted in which the initial physical and motor fitness levels of the subjects in the experimental and control group are matched.

3. A similar study be conducted in which the subjects are divided into three equal groups: a) experimental group-receiving the cross-country ski/exercise program, b) control group-receiving an Adapted Physical Education program, and c) no-treatment group-continuing normal daily routines.
BIBLIOGRAPHY


Dunn, John M. "Mainstreaming: Definition, Rationale and Implications for Physical Education," In Mainstreaming Physical Education, NAPECW and NCPEAM, Briefings, April, 1976.


APPENDIX A

LETTERS
December 8, 1982

To Whom It May Concern:

This is to certify that permission has been granted to Jim Decker to conduct a study at the School of the Holy Childhood to determine the effects of participation in a cross-country ski program upon the development of physical fitness in mentally retarded adults.

Jim has worked at the School for four years and has been teaching our handicapped adults cross-country skiing. He also is keenly interested in the physical fitness of these same students and has tested and charted their progress on many occasions. He has always been found to observe safety precautions for our students in instructional situations and does not expose our clients to undue risks.

We look forward to following Jim's progress in this study.

Respectfully,

Sister Seraphine Herbst
Director

1150 Buffalo Road, Rochester, New York 14624
December 14, 1982

Dear Parents/Guardians,

At the present time I am attempting to complete my master's degree in Adapted Physical Education. To accomplish this I am writing a thesis on the effects of our cross-country ski program on physical fitness. Two groups will be used, a skiing group and a non-skiing group. Both groups will have their physical fitness tested, once in December and again in March.

Your son/daughter would be in the ____________ group.

It is important to know that (1) we have used this same physical fitness test many times; (2) the cross-country ski program will be essentially the same as it has been over the past years; (3) your son/daughter's name will be kept confidential.

For your son/daughter to be included in this study I must have the accompanying Informed Consent Form signed by you, (required by S.U.N.Y. at Brockport). I respectfully request your signature on this form.

If you have any questions at all, please call me at school

Thank you.

Jim Decker
December 21, 1982

Dear Parents/Guardians:

When we return from Christmas vacation we will be starting our cross-country ski unit. I am sending you this note now so that you can be prepared to bring in the necessary clothing on Monday, January 3. In this way we will be able to begin skiing as soon as possible.

Bringing in the following items will help make skiing enjoyable and comfortable.

1. A complete set of long underwear (thermal)
2. Two pairs of socks (one pair cotton, one pair wool, if possible)
3. A heavy sweater (turtleneck) or sweat shirt (hooded)
4. A pair of old jeans or corduroys
5. An insulated jacket or vest
6. A set of warm gloves
7. A knit hat

If you do not have any of these items, please let me know. I have several extra pieces of ski clothes which may be used.

The cross-country ski unit will run eight weeks. It is advised that the above clothing be brought to school and clothes that require cleaning be brought home each Friday. If you have any questions or concerns, please feel free to call me at [REDACTED]

Thank you for your cooperation,

Jim Decker
APPENDIX B

INFORMED CONSENT FORM
TITLE OF THE PROJECT. The Effects of Participating in a Cross-Country Skiing Program Upon the Development of Physical Fitness in Mentally Retarded Adults.

NAME OF RESEARCHER. James T. Decker.

INSTITUTION. S.U.N.Y. College at Brockport.

I would like to request the participation of your son/daughter in this research project. The purpose of this project is to see if participating in a cross-country ski program will increase the physical fitness of your son/daughter. It is hypothesised that such a program will increase physical fitness.

Two groups (approximately 40 people), Group A (experimental) and Group B (control) will be used. Your son/daughter was selected for this study because they are a member of the Adult Day Training Program of the School of the Holy Childhood and because they meet the medical requirements of either group A or B.

Your son/daughter would participate in group ______.

For participation in Group A see the following.

(GROUP B PARTICIPANTS SKIP THIS SECTION)

If you decide to have your son/daughter participate they will be asked to:

a. Perform a physical fitness test at the beginning of the program and again at the end of the program.
   1. The physical fitness test will include the following elements:
      9-minute run/walk (indoors) flexed arm hang, sit-up (60 seconds), shuttle run, standing long jump and softball throw, sit and reach
   b. Participate in an eight week cross-country ski program (skiing three times a week for forty-five minutes per class).

Your son/daughter's participation will result in the following benefits:

a. He/she will be taught the skill of cross-country skiing.
b. He/she will exercise three times per week throughout the program.
c. He/she will be involved in a social/recreational activity with their peers.
d. He/she will be able to see if they improved their physical fitness.

It is possible that the following risks may be involved:

a. In any exercise program and physical fitness test there is always the possibility of injury due to the nature of the activity.
b. Specific injury risks pertinent to this project are: strained muscle, falling while skiing, catching a cold.
For participation in Group B see the following.

(GROUP A PARTICIPANTS SKIP THIS SECTION)

If you decide to have your son/daughter participate they will be asked to:

a. Perform a physical fitness test at the beginning of the program and again at the end of the program (eight weeks later).
   1. The physical fitness test will include the following elements:
      9-minute run/walk (indoors) flexed arm hang, sit-up, sit & reach (60 seconds), shuttle run, standing long jump and softball throw.

(Your son/daughter will not participate in Cross-Country Skiing)

Your son/daughter participation will result in the following benefits:

a. He/she will have their physical fitness evaluated.
b. He/she will be able to see if they improved their physical fitness over the intervening period.

It is possible that the following risks may be involved:

a. In any physical fitness test there is always the possibility of injury due to the nature of the activity.
b. Specific injury risks pertinent to project is muscle strain.

Your son/daughter's participation in this project is completely voluntary. That means your son/daughter does not have to participate if you or they do not want to, and this decision whether to participate or not will have no effect on any other treatment or benefits to which they are entitled. If your son/daughter does participate you or they can change and withdraw from the project at any time without penalty or losing any benefits which they have already earned. Any information you give, including your son/daughter’s identity, will be held strictly confidential. In order to insure confidentiality all results of tests will be kept in a secure place and your son/daughter’s name will not be used in any publication or presentation, nor will those results be given to any other person without your consent. If you so desire, a copy of the results of your son/daughter will be made available to you.

Although it is not anticipated that any injury will occur, I must inform you that the School of the Holy Childhood does not have a formal plan to provide for the cost of medical treatment or compensation for any injury which occurs as a result of your son/daughter’s participation. If such injury occurs you should immediately notify Sister Seraphine Herbst, SSJ.

Of course, the School of the Holy Childhood is fully responsible for any legal liability which it may incur and your agreement for your son/daughter to participate does not in any way affect your and their legal rights.

If, at any point, you have questions about this project, please feel free to contact me or my research supervisor.

My work address: School of the Holy Childhood
1150 Buffalo Road
Rochester, N.Y. 14624

Telephone: (716) 328-3750

My home address: [Redacted]
If you have any questions before you decide to have your son/daughter participate, please feel free to ask them now.

You are being asked to make a decision whether or not to have your son/daughter participate in this project. If you wish to have your son/daughter participate and you agree to the statement below, please sign in the space provided. Remember, you or your son/daughter may change at any point and withdraw from the study.

I ____________________________ having read and understood the information provided in this form, agree to have my son/daughter participate in this study as a subject.

Parent/Guardian Signature ____________________________ Date ___________

Subject's Signature ____________________________ Date ___________
INSTRUCTION TO SUBJECTS

(Amodified AAHPER/Kennedy Foundation Special Fitness Test
 for Groups A and B)

This is the physical fitness test that all clients in the Adult Program have performed. It has been changed a little to make it better. By doing this test we will be able to compare your physical scores to the scores of students around the United States. Also, by repeating the test again in eight weeks we can see if your physical fitness has improved.

The first part will be the 9-minute run/walk. When I say "GO" start jogging around the gym, making sure to go around each cone at the corners and to pace yourself. I am trying to see how many times you can run or walk around the gym in 9 minutes. Any questions?

Next is the flexed arm hang. You will step on the stool, grasp the bar with an overhand grip, when I say "GO" pull your chin over the bar with your arms and hold it there as long as you can. When you can't hold it any longer let yourself down to the floor. Any questions?

Next is sit-ups. Lie down on the mat with your knees bent and feet flat on the floor. Put your hands behind your head. When I say "GO" you have to sit up and touch your elbows to your knees as many times as you can in one minute. Any questions?

Next is the shuttle run. You stand on the starting line and when I say "GO" you run, pick up one block, run back, place it behind the starting line, run back, pick up the second block, turn and run all the way past the finish line. You get two tries at this test. Any questions?

Next is the standing long jump. You stand with your toes behind the line, bend your knees, swing your arms and jump out as far as you can. You get three tries at this test. Any questions?

Next is the softball throw. Using your best arm throw the softball overhand as far as you can. You may run up to the throwing line if you want to. You get three tries at this test. Any questions?

Last, you remove your shoes and sit down on the floor with your feet against the measuring box. Then you reach with both hands as far as possible along the measuring stick. You get three tries at this test. Any questions?
ross-Country Skiing Program
for Group A)

This winter we are going to practice our cross-country skiing a little bit differently. We are going to ski three times a week for forty-five minutes a class. When skiing season is over we will take the physical fitness test over again to see if we have improved our fitness.

Our cross-country ski classes will be run like this:

- We will get changed into ski gear and go outside;
- We will get snapped in and do four warmup exercises (bent leg stretch, foot swing, straight leg toe touches, and run in place);
- We will then go over our warmup track a few times;
- After that we will ski on different tracks in the fields for the rest of the class and you will have a chance to show me your ski skills;
- When we are done we will snap out of the skiis and return to the building to get changed.

Any questions?

Bad Weather Plans
(for Group A)

When the weather is not right for cross-country skiing we will still do ski-type exercises indoors. This will be our routine:

- We will change into gym clothes;
- We will warm up our arms and legs by stretching for five minutes;
- Then we will do ten indoor cross-country skiing exercises;
- We will do each exercise ten times:
  1. calf lifts
  2. ½ knee bends
  3. Z-lean
  4. leg curls
  5. squats
  6. squat jumps
  7. leg lifts
  8. leg scissors
  9. leg circles
  10. side double leg lifts

Then we will change into cross-country ski boots, snap into our skis and poles and practice skiing coordination on the hallway rug.

Any questions?
APPENDIX C

CROSS-COUNTRY SKI/EXERCISE PROGRAM

WARM-UP AND CONDITIONING EXERCISES
WARM UP

Given demonstration and practice the student will always warm up before cross country skiing.

AR M U P

RETCHING EXERCISES
Perform a stretching exercise with skis on.

TASK ANALYSIS
1. Step and bend one leg forward in a 90 degree angle.
2. Extend other leg backwards as far as possible.
3. Lift the heel off the ski.
4. Repeat exercise, switching leg positions.

Perform a foot swing with skis.

TASK ANALYSIS
1. Assume a standing position.
2. Position skis parallel to one another.
3. Lift one foot.
4. Swing the foot/ski freely backward and forward.
5. Place foot/ski down.
6. Repeat exercise with other foot/ski.
Perform toe touches with skis on.

**TASK ANALYSIS**

a. Assume a standing position.
b. Position skis parallel to one another, hip-width apart.
c. Keep legs as straight as possible.
d. Bend from the waist and reach as far down as possible.
e. Try to touch toes or skis, if possible.
f. Hold stretch for 5 seconds.
g. Repeat exercise 5 times.

**Run in place with skis.**

**TASK ANALYSIS**

a. Assume a standing position with skis parallel to one another, hip-width apart.
b. Lift one foot/ski and place it back down.
c. Lift other foot/ski and place it back down.
d. Run in place.
e. Continue exercise for 30 seconds, gradually increasing the time.
HOME FITNESS

HOME FITNESS PROGRAM FOR SKIING

Because skiing is a strenuous sport, here are some exercises which can be incorporated into a home fitness program that specifically tunes muscles for skiing. Our objective is to develop a program that the athletes can do on their own.

As an instructor you have the responsibility to each each student an exercise program and supervise until he/she can do the program in sequence on his/her own. Start with a small number of repetitions and do the entire program several times. The sequence should be the same every day. Remember that doing each exercise correctly is more important than the number of repetitions. Have the athlete do the program three times a week. If the workout is less than fifteen minutes, add more repetitions or more exercises.

Since cross country skiing is an endurance sport, a running program in addition to the home fitness program would be very helpful for the athletes. It will also speed their ability to learn to ski when they get on snow.

TEACHING SUGGESTIONS

- Throughout any of the activities you should constantly emphasize to the student to do the maneuver correctly (Look ahead, balanced position, arms quiet and feet pointing in the right direction).

1. Perform a calf lift 100% of the time.

   TASK ANALYSIS
   a. Assume and maintain READY position.
   b. Lift heels as high as possible by pressing the knees up and forward.
   c. Hold for a count of 4.
   d. Lower heels but do not touch heels to ground.
   e. Repeat.

2. Perform a Z-lean 100% of the time.

   TASK ANALYSIS
   a. Kneel with body perpendicular to the floor.
   b. Keep back straight and arms extended parallel to the floor.
   c. Lean back, keeping thighs straight with body, and arms out.
   d. Continue to lean back until muscle resistance is felt.
   e. Hold to a 4 count.
   f. Return to upright position.
   g. Repeat, attempting to go back more each time, but do not strain.

3. Perform knee bends 100% of the time.

   TASK ANALYSIS
   a. Stand as high as possible on toes in READY position.
   b. Balance body by placing both hands against the wall (gradually decrease to both index fingers).
   c. Lower body so the thighs become parallel to the floor (do not go lower than parallel).
   d. Return to READY position.
   e. Repeat as many times as possible (keep back straight).
Performs standing leg circles correctly 100% of the time.

**TASK ANALYSIS**

1. Stand with feet hip-width apart.
2. Place hands on hips.
3. Raise one leg to the side as high as possible.
4. Make five small circles.
5. Repeat with other leg.

Perform squats correctly 100% of the time.

**TASK ANALYSIS**

1. Extend the left leg back and straight.
2. Extend the right leg forward and bend to a right angle.
3. Keep back upright and straight.
4. Now reverse.

Perform squat jumps correctly 100% of the time.

**TASK ANALYSIS**

1. From READY Position, stand high on toes.
2. Bend the knees forward until the thighs are parallel to the floor.
3. Jump up as high as possible staying in READY position.
4. Concentrate on keeping the back straight.

Perform leg lifts correctly 100% of the time.

**TASK ANALYSIS**

1. Lie on back with hands under hips.
2. Place palms flat on floor.
3. Keep the legs straight.
4. Raise the feet 15 to 20 centimeters off the floor.
5. Continue to raise both legs up slowly until perpendicular to the floor.
6. Lower to 15-20 centimeters off the floor.
7. Repeat.
Perform leg scissors correctly 100% of the time.

**TASK ANALYSIS**

a. Lie on back with hands under hips.
b. Place palms flat on floor.
c. Keep the legs straight.
d. Raise the feet 15 to 20 centimeters off the floor.
e. Spread legs as far as possible.
f. Bring back together and cross.
g. Repeat.

Perform leg circles correctly 100% of the time.

**TASK ANALYSIS**

a. Lie on back with hands under hips.
b. Place palms flat on floor.
c. Keep the legs straight.
d. Raise the feet 15 to 20 centimeters off the floor.
e. Spread feet in large circles in opposite directions.
f. Reverse directions of circling feet.

Perform side-double leg lifts correctly 100% of the time.

**TASK ANALYSIS**

a. Lie on side placing bottom hand on floor for balance.
b. Raise both legs simultaneously about 60 centimeters off the floor.
c. Lower to start.
d. Repeat.
APPENDIX D

RAW SCORES
## RAW SCORES

### EXPERIMENTAL GROUP

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<tr>
<th>SUBJECT</th>
<th>9-MINUTE RUN <em>(Yards)</em></th>
<th>ARM-HANG (Seconds)</th>
<th>SIT-UP (Number)</th>
<th>SHUTTLE RUN (Seconds)</th>
<th>LONG JUMP (Inches)</th>
<th>SIT AND REACH (Centimeters)</th>
<th>SOFTBALL THROW (Inches)</th>
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Subjects 12 and 17 did not complete the study
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<th>SIT AND REACH (Centimeters)</th>
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Subjects 20 and 30 did not complete the study

*Unit of measurement
APPENDIX E

BAD WEATHER CRITERIA
Cross-Country Ski Program

Bad Weather Criteria

1. Temperature below 20°F.
2. Wind speed above 20 mph.
3. Wind chill below 20 equivalent temperature (°F).
4. Icy conditions.
5. Hail, sleet, rain or otherwise poor conditions.

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<th>Estimated wind speed (in mph)</th>
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(Wind speeds greater than 40 mph have little additional effect.)

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<th>LITTLE DANGER</th>
<th>INCREASING DANGER</th>
<th>GREAT DANGER</th>
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<td>(for properly clothed person). Maximum danger of false sense of security.</td>
<td>Danger from freezing of exposed flesh.</td>
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Trenchfoot and immersion foot may occur at any point on this chart.

(Henderson, 1972)
APPENDIX F

ROCHESTER, NEW YORK SNOWFALL
## Rochester, New York Snowfall

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### Average 1972-1982

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*Source: United States Weather Service Rochester, New York*