Interpretative values of fitness assessment within mentally retarded adults

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INTERPRETATIVE VALUES OF FITNESS ASSESSMENT
WITHIN MENTALLY RETARDED ADULTS

By
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B. S., University of Tennessee

Presented in partial fulfillment of the requirements for the degree of
Master of Science
University of Montana
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Approved by

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Chairman, Board of Examiners
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August 18, 1986
Date
Physical fitness assessment and programming research for mentally retarded adults is recognized as a legitimate need. The purpose of this study was to enhance interpretative values within fitness assessment, that is, cardiorespiratory functioning, low back health and percent body fat, of a specific-population sample. Additionally, the unique methodology of baseline assessment through a "referencing" distribution was proposed. When compared with other beginning adult exercise (non-handicapped) participants, the mentally retarded sample expressed a Z score of -.95 in mean resting heart rate.

Subjects included 7 handicapped and 10 non-handicapped volunteers between 21 and 36 years of age. The mentally retarded subjects (IQ 45-65) participated in an 18-month aerobic dance exercise program which met for a duration of 40 minutes, 5 days per week. The non-handicapped sample was utilized in this study for baseline purposes only.

As measured through direct maximum oxygen uptake testing, the exercise intervention led to a significant (p.<.01) sample mean enhancement of 7.4 mL/kg/min., or 26%, in aerobic functioning. No significant reductions in body percent fat or weight were noted. Flexibility demonstrated excellent gains within low back health assessment (121%, p.<.01). The other component of low back health, abdominal tone, remained constant; however, the assessment tool was questioned.

Given the opportunity, the mentally retarded sample achieved noteworthy gains in their stereotypically low levels of cardiorespiratory fitness and flexibility. Several suggestions were proposed to facilitate appropriate assessment methodologies within interventive exercise programming.
ACKNOWLEDGEMENTS:

The following individuals expressed unlimited patience and support throughout this study: Dr. Gary Nygaard, Dr. Richard van den Pol, Dr. Mark Clark, all currently at the University of Montana, and Kathy Knapp, Director of the Ronan Special Citizens' Center. Their "open door" policy and facilitation through awkward transitions are, to no small degree, respectfully appreciated. Additionally, the sincerely special citizens at the Ronan SCC are directly responsible for the energy and creativity to complete such a project.

With respect to the Director of the University of Montana Human Performance Laboratory, Dr. Brian Sharkey, I owe considerable recognition. Dr. Sharkey's unique philosophy to graduate education, which allows individual freedom to relate specific and sometime distinct interests to planned study, has permitted a productive application of exercise physiology to adapted physical education. Furthermore, his generosity and confidence in sharing hours and files of data collection have indeed made the following quote more than personally appropriate:

So let us not under-value small signs, perhaps from them it may be possible to come upon the traces of greater things....In scientific work it is more profitable to take up whatever lies before one whenever a path towards its exploration presents itself. And then, if one carries it through thoroughly, without prejudice or preconceptions, one
may, with good fortune and by virtue of the interrelationship, linking each thing to every other, find...a road to the study of the great problem.

(Freud)

Thank you, Dr. Sharkey, for the honor of continued growth in my "hobby."

Similarly, Dr. Arthur (Tucker) Miller's eager participation within the final examination of this thesis was a valued and essential boost upon Dr. Sharkey's departure from the university.

Beyond the above professional acknowledgements, Kimberly, Jacqueline and Cynthia West, my daughters, play increasingly significant roles in my educational pursuits through their continued pride and love.

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CHAPTER 1

Introduction

Mentally retarded adults are an emerging population. With improved medical and educational programming we note an enhanced longevity and participation in society by special populations (Pope, 1979). Furthermore, the human rights legislation of the 1960's and 1970's facilitated improved access to public facilities and transportation, thus heightening the visibility of handicapped adults.

Absence of Research

Within research and programming, "adults represent the last real frontier in terms of study for select populations" among the educational community (French and Jansma, 1982). Similarly, Dr. Geoffry Broadhead (1986), editor of the journal, Adapted Physical Activity Quarterly, has indicated:

Handicapped adolescents and young adults, too, should be the focus of attention; and coherent, specific effective assessment and programming is urgently needed so that job skills and the requisite physical condition can be assured... Availability of information is currently as problem."

Clearly, in dealing with problems of fitness for the handicapped adult, the adapted physical educator
quickly becomes aware that there is no retreat into the sanctuary of factual research and publication. Subject matter within research of all handicapped populations since 1981 has primarily focused upon attitudinal/psychological aspects (48%) and motor functioning (31%). That is, fitness-related topics received 21% of the total research effort within adapted physical education (Antony, 1986). When one considers that the primary emphases of current study are concentrated upon preschool and school-aged populations, these descriptive statistics sufficiently provide an insight of the lack of knowledge amassed with reference to fitness programming for handicapped adults.

Significance of Specific Research in Adapted Physical Education

Paradoxically, human service professionals have recently become more sensitive to the psychomotor domain of their adult clients; moreover, many have attempted to provide leisure skills and physical fitness services to disabled individuals in community and non-institutional settings (Crawford and Cornwall, 1986). At the same time, some administrators of institutionalized mentally retarded adults continue to generalize, because their clients are subnormal in intelligence, that they are also "motorically retarded" and unable to benefit from fitness intervention.
Despite this stereotypical myth, the performances of handicapped subjects in ongoing programs and activities have shown otherwise. Most "motorical retardation," that is, deficiencies in physical skills and low levels of physical fitness, has been caused by the lack of opportunity to participate in exercise and fitness programs, not by an inherent characteristic of mental retardation.

Nevertheless, one cannot ignore the special needs of their client. For example, the morphologic alterations noted within mentally retarded adults, observed by even the nonspecialist, are the culmination of complex, interwoven physical and social phenomena. The nature of these unique characteristics can be further compounded by the multiple, active and continuous lines of medication. Even the lifestyle of the caretaker should become a factor within health risk analyses!

Moreover, the strain of living with a handicap often involves inefficient movement and continual alertness to avoid embarrassment (Daniels and Davies, 1965); accordingly, the minimum level of fitness required for the mere daily survival of the handicapped adult may be higher than that of the non-handicapped.

The adapted physical educator must not only recognize these fundamental questions about physiological and psychological mechanisms of fitness, one must also
seek and share the answers. Regretfully, the process of essential and careful documentation, intrinsic to special education, is relatively unshared among the many professionals in the field at this time. As is often the case: "We dance around in a ring and suppose / But the Secret sits in the middle and knows" (Frost, 1971).

Indeed, a survey by Bird and Gansender (1979) of physical educators' preparedness to meet the requirement of Public Law 94-142 indicates that the majority did not feel adequately prepared to provide fitness-related programming for the handicapped. The results of this survey, the unique needs of the handicapped and the striking absence of research which focus upon the handicapped adult all infer that adapted physical educators must increase their knowledge of programming and evaluative methods.

**Purpose**

The purpose of this study is to suggest ways and means of increasing the interpretative values of fitness assessment within mentally retarded adults. While physiological adaptations to exercise will be observed, the primary goal of this research effort is to enhance the adapted physical educators' ability to select and modify measurement and, thereafter, apply corresponding baseline data to fitness programming.
Sub-Problems

In this context, it is necessary to point out that several problems and questions presented themselves throughout this study. These sub-problems not only affected this investigation, they might also influence the domain of fitness assessment in similar interventive programs.

Non-Specialist as Administrator of Fitness Intervention

The first pertains to a rather pragmatic concern of administrators throughout the nation. Due to severe personnel shortages, especially within the rural communities, few specialized individuals are available to administer and assess fitness programming for adult handicapped populations. Accordingly, does one without adapted physical education training hold the prerequisite knowledge and skill to enhance fitness within a sample of mentally retarded clients? Many non-specialists seem to lack a sound idea of the functioning of the human body. Furthermore, they approach the psychomotor domain of their client in an almost mystical way: "Either they can or they can't."

Application of Available Standardized Assessments and Normative Data

Inversely, can professionals from the discipline
of exercise physiology apply standardized assessments and normative data, derived from non-handicapped research and programming, to provide appropriate, valid and meaningful feedback to those administering a special program and, of most importance, to the clients themselves? At the same time, validity, reliability and objectivity concerns may occur due to alterations in the measurement protocol or perhaps to the testers' inexperience with special populations.

Absence of Baseline Data

This question quickly leads to the third problem encountered within this study. The impact of an absence of research and normative data, as previously discussed, creates difficulty upon establishing a baseline for mentally retarded clients. The glamorous and noteworthy research frequently focused upon the athlete and/or non-handicapped adult has led to numerous principles of physiological alterations from training and exercise which often have been extended to the handicapped adult. However, the exciting investigations of obese and diabetic adult subjects have led to the conclusion that not all individuals respond "normally" to exercise regimens. Likewise, the researcher of handicapped adults must constantly weigh the adequacy of the present norms, derived from non-handicapped samples, when addressing the specific needs of
handicapped clients.

**Limitations**

The situational analysis or case study-nature of this research contains many qualities which may circumscribe the differential treatment and observations which were manipulated beyond the control of the author. The following restraints obviously limit the freedom with which one may infer the results of this study to the population of mentally retarded adults at large.

**Intervention Treatment**

Fitness programming and the actual implementation of exercise instruction were autonomously conducted by an employee of the Ronan Special Citizens' Center. Due to the time frame in which the program was instigated and the geographical isolation of this rural community, the daily exercise sessions could not be monitored.

**Pre and Post Assessment**

Cardiorespiratory functioning, body composition and low back health were measured by trained individuals under the supervision of an exercise physiologist in the Human Performance Laboratory at the University of Montana, Missoula. With the exception of the continuing (18th month) assessment, all testing must be credited to sources other than the author. Since measures of interrater reliability and objectivity
were not considered, this limitation must be noted upon interpretation of pre and post testing scores.

Variables of Mental Retardation

One must also weigh the receptive language of the mentally retarded subjects within application of standardized assessment. Maximum oxygen uptake, flexibility and abdominal tone scores may depict less than optimal performance if instructions are not comprehended by the clients.

Assumptions

Several assumptions may be practically applied to moderate the previous limitations. Beyond supposition, these operant qualities indicate some confidence in the reliability and objectivity of the assessment data.

Interventive Treatment

Exercise for the clients of the Ronan Special Citizens' Center was encouraged by the organizational scheduling of daily aerobic dance from 9:00-9:40 each weekday morning. Subjects enjoyed the selection between exercise participation and task-specific worksite training; consequently, adherence to the exercise regimen was quite high. Meeting five days per week, the program obviously held the minimum prescriptive requirement for frequency of exercise (ACSM, 1978).
Subjects were also instructed in personal measurement of resting and training zone heart rate via the carotid artery. From this feedback, training intensity was altered by the exercise instructor to facilitate aerobic workloads 65-80 percent of the sample mean maximum heart rate. Additionally, the (net) aerobic exercise, which exceeded twenty minutes in duration, was assured through the utilization of a taped instructional format. "Intermediate" and "advanced" formats were progressively applied when clients became bored and physiologically unchallenged (i.e., the exercise routine failed to raise heart rate(s) into the training zone) between pre and post fitness assessments.

Pre and Post Assessment

With reference to the validity, reliability and objectivity of data utilized to test the hypotheses of this study, the assurances applied to non-handicapped physiological measurement were in similar manner employed within pre and post assessment. Only those tests and testing protocols which have benefited from researched scrutiny of validity and reliability were used.

To exemplify this assumption, consider the standardized measures of reliability within the assessment of body composition. To attest the
reliability of instrumentation, the Lange skinfold caliper exerts a constant 10 g/mm², irregardless of the skinfold diameter. The precise delineation of skinfold site identification similarly authenticates reliability. Furthermore, by merely recording several readings at each of these defined sites and, thereafter, applying the mean to calculations of body composition, the tester can affirm less than one percent fat error (Pollock, Wilmore and Fox, 1984). Specific research investigating the reliability of various nomograms and formulas to determine body composition refer the problem of reliability back to the protocol of measurement, not the mathematical computation (AAHPERD, 1984).

Variables of Mental Retardation

The mentally retarded clients within this study were enthusiastic and cooperative subjects. Therefore, beyond unmeasurable handicaps which the environment or the foreign experience of physiological measurement may have obtruded upon the assessment, a specific test score may be interpreted as the individual's best effort. Meanwhile, employees of the Ronan Special Citizens' Center and adapted physical educators were present to assist in the communication of desired tasks; thus, credible data can be assumed. This topic receives more attention within chapter five.
Hypotheses

With the previous considerations, a central research hypothesis can be stated: Special adaptations of both fitness testing protocols and normative data inferred from the non-handicapped sample allow functional fitness assessment of a mentally retarded adult sample.

Subjacent Hypotheses

Baseline data-referencing population.

$H_0$: Mentally retarded adult subjects will exhibit a more deviant mean resting heart rate $Z$ score within a referencing-population frequency than in a non-handicapped frequency.

$H_1$: Mentally retarded adult subjects will exhibit a less deviant mean resting heart rate $Z$ score within a referencing-population frequency than in a non-handicapped frequency.

Baseline data-resting heart rate.

$H_0$: Mentally retarded adult subjects will reveal a lower mean resting heart rate (i.e., "better" cardiorespiratory functioning) than the non-handicapped
sample.

\( H_1: \) Mentally retarded adult subjects will reveal a similar mean resting heart rate as the non-handicapped sample.

**Baseline data-body composition.**

\( H_0: \) Mentally retarded adult subjects will display a similar percentage of body fat as that of the non-handicapped sample.

\( H_1: \) Mentally retarded adult subjects will display a higher percentage of body fat than in the non-handicapped sample.

**Baseline data-flexibility.**

\( H_0: \) Mentally retarded adult subjects will show no difference in flexibility of the low back and posterior thigh than within the non-handicapped sample.

\( H_1: \) Mentally retarded adult subjects will show less flexibility in the low back and posterior thigh than within the non-handicapped sample.

**Baseline data-abdominal tone.**

\( H_0: \) Mentally retarded adult subjects will disclose no difference in abdominal tone than that of the non-handicapped sample.
$H_1$: Mentally retarded adult subjects will disclose less abdominal tone than in the non-handicapped sample.

**Intervention—resting heart rate.**

$H_0$: Mentally retarded adult subjects will show no difference in mean resting heart rate between pre and post assessments.

$H_1$: Mentally retarded adult subjects will show a lower (i.e., improved cardiorespiratory functioning) mean resting heart rate in the post assessment than in the pre assessment.

**Intervention—max $\text{VO}_2$.**

$H_0$: Mentally retarded adult subjects will express no difference in maximum oxygen uptake in the post assessment than in the pre assessment.

$H_1$: Mentally retarded adult subjects will express a higher maximum oxygen uptake in the post assessment than in the pre assessment.

**Intervention—body composition.**

$H_0$: Mentally retarded adult subjects, segregated by gender, will have the
same percentage of body fat in the post assessment as in the pre assessment.

**H₁**: Mentally retarded adult subjects, segregated by gender, will have a lower percentage of body fat in the post assessment than in the pre assessment.

**Intervention—abdominal tone.**

**H₀**: Mentally retarded adult subjects will hold no difference in abdominal tone between pre and post assessments.

**H₁**: Mentally retarded adult subjects will hold more abdominal tone in the post assessment than in the pre assessment.

**Intervention—flexibility.**

**H₀**: Mentally retarded adult subjects will maintain the same flexibility in the post assessment as in the pre assessment.

**H₁**: Mentally retarded adult subjects will be more flexible in the post assessment than in the pre assessment.

**Effects of intelligence on training.**

**H₀**: As measured in maximum oxygen uptake, physiological adaptations experienced.
from training are unaffected by intelligence.

$H_1$: As measured in maximum oxygen uptake, physiological adaptations experienced from training are affected by intelligence.
CHAPTER 2

Review of Relevant Literature

The purpose of this study is not to decipher through the maze of available research obtained from non-handicapped samples concerning fitness assessment. On the other hand, it is clear that the adapted researcher must understand, and then apply, the basic concepts of physiological assessment and programming prior to approaching the previous questions and goals. Again, the poet can best define the task at hand:

We shall not cease from exploration.
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time...
Not known, because not looked for.
(Eliot, 1943)

Fitness for the Handicapped

Fitness for the handicapped is not new; therapists and educators have been working quietly for years. The role of physical activity in the treatment and care of the mentally ill dates from ancient times (O'Morrow, 1980). Experiences from the second world war in the treatment of physical and "psychiatric casualties" in convalescent facilities led to new study of the roles that physical activity could play in rehabilitation
(Clarke and Clarke, 1963). Thereafter, initiated by parental and educational advocacy, traditional school-aged handicapped populations (i.e., ages 3-21) have received fitness-related programming through federal legislation.

Indeed, Public Law 94-142 (1975) isolates physical education and fitness as an explicit component within individualized educational programming for the handicapped. Based on this mandate, accreditation standards for teacher certification required physical educators preparation in their professional responsibility to special populations, knowledge of the cognitive and physiological components of fitness and activity modifications. As a result, the discipline witnessed the birth of a new specialist, the adapted physical educator, and approached the unexplored arena of fitness programming for the atypical.

The Exercise Prescription

Fitness for many adults, handicapped or non-handicapped, is usually approached through endless repetition, rather than through any reasoned explanation of exercise prescription (Isaacs and Kobler, 1978). Based on many scientific studies among the leading physiologists in the field, the questions: "How hard?", "How long?", and "How often?" to exercise have reliably been answered. This consensus, for the most part,
Physiological adaptations commonly associated with "improving physical fitness" occur in response to the stress of exercise and vary with the frequency, intensity and duration of the activity (Sharkey, 1979). These well known principles prescribe fitness programs which demand the use of major muscle groups within reasonable goals and progressions (American College of Sports Medicine, 1978).

Intensity of Exercise

Elevation of the exercise participant's heart rate is a prerequisite to fitness enhancement, of which one component is cardiorespiratory efficiency. The upper limit of intensity obviously depends on the motivation and/or physical ability of an individual; for some, it may be limited by medical considerations. In general, Pollock (1978) revealed there was little need to work beyond moderate intensity, or 60-75 percent of one's maximal heart rate, to enhance health-related fitness. When the total work expenditures of varying regimens were held constant, higher intensity programs did not show added physiological improvement. Therefore, it appears reasonable to recommend that the handicapped, who consistently depict the lowest initial levels of fitness among all adult populations (Antony, 1986), should start at the lower level of intensity within
the 60-75 percent maximum heart rate training zone.

**Duration of Exercise**

Still, Price, et. al. (1977) contested that the less fit and/or overweight participant, who is most susceptible to injury, should initially exercise for twenty minutes in duration; thereafter, upon "reasonable periods" of adaptation, the overweight might safely exercise for up to 40 minutes. The American College of Sports Medicine (1978) similarly translates a gradual change in exercise habits as "advisable."

**Frequency of Exercise**

Jackson, Sharkey and Johnston (1968) further assures the beginning participant that fitness enhancement is not based upon the "no pain-no gain" myth. Addressing the question of frequency, this study indicated that with subjects rating "poor" in physical fitness, exercising three times per week may be as beneficial as a five day program.

**Rationalizations of Fitness for Handicapped Adults**

The willingness to financially support fitness-related programs for the handicapped is part of a larger societal movement of profound implications. Harman (1986) has identified several ideas and events which signify the push toward greater knowledge and
practice of fitness within our lifestyle; furthermore, he defines this as a true paradigm shift. The President's Council on Physical Fitness and Sports (1980) also estimates that participation in exercise and sport has doubled since 1965. This dictum certainly holds true for adapted physical education in a belated sense, as well as for the handicapped population at large. Every adult needs physical activity and exercise. In a democracy, this infers the need of programming that serves 100 percent of the population: the normal, the gifted and the handicapped.

Ethical

Moreover, there are several benefits which society can expect to reap from sponsoring fitness programming for the handicapped. The first centers upon an ethical/moral satisfaction from enhancement of an individual's life. Physical fitness is too important an issue to be left to chance alone; the human body "confirms our presence...movement contains the seeds of creativity as well as adaptability" (Kleinman, 1986).

Physiological

There is now widespread documentation that regular aerobic activity does enhance physiological functioning or "wellness." Arthur S. Leon and Henry Blackburn (1977), both of the University of Minnesota School of
Medicine, wrote an extensive and critical review of both animal and human research on this topic and summarized the benefits of endurance exercise:

- a reduction in heart rate
- a reduction in blood pressure
- enhancement of cardiovascular efficiency in delivering oxygen and nutrients to the tissues, that is, a reduction in myocardial oxygen requirements for any given amount of work
- increased cellular sensitivity
- reduction in serum triglycerides
- increased cholesterol carried by high-density (alpha) lipoprotein
- reduction in weight
- reduction in adiposity (i.e., increased lean body mass)
- improved physical work capacity

Inversely, obesity places an individual at risk for hypertension, stroke, renal and gallbladder disease, diabetes, abnormal plasma lipid levels and, consequently, heart disease (Moon and Renzaglia, 1982). The mean health care expense associated with treatment of obesity-related insurance claims among special populations would obviously be higher than those among the non-handicapped due to increased caretaking responsibilities. With both dietary and exercise intervention, obesity is manageable.
Economical

The beneficial adaptations of the body to exercise permit the more economically feasible rationalizations. Well-documented decreases in health care costs have been strongly correlated with fitness programming for the general population. The American Heart Association in 1980 proposed astonishing cost savings from fitness intervention. At the same time, the AHA issued a blanket proclamation that "all people should be encouraged to develop a physically active lifestyle as part of their comprehensive program of heart disease prevention.

Accordingly, the cost effectiveness of lowered health care cost fitness programming provides for adult populations at large is applicable for the handicapped adult. Indeed, Joseph A. Califano, Jr. (1979), former Secretary of Health, Education and Welfare, invited rallying directives for preventive rather than rehabilitative medicine within special populations. His account, Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention, also stresses the crucial role exercise can play in wellness.

Physical fitness can also help the handicapped to directly contribute to decreased expense associated
with institutionalized care. For example, through the multi-sensory stimulation of physical activity severely handicapped individuals can gain an awareness of their senses (McNeill and Mulholland, n.d.) and thereby participate more readily in caretaking. Additionally, a similar awareness, recognition and utilization of sensory cues which are so important in independent travel for the visually handicapped, can be refined through fitness activities such as distance running (Sonka and Bina, 1978). Clearly, fitness facilitates a more productive life on the part of the mentally retarded adult by simply developing those physical qualities needed to meet the demands of daily living (Emes, 1981).

The non-institutionalized mentally retarded adult can also express similar growth in independence through fitness-related programming. Many mildly handicapped adults are supported and somewhat assimilated into society through group homes and workshops. Most clients within this moderately sheltered environment want nothing less than economic self-efficiency (Daniels and Davies, 1965). Without a doubt, this goal was succinctly described during an informal interview with a client from the Ronan Special Citizens' Center, "I just want a place of my own, you know, live by myself." The achievement of this
personal objective would provide inseparable benefits to both the individual and society. At the same time, this lifestyle most certainly follows the spirit of the Least Restrictive Environment (LRE) doctrine, mandated by federal law, directed toward agencies receiving public support.

Sadly, this idealistic client must hurdle many obstacles prior to actualizing this dream. There is prejudice against hiring the handicapped, based on both the mistaken ideas perpetuated by lack of contact with mentally retarded adults and factual realities.

Due to the poor fitness levels of handicapped adults, many are less efficient than their coworkers, even within those tasks appropriate to their mental abilities. Also linked to poor fitness and health-related factors, mentally retarded adults are more prone to illness and have higher absentee rates, thus elevating workmen's compensation insurance rates. Due to these points, the Bureau of Labor Statistics maintained in-depth files of impaired workers since 1948. Analysis of this data conclusively shows that those receiving "rehabilitative" interventions do not necessarily handicap the employer. Since 1894, when the National Cash Register Company scheduled two daily, ten-minute exercise periods, employers have noted the increased productivity from their workers' enhanced fitness.
In reality, one of the most cost beneficial interventions for handicapped adults may involve one of the least expensive to implement.

**Components of Fitness**

These interests in accountability and output measures are manifested for the professional through increased importance of testing and assessment (Merz, 1986). Following this trend, and as a guideline to the profession, the American Alliance for Health, Physical Education, Recreation and Dance (1980) delineates three components which should be included in all fitness-related assessment. They are: (1) body composition, (2) cardiorespiratory endurance or aerobic functioning and (3) low back health.

**Low Back Health**

Those outside the profession are often surprised of the inclusion of the last component, low back health. However, the American Medical Association reports that approximately nine million adults are undergoing treatment for chronic back problems each year (Shaw, 1983). Two factors most influence this poor musculoskeletal functioning of the lower back within the American society: (1) inadequate flexibility of the hamstrings (i.e., posterior thigh) and lower back, and (2) poor abdominal tone.
The YMCA provides perhaps the most convincing evidence that exercise to enhance flexibility and abdominal tone decreases the incidence of low back pain. By 1982, data on 11,809 subjects highlighted "improvement toward a healthy back" in 80.7 percent of the program participants (Melleby, 1982). Therefore, in both prevention and rehabilitation of low back disorders, an assessment of abdominal strength/ endurance and posterior thigh/low back flexibility conspicuously identifies physiological principles of musculoskeletal fitness (AAHPERD, 1980).

Body Composition

Opinion is advanced that evaluation of the remaining two components of fitness, body composition and cardiorespiratory functioning, provide the greatest challenge to the tester of special populations. This, in part, could explain the meager base of knowledge and information regarding aerobic fitness and body composition of mentally retarded adults.

Enigmatic problems within measurement of cardiorespiratory functioning are minor when compared with the controversy in determination of another component essential to fitness-related research, body composition. Without pretense, body weight can be broken down into two components: fat weight and
fat-free or lean weight. Regretfully, the simplicity of classification is not carried over when attempting to determine the percentage body fat; the questions of accuracy are always present.

**Height and weight indices.** Although height and weight indices are extensively utilized in epidemiological research, Pollock and Jackson (1984) found them inaccurate for estimating body composition. The error of such assessment can be enlarged beyond exaggeration in special populations. For example, Burkhart (1983) investigated the usefulness of height/weight standards for classification of obesity in a sample of 84 mentally retarded subjects and revealed that the use of these normative tables resulted in misclassifying 22.5 percent of the males and 13.7 percent of the females, as nonobese. Even traditional anthropometric assessments, derived from various diameter and/or circumference measurements, also often fail to differentiate between fat and lean tissue.

**Hydrostatic weighings.** At the same time, hydrostatic weighings, the "gold standard" of physiological research, could rarely be applied as a valid composition assessment with mentally retarded adults due to the extreme variability of cooperation in its underwater protocol. Moreover, the validity
of this technique, especially with the unique body densities characteristically exhibited in the young and aged sampling, is increasingly suspect.

**Skinfold estimation.** Skinfold estimation, therefore, is perhaps the most practical and valid procedure currently available to the researcher of special populations. Still, valid and reliable skinfold measurement demands the proper training in precise site selection and caliper usage.

As early as the 1950's, research on the measurement of skinfolds questioned the exertion of varying pressures at the skinfold site. Keys and Brozek (1953) found that, independent of skinfold thickness, a difference in pressure below 10 g/mm² produced substantial difficulties in both reliability and objectivity. Edwards, et. al. (1955) also found large errors at the low pressure of 2.3 g/mm². Based on these studies, calipers were designed to produce a constant tension at 10 g/mm².

Within this consideration, the Lange skinfold caliper is one of the most reliable research instruments in skinfold measurement (Lange and Brozek, 1961; Sloan and Shapiro, 1972; and Wormsley and Durnin, 1973). Indeed, the normative table most widely used by physical educators, the Health Related Fitness Test, employed the Lange skinfold caliper for interpretation.
of percent body fat (AAHPERD, 1980). The more expensive Lange caliper has the advantage in exerting the required constant, no matter the thickness of the client's skinfold or the researcher's objectivity.

Despite the availability of reliable instrumentation, even experts can differ considerably in their technique and results. Furthermore, past research has indicated that training and practice of skinfold measurements are essential for valid measurement (Lohman, Wilmore, Roby and Massey, 1979) but failed to establish the extent of training needed for accurate estimation of percentage body fat. It is interesting to note that Jackson, Pollock and Gettman (1978) discovered that testers, some notorious and some with considerably less experience, at least produced similar results upon merely practicing together prior to measurement sessions.

Notwithstanding the constant criticism of skinfold assessment, Baumgartner and Jackson (1982) have concluded skinfold measurement to be a valid estimation of body composition. They boast correlations of .8 and .9 for males and females respectively, when comparing skinfold-derived percentages with hydrostatic weighing. In addition, problems in reliability are easily solved by obtaining a mean of several measurements at each specific site. Reliability is also enhanced by a linear regression, calculated from a sum of several skin-
skinfold sites (Katch and Katch, 1980), in comparison to other normative equations or varied body composition assessment techniques.

Classification of obesity. Yet another controversial topic in body composition research among exercise physiologists is the cut-off percentage between "normality" and obesity. (Rarely does the adapted physical educator have to consider the lower limits of body percentage fat for mentally retarded populations.) Lohman (1982) recommends the upper limit for adult males at 20-25 percent and 30-35 percent for adult females with respect to obesity classification.

Body composition research. Further complicating research efforts of fitness-related assessment for mentally retarded adults is the fact that only a small number of studies have investigated the percentage of body fat and obesity among handicapped populations. With few exceptions, the methodology of these studies abrogate scientific inquiry. A literature search, which focused upon the prevalence of obesity among the mentally retarded, delineated two common weaknesses of these studies: the nature of the sample employed and/or the criteria used to determine body density.

Early research focused only on the institutionalized adult (Zankel and Field, 1959; Hodgdon and Reimer, 1960)
and reliably found that the obesity levels of their handicapped subjects to be at least 30 percent above that of the adult population at large. These fascinating studies are to be admired for their innovation; however, the samples were drawn from two rather small institutions. Due to the stereotypically rigid lifestyle of institutionalized subjects, this research cannot be inferred to other mentally retarded adult populations.

Kelly, Rimmer and Ness (1986) investigated obesity levels among 553 institutionalized mentally retarded adults, ages 18-40 years of age and objectively estimated percent body fat with regression equations. They concluded that "42.5 percent of male, and 50.5 percent of the female mentally retarded are obese." This study is noteworthy for its statistical manipulation and sheer magnitude; regardless, as in too many scientific studies which focus upon the handicapped, the sample was drawn from a population of only one institution. Again, this research cannot be inferred to "all" mentally retarded adults, only those consuming the obvious caloric intake this particular institution affords its clients.

Fox and Rotatori (1982) selected a more appropriate sample to examine the prevalence of obesity, one drawn from four settings in which mentally retarded adults
most commonly live. The sample is representative for the problem; still, the accuracy of the measure used to determine body composition and obesity can be questioned. As previously discussed, research based on height and weight standards for assessment has been criticized for all adult populations.

Similarly, Poleduak and Auliffe (1976) used height and weight, in addition to the triceps skinfold, as the criteria for determining percentage body fat. This institutionalized sample showed that 20.4 percent of the males and 17.0 percent of the females were obese. The authors did not attempt to infer their conclusion to all handicapped adults. This study utilized Seltzer and Mayer's (1965) singular tricep measurement as the criterion for obesity classification. This brief application of skinfold assessment could lead the researcher to rather invalid conclusions. All variables considered, Katch and Katch (1980), alarmed the profession by showing the use of the tricep skinfold thickness as the sole parameter for estimating percentage body fat, or obesity, to be in error by as much as 150 percent.

This literature review, intended to initiate a thought process and not an attack on the previous authors, documents the necessity of different approaches and statistical considerations within body composition-
related assessment and research of special populations. The present study represents the growing number of attempts to accurately measure the fitness of adult mentally retarded populations (Fernhall, Tymesom and Donaldson, 1986).

Causes of obesity. Variables of "unfitness" have been intensely studied throughout the career of Bryant Cratty (1980). He has concluded that many environmental factors, acting together or alone, almost guarantee extremely high levels of obesity among the handicapped. The simple lack of opportunity to play, due to an absence of (and/or rejection by) peers, is the most obvious ingredient to obesity and low cardiorespiratory functioning. This problem can further compound itself when extremely poor self-concept, correlated with mental retardation, makes it less likely that the client will become involved in social physical activity.

Relative to Cratty's early research, Mayer (1968) specified the uphill battle against obesity and poor fitness for the mentally retarded adult. While "constitutional" factors may predispose the handicapped adult to weight problems and inactivity, the key component is passivity. Social isolation also logically promotes decreased opportunities for exercise or any other activity outside the home and, consequently, increased exposure to food.
Cardiorespiratory Functioning

While these conclusions would seem to indicate that mentally retarded individuals have extreme psychological barriers inhibiting their enhancement of fitness, other studies have called our attention to successful aerobic physiological alterations from training. Properly controlled, physical activities can produce marked improvements in the cardiorespiratory fitness of mentally retarded adults (Andrew, Reid, Beck and McDonald, 1979). In addition, programs conducted by psychologists and trained adapted physical educators alike have focused on the use of aerobic physical fitness training programs for their mentally retarded clients (Folkins and Sime, 1981; Tomporowski and Ellis, 1984). These studies promise positive results from fitness intervention; nevertheless, fail to document "success" with direct physiological assessment.

Fitness enhancement is dependent upon the total work or energy cost of the exercise regimen (ACSM, 1978); consequently, physiological responses vary in different types and levels of exercise. The degree to which training affects cardiorespiratory adaptation is directly related to the actual "load" upon skeletal muscles (Fox, 1984) and the adherence to the previously discussed exercise prescription.
Resting heart rate. Within these fundamental applications, enhanced physical fitness can be reflected through a decrease in the resting heart rate (i.e., the number of cardiac cycles per minute) of an individual. Strand (1978) notes this is marvelously achieved by an increased stroke volume over normal cardiac output. Therefore, the fit individual has to increase heart rate proportionally less during exercise than the untrained subject.

Indirect assessment. The remarkable adaptations in cardiac efficiency are the physiological basis of the submaximal assessment of aerobic fitness. While the most common physiological indicator employed in assessment of fitness in the field is heart rate response to standard submaximal exercise (AAHPERD, 1984), indirect inference to VO\(_2\) max through submaximal exercise has been shown to overestimate the fitness level of non-handicapped adults (Holmes and Christensen, 1986). Of course, the indirect approach also requires that a known and specific rate of work or exercise be maintained throughout an assessment.

Direct assessment. Despite the weaknesses of submaximal testing, much of the scarce fitness-related research from handicapped sampling is based upon indirect assessment of the aerobic capacity of the subject.
(Fernhall, Tymeslon and Donaldson, 1986). True, the heart rate can be a determinant of cardiac output; however, the maximal O$_2$ consumption is the best measure of the capacity of the cardiorespiratory system (Brooks and Fahey, 1985).

$\text{VO}_2\text{ max}$, that is, the maximum rate at which an individual can consume oxygen, is merely a parameter of metabolism. The unit of measurement within assessment of this component of fitness is "milliliters of oxygen consumed per kilogram of body weight per minute" (i.e., mL/kg/min.). Simply stated, the body's ability to perform work is directly related to its ability to metabolize oxygen, relative to one's body size.

$\text{VO}_2\text{ max}$ assessment directly reflects the maximum oxygen-transport capacity of the heart and lungs and, equally important, to the ability of the skeletal muscles to "offload" and combust the fuel the oxygen delivered (Arnot and Gaines, 1984). Additionally, analysis of the subject's expired air can relay crucial measures of objectivity, from the researcher and subject alike, that an individual's maximal effort or capacity has been recorded.

This respiratory exchange quotient (R) is most often utilized to qualify an assessment as a valid maximal aerobic workload for the subject. The ratio
of carbon dioxide to the volume of oxygen consumed per minute, that is, \( \frac{\dot{V}CO_2}{\dot{V}O_2} \), generally must be over 1.1; otherwise, the assessment must be considered as a "peak" \( \dot{V}O_2 \) rather than a measurement of the subject's maximal capacity. While other factors, such as hyperventilation, will affect the respiratory exchange, \( R \) is widely accepted as an indicator or control, regardless of the specific protocol the researcher has selected within his study (Fox and Matthews, 1981).

**Pre-Exercise Screening**

Prior to experimentation involving the independent variable, an interventive exercise program, the instructor must weigh the ability of the subject to safely participate in the study, or in fitness-oriented activity. Ellestad (1979) recommends medical screening and individual assessment of exercise response for all cardiorespiratory-related research participants.

The rationale behind this rather expensive suggestion is most readily understood when one considers the biomechanics of the heart within the stress of exercise. The left ventricle, the most powerful chamber of the heart, pumps blood to the working muscles of the body via the aorta, a vessel one inch in diameter, which receives the typical heart's output of a fifth
of a pint in every beat (Johnson, 1986). In mechanical terms, this means the relentless exertion of between 35 and 50 ft.lbs. every minute during rest, or the extreme exertion of 500 ft.lbs. or more during strenuous exercise (Smith, 1985).

Astonishingly, the potential benefits of vigorous physical activity far outweigh the potential risks associated with inactivity (Pelletier, 1981). Current guidelines by the American College of Sports Medicine do suggest that the stress of exercise should not be undertaken without pre-exercise screening(s) for those over 35 years of age. On the other hand, the American Heart Association (1984) more realistically propose pre-exercise evaluations for males over 45, females over 50.

It should be noted, the hazards of aerobic training initiated after years of a sedentary lifestyle compounds the associated risks (Ellestad, 1979). Without any question, the mere rationalization of inactivity, by which de Vries (1979) bases his practice of stress testing and health risk analysis in older asymptomatic adults, is an elevated risk factor in handicapped populations.

Typically restricted in their involvement of recreational pursuits, handicapped adults exhibit progressively lower levels of fitness as they age.
(Pelletier, 1981). In reality, a suggestion by the author to a quite athletic female client of the Ronan Special Citizens' Center toward participation in a community-based softball league was countered, "You've got to be kidding."

By conclusions and valid deductions correlated with very low fitness levels of the specific population, the argument apparently to apply medical and exercise-related screenings to handicapped subjects is an acceptable premise for the effort and expense the researcher must expend when studying mentally retarded adults. Contradictory to this logic, an extensive literature search failed to provide a single reference to the needs of medical/physiological screenings for the handicapped prior to exercise involvement.

Aerobic Dance

The confidence of proper screening, representative sampling, valid evaluative methodologies, reliable tools, and supportive resources will allow the researcher to proceed to the next step within study of fitness-related assessment for the handicapped, the selection of an exercise mode. As a developing intervention, aerobic dance for the handicapped is faced with the problem of instituting the standards and validity of programming which all innovative developments must establish if they are to be professionally recognized (Chaiklin, 1974).
Beyond its popularity, exercise in the mode of aerobic dance is frequently criticized for its lack of specificity and, therefore, its inability to enhance cardiorespiratory functioning. Physical activities that are intermittent and low in energy cost (i.e., below the intensity threshold) result in little or no improvement (Cumming, Goulding and Baggley, 1969). Aerobic dance instructors with little adapted physical education experience may start and stop exercise routines excessively while attempting instruction of specific or difficult dance steps (West, Knapp and Valett, n.d.). This, in part, could explain the inconsistencies research literature projects concerning the measurable benefits of aerobic dance.

Some studies do allow significant alterations in \( V_{\text{O}_2} \max \) from aerobic dance which are similar to other forms of aerobic exercise if adequate prescriptions of intensity, duration and frequency are applied (Auxter, 1976; Dowdy, Cureton, DuVal and Ouzts, 1985; Legwold, 1982). All things considered, aerobic dance can attend the obvious needs of flexibility, strength and endurance. Additionally, it includes the unique needs so often lacking in the mentally retarded, the development of "an accurate body image and the kinesthetic awareness of the body's position and motion in space" (Riordan, 1980).
The published research focused upon aerobic dance which the adapted physical educator has at his disposal has been concentrated primarily from the sampling of college-aged females (Milburn and Butts, 1983; Vaccaro and Clinton, 1981; Mass, 1975; Durrant, 1976). On the other hand, Beal, et. al. (1986) examined the appropriateness of dance for yet another select population, older adults. This study concluded that the use of modified aerobic dance met exercise prescriptions to improve both physiological and psychological functioning. Analogously, Legwold (1982) maintains that aerobic dance, at the very minimum, offers its participants fun and enhanced feelings of "well-being."

**Psychological Benefits of Fitness**

The implications for disabled populations are obvious. The physiologist cannot ignore the psychological effects of regular physical activity: elicitation of the relaxation response (Benson, Dryer and Hartley, 1978), marked reduction in acute anxiety (Bahrke and Morgan, 1978; Morgan, 1979), and significant alleviations of depression (Kostrubula, 1976; Brown, 1978). Additionally, such research might offer a moral alternative to the frequent prescription of mood-altering medications among special populations.
Many participants of frequent exercise suggest that feelings of well-being are more closely tied to our bodies than research can realistically prove.

Of physiology from top to toe I sing. Not physiognomy alone, nor brain alone is worthy for the Muse. I say the form complete is worthier far. The Female equally with the Male I sing. * The handicapped equally with the elite. (Whitman, 1976)

* with liberties
CHAPTER 3

Methods

Participants

Handicapped

The handicapped subjects (n=?) for this study were all ambulatory participants at the Special Citizens' Center, Ronan, Montana between 21 and 36 years of age. This volunteer sample included two males and five females, all with diverse (i.e., parental, custodial, group-home and independent) lifestyles. Table 1 delineates some of the characteristics of this mentally retarded adult sample.

Non-Handicapped

The non-handicapped subjects (n=12) were volunteers between 22 and 36 years of age from an adult fitness class taught at the University of Montana, Missoula. This comparison sample included two males and ten females. Other than chronological age restrictions, no attempt was made to match or pair non-handicapped with handicapped subjects.

Baseline Referencing

A frequency distribution match was inherently
TABLE 1: CHARACTERISTICS OF MENTALLY RETARDED ADULT SAMPLE

<table>
<thead>
<tr>
<th>#</th>
<th>AGE</th>
<th>GENDER</th>
<th>IQ</th>
<th>LIFESTYLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>male</td>
<td>60</td>
<td>group home A</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>male</td>
<td>50</td>
<td>parental care</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>female</td>
<td>*</td>
<td>group home B</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>female</td>
<td>45</td>
<td>foster home</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>female</td>
<td>59</td>
<td>parental care</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>female</td>
<td>65</td>
<td>group home B</td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td>female</td>
<td>54</td>
<td>independent</td>
</tr>
</tbody>
</table>

* not known

assumed since both samples were adult volunteers initiating participation in a fitness-related program. To exemplify this assumption, both samples expressed a similar sedentary lifestyle prior to the initial (pre-intervention) assessment. Other than infrequent walks and weekly bowling sessions, the handicapped clients had never participated in adult fitness programs prior to this study. Analysis of a self-reported exercise behavior survey among the non-handicapped subjects depicted a mean period of inactivity of 4.1 years.
The utilization of pre and post related sampling of mentally retarded adults is the primary focus of this study; however, a brief exercise in independent sampling is required to assist baseline definitions of fitness for the handicapped subjects. Since the non-handicapped sample did not undergo the same intervention as the special citizens in Ronan, few statistical comparisons will be attempted. The purpose of including this treatment is to test the hypotheses current literature advocates, that mentally retarded adults characteristically have higher percentages of body fat, less cardiorespiratory efficiency, less flexibility and less abdominal tone than other similar-aged adults.

This unique treatment of independent sampling for baseline purposes (only) will not include application of population indices. While mentally retarded adults have similar characteristics and needs of fitness as those of normal intelligence (Boswell and Fulton, 1986), the American Alliance of Health, Physical Education, Recreation and Dance (1986) has established that normative standards based on non-handicapped populations are "not appropriate" for referenced assessment. On the other hand, the use of population-specific data hinders comparisons among studies (Roche, 1984). As a result, the definition of a referencing population for the present study as merely "beginning
adult exercise participants between 21 and 36 years of age," may provide a more reasonable descriptive analysis for baseline purposes.

Within the field of psychology, Pope (1979) describes this compromise to dissimilarity in intelligence as a "primary system reference." This treatment also facilitates the goal of a fair and comprehensive baseline of the mentally retarded adult by comparisons of prior activity level, not intelligence.

Dependent Measures

Height and Weight

Height and weight measurements were taken with the subjects in their stocking feet. Standing height was measured to the nearest inch and thereafter converted to centimeters to accommodate statistical manipulation. Body weight was recorded to the nearest tenth of a pound on a calibrated scale.

Body Composition

Body composition was estimated through skinfold measurements made with a Lange skinfold caliper (Cambridge Scientific Industries, Cambridge, Maryland). The skinfold measurements, taken on the right side of the body, were repeated at each site until a reliable
mean was recorded. Percent body fat was determined by a nomogram (Sharkey, 1981) which correlates age, sum of three skinfolds and gender. Due to the limited number of male volunteers (two handicapped, two non-handicapped), percent body fat computations will be the only data segregated by gender.

**Male skinfold sites.** Percentage body fat for the male sample was derived through the sum of three skinfolds: chest, abdomen and thigh. The chest skinfold site is defined as the midpoint between the anterior axillary fold and nipple; the measurement fold ran parallel to the border of the pectoral muscle group. Abdomen measurements were taken approximately two centimeters to the right of the navel with the skinfold running vertically (unless the skinfold is substantial and naturally ran in a horizontal direction). Located over the anterior quadriceps muscle group and midway between the hip and knee joints, the thigh skinfold ran parallel to the longitudinal axis of the leg.

**Female skinfold sites.** Similarly, percentage body fat for the female sample was estimated by the sum of three skinfolds: triceps, thigh and suprailium. The tricep measurement was taken parallel to the longitudinal axis of the upper arm and over the posterior tricep muscle, halfway between the flexed elbow and the
acromion process of the scapula. The suprailium site is located over the right iliac crest in the mid-axillary line; the skinfold is aligned parallel with the angled ilium. The thigh site identification is the same as in the description for males.

Flexibility

The fitness-related components of low back health are separable. Flexibility of the low back and of the hamstrings (posterior thigh) were assessed through a static sit and reach test. The procedure involves the placement of the seated subject on the floor or a large training table with knees fully extended. With the hands placed directly on top of each other (palms down), the subject slowly stretches forward for three times. The position of the fingertips, held on the third stretch, is measured to the nearest half inch, relative to the perpendicular foot.

Abdominal Tone

Abdominal tone was assessed through the "Quick and Dirty" determination of strength/power within various sit-up positions. This adaptation of David Imrie's (n.d.) interpretation of the parameters of low back health is favored over the timed sit-up test due to the exclusion of endurance and motivation prerequisites.
The "Quick and Dirty" testing procedure involves a supine position assumed by the subject with the knees flexed at 45 degrees. Throughout this assessment the feet must remain flat on the floor and to avoid the activation of the iliopsoas, rectus femoris and sartorius muscles of the leg, the feet are not to be held or tucked. Measurement implicates the assignment of an interval score to the successful performance of one sit-up with corresponding difficulty; for example, a score of six implies excellent abdominal tone while a score of one infers very poor abdominal tone. (See Table 2)

**TABLE 2: THE "QUICK AND DIRTY" TEST OF ABDOMINAL TONE**

<table>
<thead>
<tr>
<th>SCORE</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>sit up with hands inversely clasped above the head; arms are not allowed to break the longitudinal axis of the upper torso</td>
</tr>
<tr>
<td>5</td>
<td>sit up with hands clasped behind the neck</td>
</tr>
<tr>
<td>4</td>
<td>sit up with arms folded across the chest</td>
</tr>
<tr>
<td>3</td>
<td>sit up with arms extended to the side of the thighs</td>
</tr>
</tbody>
</table>
TABLE 2: (continued)

<table>
<thead>
<tr>
<th>SCORE</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>sit up with facilitation of upper torso by grasping the posterior thigh</td>
</tr>
<tr>
<td>1</td>
<td>sit up with facilitation of upper torso through physical assistance (i.e., holding the hands of the tester)</td>
</tr>
</tbody>
</table>

**Aerobic Functioning**

Conducted on a Monark bicycle ergometer, a progressive protocol was utilized to assess $\dot{V}O_2\text{max}$. (See page 99, Appendix B) The initial stage/workload was quite light, 1.0 Kg (300KPM-min⁻¹); thereafter, additional resistances of .5 Kg were added each minute until exhaustion. Respiratory exchange gases were measured with the Beckman Metabolic Measurement computer based system. This instrument provided video display every minute and hard copy data every two minutes. Volitional exhaustion and a respiratory exchange ratio greater than 1.0 were the criterion to
determine that maximal aerobic recordings had been attained.

**Statistical Treatment**

The dependent variables of body composition, flexibility, abdominal tone and maximal oxygen uptake are evaluated as quantifiable. Accordingly, data will be analyzed by t tests and an ANOVA measure with repeated treatment over the test factor assessing aerobic functioning.

Two-related-sample statistical tests will be involved to compare the differences in pre and post fitness assessments among the handicapped adults. However, the abdominal tone measures will be treated with a binomial probability to determine differences between pre and post testing.

Interval-level t tests of significance will allow comparison of the baseline assessments of all fitness-related components, with the exception of VO$_2$ max, between the handicapped and non-handicapped samples. Equipment failure prohibited the direct assessment of maximum oxygen uptake in the non-handicapped sample as in the mentally retarded clients of the Ronan Special Citizens' Center. Nevertheless, for the referencing baseline involving mean resting heart rate, the Z score will be employed to indirectly compare
cardiorespiratory functioning.*

Finally, contemplation of whether the beginning mentally retarded adult subject differs from the "trained" (but related) subject on categorical/control variables and Max $\text{VO}_2$ requires a factorial analysis of variance. Factors include extent of retardation and exercise experience. Scores within pre-program fitness assessment will be categorized as those subjects with little or no exercise involvement; likewise, post-program scores were labeled as "trained" individuals. Moderately retarded participants (IQ 45-54) were thereafter segregated from the mildly retarded participants (IQ 59-65) to test if physiological adaptations experienced from training are affected by intelligence.

**Inference of the Abilities of a Non-Specialist**

Beyond the difficulties of baseline assessment and an unclear relationship of physiological adaptations of mentally retarded adults from training, another question addressed within the stated sub-problems of this study focused upon the unknown ability of the

* Anticipation of exercise can elevate the heart rate (Brooks and Fahey, 1985). Thus, individual means were used to compute sample means.
non-specialist, that is, one untrained in adapted physical education, to enhance fitness. Implementation of the exercise intervention was conducted by an aide employed at the Ronan Special Citizens' Center and managed completely independent of the researchers. Pre and post program assessments of max VO$_2$, percent body fat and low back health will illuminate the success or failure of the non-specialist to properly direct a twelve-month exercise program. In addition, an eighteen-month "follow up" assessment of aerobic functioning (i.e., max VO$_2$ and resting heart rate) was facilitated by a continuing exercise program within the center. Therefore, the results of these measurements will reflect the ability of the non-specialist to prescribe and adapt exercise for mentally retarded adults.

**Exercise Intervention**

Subjects participated, five days per week, in aerobic dance without severe interruption throughout a twelve month program. Aerobic dance for the clients of the Ronan Special Citizens' Center was a 40 minute choreographed routine of rhythmic movements such as hopping, skipping, jumping (20 minutes) and stretching (10 minutes warm-up, 10 minutes cool-down) continuously performed to music.
CHAPTER 4

Results

Baseline Data

Subjacent hypotheses of this study (delineated in chapter one, pages 11-13) assume that mentally retarded adult subjects will hold lower fitness levels than non-handicapped adult subjects. The acceptance or the refutation of the null hypotheses demand statistical collation of the pre-intervention data of the handicapped sample with the data of the non-handicapped, "comparison," sample. (See Table 3)

Resting Heart Rate

A t-value of 4.9315, p.<.01 (two-tailed) depicts a significant difference of mean resting heart rate between the two samples.

Body Composition

Female subjects. No significant difference was noted between the mentally retarded females and the non-handicapped females in percentages of body fat (t-value=1.153, p>.5, two-tailed).

Male subjects. No significant difference was observed between the mentally retarded males and the
### TABLE 3: BASELINE DATA OF HANDICAPPED VS. NON-HANDICAPPED SAMPLES

<table>
<thead>
<tr>
<th></th>
<th>HANDICAPPED</th>
<th>NON-HANDICAPPED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGE</strong></td>
<td>$\bar{x}$ 26.4</td>
<td>$\bar{x}$ 27.9</td>
</tr>
<tr>
<td></td>
<td>$S$ 6.2</td>
<td>$S$ 5.3</td>
</tr>
<tr>
<td><strong>HEIGHT (cm)</strong></td>
<td>$\bar{x}$ 162.8</td>
<td>$\bar{x}$ 168.3</td>
</tr>
<tr>
<td></td>
<td>$S$ 12.9</td>
<td>$S$ 7.3</td>
</tr>
<tr>
<td><strong>WEIGHT</strong></td>
<td>$\bar{x}$ 147.1</td>
<td>$\bar{x}$ 138.3</td>
</tr>
<tr>
<td></td>
<td>$S$ 38.3</td>
<td>$S$ 25.5</td>
</tr>
<tr>
<td><strong>% BODY FAT</strong></td>
<td>$\bar{x}$ 23.1</td>
<td>$\bar{x}$ 22.7</td>
</tr>
<tr>
<td></td>
<td>$S$ 4.1</td>
<td>$S$ 4.9</td>
</tr>
<tr>
<td>male</td>
<td>$\bar{x}$ 20.3</td>
<td>$\bar{x}$ 17.4</td>
</tr>
<tr>
<td></td>
<td>$S$ 1.1</td>
<td>$S$ 3.7</td>
</tr>
<tr>
<td>female</td>
<td>$\bar{x}$ 24.3</td>
<td>$\bar{x}$ 23.9</td>
</tr>
<tr>
<td></td>
<td>$S$ 4.8</td>
<td>$S$ 4.7</td>
</tr>
<tr>
<td><strong>FLEXIBILITY (in)</strong></td>
<td>$\bar{x}$ 1.7</td>
<td>$\bar{x}$ 2.9</td>
</tr>
<tr>
<td></td>
<td>$S$ 4.3</td>
<td>$S$ 3.9</td>
</tr>
<tr>
<td><strong>ABDOMINAL TONE</strong></td>
<td>$\bar{x}$ 5.0</td>
<td>$\bar{x}$ 4.9</td>
</tr>
<tr>
<td></td>
<td>$S$ 0</td>
<td>$S$ .7</td>
</tr>
<tr>
<td><strong>RESTING HEART RATE</strong></td>
<td>$\bar{x}$ 92.0</td>
<td>$\bar{x}$ 71.0</td>
</tr>
<tr>
<td></td>
<td>$S$ 9.0</td>
<td>$S$ 8.4</td>
</tr>
</tbody>
</table>

Non-handicapped males in percentage of body fat (t-value=1.0530, p>.2, two-tailed).

**Flexibility**

Flexibility of the lower back and posterior thigh showed no significant difference between handicapped and non-handicapped adult samples with a t-value of .5623, p>.5 (two-tailed).
Abdominal Tone

Since the distribution of performance scores among handicapped subjects from the "Quick and Dirty" measure of abdominal tone fails to follow a normal curve (i.e., standard deviation ≈ 0), a t-value cannot be computed for the statistical difference between sample means (Minium and Clarke, 1982).

Referencing Population Comparison

A sample of beginning adult exercise participants between 21 and 36 years of age has a mean resting heart rate of 79.6 beats per minute, S = 13.1. The mentally retarded sample mean of 92 beats per minute holds a Z score of - .95 within this frequency distribution. (See Figure 1, page 61)

Pre and Post Intervention Data

Physiological adaptations from training within the handicapped sample can be reflected through the difference between fitness-related test scores obtained before and after the exercise intervention. (See Table 4)

Resting Heart Rate

A significant difference between pre and post mean sample resting heart rate is reported through a t-value
<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>PRE:</th>
<th>POST:</th>
<th>DIFFERENCE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTING HR</td>
<td>$\bar{x} = 92.0$</td>
<td>$\bar{x} = 73.6$</td>
<td>$-18.4 \ (21%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 9.0$</td>
<td>$S = 9.5$</td>
<td></td>
</tr>
<tr>
<td>MAX VO$_2$</td>
<td>$\bar{x} = 27.9$</td>
<td>$\bar{x} = 35.3$</td>
<td>$+ 7.4 \ (26%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 4.7$</td>
<td>$S = 5.7$</td>
<td></td>
</tr>
<tr>
<td>WEIGHT</td>
<td>$\bar{x} = 147.1$</td>
<td>$\bar{x} = 147.7$</td>
<td>$+ .6 \ (0%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 41.4$</td>
<td>$S = 32.5$</td>
<td></td>
</tr>
<tr>
<td>% BODY FAT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MALE</td>
<td>$\bar{x} = 20.3$</td>
<td>$\bar{x} = 21.3$</td>
<td>$+ 1.0 \ (5%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 1.1$</td>
<td>$S = 2.5$</td>
<td></td>
</tr>
<tr>
<td>FEMALE</td>
<td>$\bar{x} = 24.3$</td>
<td>$\bar{x} = 26.6$</td>
<td>$+ 2.3 \ (9%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 4.8$</td>
<td>$S = 3.6$</td>
<td></td>
</tr>
<tr>
<td>ABDOMINAL TONE</td>
<td>$\bar{x} = 5$</td>
<td>$\bar{x} = 4.7$</td>
<td>$- .3 \ (6%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 0$</td>
<td>$S = .5$</td>
<td></td>
</tr>
<tr>
<td>FLEXIBILITY</td>
<td>$\bar{x} = 1.7$</td>
<td>$\bar{x} = 4.2$</td>
<td>$+ 2.3 \ (121%)$</td>
</tr>
<tr>
<td></td>
<td>$S = 4.3$</td>
<td>$S = 4.4$</td>
<td></td>
</tr>
</tbody>
</table>
of 7.30, p.<.01 (two-tailed). (See Graph 1)

Max VO₂

A dependent t test between pre and post maximum oxygen uptake testing has a value of 6.498, p.<.01 (two-tailed). In addition, an ANOVA comparing pre, post and continuing (18th month follow-up) VO₂ max allows the F ratio of 3.61, p.=.02. (See Graph 2)

Weight

Weight was not significantly affected by the exercise intervention (t-value=.15, p.>.5, two-tailed).

Body Composition

Male subjects. The two male subjects failed to significantly alter their percentage of body fat (t-value=1.0, p.>.5, two-tailed).

Female subjects. Similarly, the female subjects, through a t-value of 1.174, p.>.2, (two-tailed), did not significantly alter percentage of body fat.

Flexibility

Flexibility was significantly enhanced (t-value, 4.583, p.<.01, two-tailed).

Text continues on page 61.
GRAPH 1: AN INDIRECT ASSESSMENT OF FITNESS

\( \bar{x} \) resting heart rate

KEY:
- . subject mean
- x sample mean

MONTHS OF EXERCISE

FIDNESS (\( \bar{x} \) resting heart rate)
GRAPH 2: DIRECT ASSESSMENT OF FITNESS
max \( \dot{V}O_2 \)

**KEY:**  . subject mL/kg/min.
   x sample mean mL/kg/min.

MONTHS OF EXERCISE

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Effects of Retardation on Training

As measured in maximum oxygen uptake, the effects of intelligence upon training response produced an interactive F-ratio of .02 (p = .8893).

Abdominal Tone

Reference to a cumulative binomial probability table (Minium and Clarke, 1982) results in a two-tailed probability greater than .454 that the decline in abdominal tone was due to chance. (See Table 5)
### TABLE 5: PRE AND POST ABDOMINAL TONE SCORES FOR MENTALLY RETARDED ADULT PARTICIPANTS IN A TWELVE MONTH EXERCISE PROGRAM

<table>
<thead>
<tr>
<th>SUBJECT #</th>
<th>&quot;QUICK &amp; DIRTY&quot; SCORES</th>
<th>SIGN ASSOC. W/ CHANGE IN SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRE</td>
<td>POST</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

* no change  

SUM OF NEGATIVE SIGNS: 2
CHAPTER 5

Discussion

Based on the previous statistical tests of significance, several critical considerations can fulfill the purpose of this study, to enhance interpretative values of fitness assessment methodologies appropriate for mentally retarded adults. Unlike many studies which heavily depend upon the university environment for sampling and interventive purposes, the Ronan Special Citizens' Center undeniably provides the setting to allow for generalization to the "real world." Still, documenting the fitness program's impact does not end with the calculation of mean score difference between pre and post intervention assessment. One must also weigh the hidden variables, the unexpected, when interpreting results.

External Variables

The somewhat correlational nature of the present case study, where conditions were set up outside the influence of the researcher (Konstantareas, 1980), also retrospectively provided a source of unplanned and unaccounted variables of crucial distinction. The
diffusion of the innovative service of exercise programming in the Ronan Special Citizens' Center changed schedules, altered relationships and aroused many unmeasureable psychological constructs.

Most exercise programs, for example, experience their most rapid and significant enhancement of cardiorespiratory functioning in the first six weeks of intervention. The special citizens of Ronan, in reality, did not show this researched trend. (See Graph 1, page 59) Positive results are the most difficult to view critically; however, the initial reflections of limited training adaptations during the first months of programming punctuate the numerous forces operating within fitness interventions for mentally retarded adults which so strongly alter validity of assessment. Graph 3 portrays the differentials outside the scope of this study which particularly touched testing performance.

The loss of an enthusiastic exercise leader through personnel changes at the center created motivational difficulties which the following instructor failed to adjust. An increase in resting heart rate mean, or decreased cardiac efficiency, remonstrated the lowered intensity and frequency of training. Inversely, the sluggish beginning of the exercise program could have been created from over
zealousness. In the early stages of the five-day-per-week intervention, muscular awkwardness/soreness, inhibitions of the clients to dance and advanced choreographed exercise routines provoked a poor rate of gain.

As any active adult will ultimately understand, one's fitness-oriented variables remain stubbornly unpredictable with transitional or interruptive stages; injuries, time restrictions, family or work responsibilities, and illness influence this relationship. Therefore, that an increase or decrease of the specific interactive agents on Graph 3 might change the behavior of the whole is a predictable, but unaccountable component of assessment.

**Baseline Data**

By reason of an universal taboo against utilization of research statistics as a drunk uses a lamppost—"for support rather than illumination" (AAHPER, 1952), the analysis of baseline data is an essential prerequisite to any study focusing upon special populations. Professionals throughout the many sub-disciplines of special education widely acknowledge that the rate at which an independent variable or intervention is assimilated by a client varies with the initial control.
and/or categorical characteristics of the individual. For example, the unfit participant of a specific exercise program will exhibit a greater enhancement of cardiorespiratory functioning than the trained aerobic athlete when all other variables are held constant (Pollock, Wilmore and Fox, 1984). Direct measures constructed a representative distribution, that is, a description of the beginning adult participant in this study.

**Utilization of Referencing Population**

A bell-shaped curve can depict the logic behind a primary system reference within analysis of the handicapped sample baseline mean of resting heart rate. Figure 1 (page 61) represents a frequency distribution of beginning adult exercise participants between 21 and 36 years of age, mean=79.6, S=13.1. Note that both the handicapped and the non-handicapped sample means inherently fall within one standard deviation of the referenced population mean.

Z scores, that is, the number of standard deviations in which a score lies above or below the distribution mean (Borg and Gall, 1983), statistically rationalize this treatment. The clients of the Ronan Special Citizens' Center have a mean resting heart rate Z score of only -.95 with the referenced population
distribution used in this study. On the other hand, an administrator or these mentally retarded adults may feel quite overwhelmed by a baseline Z of -1.6 if they choose to participant in a YMCA fitness program assessment. (See Figure 2) The handicapped sample mean, 92 beats per minute, is somewhat deviant within a distribution the YMCA utilizes for fitness assessment among adult males and females under the age of 35.

Some educators formally express discontent with manipulation of data from standardized testing so that it is "least restrictive" for specific populations. However, this philosophy of individualization within special education is analogously present in the lifestyle of the non-handicapped as well. For example, students are commonly classified according to year of study in the university environment; thus, an eighteen-year-old freshman does not compete with a twenty-two-year-old senior for a grade in Composition 101. Likewise, a beginning fifty-year-old female racquetball player does not compete against a Class A, twenty-year-old male in a community tournament. Therefore, a referencing population for fitness-related assessment does not contradict societal practices of categorization according to ability, age, gender, experience or many other observable variables.
Admittedly, the Z score simply relates the mean resting heart rate of the handicapped sample to other beginning adult exercise participants. However, to test the hypotheses that mentally retarded adult subjects will reveal lower fitness-related scores than non-handicapped adult subjects (Chapter one, pages 11-13) interval-level tests of significance, or t tests, will determine the significance of difference between the two samples.

**Resting Heart Rate**

The cardiorespiratory efficiency of the non-handicapped sample was clearly superior to that of the handicapped sample. The strong t-value of 4.9315
(p. < .01, two-tailed) is validated by the fact that several recordings of each subjects' resting heart rate were used to compute individual means. Consequently, influential variables upon resting heart rate, such as anxiety, prior activity level, or caffeine, are moderated to some degree (Strand, 1978).

**Body Composition**

As non-observables, constructs are most vividly indicated within the measurements of percent body fat for the mentally retarded subjects. The adherence to researched procedure and proper instrumentation enhance reliability and suggest that the variable was measured. The results are consistent with previous findings related both to mentally retarded children (Roberts and Clayton, 1969) and mentally retarded adults (Kreze, Zelinda and Johas, 1974). The trends of percent body fat measures in the female and male subjects of both samples are also similar with the research of McArdle, Katch and Katch (1981). No significant difference was observed between the percentages of body fat in handicapped and non-handicapped participants; therefore, the null hypothesis (page 12) is supported.

**Flexibility**

As measured through the simple sit and reach
test, flexibility also pinpointed little difference among the two (combined gender) sample means with a t-value of .5623, p > .2, two-tailed. Moreover, the (score) means of 1.7 and 2.9 inches of stretch in the handicapped and non-handicapped samples respectively, are rated "good" for those adults 18-35 years of age (Gilmore, 1981).

The sit and reach test has recently enjoyed some researched scrutiny of its validity within flexibility assessment. In addition to variables of extensibility, the sit and reach test is also influenced by the length of the arms and legs of the subject (Pollock, Wilmore and Fox, 1984) and the positioning of the head (Frischberg, 1986). Goniometry, or "the use of protractor-like instruments for measuring the range of motion in joints of the body" (Moore, 1949), has been presented in the medical literature for over 40 years. Regardless, this assessment does not enjoy the ease of comprehension that is provided from the simple feedback of the sit and reach test.

Abdominal Tone

One of the primary assumptions of the t test includes a normal distribution of measured scores; accordingly, this statistical tool becomes quite inappropriate upon a review of Table 1 (page 55)
and the standard deviation of zero within the handicapped assessment of abdominal tone. The "Quick and Dirty" measurement of low back health assessment obviously fulfills its name; thus, its validity is suspect.

This measure of abdominal tone is an evasive tool with many failing to appreciate its physiological basis and the necessity of a rigid protocol. Without any question, if the feet are held or are allowed to be lifted from the supporting surface, most individuals are capable of achieving, through a counterposing, pendulum-like movement, a score of "five." (Utilization of this test in many field testing situations has affirmed a slightly skewed distribution of frequency scores.) Since the best designed and scientifically valid assessment protocol will have no effect if it is not followed, adherence and motivation are very important.

Pre and Post Assessment

The results of the dependent measurements will suggest both the ability of the non-specialist and the physiological adaptations of the clients to the stress of exercise. Consequently, the dependent t test statistically defines the measured differences in pre and post fitness tests from Table 4, page 57.
Resting Heart Rate

Given the opportunity, the handicapped sample improved physiologically in cardiorespiratory efficiency. The rare duration (perhaps persistence) of recording resting heart rate through twelve months of exercise intervention affirmed a predictable training response as depicted in Graph 1, page 59. Clearly, a dependent t test of the pre (0 month) and post (12th month) sample mean resting heart rate supports the traditional or expected gains with a t-value of 7.30, p.<.01 (two-tailed).

Max $\overline{VO}_2$

Direct measurement of cardiorespiratory fitness through maximum oxygen uptake testing further investigates changes in aerobic functioning among the mentally retarded subjects. (See Graph 2, page 60) A dependent t test of max $\overline{VO}_2$ scores ($\text{mL/kg/min.}$) recorded before and after 12 months of exercise acknowledges a t-value of 6.498, p.<.01 (two-tailed). An ANOVA of repeated measures from pre, post and continuing (18th month) oxygen uptake scoring also translates a significant enhancement of fitness through the F-ratio of 3.61, p.<.02.

Regression equations might also be applied to describe the relationship between months of training
and an increased efficiency of the heart; nevertheless, Zinkgraf and McClendon (1986) advised that the correlation of two variables must be "generalizable" across samples for these equations to be useful to the exercise scientist. Similarly, very few fitness programs would share like characteristics of frequency, intensity and duration of interventive exercise as the aerobic dance program at Ronan. From these considerations, a correlative statistic may inhibit rather than enhance interpretative values of assessment for the adapted physical educator.

Limitations within max VO$_2$ testing. The initial awkwardness of the testers, unfamiliar with special populations, as well as the foreign environment and expectations upon the clients, could have limited performance on max VO$_2$ baseline assessments. However, an increase of response, merely from the sight of peers making the same movement and effort, was observed in the last of the tested subjects.

This phenomenon of "social facilitation" (Wankel, 1980) has been frequently researched within the discipline of motor behavior. As any exercise physiologist will attest, the presence of significant others in the laboratory during testing sessions can markedly improve or limit the work performance of subjects.
The mentally retarded subjects typically had little comprehension as to "why" they should push themselves beyond discomfort to gratify the difficult-to-conceptualize measurement protocol of maximal oxygen uptake testing. Indeed, the ultimate outcome of an exercise-related test to some of the moderately handicapped may have been no more than the immediate feedback of verbal praise from the tester. Meanwhile, an aversion to perspiration and the other uncomfortable sensations associated with intense exercise are often physiologically linked to fear (Brooks and Fahey, 1985).

Assumption of validity of max VO\textsubscript{2}. Despite the unknown effect of the limitations noted above, correlations of resting HR and maximum oxygen uptake measures within Graph 4 suggest a reliable and valid assessment of cardiorespiratory functioning. Meanwhile, the 22 percent (net) enhancement of mean oxygen uptake is similar to that of other long-term exercise programs (Fox and Matthews, 1981).

Body Composition

Although large improvements in VO\textsubscript{2} max were derived from training, body composition measures were not improved between pre and post assessment. Instead, the male and female samples experienced an insignificant
GRAPH 4: COMPARISON OF DIRECT AND INDIRECT ASSESSMENTS OF FITNESS

KEY: x—mean sample resting heart rate 
O—mean sample max VO₂

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increase of 1.0 and 2.3, respectively, in percentages of body fat. Many of the handicapped subjects who exhibited the greatest enhancement of cardiorespiratory functioning also contradicted their gains with increased percentages of body fat.

Contradictious data may lead to questioning of the reliability or objectivity of measurement; on the other hand, incongruent results may implicate a weakness in the intervention program. Maxwell, et. al., (1985) investigated an aerobic dance program for non-handicapped adults and also questioned an insignificant amount of alteration in percent body fat from prescribed levels of training. Analogously, Dowdy, et. al., (1985) found that without dietary intervention, body composition remained unchanged from a moderate aerobic dance program.

These types of exercise programming typically employ activities which increase both the caloric expenditure and aerobic functioning of the participants. While the significant improvements in cardiorespiratory functioning would seem to guarantee at least maintenance of mean percentages of body fat, exercise alone cannot manipulate or counteract extremely excessive caloric intake(s) (Pollock, Wilmore and Fox, 1984). "The belief that exercisers counterbalance any weight worked off by eating more arises from an
undeniable fact: Vigorous exercisers do eat more" (Gilmore, 1981).

**Flexibility**

In spite of these anthropometric discontinuities, flexibility demonstrated excellent gains within low back health assessment. The t-value of 4.583 held a probability less than .01; thus, the 121 percent improvement of extensibility was indeed significant. Flexibility was as obvious focus of training within the fitness programming at the Ronan Special Citizens' Center.

Increased attention has recently been applied to the biomechanical importance of range of motion in musculoskeletal functioning. Excessive "wear and tear", as well as inefficient movement or wasted expenditure of energy are common disabilities of handicapped populations (Clarke and Clarke, 1963). Undeniably, restrictions of flexibility are most often associated with inactivity (Winnick, et. al., 1980); therefore, the incentive for the inclusion of this fitness component into assessment and programming for the mentally retarded is a logical one. Moreover, the sit and reach test of posterior thigh and low back extensibility is a quick and clean measure which requires no specialized equipment other than a common yard stick.
Abdominal Tone

Having failed the underlying assumption of most interval-level tests of significance; that is, a normal distribution, the scores of the abdominal tone measurement were analyzed by the nonparametric sign test. The decline in (performance of) abdominal tone within two of the seven mentally retarded adults was statistically considered insignificant.

Effects of Intelligence on Training

Examination of the handicapped sample with a factorial analysis of variance design lends little support to the hypothesis that training response in max $\dot{V}O_2$ is affected by intelligence. One female subject was excluded from the computation of the two-way ANOVA due to an absence of IQ assessment for that individual.
Conclusions

This research effort retrospectively studied the interpretative values of fitness assessment for mentally retarded adults participating in an aerobic dance program at the Ronan Special Citizens' Center, Ronan, Montana. Utilization of a referencing population proved to be a contributing method of baseline comparison. When compared with (10) other beginning adult exercise participants, the (7) moderately and mildly handicapped clients were significantly higher (i.e., less fit) in sample mean resting heart rate, but similar in body composition and flexibility.

Physiological adaptations from twelve months of intervention exercise led to significant enhancements of mean resting heart rate (21%), max $\dot{V}O_2$ (26%) and flexibility (121%). Body composition and abdominal tone were not significantly altered. As measured in max $\dot{V}O_2$, cardiorespiratory adaptations from exercise were not affected by intelligence.

Based on these results, the abilities of a non-
specialist to conduct an exercise program for mentally retarded adults may be labeled "adequate." Similarly, special adaptations of standardized testing procedures and baseline referencing, enabled by the non-handicapped sample allowed functional fitness assessment of the mentally retarded exercise participants.

Recommendations

Practical Recommendations

Familiarity of tester. French and Jansma (1982) stress that any handicapped subject must know or at least be familiar with the test administrator and vice versa for valid interpretations. The client's feelings about not only the surroundings and expectations, but also the personality of the tester may greatly influence the effort expended. To exemplify this, Franks and Mayer (1985), through a controlled experiment using non-handicapped adult subjects, noted enhanced oxygen uptake scores with the application of informal "small talk."

Workshops which train the non-specialist in measurements of percent body fat, low back health and submaximal or indirect testing of cardiac efficiency may provide the competency and confidence to hurdle the obstacle of fitness assessment and education for the atypical.
Record keeping. Record keeping may improve both exercise adherence and the client's understanding of the assessment process. Indeed, a record of the client's activity placed beside assessments of various related fitness components could serve to focus attention to the whole, the interrelated task of improving the body. If sensible goals are established, records help document their attainment and serve an aim of awareness of the expectations upon the client's body.

Specificity. The specificity principle demands that it is essential for the objectives of a physical fitness program to be carefully planned and stated prior to exercise intervention. Therefore, assessment is to be designed to initially expose deficiencies and thereafter, to support and guide the fitness program. Accordingly, the tool of measurement should not only be appropriate to the specific population, it should also facilitate the transitions of exercise program involvement.

Safety. How does the researcher or educator decide between safety and specificity? Within this concern, the bicycle ergometer was chosen to assess cardiorespiratory functioning of the clients of the Ronan Special Citizens' Center over the more
reliable treadmill. The client with limiting mental factors does not always have the prerequisites of normal alignment, good balance, strength and coordination (Adams, et al., 1982) which can become distorted even among elite athletes during the final stages of maximal oxygen uptake testing.

Consequently, the greater susceptibility to injury held by mentally retarded adults must be taken into account. The distractibility or emotional stability of the client not only influences testability or the absolute score but also safety during efforts to obtain one's best fitness measure. Thus, any record of scores should be accompanied by statements concerning subjective or limiting assessments which might assist another when interpreting raw scores.

**Body composition.** The propensity for success, that is, for meaningful measurement, hinges on the client's ability to focus beyond the "test" to assessment. Long-term goals may be best served after percent body fat estimation by a reference to the body in addition to the abstract percentage recording. For example, "You've improved. Two months ago you were 28 percent fat; now you are 25 percent fat. I thought I noticed more muscle tone on your shoulders when we were swimming last week." If needed, dietary intervention
Max VO\textsubscript{2}. Despite the fact that all handicapped subjects were able to follow verbal commands, ambulatory and free of gross motor defects, limiting mental factors did not always assure the absolute cadence or constant workload on the bicycle ergometer for oxygen consumption testing. Rather than attempt the seemingly impossible feat of a rhythmical cadence-directed test of maximal work response, afix tape on the speedometer so that the needle is viewed only at the desired rounds per minute. Thereafter, announce, "Don't allow the red stick to leave your sight. If it does, pedal faster until you see it again." Admittedly, this adaptation would be scorned by many scientists; however, it provides the most reliable steady work rate load for atypical populations such as children, the deaf or mentally retarded adults. Beyond this, a gentle tap on the raised knee just prior to the downstroked cadence on one leg may assist a constant workload. Avoid choir-like cues, where several individuals chant "push" on the cadence. This may evoke the "cheerleader" effect; that is, the client's heart rate may be superficially elevated in response to the excitement of the situation.
Realistic expectations. It should be noted that not all similar programs for handicapped adults will yield such dramatic increases in aerobic functioning. The extremely low baselines of the clients of the Ronan Special Citizens' Center explains, in part, the (net) 22 percent enhancement achieved in this particular study. Cureton (1969) points out that individuals with sedate lifestyles enhance cardiorespiratory fitness through very modest exercise programs in which those of higher fitness levels would receive no gain in oxygen uptake. For example, Mulholland and McNeil (1985) detected a significant lowering of heart rates among three institutionalized, profoundly-retarded children from activities developmentally targeted in psychomotor growth, with no instructional goals of aerobic conditioning. In this case, indiscriminating movement became a training regimen.

An interesting and important note is brought to mind upon the review of declining aerobic capacity during the last months of this study. (See graph 2, page 60) It takes far less effort to maintain fitness than to gain significantly in cardiorespiratory functioning (Strand, 1978). Reducing the training frequency (days per week) by as much as 50 percent for up to five weeks may not show much decrement in fitness (Brynteson and Sinning, 1973). This has
important implications for the handicapped who are frequently at the mercy of the daily schedule of their caretaker or institution.

Recommendations for Future Study

Both exercise physiology and adapted physical education are dynamic disciplines; controversial ideas and hypotheses must be explored whenever inadequate resources specific to handicapped populations are not available to support the layperson. If one of the purposes of research is to "contemplate the question with another question" (Borg and Gall, 1983) this study has been a success.

Body composition. Lohman (1984) predicts the development of population-specific approaches to body composition assessment. Normative data for special school-aged populations are currently being compiled (Broadhead, 1986). This effort should be extended into the community to include handicapped adult populations. The increased reliability and validity available through the ultrasound technique (Neiss and Clark, 1985) promises development of diagnostic methods for body composition assessment which may facilitate this goal of normative data for mentally retarded adults.
\( \text{\(VO_2\) max.} \) The adaptations noted within maximum oxygen consumption testing spawn questions: To what extent can the poor fitness levels of this sample be attributed to the stereotypical "handicapping" of the clients by the testers? Would the mean percent of cardiorespiratory enhancement be quite so high if the testers had been more familiar with the clients or if the clients had been prepared for the testing environment, protocol and purpose? That is, did the benefits of familiarity during the post program assessment allow greater expectations and thus, improved performance?

Any of these questions could serve within experimental-design research which included a control group composed of non-participatory mentally retarded adults. Still, the many "hidden" variables would be difficult to isolate.

**Abilities of the non-specialist.** Many non-specialists who lead fitness programs for the handicapped perceive their efforts as something foreign from their professional preparation and experience. However, the improvements of cardiorespiratory fitness and flexibility within the intervention program of this study suggest that fitness endeavors can be conducted by individuals who have not been specifically trained in adapted physical education.
This study allowed the client and trainer to engage in an activity as co-participants, where both parties shared the same benefits and laughs. Still, except for a handful of individuals, the majority of physical educators state that adapted physical education should be conducted by individuals who have been specifically trained and that such programming should exist in a separate program. Again, future research of this topic could open the doors to the community, to other beginning exercise (non-handicapped) participants, to assess equal treatment over time.

Other researchers are looking beyond the trained psychologist or adapted physical educator for the answers for meeting the fitness-related programming for the mentally retarded adult (Folkins and Sime, 1981; Tomporowski and Ellis, 1984). However, Trmer, Odenkirk and Glasenapp (1983) reach beyond merely noting a "lack of properly trained teachers" to the fact that many educators are not aware of the contributions they can make.

Causes of low aerobic fitness among mentally retarded adults. The cause for the typical trend of less cardiorespiratory fitness among mentally retarded adults is not within the scope of this study; nevertheless, it warrants immediate attention in light
of the severe health implications associated with low levels of fitness. The relationship between such factors as the extent of mental retardation, the number of years in an institution and fitness assessment will hopefully be researched. In reality, lower functioning clients rarely participate in the infrequent intervention program; could their needs be met if they were addressed?

**Closing Statement**

Mentally retarded populations represent a larger percentage of our society than we realize, 6.4 million in the United States (Cratty, 1980). Despite the fact that their fitness-related needs of programming and assessment are rarely researched (Antony, 1986), this study suggests that standardized measures can be meaningfully applied to assessment of mentally retarded exercise participants. From a developmental point of view, it is counterproductive to develop vocational skills of mentally retarded adults, while at the same time ignoring fitness factors that will ultimately limit the ability of these individuals to use these skills. Therefore, the most valuable tool for use within exercise intervention for mentally retarded adults may be concern for their somatic development.
APPENDIX

A

INFORMED CONSENT FORMS
I HAVE EXAMINED_____________________________

AND BELIEVE THAT HE/SHE IS PHYSICALLY CAPABLE OF
UNDERGOING A STRESS TEST AT THE HUMAN PERFORMANCE LAB AT
THE UNIVERSITY OF MONTANA AND AN ONGOING AEROBIC EXERCISE
PROGRAM THROUGH THE RONAN SPECIAL CITIZEN'S CENTER.

__________________________

DATE
UNIVERSITY OF MONTANA PHYSICAL FITNESS EVALUATION RELEASE

In consideration of the acceptance of ____________'s entry into the University of Montana Human Performance Laboratory Physical Fitness Evaluation activities I for myself, ____________, and the client's executors, administrators, and assignees, hereby release and discharge the University of Montana, Health and Physical Education department, the testing personnel, their agents, employees, and all other associated with this physical fitness testing of ____________ from any and all claims for damages, actions, demands and injuries arising out of ____________'s participation in this testing as his/her sole supervisor responsible for all of his/her actions while entrusted to my supervision.

I confirm and represent that I have full knowledge and responsibility for the risks involved in the physical fitness testing of ____________ and that he/she is physically fit and sufficiently able to participate.

_________ date ____________

Agency Representative FOR

______________

Client's Signature

______________

Witnessed
PHYSICAL FITNESS EVALUATION

As part of a health and fitness evaluation, the Human Performance Lab administers an exercise test on the Bicycle Ergometer. This test is preceded with appropriate risk factor information and a resting electrocardiogram. The work levels will begin at a level you can easily accomplish and will be advanced in stages, depending on your work capacity. We may stop the test at any time because of signs of fatigue or you may stop when you wish, due to the client's personal feelings of fatigue or discomfort. We do not wish to exercise your clients to a level which is abnormally uncomfortable for them.

There exists the possibility of certain changes occurring during the test. They include abnormal blood pressure, fainting, disorders of heart beat, and very rare instances of heart attack. Every effort will be made to minimize these by the preliminary examination and by observations during testing. Emergency equipment and trained personnel are available to deal with situations which may arise.

The results obtained from the exercise test may assist in the diagnosis of what types of activities you might carry out for your clients with no or low hazards.

This exercise test is voluntary. You are free to deny consent if you so desire. I have read this form and certify that I know, understand and appreciate the risks to my clients. I understand the test procedures that will be performed by
clients under my supervision and I consent for them to participate in this test.

_________ date _________

____________________ signature of client ___________________

____________________ signature of agency representative ___________________

____________________ witness ___________________
UNIVERSITY OF MONTANA HUMAN PERFORMANCE LABORATORY

Please answer the following:

Client's AGE ___________ HEIGHT ___________

WEIGHT ___________

PRESENT MEDICATIONS:

ALLERGIES OR ASTHMA:

YES NO

___ ___ Has a doctor ever said the client has heart trouble?

___ ___ Does the client frequently have pains in the heart and chest?

___ ___ Has a doctor ever said the client's blood pressure was too high?

___ ___ Has a doctor ever told the client that he has a bone or joint problem that has been aggravated by exercise, or might be made worse with exercise?

___ ___ Is there a good physical reason not mentioned here why the client should not follow an activity program, even if they wanted to?

___ ___ Is the client over age 65 and not accustomed to vigorous exercise?

I as an agency supervisor of ____________________(client name) attest that to my knowledge and agency records that the above information is correct.

___________________________ (agency representative)

___________________________ (date)
APPENDIX

B

DATA COLLECTION FORMS
UNIVERSITY OF MONTANA HUMAN PERFORMANCE LABORATORY

CLIENT DATA:

NAME:____________________________________________________

BIRTHDATE:____________________

SOCIAL SECURITY #:_______________________________________

CURRENT RESIDENCE:______________________________________

PARENT OR GUARDIAN:_______________________________________

ADDRESS:_________________________________________________

PHONE:____________________________________________________

AGENCY REPRESENTATIVE:____________________________________

PHONE:____________________________________________________

CURRENT DOCTOR:___________________________________________

PHONE:____________________________________________________

DATE OF LAST PHYSICAL:____________________________________

ALLERGIES:_________________________________________________

SEIZURES:___________________________________________________

MAJOR SURGERIES: (DATE)___________________________________

MAJOR INJURIES OR ILLNESS:________________________________

MEDICATIONS:______________________________________________
UNIVERSITY OF MONTANA HUMAN PERFORMANCE LAB

NAME______________________________________

CONSENT: YES____  NO____

AGE_______  HT_________  WT(1)_______  (2)________ (3)________

PRE:  POST:  CONTINUING:

% FAT

LUNG FVC

FLEXIBILITY

ABDOMINAL TONE

BIKE VO₂

HEART RATE

KGM/M

COMMENTS:
UNIVERSITY OF MONTANA HUMAN PERFORMANCE LAB

PHYSICAL WORK CAPACITY WORKSHEET

NAME: ___________________________________ AGE: ______________

WEIGHT: (lbs)_________ (Kg)____________

PERCENTAGE MAXIMUM HR:________ (70%)

________________ (85%)

RESTING HR:________

MIN. STAGE/WORKLOAD: HEARTRATE: COMMENTS: (KP) (KPM-min-1)

1

2

3

4

5

6

7

8

9

COOLDOWN (OKP, 1 min): POST HR:____

3 min HR:____

6 min HR:____
SUBMAXIMAL TEST RESPONSE FOR PREDICTION OF AEROBIC FITNESS ($\text{MAX } \dot{V}O_2$)

<table>
<thead>
<tr>
<th></th>
<th>WORKLOAD (Kpm)</th>
<th>HR</th>
<th>ESTIMATED mL/kg/min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300</td>
<td></td>
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<tr>
<td>2</td>
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<td>4</td>
<td>600</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
<td></td>
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</tr>
</tbody>
</table>

OPTIONAL: MAX HR: ___________ @: ___________ Kpm

COMMENTS:


---------, K.M. Greenochle and A.M. Lee. (1986). The influence of health value and locus of control on...


Behavioral Research Therapy. 16.


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