# THE RELATIONSHIP OF MUSCULAR STRENGTH AND BALANCE ON WORK PERFORMANCE MEASURES IN HIGH SCHOOL STUDENTS WITH MENTAL RETARDATION

by

KAREN MARY SMAIL

(Under the direction of Michael A. Horvat)

## ABSTRACT

The purpose of this study was to investigate the effectiveness of a balance and strength training program on physical functioning and work performance of individuals with mental retardation. Ten students with mental retardation were matched according to gender, age, height, and weight then randomly assigned to the treatment or control group. The treatment group participated in a 12 week balance and strength training program while the control group participated in low intensity recreational games. Isometric strength and work performance measures were collected at three intervals throughout training 6 weeks apart, with a retention measure collected 6 weeks past training. Balance measures were collected at pre and post intervals. Work performance measures included: box stacking (timed repetitions), pail carry (timed distance), dolly cart push (timed distance), and sack carry (speed). Peak isometric muscular strength was assessed bilaterally using a hand held dynamometer at the following sites: elbow flexion and extension, knee flexion and extension, and shoulder abduction. Balance tasks were performed using the Balance Master, with the following tasks being measured: sensory organization test, weight bearing squat, step up and over, and weight bearing squat over 15 repetitions. Based on a randomized complete block design with repeated measures, a significant difference between the post to pre test was calculated on all vocational tasks; box stacking $F(1,4) = 20.39$, $p<.005$; pail carry $F(1,4) = 13.06$, $p< .01$; dolly cart push $F(1,4) = 112.64$, $p< .002$; and sack carry $F(1,4) = 4.02$, $p< .05$ with the treatment group displaying higher percent gains (32.05%) over the 12 weeks then the control group (13.36%). In addition, all isometric strength measures indicated a significant difference between groups with the treatment group increasing on average 50.42% while the control group increased 9.82%. Retention measures indicated decreases on work performance and isometric strength for both groups. Each group improved balance scores along with producing more symmetrical weight distribution throughout movement activities. Based on the data analysis it was concluded that participation in a balance and strength training program was effective in increasing physical functioning and work related skills which can facilitate the school to work transition process.

INDEX WORDS: Mental retardation, Strength, Work related skills, Transition, Balance, Strength training program, Balance program, Bilateral weight distribution.

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KAREN MARY SMAIL

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by

KAREN MARY SMAIL

Major Professor: Michael Horvat

Committee: Bruce Blasch
Karen Jones
Bryan McCullick
Zolinda Stoneman

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
May 2003

# DEDICATION

To my husband, Edwin, without your love and support I never would have finished. To my son, Jacob, your unconditional love has touched my soul.

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It would be impossible to thank all those individuals who have influenced and inspired me along my journey.  My mom and dad have shown me the meaning of hard work and perseverance.  My husband, Edwin has pushed me to the finish line.  Jacob, my son, although you will not remember this time you are the reason why I do this.  You provided the inspiration to survive the long hours and late nights required in order to finish.

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# CHAPTER 1

# INTRODUCTION

A primary focus of research in the field of disabilities has been the quality of life experienced by individuals with mental retardation. The enhancement of quality of life for transitory gains in adaptive behavior, employment skills, or social competency (Hughes, Hwang, Kim, Eisenman & Killian, 1995) has been accomplished through programming goals and objectives that emphasize placement in integrated community settings. Several model programs have emerged that have placed adults with a disability into nonsegregated work situations as a way of integrating into employment situations (Kiernan, Gilmore, & Butterworth, 1997; Wehman, & Kregel, 1995; Brickley, Campbell, & Browning, 1985; Williams & Vogelsberg, 1980). Although there has been increased support for employment for individuals with mental retardation, there still is some resistance against this movement resulting in underemployment for this population (Trupin, Sebesta, Yelin, & LaPlante, 1997).

The concept of employment for individuals with mental retardation has been present since the early 1950s. Sheltered workshops were established to provide a highly structured and protective setting where individuals could work at their own pace, perform repetitive tasks and would be reimbursed based on their individual level of productivity. Many organizations for individuals with mental retardation embraced the opportunity they afforded and companies often would subcontract to sheltered workshops for production items. In the early 1970's it became apparent that sheltered workshops did not provide appropriate economical benefits or social opportunities for individuals with mental retardation. Skills learned in sheltered workshops did not generalize to employment opportunities. As a result advocacy groups encouraged more supported employment opportunities (Wehman & Kregel, 1995). In addition, at this time came a shift in the economy from manufacturing to more service based industry thus questioning the demand for sheltered workshops. This resulted in a place-and-train approach with demonstration programs being offered. The supported employment approach was based on what was known about the learning process of individuals with mental retardation, how the economy was changing and recognition of benefits of inclusion into the work place environment.

Social support for this movement to non-segregated work environment or competitive employment, has been accompanied by numerous Legislative Acts that have focused on an area of concern or need in employment or education of individuals with a disability. The most influential legislation impacting employers was The Americans with Disabilities Act (ADA) of 1990 (PL 101-336) which attempted to eliminate discrimination of individuals with disabilities in areas such as employment, public accommodation, transportation, state and local government services and telecommunications. Any business or school that received government money to operate was required to make any program, service or activity accessible to and usable by students with disabilities. The legislation attempted to level the playing field in posting job notices, setting job qualifications, interviewing, testing of applicants, making reasonable accommodations and training for individuals with a disability. This

Act addressed the physical working environment and required employers to provide physically accessible buildings which attempted to lower physical barriers to employment for individuals with a disability.

Legislation refocused the goals of education for individuals with disabilities with the passing of The Individuals with Disabilities Education Act of 1997 (IDEA) (PL 101-476). This legislation expanded on the 11 categories covered by special programs to include autism and traumatic brain injury. The Individualized Education Plan (IEP) was expanded and the ITP (Individual Transition Plans) was developed as part of the IEP and deemed mandatory by the age of 14 for all students in special education programs. Workplace and training sites were also included in the definition of special education instructional settings. The term transition services were defined as a means of coordinating a set of activities for a student with a disability that is designed using an outcome oriented process, which promotes movement from school to post school activities including post secondary education, employment, and adult services (Sarkees-Wircenski & Scott, 1995). This legislation placed the responsibility on schools to prepare students for life after formal schooling is terminated. IDEA placed the burden on schools to recognize the transition process and the services required to prepare students for employment related tasks.

Employment programs have been present for individuals with mental retardation since the early 1950s and the government legislation has supported the movement of individuals with disabilities into the work force with legislation such as ADA and IDEA 97, present statistics indicates that the process of transition is not very successful. Opportunities to seek employment have increased only 26% for individuals between the ages of 16-64 who have a disability while the employment rate for those without a disability is 78% (Lou Harris and Associates, Inc., 1998). Sixty eight percent of individuals with a disability did not participate in the labor force which resulted in a 13.4% unemployment rate amongst this population compared to 5.6 % for individuals without a disability. In 1998, of the 16.9 million individuals with a disability in the United States between the ages of 16-64, 11.4 million ( 67%) did not participate in the labor force, 5.4 million (32%) were employed, and 723,000 (4%) were unemployed but seeking employment. Only 3 out of 10 working age individuals with a disability are actually working (Lou Harris and Associates, Inc., 1998).

Although the percentage of individuals with a disability in the work force is considerably lower then their nondisabled peers, researchers have indicated an improvement in job placement from 1985-1995 (Gilmore, Schuster, Timmons & Butterworth, 2000). This is reflected in the improvement of employers attitudes toward the employment of individuals with mental retardation (Levy, Jessop, Rimmerman, & Levy, 1992). This is a marked improvement in attitude from the results of Fuqua, Rathbun, and Gade (1983) which suggested that individuals with mental retardation encounter the greatest discrimination in job placement than any other sub population. The same study suggested that employers were more concerned with work productivity stemming from the individual with a disability then the disability itself.

Employees who have had the opportunity to work with an individual with mental retardation have found the experience to be positive. Employees with mental retardation have been viewed as dependable (Millington, Syzmanski, & Hanley-Maxwell, 1994), having high retention rates (Wehman & Kregel, 1995: Adams-Shollenberger &

Mitchell, 1996), and low absenteeism (Adams-Shollenberger & Mitchell, 1996). Although these factors are positive in nature and could decrease administrative costs to a company in hiring and retraining staff, individuals with mental retardation still are not employed at an acceptable rate.

Employers concerns regarding employment of individuals with mental retardation stem from issues such as work productivity, higher accidents and social integration limitations (Greenwood & Johnson, 1987; Botuck, Levy, & Rimmerman, 1998). These concerns often are limiting factor in not hiring an individual with mental retardation. These concerns are hampered by the individual's disability and their inability to be properly prepared for their experiences at work.

Individuals with mental retardation are often referred to as clumsy due to their lack of balance or stability (Auxter, Pyfer & Huettig, 2001). Individuals with mental retardation score significantly lower on balance assessments than their nondisabled peers (Davis, 1986; Rider, Mahler & Ishee, 1983). Difficulties in balance related activities have been listed by employers as a contributing factor to some accidents at the work place (Davis, 1986). Balance in individuals with mental retardation can be improved with practice and proper activities (Horvat, 1983; Rider et al., 1983). Balance is task specific and can be improved through proper strength training activities (Haywood, 1997). Balance is learned and based around maturation of muscles and biomechanical elements (Auxter, Pyfer & Huettig, 2001). Improvement in balance can produce greater stability while performing work related tasks thus decreasing the occurrence of accidents at the work place.

Many of the job placements provided for individuals with mental retardation are low level or entry level positions with little opportunity for advancement (Parmenter, 1993). These low level positions often require a great deal of physical skill and require manual handling of objects. This physical component to work performance often is a stumbling block due to their already low level of physical strength as present by their significantly lower scores in physical assessments (Fernhall, 1992). Genaidy, Bafna, Sarmidy, & Sana, (1990) studied the effects of physical training and the relationship to manual material handling with non disabled college age students. Their results indicated a 248% increase in endurance time for symmetrical lifting tasks and frequency of handling increased by 44%. Research has shown that individuals with mental retardation respond similar to their non disabled peers in response to physical training (Croce, 1990; Halle, Silverman, & Regan, 1983; Tomporowski & Ellis, 1984,1985; Tomporowski & Jameson, 1985).

The need to improve physical function in order to improve work performance tasks in individuals with mental retardation stems from the need to maintain equilibrium and have the physical strength to carry out the required activities. The function of muscular strength as a component of work performance has been investigated by Seagraves, Horvat, Franklin & Jones, 2003; Zetts, Horvat, & Langone, 1995 and Croce & Horvat, 1992. The results show a significant improvement in performance in work related tasks occuring with an improvement in muscular strength due to adherence to a training program. No studies have investigated the effects of improvement in balance and the effect to work related activities. Improvement in muscular strength and balance can increase productivity thus decreasing employers concerns regarding work productivity and accidents. This could result in a more beneficial working relationship between employees and individuals with mental retardation thus a more favorable working environment can be established.

## Statement of the Problem

Individuals with mental retardation are not physically prepared for employment situations. Research has indicated physical functioning in the form of muscular strength and balance can hinder individuals with mental retardation from obtaining, maintaining, and retaining meaningful employments. This study hypothesized that there will be a significant difference in physical functioning and work performance measures of individuals with mental retardation from participation in a progressive resistance strength training and balance program.

## Purpose of the Study

The purpose of this study was to determine if an individualized balance and resistance strength training program is more effective then traditional physical education class in improving physical functioning and work performance of high school student with mild mental retardation. Research has indicated that individuals with mental retardation consistently score lower in fitness and balance assessments than individuals without mental retardations. Along with the fact that a major deterrent to work placement is the inability to adequately sustain their physical functionality over an extended allotment of time to ensure employment is beneficial to both employer and employee.

## Hypotheses

This study was designed to investigate the relationship between a school based balance and resistance strength training program and work performance. There will be a positive relationship between the dependent and independent variables. That is, an increase in the length of time the subjects participate in the balance and strength training programs will result in an increase in performance on the work performance measures. The following null and research hypotheses between the dependent and independent variables will be tested at the .05 significance level:

Hypotheses 1:

Null: There will be no significant change in muscular strength after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

Research: There will be a significant change in muscular strength after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

Hypotheses 2:

Null: There will be no significant change in work performance skills after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

Research: There will be a significant change in work performance skills after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

Hypotheses 3:

Null: There will be no significant change in balance after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

Research: There will be a significant change in balance after participation in a 12 week school based progressive resistance training program in high school students with mild mental retardation.

## Justification for the Study

The deinstutitionalization movement has taken individuals with mental retardation out of sheltered workshops and placed them into non-segregated work situations. Legislation has been put in place to insure the rights and freedoms of individuals with mental retardation in their quest to lead lives of "normalcy". School systems are involved in providing transitional services to individuals 14 years of age and older in order to provide a plan of action to assist with the transition from school to work. Although all these factors are in place to assist and prepare individuals with mental retardation for employment research indicates that only 3 out of 10 individuals are employed. Research indicates that employer's major concerns regarding hiring stem from issues of work productivity and increased accident rates amongst individuals with a disability in the work force. Physical functioning has been linked to work performance through muscular strength. There have been no studies that have attempted to investigate the relationship between muscular strength and balance as they relate to work performance measures. Therefore this study is designed to investigate the relationship between progressive resistance strength training and balance and work performance in individuals with mild mental retardation.

## Significance of the Study

This study will be the first to investigate muscular strength and balance as they relate to work performance measures in individuals with mild mental retardation. The intervention of a progressive resistance strength training and balance program will be implemented for individuals with mild mental retardation. The strength training program will use equipment that is available in a traditional high school physical education program. The balance program will incorporate a progressive sequence of balance activities.

## Delimitations

The study will be delimited to:

1. Students from Oconee County High School in Northeast Georgia who were enrolled in the Mild Intellectual Disability (MIID) program.
2. A balance and resistance exercise program using universal gym equipment, dyna bands, and free weights offered 3 times a week for 60 minutes for 12 weeks.
3. A simulated series of work performance activities designed around work related tasks in a simulated environment.

## Limitations

The following are the limitations to this study:

1. The findings from this study will only be generalizable to other studies utilizing high school students with mild mental retardation.

2. The findings from this study will only be generalizable to other studies utilizing the specific training equipment and techniques used in this study.
3. The findings from this study will only be generalizable to studies involving the designated work skills used in this study

Definition of Terms

*Mental Retardation* - The American Association on Mental Retardation (AAMR) defines mental retardation (MR) as a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. The onset is before the age of 18. (American Association on Mental Retardation, 2002).

In this investigation each participant will adhere to the definition for mental retardation as outlined by IDEA. The participants have been assessed following the United States Department of Education guidelines (IDEA, 1997) and placed in the Mild Intellectually Delayed (MIID) program offered through Oconee County High School.

*Muscular Strength* - Muscular strength is defined as the ability to exert maximum force against resistance. Strength is usually determined by the maximal amount of resistance that an individual is able to lift in a single effort (Hoeger & Hoeger, 2001).

In this investigation muscular strength will be assessed using a MicroFet2 hand held dynamometer (1991).

*Muscular Endurance* - Muscular endurance is the ability of a muscle to exert submaximal force repeatedly over a period of time. Endurance is commonly established by the number of repetitions that an individual can perform against a submaximal resistance or by the length of time that a given contraction can be sustained (Hoeger & Hoeger, 2001).

*Transition* – The Individuals with Disabilities Education Act (IDEA) PL 101-476 defined the term transition as a coordinated set of activities for a student, designed within an outcome oriented process, that promotes movement from school to post school activities, including postsecondary education, vocational training, integrated employment (including supported employment), continuing and adult education, adult services, independent living, or community participation. The coordinated set of activities must be based on the individual students needs, taking into account the students preferences and interests, and include instruction, community experiences, the development of employment and other post school adult living objectives and acquisition of daily living skills and functional vocational evaluation. (National Information Center for Children and Youth with Disabilities, 1993).

*Progressive Resistance Exercise Program* - Progressive resistance exercise program (PREP) is defined as exercises that require a muscle or muscle group through a full range of motion against a resistance. Improvement in strength occurs only when the muscle is overloaded. Progression in resistance should occur only when the muscle or muscle group has adapted to the increase in overload (Prentice, 1991). In this investigation the PREP will be designed using free weights, dyna bands, gravity assisted exercises, and universal gym equipment

*Work Productivity* - Work productivity is defined as the amount of a specific work task completed in a specific time period (Croce & Horvat, 1992). In this investigation work productivity will be measured by the tasks of box stacking, pail carry, and dolly cart push.

*Balance* – Balance is the ability of an individual to maintain equilibrium in a held (static) or moving (dynamic) position. In this investigation balance will be assessed using the weight bearing squat, step up and over, and sensory organization assessments on the NeuroCom Balance Master (2001).

*Isokinetic* - Isokinetic refers to exercises that provide resistance through the entire range of movement, either by pushing one limb against the other or by using an exercise machine that provides resistance equal to the amount of pull throughout the range of motion.

*Isometric* – Isometric refers to muscle contraction in which the length of the muscle remains constant while tension develops toward a maximal force against an immovable resistance. In this investigation the strength will be assessed using isometric strength measures.

# CHAPTER 2

# REVIEW OF LITERATURE

This chapter examines literature related to physical functioning and work performance. This chapter outlines research findings under the following categories: employment, physical functioning in relation to balance and muscular strength and endurance, effects of training, work productivity and work performance and training.

## Employment for Individuals with Disabilities

The role of employment in the lives of adults with mental retardation has received considerable attention during the past decade. Employment has emerged as an effective and efficient rehabilitation model for moving and maintaining large numbers of workers with mental retardation into the competitive labor market (Wehman & Kregel, 1995). Recent federal initiatives on employment have focused a great deal of effort towards creating employment opportunities within the private sector for persons with mental retardation.

Gilmore, Schuster, Timmons, Butterworth (2000) conducted a secondary data analysis of information provided by the Rehabilitation Services Administration looking into trends in placement options for individuals who had been placed in vocational rehabilitation centers from 1985 to 1995. The researchers focused on successful closure of cases which defined for this study represented an individual obtaining and maintaining employment for a minimum of 90 days. The results indicate that over the time span of this study no significant differences occurred in the amount of closures occurring but there was significant reduction in the amount of closures occurring in sheltered workshops. The total number of case closures investigated in 1995 indicated 48.4% were for individuals with mild mental retardation. During this time frame, 1985-1995, the trend in competitive employment placements for individuals with mild mental retardation increased from 69.3% to 82.8%. This indicates a positive trend in job placements for individuals with mild mental retardation from 1985-1995.

This positive trend was not duplicated in Millington, Szymanski, Hanley-Maxwell (1994) when they attempted to investigate a) the underlying factors used in employer selection for entry level jobs in manufacturing and commerce and b) assess the effects of the label mental retardation has on the selection process. This study randomly surveyed 1000 Human Resources departments in the manufacturing industry. The findings indicate that the label of mental retardation influenced employer perceptions before meeting the individual. Thus lower expectations were initiated prior to hiring or any opportunity to perform is given. Employers indicated that factors they consider when hiring included fundamental skills, advanced skills, job knowledge, skills, and abilities, and personal assets. Factors listed for not hiring included dependability, organization demands, job knowledge, skills, and abilities, personal assets, personal liability, and advanced skills. These results confirmed findings that employer's attitudes and perceptions toward individuals with a disability in the work force were still the main deterrent in hiring an individual with mental retardation.

Fuqua, D. R., Rathbun, M. & Gade, E. M. (1983) surveyed businesses in an upper great plains state to investigate attitudes toward hiring an individual with a disability. Eighty employers filled out the Hartlage questionnaire. The results indicated that employers most concerned about productivity, accident rates, and workman compensation problems. They were least concerned about worker reliability and relationships with co-workers. The employers indicated that they were most concerned about individuals with mental retardation over other disabilities. This indicates that employer's attitudes vary discriminately toward specific types of disability. It was easier for employers to accept individuals with bodily injuries rather then cognitive impairments. Bodily limitations were perceived as more consistent and predictable thus supporting the notion that individuals with mental retardation are discriminated against based on their disability not their ability.

Attitudes and perceptions reflected change when employers have had an opportunity to experience first hand the abilities of their coworkers with mental retardation. Levy, Jessop, Rimmerman, Levy (1992) sampled 341 of the Fortune 500 companies to investigate their attitudes toward hiring an individual with a disability. A 30% response rate was provided in filling out and returning a questionnaire. Results indicate that employers had a favorable attitude toward hiring an individual with a disability. This favorable attitude was attributed to positive experiences in the work force and positive evaluations of past experiences. These experiences allowed employees to witness the abilities and capabilities of their co-worker with a disability first hand. Effective job matching techniques were listed as the main reason given for successful placement of individuals with a disability into the work force. Employers felt that more work study, internship programs, or practicum experiences should be offered to assist with the transition process into a new work environment.

Mank, Cioffi, and Yovanoff (1998) reinforced that coworkers responded more positively to employees with severe mental retardation if they were provided with proper training and support. This study compared individuals with mild mental retardation to those with severe mental retardation on wage and job placement. Results indicated that wage was linked to severity of the disability with individuals with a lesser severe disability receiving a higher salary. Higher expectations were placed on individuals with mild mental retardation although employers felt that individuals with severe mental retardation were capable of more then what was expected of them.

Since the influx of individuals with mental retardation into the work force researchers have been attempting to determine what would be the most appropriate method to transition. By investigating programs that have attempted to integrate individuals into the work force it is hoped that a best practices method can be determined. Unfortunately not all program results of transitioning individuals with a disability into the work force are favorable. Botuck, Levy & Rimmerman (1998) investigated the results of post placement outcomes of individuals who participated in the YAI employment program sponsored by the National Institute for People with Disabilities. The program offers 3 months of job training in simulated situations. Placements were in competitive employment with individuals receiving a minimum of minimum wage or higher. This study investigated changes in employment following the completion of the YAI program. Specifically the researchers tracked wages, hours, and benefits. To be included in the study each participant had to work between 20-40 hours per week and have held their job for a minimum of 30 days. Results from this study indicate that the average length it took a participant to seek employment after completion of the program was 6.5 months. Employment distribution was primarily in maintenance (30%), and retail (24%). Job turnover was an area of concern as 77% of participants had changed jobs at least once.

Layoffs affected 35% of the participants and were listed as the reason for job change. Thirty seven percent of job changes were employee terminations (26% due to absenteeism, 39% due to lack of skill and 36% as a result of behavior problems). The average hourly wage over the 24 month study was $5.50. Individuals with learning disabilities earned significantly higher wages then did participants with mental retardation or psychiatric problems in the beginning but over time individuals with mental retardation or psychiatric disabilities surpassed the hourly wage of individuals with learning disabilities. The findings found no significant factors associated with job retention or job separation suggesting that they are situational and reflective of a combination of circumstances relating to the individual, the employer, and the job market.

Fabian, Lent, Willis (1998) attempted to predict work transition outcomes of individuals leaving high school. For this study, 2258 special education students involved in the "Bridges… from School to work" intervention program were tracked six month after completing the program. The program was funded by the Marriott Foundation for People with Disabilities and was operating in seven locations across the United States. The program has three phases:1) the prevocational orientation program which the parents and the student set goals, 2) prevocational preparation which entails career guidance, job preparation, an job search skills; and 3) internship placement and support. Support is provided as required. Each placement is paid and in a competitive employment situation with a local business. The researchers attempted to predict student's ability to complete the internship, accept post-internship employment, and maintain employment minimum of six months. Results indicate that 76% of students enrolled in the Bridges program completed their internship. Of the students who completed the program 71% were able to find employment after their internship. Eighty four percent who completed their internships were still employed or enrolled in postsecondary education six months after completion of the program. The researchers also determined that during the internship the average wage was $5.17 while during the six month follow up assessment the average wage was $5.44. It was reported that the average number of hours worked per week was 23 during the internship and increased to 39 hours per week during the follow up assessment. On average 2.5 days were missed during the internship and employers reported only 1.3 days tardy during the follow up assessment. This study suggests that a highly structured, school based program that incorporates work experience opportunities is favorable to providing the necessary skills that allow an individual to be successful post high school.

The transition process implemented at high schools is set up to be a program that allows an individual to gain the skills and knowledge necessary to be successful after high school. With such a program already operating in the school system one would question why only 3 out of 10 individuals with mental retardation are working 6.5 months after graduation. This fact indicates that more needs to be done then just provide highly structured programs.

Shafer, Hill, Seyfarth, and Wehman (1987) investigated employers' experiences with workers who were mentally retarded and received supported competitive employment. The sample consisted of 483 direct supervisors from central and southeast Virginia. All companies had hired at least one worker with mental retardation.

A mail survey instrument was sent to all participants regarding job evaluation concerning performance of workers with mental retardation and comparing performance and turnover to those of workers without handicaps. The results from this study suggest that employers hire individuals with mental retardation due to a commitment that such individuals deserve an opportunity to work. The instrument consisted of 12 performance indicators; appearance, returning from breaks on time, accepting authority, learning new skills, quality of work, speed of work, degree of supervision required, acceptance by the public, attendance, communication, on time arrival and departure, and safety record. The 4 indicators receiving the highest mean ratings from employers were: attendance, on-time arrival and departure, returning from breaks on time, and safety record. These ratings portray a perception of workers with mental retardation as dependable, trustworthy, and loyal employees. The lowest 4 ratings portrayed the image of an employee with mental retardation who is slower to learn, slower to perform, and in need of supervision.

A follow up study by Shafer, Banks, and Kregel (1991) studied employment retention among individuals with mental retardation. Three hundred-two participants were selected from the Virginia Employment Information System which is operated by the Rehabilitation Research and Training Center, Virginia Commonwealth University. The participants met the following criteria for participation in the study: (a) a primary disability of mental retardation, (b) employment for at least 2 years prior to analyses, and (c) availability of data regarding active employment services collected at regular intervals during a 24 month study period. Analysis of data yielded retention rates of 64.2% for 12 months and 53.4% for 24 months. Slightly more than 30% of all consumers were unemployed and on referral awaiting replacement at various times throughout the study. Nearly 9% of employees were discharged after 12 months and 19% after 24 months. This suggests that individuals with mental retardation have high retention rates thus could contribute to decreasing a company's cost or hiring and retraining personnel.

Similar positive results in retention and absenteeism were found by Adams-Shollenberger and Mitchell, 1996 when they compared janitorial workers with mental retardation and those without. The study composed of 99 janitors with mental retardation and 318 non-disabled workers. Researchers tracked the termination rates and frequency and reason for absenteeism for two years. It was determined that 34% of workers with mental retardation remained on the job at the completion of the first year to the study compared to only 10% on nondisabled workers. Workers with mental retardation had higher rates of involuntary dismissals during the second year of the study. Employees with mental retardation had more absences due to bad weather but lower absences due to family/personal reasons. Bad weather absences were due largely to the fact that these individuals had to rely on others for transportation to and from work. This study supported the hiring on employees with mental retardation because they are committed to the job and dependable. These traits in an employee could reduce the cost of hiring and retraining new recruits.

In order to better understand successful placements of an individual with mental retardation, Kiernan, McGaughey, & Schalock (1988) investigated the changes in placement patterns and outcomes of adults with mental retardation as the utilization or real work settings increased. Data was collected on individuals within sheltered workshops and three additional types of employment environments; transitional training, supported employment and competitive employment. Two survey instruments were mailed to 3652 agencies and organizations across the United States. There was a 49.9% response rate or 1048 organizations responded. The survey data yielded the following results; thirty-two percent of individuals were employed full time, 68% of individuals were employed part time; 26% of individuals were employed in the food and beverage preparation industry, 26.8% janitors, 13.8% fabrication and repair of assorted products, 11.2% kitchen worker, the rest were less then 4% of the total population surveyed. These findings indicate that individuals with mental retardation work primarily on manual labor jobs. These jobs required a great deal of physical skill and motor control.

The placement of individuals with mental retardation into highly structured programs that incorporate work experience provide a more favorable opportunity to gain the skills necessary to gain successful employment. Research supports the fact that individuals with mental retardation are loyal, committed, dependable employees. Concerns regarding their employment stem from issues of productivity and accidents. Job placements indicate that individuals with mental retardation are likely to be employed in a job that requires physical tasks. Therefore in order to improve the productivity and decrease accidents in the work force it is imperative to improve physical functioning with individuals with mental retardation.

## Physical Functioning in Individuals with Mental Retardation

A large emphasis in research involving individuals with mental retardation has focused on devising strategies to allow participation in physical activity. Finding strategies for allowing individuals with mental retardation to engage in physical activity and improving individuals with mental retardation's physical fitness and possible their achievement or performance has been the objective of researchers over the past decade. The following section outlines research that has investigated physical functioning in individuals with mental retardation, methodology, participants, and findings. The section is divided into two subsections; muscular strength and endurance and balance.

Muscular Strength and Endurance in Individuals with Mental Retardation

Individuals with mental retardation score significantly lower then their nondisabled peers on physical fitness assessments (Reid, Montgomery, & Seidl, 1985; Moon & Renzaglia, 1982). Canadian researchers Reid, Montgomery, and Seidl (1985) used the Canadian Standardized Test of Fitness to evaluate 220 adults (males and females) with mental retardation. The test compares participant's results with normative data to indicate where the subject performs relative to the rest of their age category. The individual tests are performed in non laboratory settings. The results indicated that adults with mental retardation scored significantly lower then their nondisabled peers in muscular strength, muscular endurance, and flexibility. Poor performances in grip strength and sit up scores were determined. Poor aerobic performance by adults with mental retardation confirmed previous research suggesting that cardio respiratory deficiencies may be an underlying condition of mental retardation (Pitetti, Rimmer & Fernhall, 1993). Lower levels of fitness affect overall physical functioning and the ability to sustain physical effort during performance.

The main area of physical functioning that researchers focus on is muscular strength and endurance. Pitetti and Boneh (1994) compared cardiovascular fitness to leg strength of young adults with mental retardation with and without Down Syndrome. Thirteen adults (9 males and 4 females) with Down Syndrome and 24 adults (16 males and 8 females) with mental retardation but without Down Syndrome participated in the study. Cardiovascular capacity was determined for each participant using a treadmill test and isokinetic knee flexion and extension strength were determined using an isokinetic dynamometry. Results indicated a positive relationship between $VO_{2peak}$ and isokinetic leg strength thus suggesting leg strength may play an important contributor to $VO_{2peak}$ in individuals with mental retardation.

More specifically, Pitetti and Yarmer (2002) studied isometric knee flexion, knee extension strength, and combined leg and back strength between a large sample of children and adolescents with and without mental retardation. Participants were 269 children and adolescents with mild mental retardation (158 males, 111 females) and 449 children and adolescents without mental retardation (223 males and 226 females). The Nicholas Manual Muscle Tester (NMMT) was used to assess leg strength. The researchers used the protocol outlined by Horvat, Croce & Roswal (1993). There was significant increase in knee flexion and extension strength and leg and back strength for age ranges 8-18 yrs for participants without mental retardation. Knee flexion and extension strength for participants with mental retardation were significantly lower then their peers without mental retardation.

Horvat, Croce, Pitetti and Fernhall (1999) studied isokinetic knee flexion and extension strength in youth with mental retardation (15 males and 15 females) and youth without mental retardation (17 males and 13 females). Parameters measured for this study included: peak torque (PT), time to PT, angle to PT, total work, and PT hamstring/quadriceps ratio. A Kin-Con isokinetic dynamometer at a speed $60^{o}{\cdot}s^{-1}$ was used to evaluate each participant. Peak torque was corrected by body weight and body mass index. Descriptive statistics were calculated for age, height, weight, and BMI. A statistical inquiry was conducted using peak torque, time to peak torque, angle of peak torque, and total work using a 2 X 2 X 2 (groups X gender X muscle) repeated measures analysis of variance (MANOVA). Flexion/extension ratios, BMI, and BW were analyzed by a separate 2 X 2 (group X gender) ANOVA. Separate ANOVA were conducted because there was no ά priori assumption that these two distinct variables would be correlated. This assumption was supported by a Pearson correlation between variables of r=0.25, which is considered low. The conservative Greenhouse-Geisser correction factor was used to evaluate observed within group F ratios. A Tukey test was applied in post hoc comparisons. The results from this study suggested that 1) while gender differences were apparent in the participants without mental retardation they were not present in the participants with mental retardation, 2) knee extension strength was higher for participants without mental retardation thus resulting in lower peak torque in hamstrings/quadriceps ratio, 3) angel of peak torque and time to peak torque were similar between both groups, and 4) total work performed was lower for participants with mental retardation.

Angelopoulou, Tsimaras, Christousas, Kokaridas, & Mandroukas (1999) assessed differences in isokinetic muscle torque in the knee with 7 individuals with Down Syndrome, 8 with mental retardation, and 12 sedentary individuals without Down Syndrome or mental retardation. All participants were males and enrolled in school. The Cybex II isokinetic dynamometer was used to measure peak torque at angular velocities at 60, 120, and 300$^\circ \cdot sec^{-1}$. The right leg of each participant was used in the assessment. An orientation was given prior to the subjects performing for the study. Each participant was able to become familiar with the machine by sitting on it and doing 10 repetitions. Participants were given a six minute warm up then three test repetitions with maximal effort were conducted. The highest peak torque of the three trials were used in the analysis of variance. The subjects with mental retardation performed their trials on two different days. This was done to ensure that maximal effort was given on the assessment. Results from the two day assessment indicated that there was no significant difference between the results from either trial. Peak torque values were corrected for the effects of gravity. Statistical analysis indicated that the peak torque at all angular velocities studied were significantly higher in the sedentary participants then in the individuals with mental retardation. Individuals with mental retardation had significantly higher torque in their hamstrings then Down Syndrome individuals at angular velocities of 120 and 300°/sec but not at 60°/sec. The ratios between peak torque in hamstrings and quadriceps did not differ significantly among the three groups.

Isokinetic arm and leg strength were incorporated into a study by Pitetti, Climstein, Mays & Barrett (1992). The study compared participants with Down Syndrome (n=18), mental retardation without Down Syndrome (n=18), and sedentary individuals without mental retardation or Down Syndrome (n=18). Participants with mental retardation were from 2 sheltered workshops or vocational training centers. The Cybex 340 dyanmometer was used for assessing the dominant leg and arm of each participant using an angular velocity of 60°/sec. Subjects performed four repetitions two at moderate speed and two at maximal speed. Participants with Down Syndrome or mental retardation performed the sequence twice with 48-96 hours in between. The best results between the two attempts were used in the statistical analysis. A repeated measures one way analysis of variance (ANOVA) was applied with the Tukey multiple comparisons to detect specific differences. Statistical significance was set at p<.01. Results indicate that individuals without mental retardation were stronger in arm flexion and extension as well as in leg flexion and extension then individuals with mental retardation.

Horvat, Pitetti & Croce (1997) looked specifically at peak torque and average power in elbow flexion and extension in individuals with Down Syndrome, mental retardation, and sedentary adults without mental retardation. Participants with mental retardation were selected from two sheltered workshops or vocational training centers based on their availability to get to the test facility. Dominant arms were assessed using the Cybex 340 dynamometer at angular velocities of 60 and 90 ° /sec. The participants had six trials at each speed. Participants with mental retardation performed the test protocol twice 48 hours between each test. The highest score at each speed for each trial was used in the statistical analysis. A 3 (subject group) X 2 (muscle group) X 2 (velocity) repeated measures analysis of variance (ANOVA) was conducted on peak torque and average power measurements. A conservative Greenhouse-Geisser correction factor was used to evaluate observed within group F ratios. Tukey tests were used for between group post hoc comparisons. Statistical significance was set at p< .01 to protect against a Type I error. Results indicated that participants without mental retardation displayed significantly higher peak torque elbow flexion and extension then participants with mental retardation. Results also suggested that average power in elbow extension was greater then average power in elbow flexion.

Balance in Individuals with Mental Retardation

Balance is an integral part of skilled movement performance of individuals of all ages. Successful performance of motor skills depends upon the individual's ability to establish and maintain balance (Williams, McClenaghan, Ward, Carter, Brown, Byde, Johnson & Lasalle, 1986). Movements requiring balance involve successful integration of anatomical, muscular, and neurological functions. The deterioration of any of these functions may impede the ability to maintain equilibrium.

Research indicates that individuals with mental retardation perform lower on assessments of balance then their nondisabled peers (Rider, Mahler & Ishee, 1983). Rider et.al. (1983) compared static balance in 31 children with moderate mental retardation to 31 children without mental retardation. A modified version of the Stork Stand was used to assess bilateral static balance. The participants were asked to stand on their leg of choice on the Automatic Performance Analyzer for as long as they could without falling. Total time standing was recorded for the left leg, right leg and combined total time. Each participant was allowed three attempts and the greatest amount of time standing in each position was used for statistical analysis. T test for correlated data indicated that there was no significant difference between left leg and right leg balance on children with mental retardation. There was a significant difference between balance time between the two groups of participants. Participants without mental retardation could balance on either leg significantly longer then the participants with mental retardation. Static balance must be developed before dynamic balance in order to achieve motor proficiency. This research indicates that individuals with mental retardation are delayed in the acquisition of balance at an early age which will make it difficult to develop mature motor patterns later on in life.

Balance can be improved upon with proper practice. Horvat (1982) studied the effects of a home learning program on children's balance. Fifteen males ranging in age from 7 to 9 years old participated in the study. Participants in the study scored at least 1 standard deviation below the mean for normal children of like chronological age on the Six Category Gross Motor Survey. Participants were randomly assigned either to a treatment group; received fine motor program and pre academic tasks, or no treatment. All participants received physical education from their classroom teacher. The home program was conducted by parents therefore it was imperative that parents were willing to work a minimum of 30 minutes three times a week for 12 weeks with their child on the balance program. The program consisted of static and dynamic balance tasks such as standing on one foot, walking backward, or walking between lines. Each parent was provided with a detailed package describing prompts, cues, praise, diagrams, and scoring charts. Weekly training sessions were provided for parents to assure proper teaching techniques were carried out. Upon completion of the program all participants were assessed using the Six Category Gross Motor Survey. The Wilcoxon matched pairs signed ranks analysis was used to determine differences of mean score of subject in the treatment group or the control group in static, dynamic, and overall balance performance. The Mann Whitney U test was used to compare the differences of mean scores within groups on static, dynamic, and overall balance performance. Statistical significance was set at $p<.05$. Results indicated that the children who participated in the home program scored significantly higher on the post test in both static and dynamic balance then the group who did not receive any other training other then regular physical education class. These findings suggest that balance can be improved upon in individuals with learning difficulties through specific practice. This also suggests that participation in regular physical activity is not enough the activities need to be specific to the task.

## Effects of Training in Individuals with Mental Retardation

The benefits of fitness for individuals with mental retardation were often sought for the social reasons. Social interaction was the main focus of research involving individuals with mental retardation until Brown (1977) used an isometric strength training program with forty males 12 years of age to investigate the physical benefits of physical activity for individuals with mentally retardation. In Brown's (1977) study subjects were randomly assigned to one of two treatment groups. The treatment group participated daily for six weeks in a series of 12 isometric exercises each for 10 seconds. The control group had no organized program but would go for a walk when the treatment group was exercising. Pre and post assessment were provided using the Stanford Binet Intelligence Test and the Vineland Social Maturity Scale. Strength assessments were conducted using a spring scale. The researchers assessed arm and shoulder, abdominal, back, and leg strength. Each participant received three trials at each site with the best performance being using in the statistical analysis. Analysis of variance (ANOVA) with statistical significance set at $p<.05$. Pre test results indicated no significant differences between groups on any of the variables assessed. However the treatment group scored significantly higher on the post test on all variables then the control group. This research suggested that individuals with mental retardation could improve muscular strength from participation in a six week isometric strength training program.

The work of Brown (1977) set the ground work for Rimmer and Kelly (1991) when they investigated adults with mental retardation and the effects of a 9 week resistance training program. Twenty four adults (13 women and 11 men) ranging in age from 23 to 49 years of age from two intermediate care facilities participated in the study. The participants were randomly assigned to a treatment group (participated in a progressive resistance training program twice a week), or control group (participated in a clinic once a week which consisted of dance (35 min), aquatics (35 min), and lifetime sports (35 min)). Pre assessment data was collected on all subjects using 1 repetition maxs on the let extension, leg curl, pullover, pectoral deck, and shoulder abduction. The participants were allowed three attempts to achieve the maximum scores over a two day period. This was to ensure that maximum effort was achieved. The highest score was used for data analysis. The training program occurred twice a week for one hour sessions for 9 weeks. The training program consisted of three sets of exercises on each machine. Set 1 was performed at 30% of 1-RM, 8-10 repetitions, set 2 was performed at 60% of 1-RM, and set 3 was 70% of 1-RM using Nautilus machines. When the participant could complete 12 or more repetitions on set 3 then the next plate was added to the weight. Multivariate analysis of covariance (MANCOVA) were conducted with statistical significance set at $p<.05$. Results indicate that the treatment group had significantly higher post test scores then did the control group on all assessment areas. Upper body strength measures improved 42%-121% and lower body strength measures improved 42%-52%. This study supported the notion that individuals with mental retardation are capable of participating in a weight training program with minimal amount of assistance.

Another form of training that has been used to train individuals with mental retardation is hydraulic resistance. Suomi, Surburg & Lecius (1995) investigated the effects of hydraulic resistance training on total work and peak torque measures of isokinetic strength in knee extension and hip abduction in 22 men with mild to moderate mental retardation. The participants were randomly assigned to two groups; treatment group received training 3 times a week for 12 weeks while the control group received light recreational activities such as darts, cards, or shuffleboard. All participants were employed in a vocational training center. All muscular assessments were performed using the Musculoskeletal Evaluation, Rehabilitation and Conditioning (MERC) Systems Dynamometer. Pre and post assessments on the knee and hip were conducted using 60 and 30 °/sec velocities respectively. The training program was devised using the principles of Hydra Fitness machines cited in the training manual. Repetitions were to be performed as fast as possible and each repetition was performed through a full range of motion. Mean peak torque in knee extension and hip abduction in the treatment group were significantly higher in the post test data scores. A 2 X 2 analysis of variance (ANOVA) was conducted to investigate the relationship between group X test. The level of significance was adjusted using the Bonferroni method to reduce the influence of a Type I error. Statistical significance was set at $p<.01$. The post data results indicate that high intensity hydraulic resistance training programs are capable of producing significant change in muscle strength after a 12 week program. Both Suomi et at. (1991) and Rimmer & Kelly (1991) noted that there were no drop outs in the treatment groups for their studies. They noted that individuals with mental retardation enjoy training and being able to be physically active in a strength training program.

Similar results have been observed in cardiovascular exercise programs. Croce (1990) recruited three obese males (mean age = 27.3) from a residential community who were classified as severely mentally retarded. Each participant reduced their daily caloric intake by 500 kcal along with a one hour exercise program five days a week for 20 weeks. The exercise program consisted of a 15 minute calisthenic warm up, 30 minutes of vigorous aerobic exercise on a stationary bike or a brisk walk/run on a treadmill followed by a 15 minute cool down. Two aerobic exercise modes were utilized to decrease boredom by the participants and thus increase motivation throughout the duration of the study. A multiple baseline across subjects design was utilized to predict maximal oxygen uptake, body weight, and body composition. Maximal oxygen uptake was assessed using actual tempo stepping test as opposed to a desired tempo step test. The sum of three skinfolds (abdomen, thigh, and chest) determined body density and percent body fat was determined using standard Siri equation. The participants varied in the length of treatment, subject 1 exercised all 20 weeks, subject 2 participated 17 weeks while subject 3 underwent treatment for 14 weeks. The results indicate that the longer the participant underwent treatment the greater the change. Although, all participants showed improvements from the beginning of the program in maximal oxygen uptake, body composition, and body weight. These results support the notion that individuals with mental retardation respond to exercise programs. The participants in this study were dependent on their supervisors for motivation and direction throughout the study. In order for participation to continue after the study is completed individuals with mental retardation need to have an exercise program that can be generalized to community settings.

Strength training in the form circuit training has shown to be a type of training that is highly structured and produce positive results with individuals with mental retardation. Horvat, Croce & McGhee (1993) investigated the effects of circuit training on muscular strength and endurance on six high school aged individuals with mental retardation. Each participant was enrolled in adapted physical education and could follow directions and complete assessment tasks without excessive verbal or physical prompting. The exercise program consisted of a 50 minute workout 5 days a week with the first 5 minutes being used for warm up, 40 minutes of circuit training, and 5 minute cool down. The circuit training program was designed to increase muscular strength in both the upper and lower body. The exercises consisted of step ups, leg extensions, push ups, sit ups, curls, bench press, and overhead press. Initially each participant performed one set of 12 repetitions for each exercise. An additional half set of six repetitions were added after 14 days of training until each participant could perform three sets of 12 repetitions. Strength measures were assessed using a Nicholas Manual Muscle Tester (MMT) at the following sites: elbow extension, hip flexion, and quadriceps extension. Three trials were conducted at each location with the mean of the trials being used for statistical analysis. Results indicate that the participants showed a 51% increase in composite isometric strength scores from baseline to treatment. This study suggested that circuit training provides sufficient intensity to elicit sufficient increases in muscular strength in individuals with mental retardation. Circuit training provides a structured format that keeps that participants focused and on task. This could assist in limiting unwanted behaviors brought about through boredom or lack of focus.

Research has indicated that individuals with mental retardation perform significantly below their peers in strength activities. Although studies have indicated that through strength training activities individuals with mental retardation can improve their present level of strength. Circuit training provides a structured format that keeps the participants on task and focused at the task at hand.

## Work Productivity and Physical Training Programs

Employers have been concerned about improving work performance in manual labor jobs while decreasing the risk of injury or accident due to overexertion. The link between improving physical strength and work productivity has been studied by Genaidy, Gupta & Alshedi (1990) in an attempt to investigate muscular endurance, muscular strength, and cardiovascular endurance and workload perception with employers without disability. Fifteen participants were assigned to one of three groups. Two groups received progressive resistance training while the third group served as the control. Group one used six repetition maximum while group 2 used ten repetition max. protocol. The training program consisted of 16 sessions over a 6 week period. The physical training program was designed to enhance muscular strength for manual material handling (MMH) tasks. The MMH consisted of a combination of lifting, lowering, carrying, pushing, and pulling activities. Group 1 was to perform a total of 18 repetitions divided into 3 sets of 6 repetitions. Set 1 = 6 repetitions at a load equal to one half the 6RM load; Set 2 = 6 repetitions at a load equal to three quarters of the 6RM load; Set 3 = 6 repetitions at a load equal to the 6 RM load. Each set was performed without resting at a rate of 5 times/min. Whenever the subject was able to handle the third set of 6 RM eight cycles, the weight was increased in the next training session by 4kg. In the 10RM training group, all subjects performed 30 repetitions divided into 3 sets of 10 repetitions as follows: Set 1 = 10 repetitions at a load equal to one half the 10RM load, Set 2 = 10 repetitions at a load equal to three quarters of the 10 RM load, and Set 3 = 10 repetitions at a load equal to the 10 RM load. Each set was performed at a rate of 5 times/min. Whenever the subject was able to handle the third set of 100% 10 RM 12 cycles, the weight was increased in the next training session by 4 kg. Cardiovascular assessments were performed using three surface electrodes during the training programs. Strength measures were collected using a BLH load cell and digital display meter. Dynamic strength was measured using a wooden box with cutout handles. Borg's perceived exertion ratings were used to allow the participants to rank their perceived effort. An analysis of variance (ANOVA) was conducted on the data collected. The results indicate that the training effect was statistically significant at the 5% level for static arm strength, static back strength, static leg strength, static composite strength, and dynamic strength for the 6RM group. While the 10RM group had significant training effects at 5% for static back strength, static leg strength, static composite strength and dynamic strength. These results suggest that muscular strength and endurance are factors in performance in manual handling tasks and physical training can improve performance in such tasks.

Genaidy, Bafna, Sarmidy & Sana (1990) investigated whether endurance limits of new employees engaged in symmetrical and asymmetrical manual lifting tasks could be increased through participation in a physical training program. Twenty seven males were randomly assigned to one of three treatment groups: symmetrical lifting (SLT), asymmetrical lifting (ALT), and control. The training sessions was 16 sessions long and occurred every other day. The results indicate that the endurance time for the SLT and

ALT groups were statistically significant at 1%. Endurance time increased 248% for SLT and 46% for ALT. There was no significant difference between the control group scores on endurance time. The frequency of handling was statistically significant at 5% for both the SLT and the ALT groups. Frequency of handling increased 44% for SLT and 34% for ALT. Researchers noted the improvement in performance was linked to both an improvement in muscular strength and an improvement in lifting techniques. The results suggest that injuries due to overexertion could be decreased with proper physical training.

Genaidy, Davis, Delgado, Garcia & Al-Herzalla (1994) combined progressive resistance exercise (PRE) and truck flexibility exercises (TFE) to investigate the effects on manual material handling (MMH). A total of 28 employees from three different manufacturing plants volunteered to participate in the study. The training programs were conducted over a four week period with a week prior to a after the conclusion of the training program being used for assessment purposes. Each session lasted approximately 20 minutes. The training protocol was similar to the one conducted in Genaidy et al. (1991a) using 10RM. The flexibility training was used as a warm up and cool down activity for one group with progressive resistance exercises to occur between TFE. Trunk flexion and extension, lateral bending, trunk twisting, and sit and reach activities were included as TFE. The control group participated in the pre and post testing only with no training in between. The results from this study indicate that strength training and flexibility can be used to increase dynamic strength in employees using manual material handling tasks. The average increase in muscular strength in the two treatment groups was 127% which was similar to the findings in Genaidy et al. 1990a.

Although Genaidy et al. 1990a,b,1994 did not used individuals with mental retardation as subjects their research does begin to give us some incite into the effects of improvements in muscular strength and work performance. The next session reviews literature that focuses specifically with work performance with individuals with mental retardation.

## Work Performance and Physical Training of Individuals with Mental Retardation

There have been a few studies that have attempted to investigate the effects of work performance in relation to muscular strength. Seagraves, Horvat, Franklin & Jones (2003) studied the effects of a school based resistance training program on muscular strength and work productivity in high school students with moderate mental retardation. Fourteen participants were matched according to height, weight, and gender and randomly assigned to either the treatment group which received a 10 week strength training program or the non treatment group which participated in low intensity activities during the study. Muscular strength and vocational productivity were assessed at three equal intervals throughout the study along with a retention measure. Peak isometric strength was measured using the MicroFet2 hand held dynamometer bilaterally at the following sites; elbow flexion and extension, knee flexion and extension, and shoulder abduction. Upper and lower body composite scores were calculated for analysis purposes. Vocational assessments included occupational tasks such as weighted dolly cart push, weighted pail carry, weighted box stacking, and chair stacking tasks. The analysis of data collected indicated a significant difference between treatment groups in all vocational tasks with the strength training group receiving higher mean scores. Isometric strength data suggested an average increase of 38.35% across composite scores for the treatment group and a 4.08% in composite score for the control group. Retention rates for vocational tasks decreased 12.64% and isometric strength composite scores decreased 11.42% five weeks post study. This data encourages individuals with mental retardation to participate in a strength training program to increase muscular strength and improve work performance in occupation tasks.

Similarly, Zetts, Horvat & Langone (1995) studied 6 moderate to severe intellectually delayed high school males and the effects of a community based exercise program on work related tasks. A single subject multiple probe design was used to investigate changes in strength. Pre and post data were collected using the Nicholas Manual Muscle Tester on maximal lifts using bench press, military press, leg press, leg curls, leg extensions, and bicep curls. All participants improved their performance in the work productivity tasks throughout the study. The box stacking tasks saw the greatest increase in performance while the pail carry had the smallest increase. This study altered the participant' daily routine from strength training to work productivity tasks throughout the study. The results suggest that improvement in work productivity tasks come more so from the improvement in strength then have the opportunity to practice the tasks.

Research indicates that motivation often is a deterring factor in performance in individuals with mental retardation. Croce & Horvat (1992) used a reinforcement based aerobic and exercise program with three obese men with mental retardation to study the role they played in work productivity. A multiple baseline across subjects design was used to measure body weight, percent body fat, oxygen consumption, composite isometric strength, and work productivity. The subjects participated in a one hour exercise program three days per week and a 40 minute exercise program one day per week. Each exercise session consisted of 10 minutes of warm up, 20 minutes of isotonic strength training, 20 minutes of aerobic exercise, and a 10 minute cool down. The exercise portion of the program was performed three times per week and used surgical tubing. Exercises focused on elbow flexion and extension, shoulder transverse adduction, and shoulder abduction. Statistical analysis suggested that body weight and percent body fat were inconsistent across all subjects. All subjects showed marked improvements in cardiovascular measures. There was also an improvement in composite isometric strength scores across the treatment and retention phases of the study. There was a modest improvement in work productivity data from baseline to treatment phases. This study reinforced the idea that individuals with mental retardation can improve strength and also improve performance in work productivity measures.

## Summary

Attitudes and placement opportunities for individuals with mental retardation have improved over the past decade. Research indicates that the best transition program is a highly structured experience. Employees that have had the opportunity to work with individuals with mental retardation find it to be rewarding. Employers find individuals with mental retardation to be dependable, loyal, low absenteeism, and high retention rates. Employers concerns regarding hiring individuals with mental retardation focus around issues such as low productivity and higher rate of accidents.

The issues of productivity and accidents can be addressed through better understanding of the physical functioning of individuals with mental retardation. This group has significantly lower scores on fitness assessments then their nondisabled peers. Individuals with mental retardation score significantly lower then their nondisabled peers on static and dynamic balance assessments. This inability to sustain balance and maintain physical functioning has greatly affected the employability of individuals with mental retardation. Research has indicated that physical functioning and balance can be improved with proper training programs. Improvement in work related tasks are essential in order for an individual with mental retardation to obtain and maintain employment. Research has indicated that individuals with mental retardation that participate in a specific training program do improve balance and strength as well as increase their performance in work related tasks which would assist in the employability of these individuals.

# CHAPTER 3

# METHODS AND PROCEDURES

This chapter examines the methods and procedures used during the implementation of this study. This chapter outlines the following: participants, setting, instrumentation and equipment, variables, data collection, experimental design, and data analysis.

## Participants

This study used a total of ten participants (N=10). All participants were enrolled at Oconee County High School, Athens, GA. The participants had been assessed and placed in the Mild Intellectually Delayed (MID) program which is a self contained classroom that offers academic special education classes along with an opportunity to work in the community three half days a week. The students may choose physical education as an elective course but are not required to take any physical education classes. The students may graduate with a Special Education Diploma from the State of Georgia. This program was under the regulations of the United States Department of Education guidelines outlined under IDEA, 1997. Participation in this study was voluntary and participants did not receive extra school credit for their involvement. The University of Georgia's Human Subjects Office granted permission for this study.

## Setting

This investigation took place in an urban/suburban community of 22,000 residents in Southeastern United States of America. The High School involved in this study had an enrollment of approximately 1700 students and serviced grades 9-12. The Special Education program at the High School serviced approximately 150 students across 5 programs. The

School District had received accreditation through the Georgia Accrediting Commission as well as the Southern Association of Colleges and Schools. Sites for data collection included Oconee County High School gymnasium for muscular strength, training program, and low intensity recreational activities. The Movement Studies Laboratory at the University of Georgia was used for balance assessment and the gymnasium at the Ramsey Student Center at the University of Georgia was used for the simulated work performance tasks, training program, and low intensity recreational activities.

Strength training and balance exercise program took place twice a week at Oconee County High School and once a week at the Ramsey Student Center located on the campus of the University of Georgia. One of the purposes of this study was to establish a strength training and balance program that could implemented at the local high school using equipment that was available to the students and teaching staff on a daily basis. The Ramsey Student Center at the University of Georgia was used as a training location to satisfy one of the purposes of the Oconee County Special Education program which was to offer a community based program. By having the participants experience exercising in a local facility it was hoped that the subjects would feel comfortable in further pursuing exercise opportunities in other community facilities after the completion of the study. Equipment used in the weight room at the University of Georgia was available in Oconee County High School weight room thus it would be realistic that the participants could continue to train and use the existing workout program at a facility in the community or their local physical education class. The low intensity recreation activities were chosen based on the traditional high school physical education curriculum.

## Instrumentation and Equipment

The strength training program used for this study used the following equipment: 1) Cybex weight room equipment, 2) free weights, 3) gravity assisted exercises, and 4) resistance tubing. Cybex equipment was used for the following exercises: leg curls, leg extension, chest press, overhead press, lat pull down, row, flies, and squat press. Dumbbells manufactured by Hampton and weighting 2,5,8,10,15, and 20 pounds were used. The resistance tubing used were color coded based on their resistance (blue-most resistance, red-heavy, green-medium, and yellow-light). Gravity weighted exercises used were squats, sit ups, and push ups.

The balance activities chosen for this study related to the stabilization of postural positions related to work tasks i.e., lifting, pushing, pulling, and carrying. Activities chosen to improve balance will be based on the research of Horvat (1980). Appendix B outlines the strength training and balance program the treatment group participated in as well the low intensity recreational activities the control group participated in during the study.

The tasks performed to assess work performance included weighted box stacking, weighted pail carry, weighted dolly cart push, and weighted sack carry. Each task followed the protocol implemented in the research of Seagraves, Horvat, Franklin & Jones (2003); Zetts et al. (1995). Equipment required to complete the tasks included cardboard moving boxes weighing approximately 6 pounds, large table to stack boxes on, two five gallon buckets weighted with 20 pounds each, a two wheel push cart similar to ones used in moving furniture weighted with a 50 pound box, and two sacks weighted with 5 pounds each.

## Variables

The dependent variables for this investigation were the work performance tasks. Four separate work performance tasks were measured for each participant in the study. These tasks were included in this study based on the literature outlining desired employment outcomes. The work performance tasks included weighted box stacking, weighted pail carry, weighted dolly push, and weighted sack carry.

The independent variable was the progressive resistance exercise program that was assessed through muscular strength measures and balance assessment. Exercises were chosen for each participant based on literature that indicated a relationship between improved strength and balance and desired outcomes. The exercises were related to specific muscle groups and stabilizing function that would be used while performing the work performance tasks.

## Data Collection Procedures

Muscular strength was assessed using the MicroFet 2 hand held dynamometer (1991) in the High School classroom. Balance was assessed using the Balance Master manufactured by NeuroCom International Inc. (2001) located in the Movement Studies Laboratory at the Ramsey Center located at the University of Georgia.

### Isometric Muscular Strength Assessment

Isometric muscular strength was assessed using the MicroFet2 hand held dynamometer (1991). Assessment locations included bilateral elbow flexion and extension, knee flexion and extension and shoulder abduction. Three trials were recorded on each test location with the mean score (Horvat, Croce, Roswall, & Seagraves, 1995) used for statistical analysis. Data was recorded in pounds. This method of evaluating muscular strength has been proven reliable and valid on individuals with mental retardation through research by Horvat, Croce, & Roswall, 1993, 1994. Measurements were collected at pre test (0 week), mid test (6 weeks), post test (12 weeks), and retention (18 weeks).

Balance Assessment

Balance in each participant was assessed using the NeuroCom Equitest. Four assessment protocols were used: sensory organization test, bilateral weight bearing squat, step up and over and weight bearing squat repetitions. Each assessment followed the protocol outlined in the CIS lab manual (2001) published by Neurocom International the manufacturers of the assessment instrument. Balance assessments were collected pre test (0 week) and post test (12 weeks)

1. Sensory organization test (SOT) alters the somatosensory and visual environments and measures the participant's responses to sway via orientation of the eyes, feet, and joints. Six test situations occured; 1) eyes open, floor fixed, walls fixed; 2) eyes closed, floor fixed, walls fixed; 3) eyes open, floor fixed, walls variable; 4) eyes open, floor variable, walls fixed; 5) eyes closed, floor variable, walls fixed; 6) eyes open, floor variable, walls variable. Participants had three attempts under each condition. Composite scores are calculated across all trials and displayed as age related normative data. This assessment assisted in identifying an individual who might be at risk for a fall as well as identifying strategies that the body adapts to when an individuals sense of equilibrium has been altered.

2. Weight bearing squat – While standing on a force plate each participant was asked to do one squat and bilateral weight distribution was calculated at knee flexion of 0º, 30º, 60º, and 90º. Knee flexion was measured using a goniometer. Unequal weight bearing outside normal ranges may indicate an inability or unwillingness to bear weight on an affected limb which would impede an individual's ability to perform tasks which require bending or squatting with any efficiency. This assessment can detect a person's instability during sit to stand transitions, instability to retrieve objects from the ground, or reduce readiness to move side to side. Data was recorded in percentage of weight distribution on the left and right side of the lower body throughout the movement.

3. Step up and over task assessed functional limitations. This assessment quantifies motor control characteristics as a subject steps up and over a stationary box with one foot, lifting the body through an erect position over the box, swing the other foot over the box and then lower the body to land the swing leg on the force plate. This task measured parameters of force to rise, movement time, and impact index (impact force) on both the right and left feet. This assessment measured balance, coordination, and control of movement using strength and range of motion as the participants were required to manipulate the body through the complete range of motion and weight transfer as they step up and over a stationary 8 inch object. This assessment indicates a person's inability to ascend/descend stairs, inclines etc as well as any difficulties stepping over objects. Lift up index and

impact index are measured as a percentage of body weight on both the left and right sides of the body, movement time is measured in seconds.

4. Weight bearing squat repetitions measured muscular endurance over 15 repetitions. Each participant stood on the force plate and performed 15 squats at a constant pace. Weight distribution on every fifth squat at knee flexion 90º was taken to investigate difficulties in weight distribution over an extended period of exercise. This assessment indicates a person's ability distribute weight bilaterally during an endurance activity. Weight bearing squat measures the percentage of weight distribution over the left and right sides of the lower body.

Work Performance Assessment

Each task used to evaluate work performance was performed separately in a circuit formation. All work performance measures were performed on the same day. Four data collections periods occurred throughout the study, pre test (0 week), mid test (6 weeks), post test (12 weeks), and retention (18 weeks).

*Box Stacking*

Each participant had one minute to stack 6 pound boxes from one corner of a table 30 inches off the ground to the opposite corner of the table. Proper lifting technique was discussed and practiced with each participant before attempting to complete the task. The task begun with the command (ready?/go). The observer began the stopwatch on the participant's first movement and after the command was given. The task ended when one minute had elapsed and the observer gave the command to stop. The observer counted all boxes stacked in the opposite corner of the table. Any boxes not in the corner after one minute were not counted toward the final tally. If the participant had lifted a box off the table but not completely stacked when the stop command was given half a box lifted was counted toward the final tally. As the subject participated in the activity other classmates and the researcher offered encouragement through verbal prompts. The observer recorded the total number of boxes stacked on the data collection sheet.

*Pail Carry*

This task required that each participant carry two five gallon pails weighted with 20 pounds around an oblong course outlined with cones. Proper safety and lifting techniques were discussed and practiced with each participant prior to their participation in this activity. Two 5 gallon pails were placed on the starting line between the participant. The command (ready?/go) was given at which time the participant was to lift the two pails by the handles and walk with them following the course outlined with cones. The participants were instructed that running was not allowed. The observer began the stopwatch when the command (go) was given. Each participant had thirty seconds to walk as far as possible along the course carrying the pails. Upon the completion of thirty seconds and the command to stop, the amount of distance traveled was measured to the nearest half inch. The researcher measured the distance using a rolling tape measure to determine the total distance traveled. The participants were instructed that they could stop along the course if required or they felt a need to regrip the pails. No time penalty was given for stoppage along the course. As the subject completed the task other participants and the researcher offered encouragement through verbal prompts. The observer recorded the total distance traveled by each participant on the data collection sheet.

*Dolly Cart Push*

The dolly cart used was typical of those used by individuals interested in moving boxes. Each participant was instructed on safety and proper lifting techniques prior to participation in this task. The dolly cart was loaded with a 50 pound box and participants were asked to maneuver the cart through an oblong course outlined with cones. The box was loaded on the cart prior to the go command. The wheels were at the start line, upon the command (ready?/go) the participant had to put a foot on the axle and tilt the cart backwards to a position in which the cart could be pushed. The researcher began the stopwatch with the go command and the participant's first movements. The participants maneuvered the cart as far as possible through the course in thirty seconds. After thirty seconds had elapsed the researcher gave the stop command. The total distance traveled was marked with tape using the wheels of the push cart as the indicator. As the subject participated in the activity other classmates and the researcher offered encouragement through verbal prompts. The researcher measured the total distance traveled using a rolling tape measure. The researcher recorded the total distance on the data collection sheet.

*Sack Carry*

Each participant attempted to carry two 5 pound bags on their shoulders up and down two flights of stairs. Proper lifting and carrying techniques were discussed and practiced prior to the first attempt. The task began with the bags being placed on the ground at the bottom of the stairs. On the ready/go command the participant picked up each bag and placed them on their shoulders. The participant then proceeded to walk up, touching each step, two flights of stairs and then turn around immediately and descend those same two flights of stairs. The observer began the stop watch on the go command and walked with the participant for the entire task. Time was recorded at the top of the stairs as well as total time up and down along with the number of stumbles or fall. The participants were instructed they could stop at any time to regrip or if they felt unsafe. The observer and fellow participants provided verbal prompts of encouragement throughout the task. Time was recorded in seconds.

Progressive Resistance Strength Training and Balance Programs

After initial assessments were completed using the Balance Master, manual muscle tester, and work performance tasks a progressive resistance training and balance program were designed for each participant. Exercises were chosen for specific muscle groups based on the work performance tasks and the type of muscle responses they elicit following the guidelines for resistance training prescribed by Kraemer and Fleck (1993). A three day work out plan was established for the study based on the facility and equipment available at each location. The three day workout schedule along with balance and low intensity recreational activities are outlined in Appendix B. Initial resistance levels were established for each participant based on pre assessment data.

Before the participants began the exercise program an orientation was conducted to introduce the participants to the equipment and proper lifting techniques associated with each exercise. Safety issues were discussed and the mandatory use of a spotter was initiated for the study. For this reason each participant was partnered up for the purpose of safety and motivation throughout the study. A daily routine was established for the study which consisted of a proper group warm up, training session in a circuit formation with a partner, and proper group cool down. The training sessions were conducted in a circuit formation to keep participants organized and on task. Each participant performed 3-4 sets of each exercise with 8-12 repetitions per set. The exercise program had three levels of intensity. Participants did not move to the next level until the prescribed criteria has been accomplished. Successful completion of a level entailed completing a required number of sets and repetitions. Level one involved three sets of twelve repetitions, level two included three sets of ten repetitions, and level three included four sets of eight repetitions. The exercise program was implemented three times a week for twelve weeks. Each session lasted approximately 60 minutes. At each session the researcher, teacher, two para professionals, and two graduate students were present to assist, answer questions, and ensure proper techniques were implemented. Training sessions were held prior to commencing this study to inform the teacher, para professionals and graduate students of proper lifting techniques and the details of the study.

## Experimental Design

The research design chosen for this study is a randomized complete block design with repeated measures. Each block consisted of matched pairs based on gender, height and weight. None of the matching attributes were dependent variables as outlined by Huck and Cromier (1996). The treatment block received a strength training and balance program while the no treatment block (control group) participated in low intensity recreational activities. In block design participants are assigned to a homogeneous group of some form. Each block is a form of control and allows more precise conclusions to be drawn based on each block (Yates, Moore, & McCabe, 2001). By blocking some sources of unavoidable variability between groups can be eliminated. A blocking design reduces the variance and thus increases the statistical power of the study (Dehlert, 2000). Randomization within each block will average out the effect of the remaining variation and allow an unbiased comparison of the two treatment groups (Moore & McCabe, 2002). For this study a matched pairs design was used with a total sample size of N = 10 with two participants per block equaling 5 blocks. This study used a convenient sample based on location and accessibility to the population. Participants were randomly assigned to either the treatment block (received 12 week progressive resistance exercise and balance program) or control group (participated in low intensity recreational activities).

## Data Analysis

Means and standard deviations were calculated on all variables. A separate analysis of variance (ANOVA) was performed on each complete block and treatment effect to distinguish any significant changes between pre test to post test between the treatment group and control group on work performance measures, balance, and muscular strength assessments. This was performed to determine if significant changes were due to the treatment effect or the blocking effect of the study. Significance levels were set at $p=.05$ to reduce the chance of a Type 1 error. Sphericity tests were conducted on each ANOVA to ensure that the assumption of equal variances were not violated. Percent change was calculated between the pre assessment and the post assessment and again from the post test to the retention measures for strength measures, balance assessments, and work performance measures for both the treatment block and control group. SAS was used to perform all statistical analyses.

# CHAPTER 4

# RESULTS

The research design for this study used a randomized complete block design with repeated measures to assess the benefits of muscular strength and balance on the performance of work related tasks. This chapter outlines the statistical analysis of data under the following categories: descriptive statistics including means and standard deviations, percentage change over assessment periods, and the differences between groups for each of the assessments including muscular strength, balance and vocational tasks.

## Descriptive Analysis

A sample of convenience (N=10) participated in this study. Participants were matched according to age, height, and weight and then randomly assigned to the treatment group (strength training) or control group (recreational activities). Means and standard deviations were calculated and are included in Table 4.1 for both the treatment and control groups.

## Muscular Strength

Isometric muscular strength was assessed bilaterally at the elbow, knee, and shoulder. The mean of three trials, recorded in pounds, was used for data analysis. Assessments were taken at six week intervals: pre test (0 week), mid test (6 weeks), post test (12 weeks), and retention (18 weeks). The retention measure was performed six weeks after the treatment program had ceased which coincided with winter break for the participants. The means and standard deviations for elbow flexion/extension are included in Table 4.2, knee flexion/extension in Table 4.3, and shoulder abduction in Table 4.4. All numbers represent peak isometric strength measured in pounds (lbs).

An ANOVA (analysis of variance) (Table 4.5) was performed to determine differences between groups from post test to pre test assessment periods. Significant differences were found between the treatment group and control groups at $p \leq .05$ for muscular strength; right elbow flexion, $F(1,4) = 16.66$, $p < .008$; right elbow extension, $F(1,4) = 8.93$, $p < .02$; left elbow extension, $F(1,4) = 18.44$, $p < .006$; right knee flexion, $F(1,4) = 11.70$, $p < .01$; right knee extension, $F(1,4) = 5.78$ $p < .037$; left knee flexion, $F(1,4) = 11.68$, $p < .01$; left knee extension, $F(1,4) = 5.78$ $p < .037$; right shoulder abduction, $F(1,4) = 27.57$, $p < .003$; and left shoulder abduction, $F(1,4) = 4.30$, $p < .05$. Left elbow flexion had a significance level of $F(1,4) = 3.88$, $p < .06$ which is slightly higher then the $p < .05$ significance level set for this study. No significant differences were evident at ($p > .05$) for muscular strength assessments between any of the blocks indicating that the differences occurred from the intervention rather than blocking.

Percent change was also calculated for muscular strength measurements at 6 week interval periods (0-6 weeks, 6-12 weeks, 0-12 weeks, and 12-18 weeks) and are included in Tables 4.6-4.8. The primary interest in this study was the percent change between assessment period 0-12 weeks which represented the pre test to post test assessment in order isolate the effects of the training program as well as the retention interval to examine the effects of ceasing the intervention strategy. Based on the data analysis, left elbow flexion and extension for the treatment group increased 31.39% (12.73 lbs) and

67.98% (14.67 lbs) respectively from pre to post test while the control group decreased 3.14% (-1.3 lbs) on flexion and increased 12.42 % (4.8 lbs) for elbow extension. Right elbow flexion and extension for the treatment group increased 30.73% (11.52 lbs) and 56.71% (14.25 lbs) in relation to right elbow flexion for the control group which increased 13.04% (4.75) and extension 7.71% (1.99 lbs). Percent changes for elbow isometric strength measures were apparent at each assessment interval and are outlined in Table 4.6.

Training effects began to diminish as early as six weeks post treatment as evident by the 11.92% (6.35 lbs) decrease in strength in the left elbow flexion of the treatment group and 29.9% (10.84 lbs) in extension. Similar results were evident on the right side of the body for the treatment group with flexion decreasing 13.97% (6.85 lbs) and extension decreasing 13.53% (5.33 lbs). The control group experienced diminished strength after 6 weeks with flexion on the left side of the body decreasing 8.61% (3.74 lbs) and extension 1.89% (0.38 lbs) while the right side of the body decreased 19.1% (7.86 lbs) for flexion and 5.18% (1.44 lbs) for extension.

Assessment of flexion and extension of the left knee for the treatment group had increased 47.66% (16.82lbs) and 63.95% (18.27lbs) from pre test to post test compared to the left knee of the control group which had a decrease of -1.77% (0.59 lbs) for flexion but knee extension increased 20.93% (6.22 lbs). Right knee for the treatment group increased 35.98% (13.38 lbs) for flexion and 60.24% (18.21 lbs) for extension while the control group had increases of 11.13% (4 lbs) and 17.01% (5.35 lbs) for extension of the right knee. Percent changes for knee isometric strength measures were apparent at each assessment interval and are outlined in Table 4.7.

Isometric strength decreased on both the right and left sides of the body for the treatment and control groups upon ceasing training. Knee flexion and extension on the left side of the body decreased 19.19% (10 lbs) and 38.66% (18.11 lbs) respectively for the treatment group. While right knee flexion decreased 21.26% (10.75 lbs) and extension decreased 26.84% (13 lbs) for the treatment group. The control group experienced similar decreases with flexion on the left side decreasing 3.58% (1.17 lbs) and extension 15.64% (5.62 lbs). Flexion and extension on the right side of the body for the control group decreased 3.5% (1.4 lbs) and 14.95% (5.5 lbs) after ceasing training for six weeks.

Shoulder abduction assessments for the treatment group increased 56.97% (14.92 lbs) on the left side and 58.66% (16.08 lbs) on the right side of the body. The control group had increases of 22.94% (5.09 lbs) on the left side and a decrease of 2.08% (-0.53 lbs) on the right side of the body respectively. Percent changes for shoulder abducation isometric strength measures were apparent at each assessment interval and are outlined in Table 4.8.

Six weeks post training left shoulder abduction decreased 25.76% (10.59 lbs) and 27.94 % (12.15 lbs) for the treatment group. While the control group experienced decreases of 11.36 % (3.1 lbs) on the left side of the body and 5.73% (1.43 lbs) on the right side of the body.

## Balance Assessment

### Sensory Organization Test (SOT)

Balance was assessed using the Neurocom Equitest at pre test (0 week) and post test (12 weeks) on the Sensory Organization Test (SOT), weight bearing squat, step up and over, and 15 repetition weight bearing squat. The means and standard deviations were calculated for each assessment using the Neurocom and are outlined in Table 4.9-4.12. The Sensory Organization Test (SOT) is displayed as a composite score with 100 being the maximum value achieved. This assessment systematically alters the somatosensory and visual environments then measures the participant's response in reference to anteroposterior sway (Neurocom, 2001). A normative score >70 represents an individual at risk for a fall. The analysis of variance for the SOT displayed in Table 4.13 determined there were block difference $F(1,4) = 8.34$, $p \leq .002$ where as treatment differences were not apparent $F(1,4) = 1.58$, $p \leq .14$. The treatment group had a mean composite score of 67.4 ±14.61 at the pre test level while the control group had a mean score of 74.2 ±8.32. The post test evaluation showed improvements by both groups. The treatment group improved their composite score to 81 ±8.09 which represented a 20.18% (13.6 percentile) increase from pre test to post. The control group improved their composite scores to 84.8 ±6.7 or 14.19% (10.6 percentile) during the 12 week intervention strategy.

### Weight Bearing Squat

Bilateral weight bearing squat measured the weight distribution across the left and right sides of the lower body at varying angles (0°, 30°, 60°, 90°) of knee flexion. The analysis of variance (ANOVA) for the weight bearing squat at varying degrees of knee flexion is displayed in Table 4.13. The ANOVA analysis examined the differences (post – pre test) at 0º $F(1,4) = 0.52$, $p \leq .25$; 30º $F(1,4) = 0.73$, $p \leq .22$; 60º $F(1,4) = 0.01$, $p \leq .19$; and 90º $F(1,4) = 0.69$, $p \leq .23$. The ANOVA results suggest that there were no significant differences between the treatment strategy or blocking effect at any of the angles assessed.

The pre test assessment indicated that the treatment group at 0º knee flexion had 52.2% of their body weight distributed on the left side and 47.8% on the right side of the lower body. At 30º 55.4% was placed on the left side and 44.6% on the right side of the body. Knee flexion at 60º had 54 % of weight on the left side and 46% on the right side, while at 90º 56.2% of weight was distributed on the left side of the body and 43.8 % on the right side.

The control group at the pre assessment at 0º indicated 59.6% of body weight was distributed on the left side of the body and 40.4% was on the right side. At 30º body weight distributed on the left side was 56.2% and 43.8% on the right. At 60º 55.2% of weight distribution was located on the left side while 44.8% was on the right. At 90º 50.2% of weight was distributed on the left side while 49.8% was on the right side of the body.

At the post test assessment the treatment group at 0º had 51.8% of weight distributed on the left side of the body and 48.2% on the right. At 30º 52.8% of weight was on the left and 47.2% was on the right side. Knee flexion at 60º had 51.8% of weight on the left side and 48.2% on the right while at 90º 51.4% of body weight was distributed on the left side of the body and 48.6% on the right.

The control group at the post test assessment for knee flexion at 0º had 53.2% weight distributed on the left side of the body and 46.8% on the right side. At 30º the weight was evenly distributed across the left and right side indicating 50% ratio on either side. Knee flexion at 60º indicated that 53.6% of weight was distributed on the left side and 46.4% on the right side while at 90º 51% was placed on the left side of the body and 49% on the right.

Step Up and Over

The step up and over assessment measured lift up index as a percentage of body weight, movement time in seconds and impact index as a percentage of body weight. The analysis of variance for the step up and over is outlined in Table 4.13. The ANOVA for the task of step up and over resulted in he lift up index for the left side of the body $F(1,4) = 2.00$, $p \leq .12$; lift up index right side $F(1,4) = 0.71$, $p \leq .22$; movement time left $F(1,4) = 1.51$, $p \leq .14$; movement time right $F(1,4) = 1.63$, $p \leq .14$; impact index left $F(1,4) = 3.8$, $p \leq .06$; impact index right $F(1,4) = 1.05$, $p \leq .18$.

The means and standard deviations for the treatment and control group at the pre and post assessments are displayed in Table 4.11. During the pre test for the lift up index the treatment group measured 40.73 on the left side and 56.13 on the right side where as the control group measured 36.6 on the left and 42.47 on the right. The movement time at the pre test for the treatment group was 1.08 seconds on the left side and 1.03 on the right. The control group required 1.36 seconds on the left side and 1.61 on the right side. The impact index for the treatment group on the left side was 44.47 and 54.2 on the right side. The control group measured 54.0 on the left and 54.47 on the right.

The post test assessment for the step up and over for the lift up index for the treatment group measured 47.33 on the left side of the body and 58.27 on the right. The control group measured 33.2 on the left and 36.4 on the right. The treatment group required 1.01 seconds on the left side of the body and 1.02 on the right. Movement time for the control group required 1.19 seconds on the left and 1.22 seconds on the right. The impact index for the treatment group on the left side of the body was 50.53 and 50.4 on the right. The control group measured 44.8 on the left and 54.4 on the right side of the body.

Weight Bearing Squat Repetitions

The analysis of variance for the 15 repetition weight bearing squat is outlined in Table 4.13. The ANOVA for the difference between pre and post test at the varying number of repetitions indicated at 0 repetition $F(1,4) = 0.82$, $p \leq .21$; 5 repetitions $F(1,4) = 0.01$, $p \leq .46$; 10 repetitions $F(1,4) = 0.54$, $p \leq .25$; and at 15 repetitions $F(1,4) = 0.79$, $p \leq .21$.

Means and standard deviations for the 15 repetition weight bearing squat are outlined in Table 4.12. The pre test for the treatment group at repetition 0 had 43.6% of their weight distributed on the left side of their body and 56.4 on their right. At 5 repetitions 50.6% was distributed on the left side and 49.4% on the right. At 10 repetitions 49% was distributed on the left side while 51% was on the right side. Where as at 15 repetitions 50.8% was distributed on the left side and 49.2% was on the right side of the body.

The control group at repetition 0 had 49.6% of weight distributed on the left side of the body and 50.4% on the right. At 5 repetitions 53.8% was distributed on the left side and 44.2% on the right side of the body. At 10 repetitions 52.2% was distributed on the left side while 47.8% was on the right side of the body. Where as at 15 repetitions 51% weight was distributed on the left side and 49% was on the right side.

The post test for the treatment group at 0 repetitions indicated 53.8% of weight distribution on the left side of the body and 46.2% on the right side. At 5 repetitions 49.2% of weight was on the left side and 50.8% on the right side. At 10 repetitions 45.8% was on the left side and 54.2% was on the right. At 15 repetitions 47.2% was on the left side and 52.8% on the right side of the body.

The control group at the post test had 51.4% of weight distributed on the left side of the body and 48.6% on the right side at 0 repetitions. At 5 repetitions 52.4% was on the left side and 47.6% on the right side of the body. At 10 repetitions 53.8% was on the left side and 46.2% on the right side of the body. At 15 repetitions 52.8% of weight was distributed on the left side of the body and 47.2% on the right side.

## Vocational Tasks

Four vocational tasks (box stacking, pail carry, dolly cart push, and sack carry) were performed over four assessment periods (pre test, mid test, post test, and retention) by all participants. Box stacking task required that each subject stack as many weighted boxes (6 lbs) as possible in sixty seconds (1 minute). Pail carry required that each participant carry two 20 pound pails as far as possible in 30 seconds around an oval course. Dolly cart push required that each participant maneuver a moving dolly loaded with a 50 pound box around an oval course. Each participant had 30 seconds to push the cart, without running as far as possible along the course. Sack carry required two 5 pound bags be placed on each shoulder and carried up and down two flights of stairs.

Time for each participant to climb to the top of the stairs and then immediately descend was collected.

An ANOVA was performed to determine differences between groups from pre test to post test across assessments periods for each vocational task. The data summary for the vocational tasks is located in Table 4.14, with the associated ANOVA table for the post – pre differences displayed in Table 4.15. Significant differences were found between treatment and control groups at $p \leq .05$ for each of the following vocational tasks; box stacking, $F (1,4) = 20.39$, $p<.005$; pail carry, $F (1,4) = 13.16$, $p< .01$; dolly cart push, $F (1,4) = 112.64$, $p< .002$; sack carry up, $F (1,4) = 12.1$, $p< .05$. The sack carry total had a significance value of $F (1,4) = 14.81$, $p< .15$.

Percent change between the pre test and post test levels for each vocational task are located in Table 4.14. Box stacking for the treatment group increased 42.4% (11.2 boxes) and the control group increased 11.02% (2.8 boxes). The treatment group increased 30.12% (14.1 m) on the pail carry while the control group increased 12.52% (5.61 m). The dolly cart push for the treatment group increased 30.31% (14.14 m) while the control group increased 10.87% (4.48 m). The treatment group increased their time in the sack carry up by 35.48% (5.73 sec) and the control group increased 19.89% (3.53 sec). The treatment group increased their performance in the sack carry total by 21.92% (6.36 sec) while the control group increased 12.5% (3.91 sec).

Table 4.1

Demographics of Participants by Groups

| | Gender | Age (years) | Height (cm) | Weight (kg) |
|---|---|---|---|---|
| Group 1 | F | 19 | 51.71 | 157.48 |
| | F | 16 | 46.72 | 149.86 |
| Group 2 | F | 19 | 106.6 | 162.56 |
| | F | 16 | 89.56 | 152.4 |
| Group 3 | M | 16 | 77.11 | 185.42 |
| | M | 14 | 79.38 | 181.61 |
| Group 4 | M | 18 | 77.11 | 175.93 |
| | M | 15 | 88.45 | 167.64 |
| Group 5 | M | 18 | 83.96 | 167.64 |
| | M | 17 | 65.32 | 174.25 |

Table 4.2

Means and Standard Deviations for Isometric Elbow Strength Measurements by Assessment Period

| Evaluation | | Treatment Left | | Treatment Right | | Control Left | | Control Right | |
|---|---|---|---|---|---|---|---|---|---|
| Pre test | | F | E | F | E | F | E | F | E |
| (0 week) | M | 40.56 | 21.58 | 37.5 | 25.13 | 38.66 | 21.37 | 36.43 | 25.81 |
| | SD | 11.61 | 6.18 | 13.66 | 6.47 | 6.99 | 5.88 | 9.16 | 4.20 |
| Mid test | | | | | | | | | |
| (6th week) | M | 47.14 | 28.54 | 42.21 | 31.63 | 37.14 | 18.26 | 36.44 | 24.31 |
| | SD | 13.97 | 3.98 | 12.42 | 7.24 | 9.43 | 6.15 | 11.07 | 4.64 |
| Post test | | | | | | | | | |
| (12th week) | M | 53.29 | 36.25 | 49.02 | 39.38 | 43.46 | 20.07 | 41.18 | 27.8 |
| | SD | 13.56 | 2.54 | 12.47 | 8.91 | 5.07 | 7.04 | 7.38 | 4.00 |
| Retention | | | | | | | | | |
| (18th week) | M | 46.94 | 25.41 | 42.17 | 34.05 | 39.72 | 19.69 | 33.32 | 26.36 |
| | SD | 12.37 | 3.83 | 13.08 | 8.12 | 6.33 | 6.43 | 13.47 | 0.73 |

Note. F= Flexion and E = Extension

Values represent pounds of peak isometric strength as measured by a Micro-Fet 2 hand held dynamometer.

Table 4.3

Means and Standard Deviations for Isometric Knee Strength Measurements by Assessment Period

| Evaluation | | Treatment Left | | Treatment Right | | Control Left | | Control Right | |
|---|---|---|---|---|---|---|---|---|---|
| Pre test | | F | E | F | E | F | E | F | E |
| | M | 35.29 | 28.57 | 37.19 | 30.23 | 33.28 | 29.72 | 35.95 | 31.45 |
| | SD | 13.87 | 8.02 | 16.11 | 9.73 | 6.60 | 5.44 | 16.69 | 10.37 |
| Mid test | | | | | | | | | |
| | M | 45.03 | 36.92 | 42.71 | 41.67 | 31.89 | 32.83 | 38.11 | 31.32 |
| | SD | 13.65 | 14.13 | 15.42 | 9.56 | 3.98 | 12.32 | 14.2 | 13.07 |
| Post test | | | | | | | | | |
| | M | 52.11 | 46.84 | 50.57 | 48.44 | 32.69 | 35.94 | 39.95 | 36.8 |
| | SD | 12.85 | 15.01 | 14.22 | 10.47 | 9.19 | 6.90 | 15.24 | 9.63 |
| Retention | | | | | | | | | |
| | M | 42.11 | 28.73 | 39.82 | 35.44 | 33.86 | 30.32 | 38.55 | 31.3 |
| | SD | 13.58 | 11.16 | 15.18 | 9.53 | 4.70 | 8.45 | 14.77 | 11.69 |

Note. F= Flexion and E = Extension

Values represent pounds of peak isometric strength as measured by a Micro-Fet 2 hand held dynamometer.

Table 4.4

Means and Standard Deviations for Isometric Shoulder Abduction Strength Measurements by Assessment Period

| Evaluation | | Treatment Left | Treatment Right | Control Left | Control Right |
|---|---|---|---|---|---|
| Pre test | | | | | |
| | M | 26.19 | 27.41 | 22.19 | 25.49 |
| | SD | 7.53 | 5.74 | 10.05 | 5.36 |
| Mid test | | | | | |
| | M | 33.37 | 39.09 | 24.85 | 26.19 |
| | SD | 10.6 | 13.0 | 10.65 | 7.04 |
| Post test | | | | | |
| | M | 41.11 | 43.49 | 27.28 | 24.96 |
| | SD | 15.31 | 12.35 | 9.30 | 7.68 |
| Retention | | | | | |
| | M | 30.52 | 31.34 | 24.18 | 23.53 |
| | SD | 8.73 | 6.96 | 9.91 | 6.08 |

Note. Values represent pounds of peak isometric strength as measured by a Micro-Fet 2 hand held dynamometer.

Table 4.5

Analysis of Variance for Differences (Post – Pre) on Isometric Muscular Strength Measurements

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Elbow Flexion | | | | | |
| Right | Treatment | 1 | 114.72 | 16.66 | .008** |
| | Block | 4 | 9.072 | 1.32 | .19 |
| | Error | 4 | (2.623) | | |
| Left | Treatment | 1 | 157.21 | 3.88 | .06 |
| | Block | 4 | 13.95 | .34 | .42 |
| | Error | 4 | (6.36) | | |
| Elbow Extension | | | | | |
| Right | Treatment | 1 | 375.52 | 8.93 | .02* |
| | Block | 4 | 26.06 | 0.62 | .34 |
| | Error | 4 | (6.48) | | |
| Left | Treatment | 1 | 637.92 | 18.44 | .006** |
| | Block | 4 | 11.70 | 0.34 | .42 |
| | Error | 4 | (5.88) | | |
| Knee Flexion | | | | | |
| Right | Treatment | 1 | 219.49 | 11.70 | .01* |
| | Block | 4 | 31.89 | 1.70 | .16 |
| | Error | 4 | (4.33) | | |

Table 4.5

Analysis of Variance for Differences (Post – Pre) on Isometric Muscular Strength Measurements (cont'd)

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Left | Treatment | 1 | 756.73 | 11.68 | .01* |
| | Block | 4 | 157.38 | 2.43 | .10 |
| | Error | 4 | (8.05) | | |
| Knee Extension | | | | | |
| Right | Treatment | 1 | 413.45 | 34.58 | .002** |
| | Block | 4 | 47.24 | 3.95 | .053 |
| | Error | 4 | (3.46) | | |
| Left | Treatment | 1 | 363.25 | 5.78 | .037* |
| | Block | 4 | 40.17 | 0.64 | .331 |
| | Error | 4 | (7.92) | | |
| Shoulder Abduction | | | | | |
| Right | Treatment | 1 | 690.23 | 27.57 | .003** |
| | Block | 4 | 75.55 | 3.02 | .078 |
| | Error | 4 | (5.00) | | |
| Left | Treatment | 1 | 241.18 | 4.30 | .05* |
| | Block | 4 | 57.25 | 1.02 | .23 |
| | Error | 4 | (7.49) | | |

Note. The number in ( ) indicates the root mean squared error.

* represents significance $p \leq .05$, ** represents significance $p \leq .01$

Table 4.6

Percent Change of Isometric Elbow Strength Measures at Weeks 6,12, and 18

| Assessment | Treatment Left | | Treatment Right | | Control Left | | Control Right | |
|---|---|---|---|---|---|---|---|---|
| | F | E | F | E | F | E | F | E |
| (1) 0-6 week | 16.22 | 32.25 | 12.56 | 25.87 | -3.93 | -14.55 | .03 | -5.81 |
| (2) 6-12 week | 13.05 | 27.01 | 16.13 | 24.5 | 17.01 | 9.91 | 13.0 | 14.36 |
| (3) 0-12 week | 31.29 | 67.98 | 30.73 | 56.71 | 12.42 | -3.14 | 13.04 | 7.71 |
| (4) 12-18 week | -11.92 | -29.9 | -13.97 | -13.53 | -8.61 | -1.89 | -19.1 | -5.18 |

Note. F= Flexion, E= Extension

Assessment: (1) 0-6 week (pre test to mid test)

(2) 6-12 week (mid test to post test)

(3) 0-12 week (pre test to post test)

(4) 12-18 week (post test to retention)

Table 4.7

Percent Change of Isometric Knee Strength Measures at Weeks 6, 12, and 18

| Assessment | Treatment Left | | Treatment Right | | Control Left | | Control Right | |
|---|---|---|---|---|---|---|---|---|
| | F | E | F | E | F | E | F | E |
| (1) 0-6 week | 27.6 | 29.23 | 14.84 | 37.84 | -4.18 | 10.46 | 6.01 | -0.41 |
| (2) 6-12 week | 15.72 | 26.85 | 18.40 | 16.25 | 2.5 | 9.47 | 4.83 | 17.5 |
| (3) 0–12 week | 47.66 | 63.95 | 35.98 | 60.24 | -1.77 | 20.93 | 11.13 | 17.01 |
| (4) 12-18 week | -19.19 | -38.66 | -21.26 | -26.84 | 3.58 | -15.64 | -3.5 | -14.95 |

Note. F= Flexion, E= Extension

Assessment: (1) 0-6 week (pre test to mid test)

(2) 6-12 week (mid test to post test)

(3) 0-12 week (pre test to post test)

(4) 12-18 week (post test to retention)

Table 4.8

Percent Change of Isometric Shoulder Abduction Strength Measures at Weeks 6, 12, and 18

| Assessment | Treatment Left | Treatment Right | Control Left | Control Right |
|---|---|---|---|---|
| (1) 0-6 week | 27.42 | 60.14 | 11.99 | 2.75 |
| (2) 6-12 week | 23.19 | 11.26 | 9.78 | -4.7 |
| (3) 0-12 week | 56.97 | 58.66 | 22.94 | -2.08 |
| (4) 12-18 week | -25.76 | -27.94 | -11.36 | -5.73 |

Note. F= Flexion, E= Extension

Assessment: (1) 0-6 week (pre test to mid test)

(2) 6-12 week (mid test to post test)

(3) 0-12 week (pre test to post test)

(4) 12-18 week (post test to retention)

Table 4.9

Means, Standard Deviations, and Percent Change in Means for the Sensory Organization Test

| Assessment | | Group | |
|---|---|---|---|
| | | Treatment | Control |
| Pre test | M | 67.4 | 74.2 |
| | SD | 14.61 | 8.32 |
| Post test | M | 81 | 84.8 |
| | SD | 8.09 | 6.7 |
| Percent Change | | 20.18% | 14.3% |

Note: Means and Standard Deviations are composite scores. Maximum score achievable is 100.

Table 4.10

Means and Standard Deviations for the Weight Bearing Squat Bilateral Weight Distribution

| | | Pre Test | | | | Post Test | | | |
|---|---|---|---|---|---|---|---|---|---|
| Degrees | | Treatment | | Control | | Treatment | | Control | |
| | | L | R | L | R | L | R | L | R |
| 0 | M | 52.2 | 47.8 | 59.6 | 40.4 | 51.8 | 48.2 | 53.2 | 46.8 |
| | SD | 4.71 | 4.71 | 10.99 | 10.99 | 6.53 | 6.53 | 4.15 | 4.15 |
| 30 | M | 55.4 | 44.6 | 56.2 | 43.8 | 52.8 | 47.2 | 50 | 50 |
| | SD | 8.76 | 8.76 | 7.79 | 7.79 | 4.21 | 4.21 | 7.48 | 7.48 |
| 60 | M | 54 | 46 | 55.2 | 44.8 | 51.8 | 48.2 | 53.6 | 46.4 |
| | SD | 11.96 | 11.96 | 9.09 | 9.09 | 7.4 | 7.4 | 8.88 | 8.88 |
| 90 | M | 56.2 | 43.8 | 50.2 | 49.8 | 51.4 | 48.6 | 51 | 49 |
| | SD | 8.44 | 8.44 | 7.92 | 7.92 | 5.68 | 5.68 | 6.67 | 6.67 |

Note. Score indicate the percentage of body weight distributed across the left and right sides of the lower body at specific knee angles during a squat.

Table 4.11

Means and Standard Deviations for the Step Up and Over

| | | Pre Test | | | | Post Test | | | |
|---|---|---|---|---|---|---|---|---|---|
| Assessment | | Treatment | | Control | | Treatment | | Control | |
| | | L | R | L | R | L | R | L | R |
| Lift Up Index | M | 40.73 | 56.13 | 36.6 | 42.47 | 47.33 | 58.27 | 33.2 | 36.4 |
| | SD | 13.15 | 32.9 | 16.01 | 16.22 | 16.81 | 21.29 | 11.98 | 11.83 |
| Movement Time | M | 1.08 | 1.03 | 1.36 | 1.61 | 1.01 | 1.02 | 1.19 | 1.22 |
| | SD | 0.15 | 0.09 | 0.43 | 0.78 | 0.12 | 0.11 | 0.50 | 0.55 |
| Impact Index | M | 44.47 | 54.2 | 54.0 | 54.47 | 50.53 | 50.4 | 44.8 | 54.4 |
| | SD | 22.29 | 31.63 | 8.99 | 19.82 | 22.87 | 21.01 | 12.46 | 10.67 |

Note. Lift Up Index and Impact Index are measured as percentage of body weight. Movement time is measured in seconds. An 8 inch box was used for each participant.

Table 4.12

Means and Standard Deviation for Weight Bearing Squat Bilateral Weight Distribution over 15 Repetitions

| | | Pre Test | | | | Post Test | | | |
|---|---|---|---|---|---|---|---|---|---|
| Repetitions | | Treatment | | Control | | Treatment | | Control | |
| | | L | R | L | R | L | R | L | R |
| 0 | M | 43.6 | 56.4 | 49.6 | 50.4 | 53.8 | 46.2 | 51.4 | 48.6 |
| | SD | 19.95 | 19.95 | 5.86 | 5.86 | 8.35 | 8.35 | 7.37 | 7.37 |
| 5 | M | 50.6 | 49.4 | 53.8 | 44.2 | 49.2 | 50.8 | 52.4 | 47.6 |
| | SD | 13.65 | 13.65 | 8.93 | 11.86 | 8.93 | 8.93 | 9.96 | 9.96 |
| 10 | M | 49.0 | 51.0 | 52.2 | 47.8 | 45.8 | 54.2 | 53.8 | 46.2 |
| | SD | 6.67 | 6.67 | 9.58 | 9.58 | 7.01 | 7.01 | 9.71 | 9.71 |
| 15 | M | 50.8 | 49.2 | 51.0 | 49.0 | 47.2 | 52.8 | 52.8 | 47.2 |
| | SD | 7.36 | 7.36 | 8.8 | 8.8 | 6.02 | 6.02 | 8.53 | 8.53 |

Note. Score indicate the percentage of body weight distributed across the left and right sides of the lower body at 0, 5, 10, and 15 repetitions during a squat.

Table 4.13

Analysis of Variance for Differences (Post – Pre) on Balance Assessments

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| SOT | Treatment | 1 | 22.5 | 1.58 | .14 |
| | Block | 4 | 118.85 | 8.34 | .002** |
| | Error | 4 | (3.77) | | |
| Weight Bearing Squat | | | | | |
| 0° | Treatment | 1 | 90 | 0.52 | .25 |
| | Block | 4 | 40.6 | 0.24 | .45 |
| | Error | 4 | (13.11) | | |
| 30° | Treatment | 1 | 32.4 | 0.73 | .22 |
| | Block | 4 | 17.1 | 0.39 | .41 |
| | Error | 4 | (6.66) | | |
| 60° | Treatment | 1 | 0.90 | 0.01 | .19 |
| | Block | 4 | 36.35 | 0.36 | .41 |
| | Error | 4 | (10.0) | | |
| 90° | Treatment | 1 | 78.4 | 0.69 | .23 |
| | Block | 4 | 26.25 | 0.23 | .45 |
| | Error | 4 | (10.64) | | |

Note. The number in ( ) indicates the root mean squared error.

* represents significance $p \leq .05$, ** represents significance $p \leq .01$

Table 4.13

Analysis of Variance for Differences (Post – Pre) on Balance Assessments (cont'd)

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Step Up and Over | | | | | |
| Lift Up Index (left) | Treatment | 1 | 250.0 | 2.00 | .12 |
| | Block | 4 | 36.41 | 0.29 | .44 |
| | Error | 4 | (11.18) | | |
| Lift Up Index (right) | Treatment | 1 | 168.1 | 0.71 | .22 |
| | Block | 4 | 452.6 | 1.90 | .14 |
| | Error | 4 | (15.42) | | |
| Movement Time (left) | Treatment | 1 | 0.024 | 1.51 | .14 |
| | Block | 4 | 0.018 | 1.09 | .23 |
| | Error | 4 | (0.127) | | |
| Movement Time (right) | Treatment | 1 | 0.361 | 1.63 | .14 |
| | Block | 4 | 0.268 | 1.21 | .21 |
| | Error | 4 | (0.47) | | |
| Impact Index (left) | Treatment | 1 | 582.68 | 3.80 | .06 |
| | Block | 4 | 117.85 | 0.77 | .30 |
| | Error | 4 | (12.38) | | |
| Impact Index (right) | Treatment | 1 | 34.84 | 1.05 | .18 |
| | Block | 4 | 364.46 | 10.98 | .01** |
| | Error | 4 | (5.76) | | |

Note. The number in ( ) indicates the root mean squared error.

* represents significance $p \leq .05$, ** represents significance $p \leq .01$

Table 4.13

Analysis of Variance for Differences (Post – Pre) on Balance Assessments (cont'd)

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Weight Bearing Squat | | | | | |
| 0 Repetitions | Treatment | 1 | 176.4 | 0.82 | .21 |
| | Block | 4 | 99.25 | 0.46 | .38 |
| | Error | 4 | (14.65) | | |
| 5 Repetitions | Treatment | 1 | 2.5 | 0.01 | .46 |
| | Block | 4 | 21.6 | 0.08 | .50 |
| | Error | 4 | (16.06) | | |
| 10 Repetitions | Treatment | 1 | 57.6 | 0.54 | .25 |
| | Block | 4 | 41.15 | 0.39 | .41 |
| | Error | 4 | (10.34) | | |
| 15 Repetitions | Treatment | 1 | 72.9 | 0.79 | .21 |
| | Block | 4 | 37.35 | 0.41 | .40 |
| | Error | 4 | (9.6) | | |

Note. The number in ( ) indicates the root mean squared error.

* represents significance $p \leq .05$, ** represents significance $p \leq .01$

Table 4.14

Means and Standard Deviations for Vocational Tasks by Assessment Period

| Evaluation | | Box* | | Pail** | | Dolly** | | Sack Up*** | | Sack Total*** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre test | | T | C | T | C | T | C | T | C | T | C |
| | M | 26.4 | 25.4 | 46.81 | 44.82 | 46.65 | 41.2 | 16.15 | 17.75 | 29.02 | 31.27 |
| | SD | 3.21 | 5.13 | 4.1 | 3.89 | 6.42 | 13.52 | 3.54 | 3.56 | 7.85 | 4.63 |
| Mid test | | | | | | | | | | | |
| | M | 32.4 | 26.2 | 53.69 | 47.21 | 52.18 | 41.09 | 11.38 | 15.26 | 24.64 | 28.22 |
| | SD | 1.82 | 7.22 | 4.56 | 5.80 | 6.22 | 13.63 | 2.19 | 4.82 | 8.72 | 7.22 |
| Post test | | | | | | | | | | | |
| | M | 37.6 | 28.2 | 60.91 | 50.43 | 60.79 | 45.68 | 10.42 | 14.22 | 22.66 | 27.36 |
| | SD | 1.14 | 6.83 | 4.05 | 5.16 | 4.68 | 12.00 | 2.80 | 4.55 | 9.60 | 7.24 |
| Retention | | | | | | | | | | | |
| | M | 33.2 | 26.6 | 55.01 | 47.15 | 54.64 | 43.01 | 12.48 | 15.5 | 25.72 | 29.12 |
| | SD | 1.30 | 5.37 | 5.04 | 3.80 | 4.79 | 10.98 | 2.69 | 5.92 | 9.15 | 7.75 |

Note. T = Treatment Group, C = Control Group; * Number of boxes stacked in 1 minute; ** Total distance covered in meters in 30 seconds; ***Total time to ascend up two flights of stairs (up) and then descend (total).

Table 4.15

Analysis of Variance for Differences (Post – Pre) on Vocational Tasks

| | Source | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Box Stacking | Treatment | 1 | 176.4 | 20.39 | .005** |
| | Block | 4 | 2.25 | 0.26 | .44 |
| | Error | 4 | (2.94) | | |
| Pail Carry | Treatment | 1 | 18025.11 | 13.16 | .01** |
| | Block | 4 | 1936.82 | 1.41 | .19 |
| | Error | 4 | (3.70) | | |
| Dolly Cart Push | Treatment | 1 | 23383.8 | 112.64 | .002** |
| | Block | 4 | 1394.64 | 6.72 | .023* |
| | Error | 4 | (114.08) | | |
| Sack Carry Up | Treatment | 1 | 12.1 | 4.02 | .05* |
| | Block | 4 | 6.47 | 2.15 | .12 |
| | Error | 4 | (1.74) | | |
| Sack Carry Total | Treatment | 1 | 14.81 | 1.39 | .15 |
| | Block | 4 | 10.07 | 0.94 | .26 |
| | Error | 4 | (3.27) | | |

Note. The number in ( ) represents the root mean squared error

* represents significance $p \leq .05$, ** significance $p \leq .01$

Table 4.16

Percent Change of Means in Vocational Tasks at Weeks 6, 12, and 18

| Assessment | Box | | Pail | | Dolly | | Sack Up | | Sack Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | T | C | T | C | T | C | T | C | T | C |
| (1) 0-6 week | 22.73 | 3.15 | 14.7 | 5.33 | 11.85 | (0.27) | 29.54 | 14.03 | 15.09 | 9.75 |
| (2) 6-12 week | 16.05 | 7.63 | 13.45 | 6.82 | 16.5 | 11.17 | 8.44 | 6.82 | 8.04 | 3.05 |
| (3) 0-12 week | 42.4 | 11.02 | 30.12 | 12.52 | 30.31 | 10.87 | 35.48 | 19.89 | 21.92 | 12.5 |
| (4) 12-18 week | (11.7) | (5.67) | (9.69) | (6.5) | (10.12) | (5.85) | (19.77) | (9.00) | (13.59) | (0.88) |

Note. T = treatment group, C = control group, a number in ( ) indicates a negative direction from the desired results

Assessment: (1) 0-6 week (pre test to mid test)

(2) 6-12 week (mid test to post test)

(3) 0-12 week (pre test to post test)

(4) 12-18 week (post test to retention)

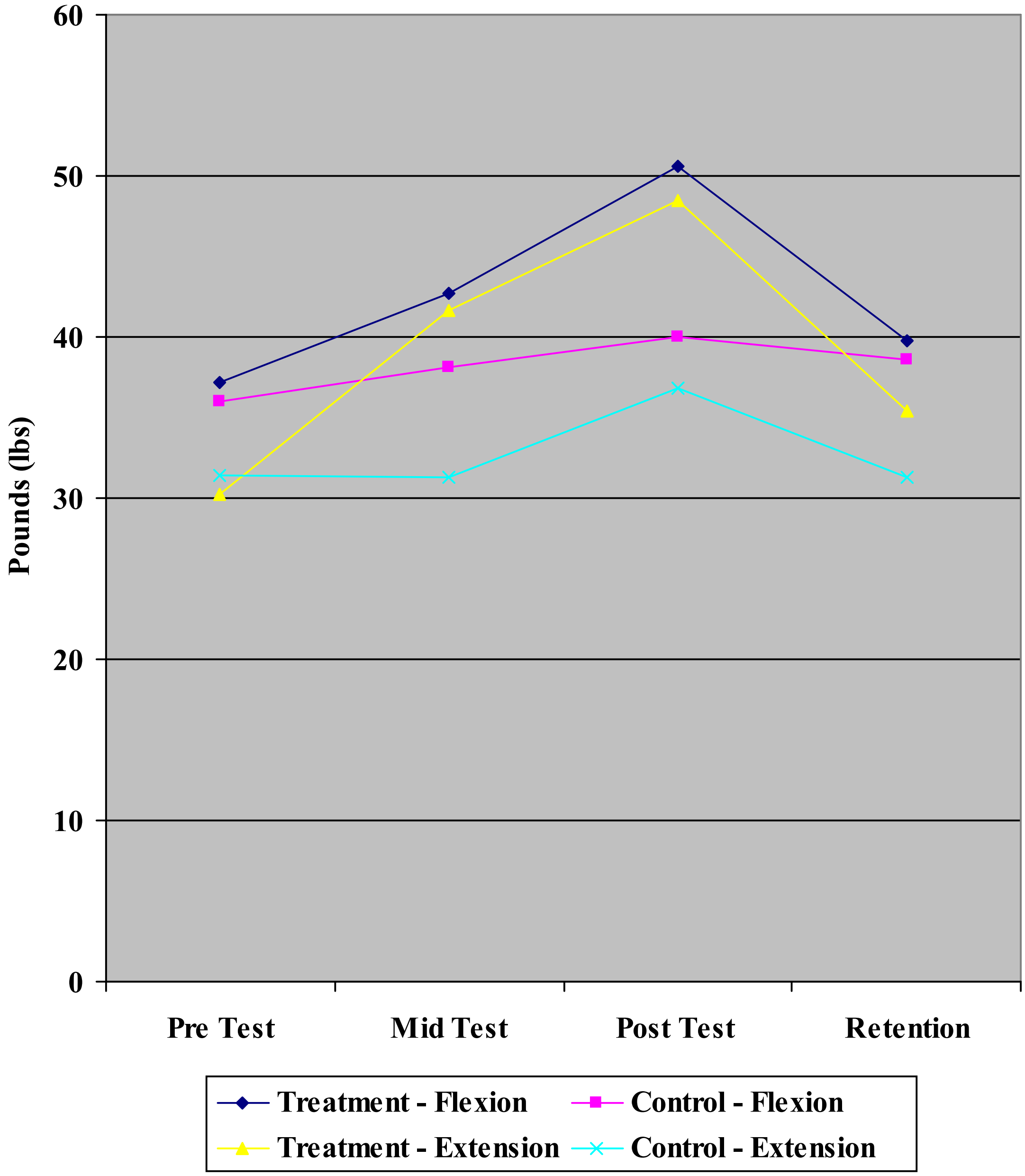


**Figure 4.1 Means for Isometric Right Knee Muscular Strength**

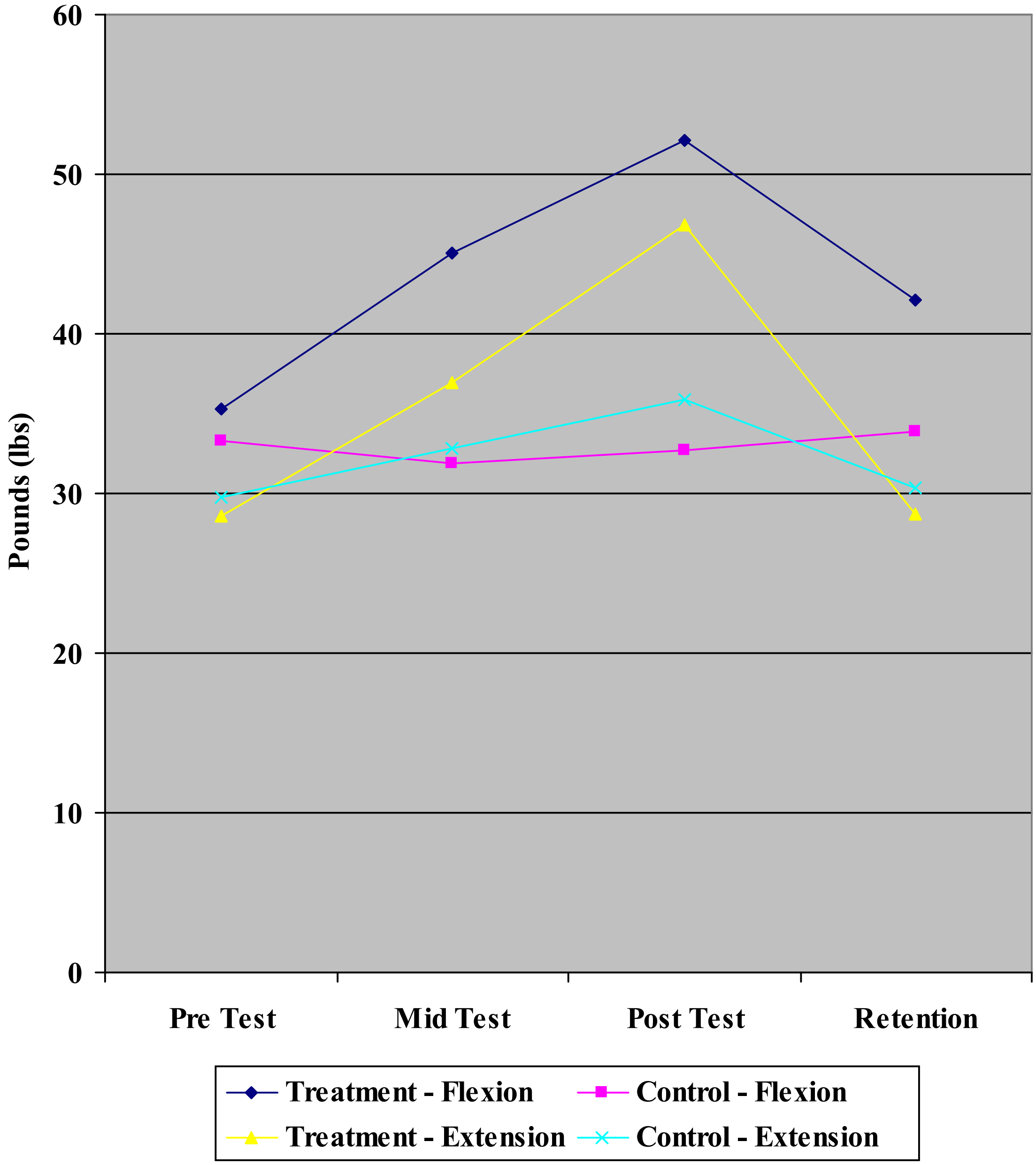


**Figure 4.2 Means for Isometric Left Knee Strength Measurements**

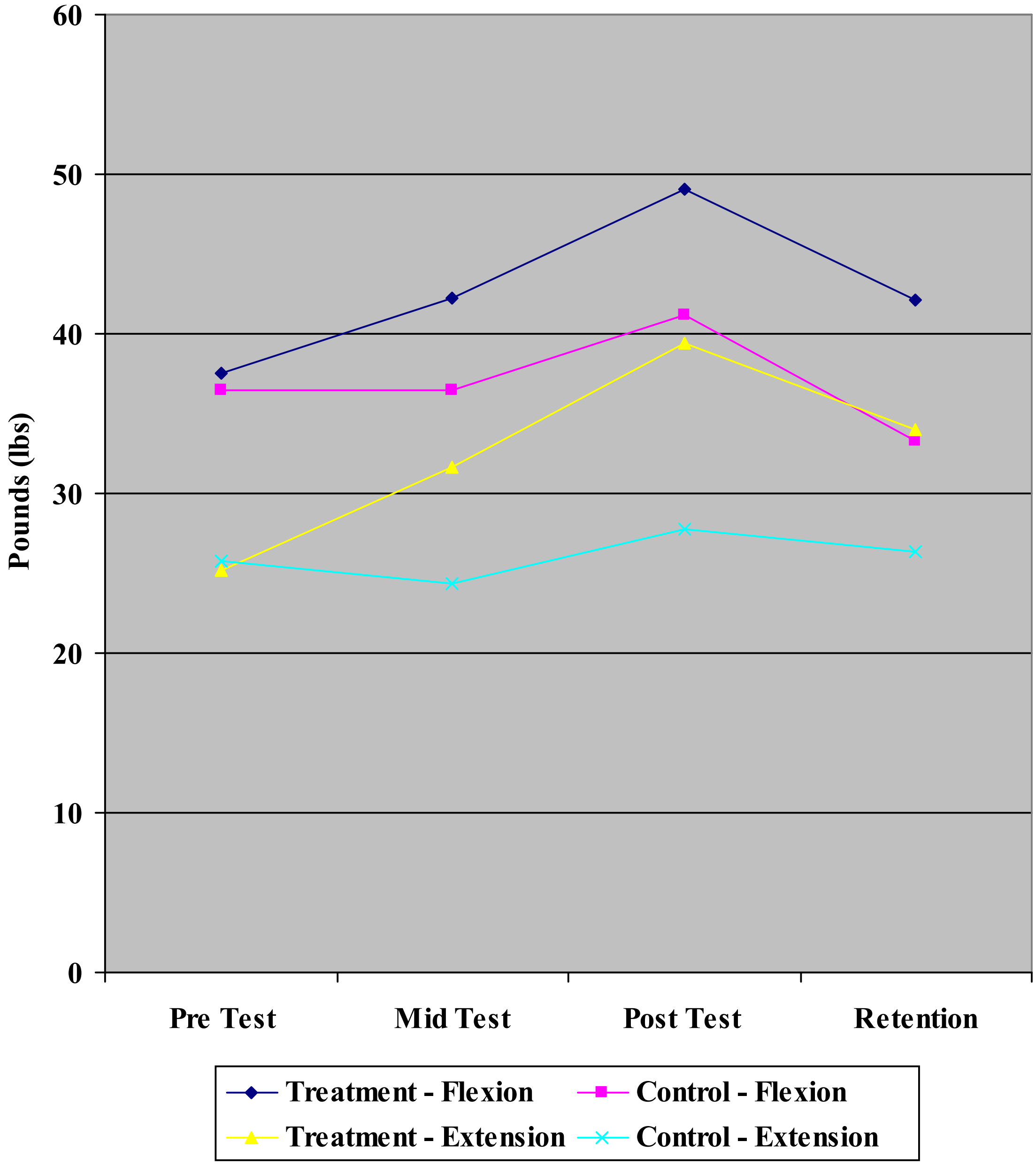


**Figure 4.3 Means for Isometric Right Elbow Muscular Strength**

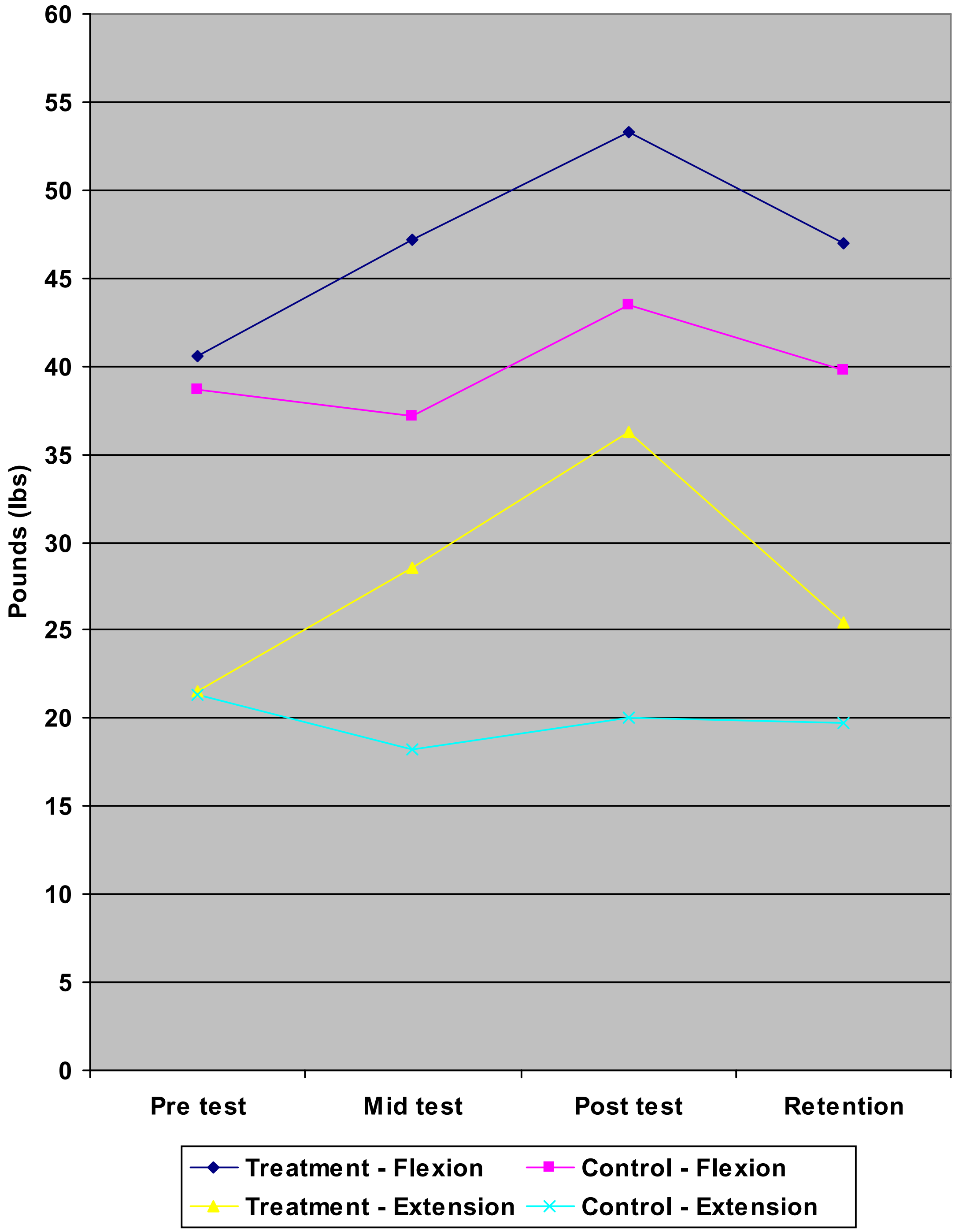


**Figure 4.4 Means for Isometric Left Elbow Muscular Strength**

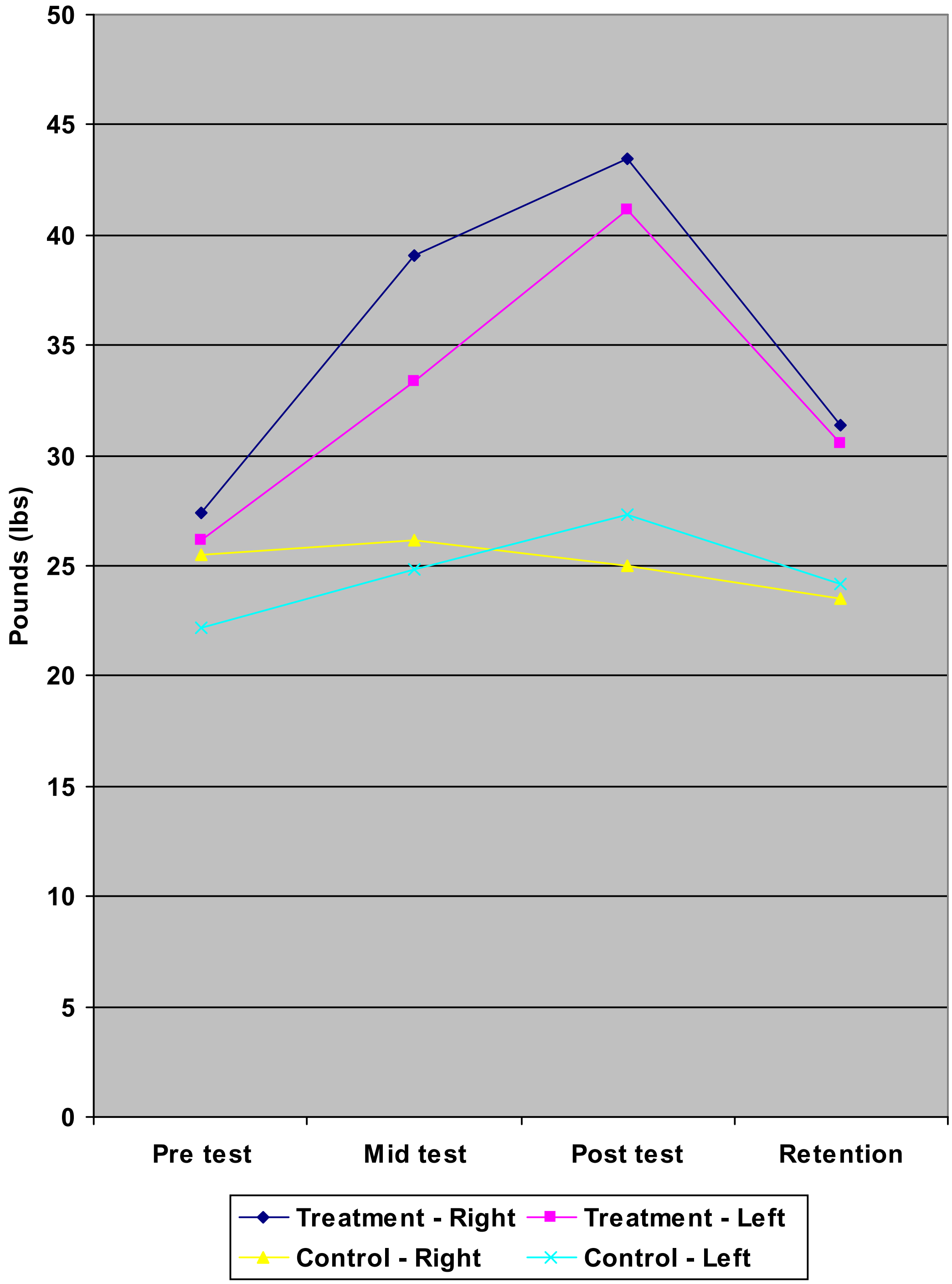


**Figure 4.5 Means for Isometric Right and Left Shoulder Abduction Strength**

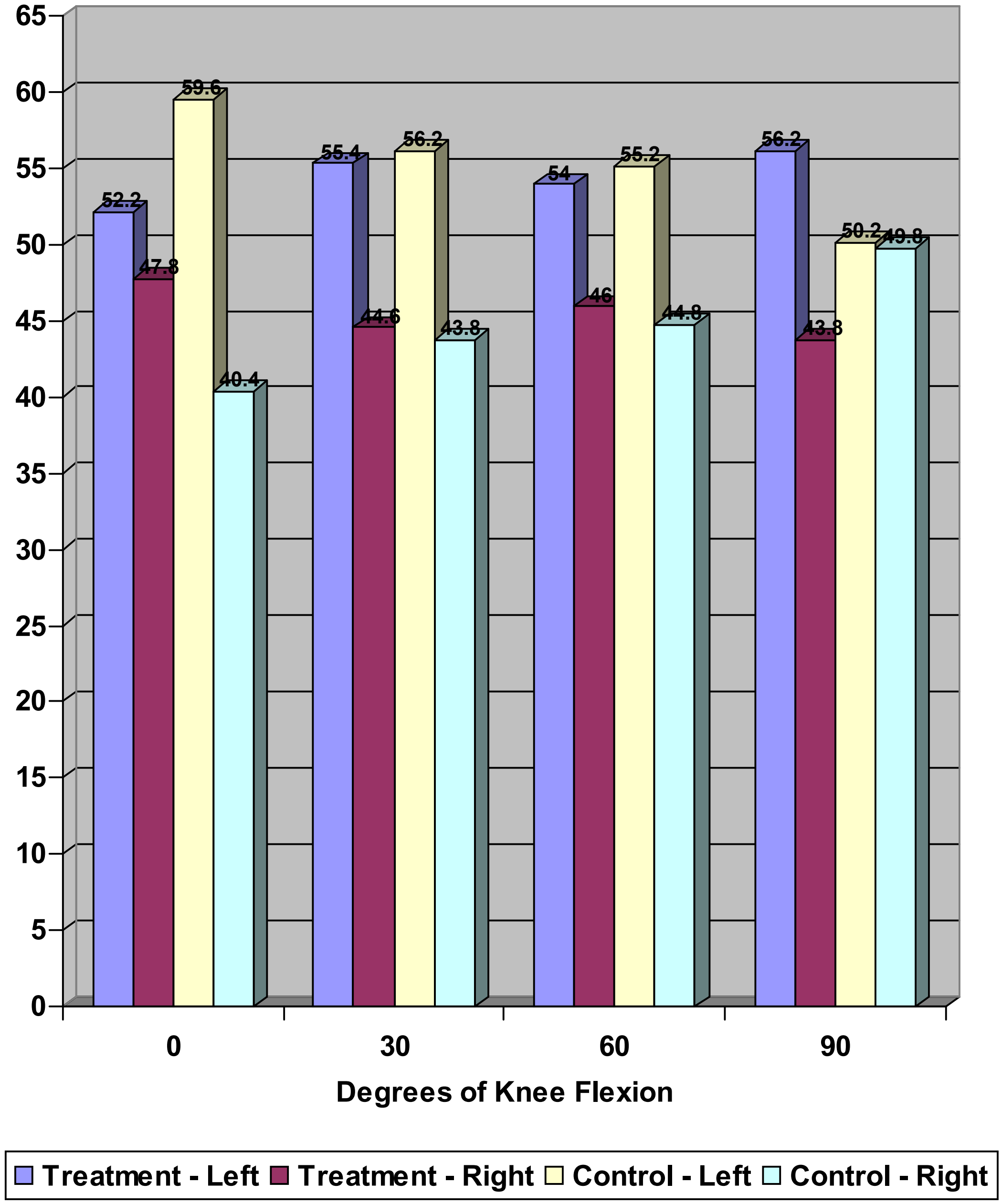


**Figure 4.6 Pre Test Measures for Bilateral Weight Bearing Squat**

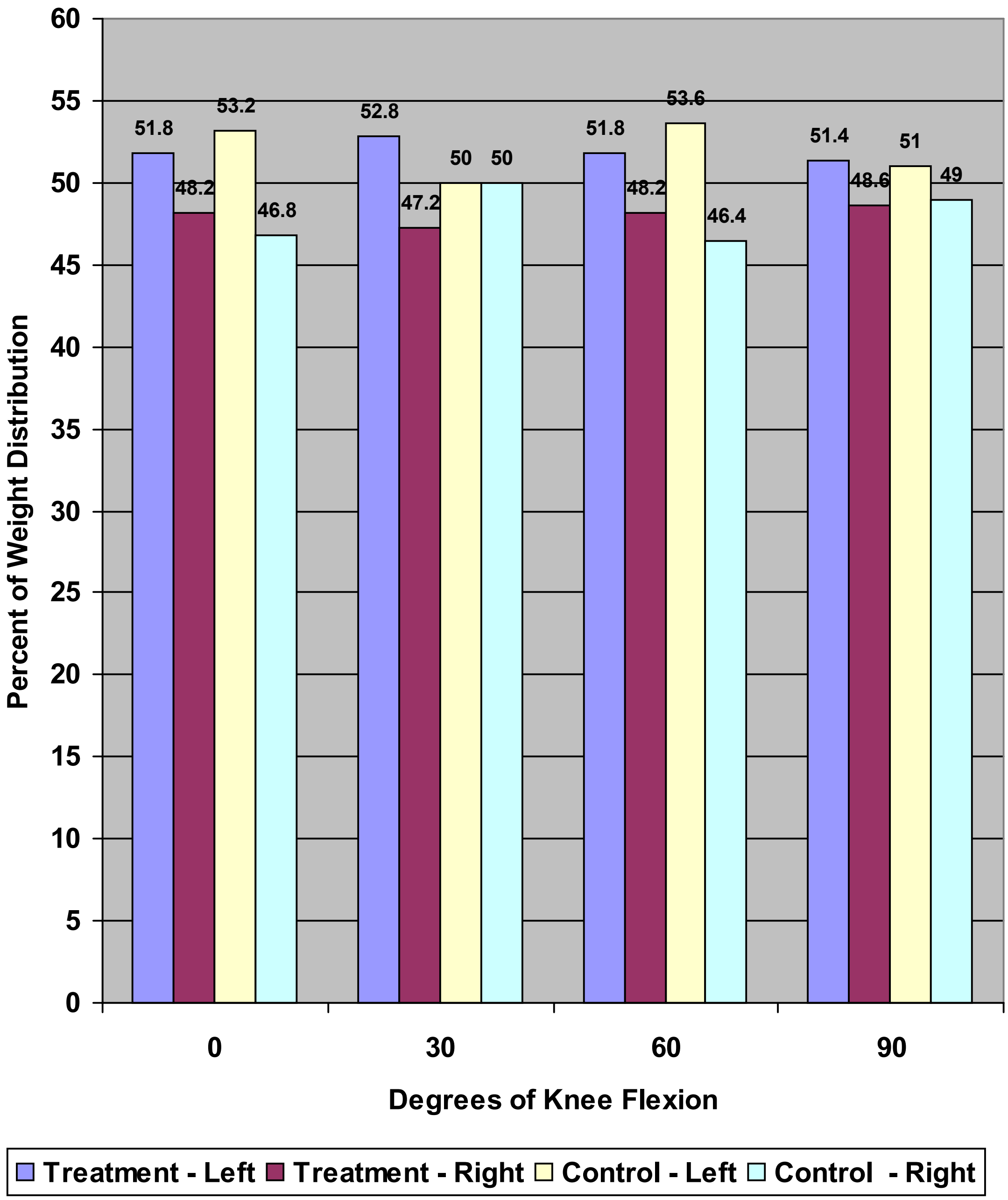


**Figure 4.7 Post Test Means for Bilateral Weight Bearing Squat**

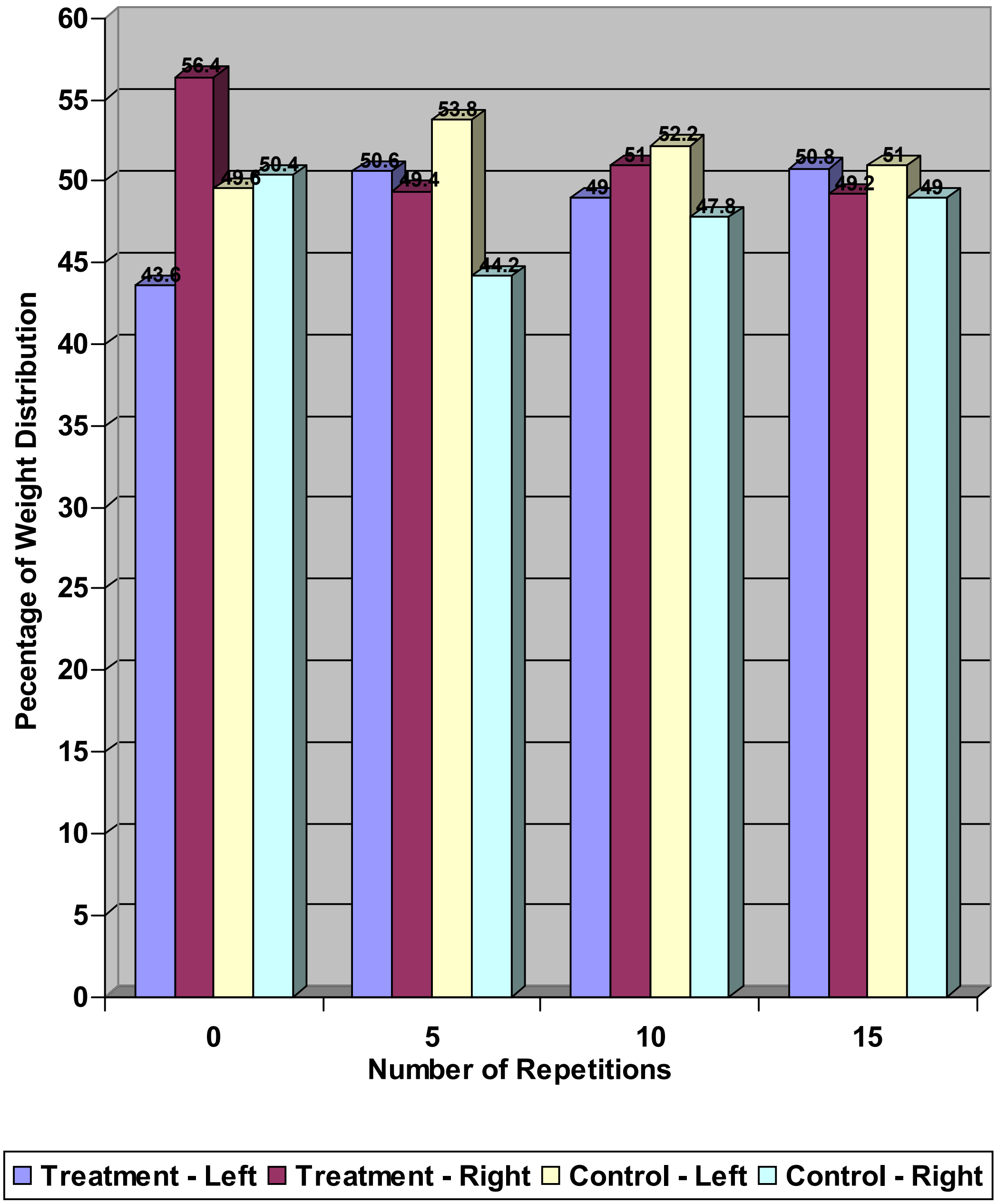


**Figure 4.8 Pre Test Means for Weight Bearing Squat Over 15 Repetitions**

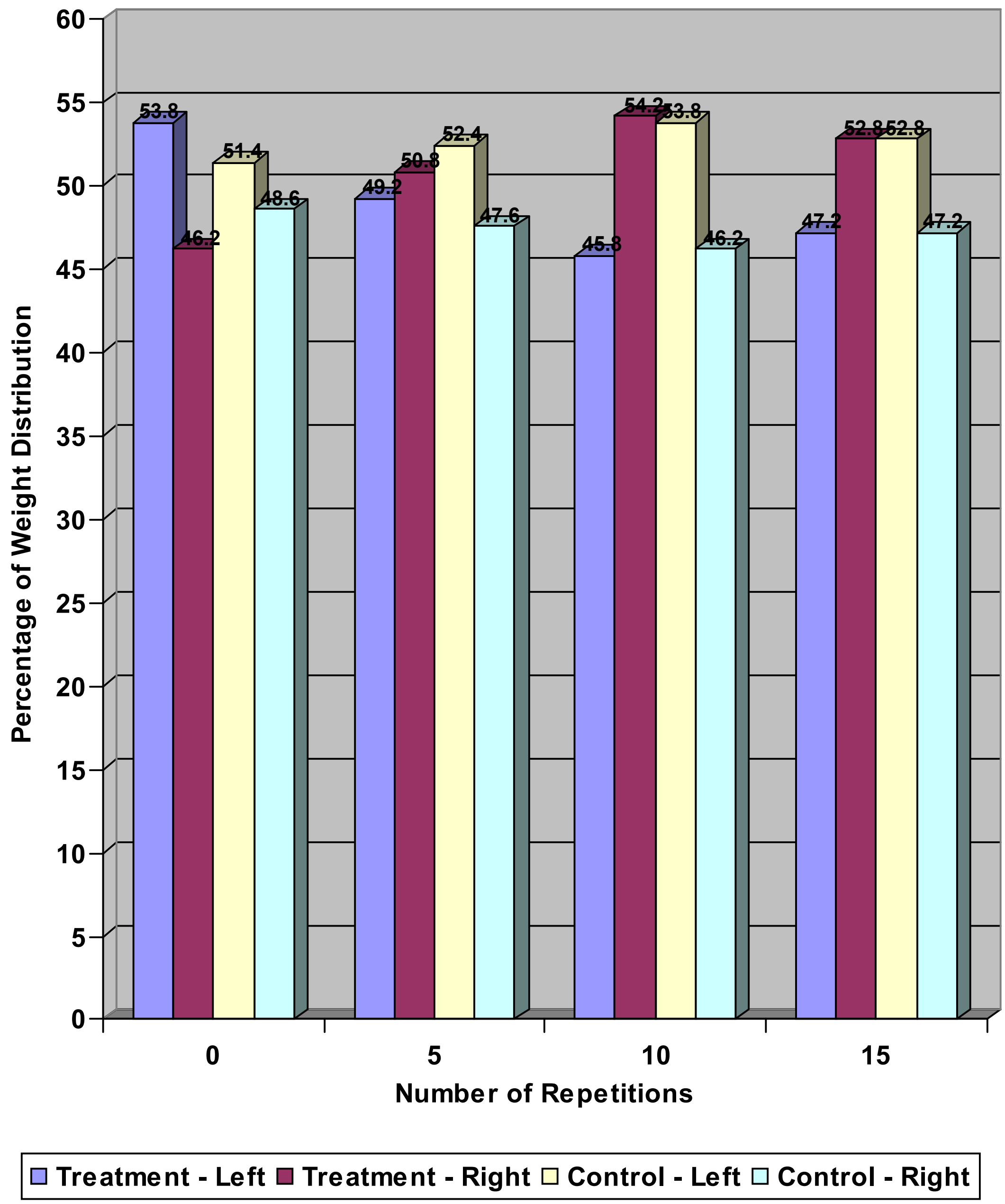


**Figure 4.9 Post Test Means for Weight Bearing Squat Over 15 Repetitions**

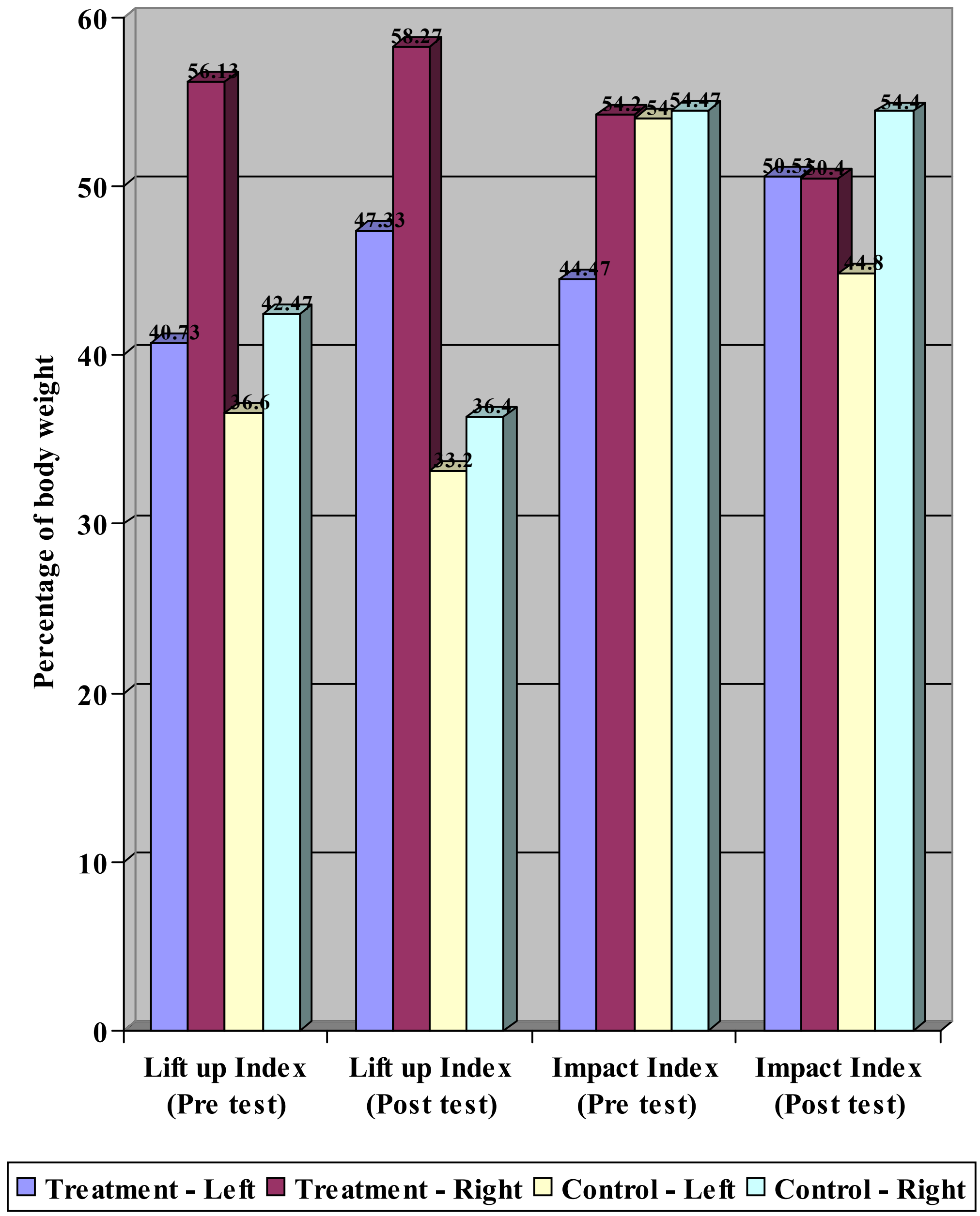


**Figure 4.10 Pre and Post Test Means for Step Up and Over Lift Up Index and Impact Index**

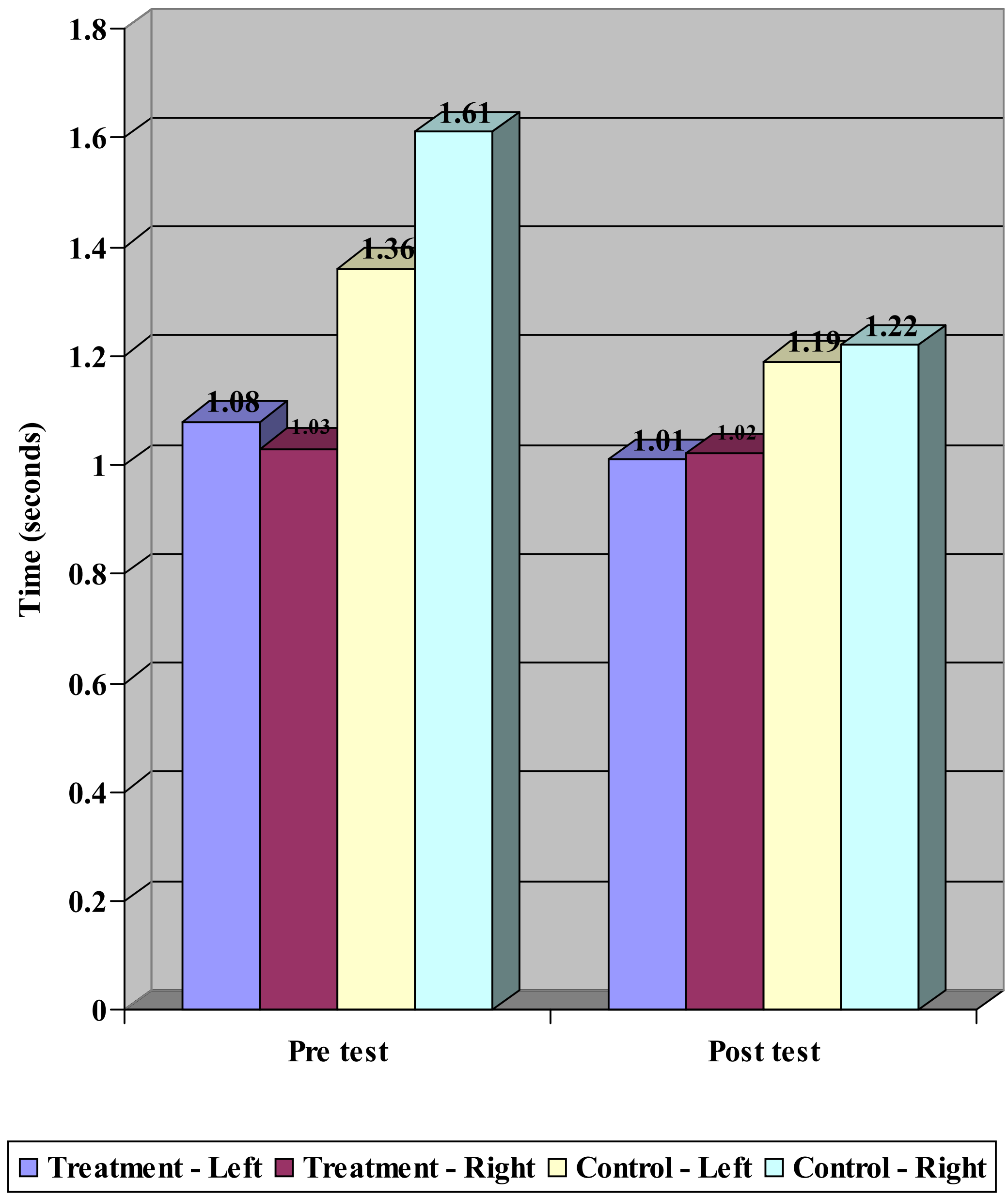


**Figure 4.11 Pre and Post Test Means for Step Up and Over Movement Time**

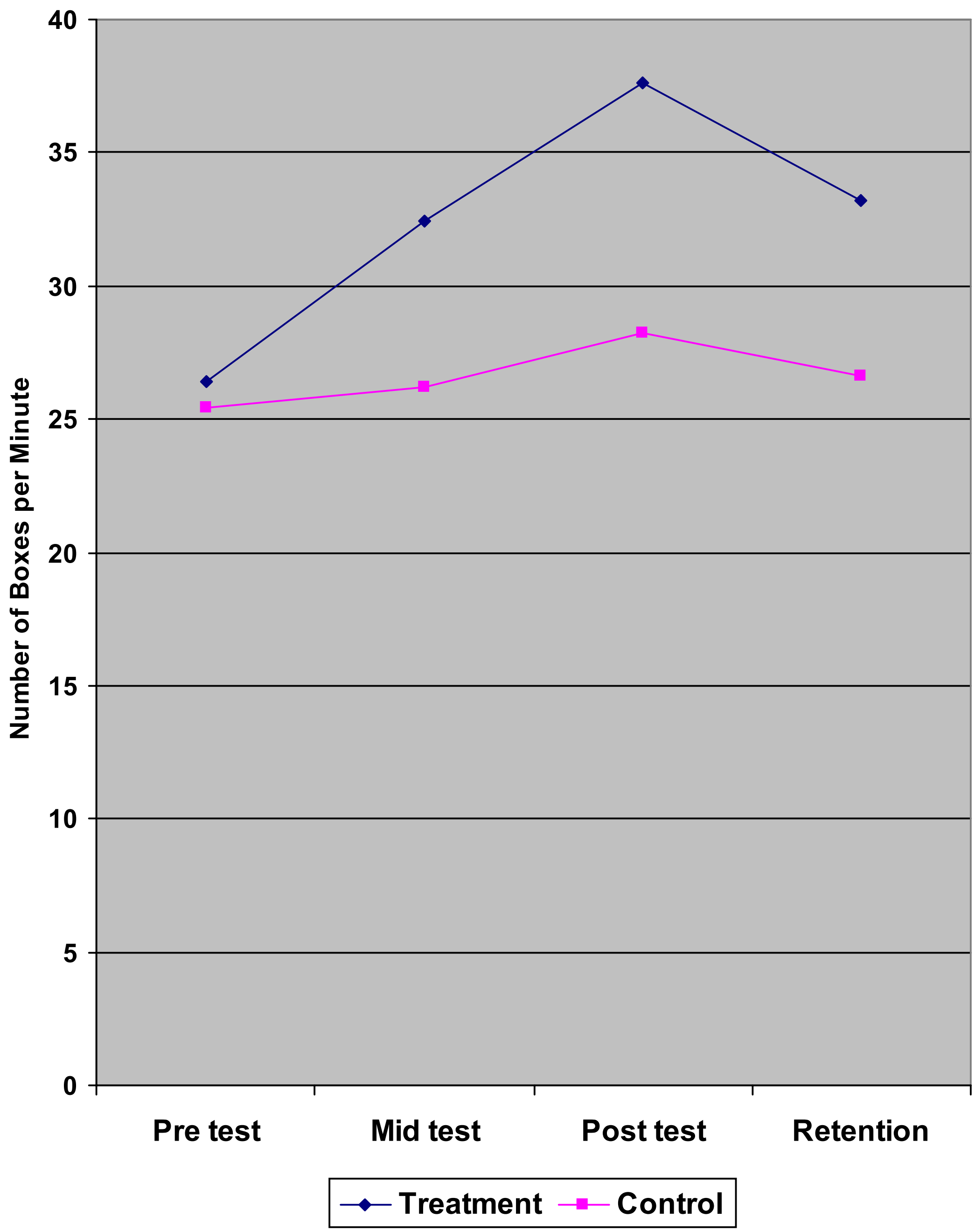


**Figure 4.12 Means for Box Stacking by Assessment Period**

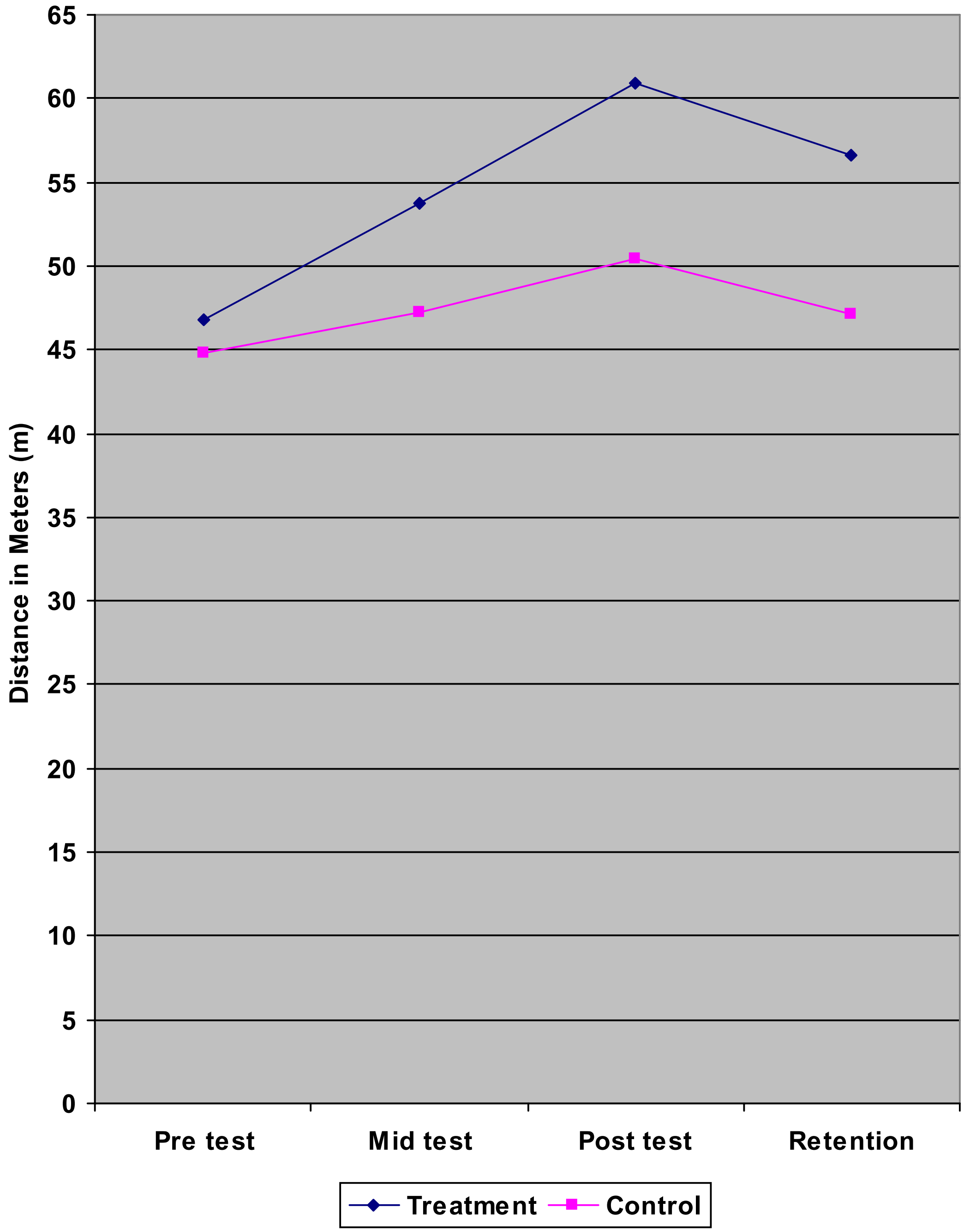


**Figure 4.13  Means for Pail Carry by Assessment Period**

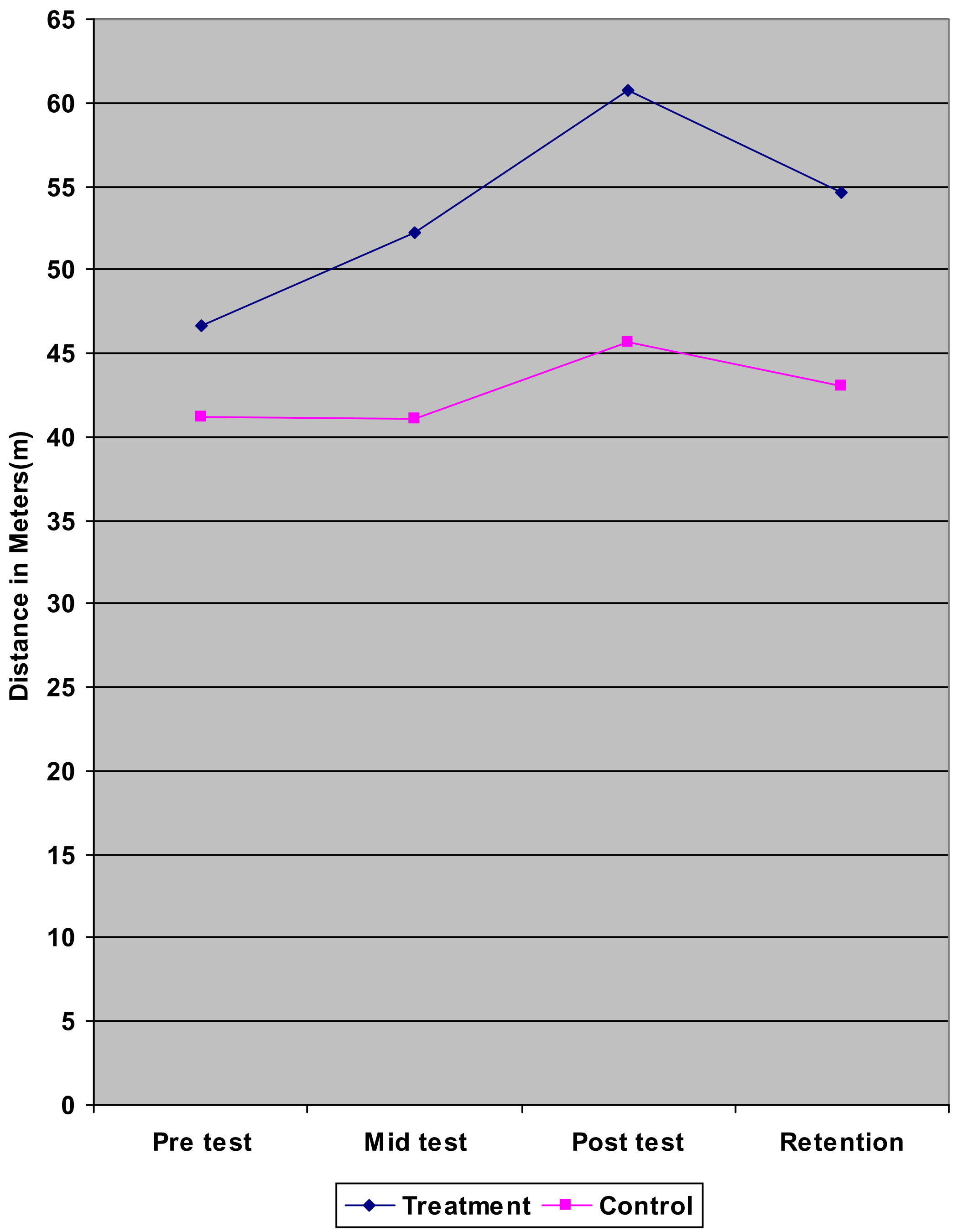


**Figure 4.14 Means for Dolly Cart Push by Assessment Period**

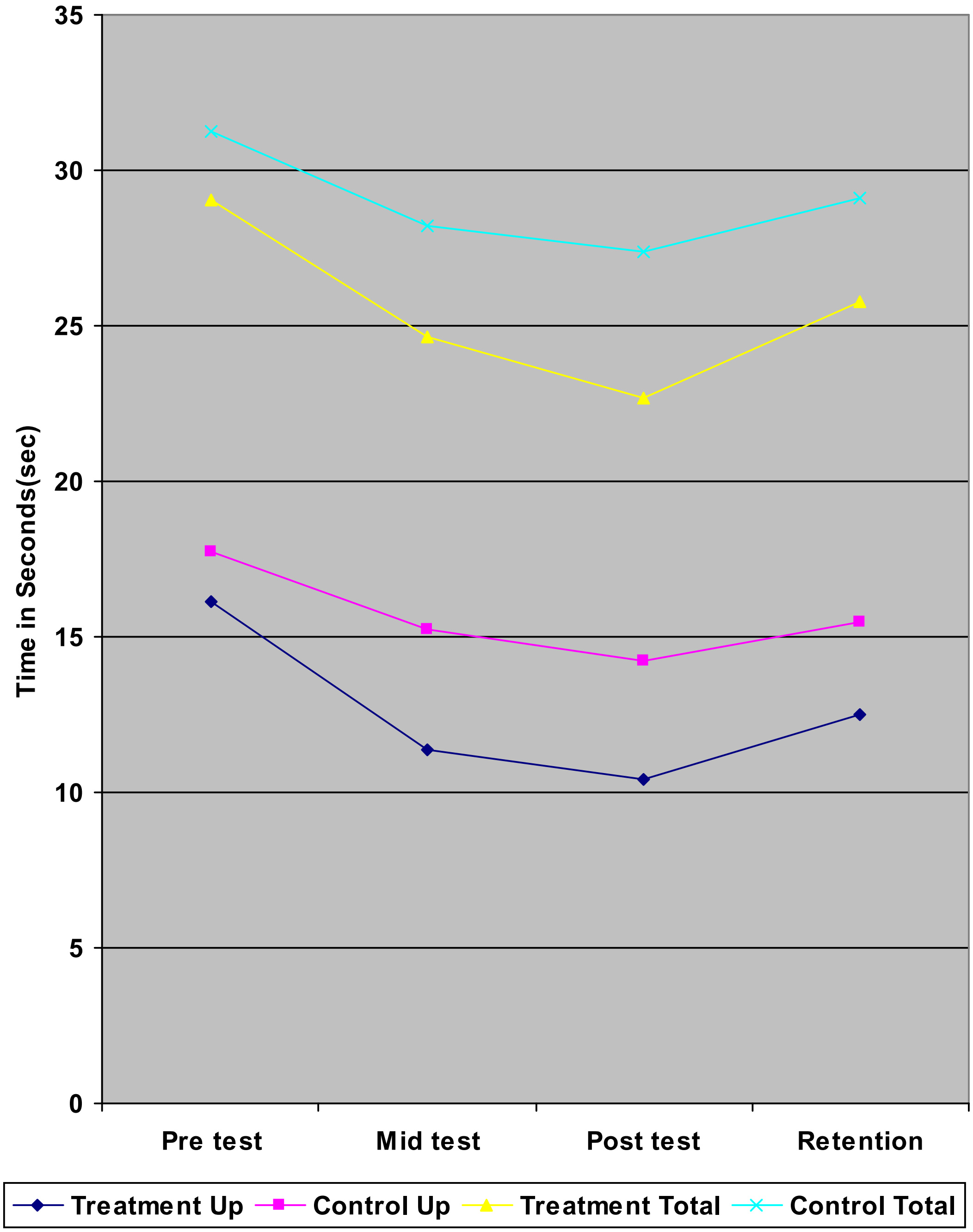


**Figure 4.15 Means for Sack Carry Up and Sack Carry Total**

# CHAPTER 5

# DISCUSSION

It is essential that individuals with mental retardation develop the necessary pre-requisite physical skills required to perform manual labor job tasks often required of them at job sites (Croce & Horvat, 1992; Horvat & Croce, 1995). Physical skills are job specific tasks and can improve with specific training programs that correlate with work performance (Croce & Horvat, 1992; Zetts, Horvat, & Langone, 1995; & Seagraves, Horvat, Franklin, & Jones, 2003). Results from this study reveal significant increases in physical functioning and vocational tasks for individuals with mental retardation after participation in a strength and balance training program. These increases in work productivity and strength were expected and support previous research which suggests that participation in a training program can increase physical functioning (Croce & Horvat, 1992; Serr, Lavay, Young, & Greene, 1994; Zetts et. al., 1995; & Seagraves et. al., 2003). The training program implemented for this study was noteworthy since it was based in a High School and used facilities and equipment readily available to Adapted Physical Education (APE) teachers. For transition purposes, these findings can be useful in the future training and serve as a model for preparation of high school students for employment opportunities.

## Vocational Tasks

In particular, significant differences occurred between the treatment group and the control group at $p \leq .05$ for all four vocational tasks (box stacking, pail carry, dolly cart push, sack carry). Percent gains were apparent as early as 6 weeks into the training program supporting the effectiveness of the training program specific to work related tasks. For teachers, it is important to note that the training program took place at the high school using equipment available to Adapted Physical Education teachers. The training program implemented can be used to complement programs of preparation for work related tasks or transition programs.

Results from this study were higher than previous work by Zetts et. al. (1995) and Seagraves et. al. (2003) which implemented similar intervention programs. However, it should be noted that participants in this study were functionally higher than participants in previous studies and would be considered to be mildly involved as opposed to the moderate – severe range of mental retardation. In addition, the intervention for this study occurred three times a week over a 12 week period as opposed previous studies which required training twice weekly for 10 weeks, although the intensity and protocol of the studies were identical.

Performance of vocational tasks improved over the 12 week training period (Figure 5.1) with the treatment group increasing box stacking 42.4% compared to an 11.02% increase by the control group. This represented the largest increase in performance by the treatment group in relation to all four vocational tasks primarily due to the easier nature of the task and the students familiarity and understanding of the task demands.

For the pail carry, the treatment group increased 30.12% as opposed to the control group which increased performance 12.52%. These values were approximately 10% higher than previous studies and may be due to the complexity of the task or level of functioning of the participants. The pail carry requires multiple skills such as balance, grip, shoulder girdle, torso, leg strength, and coordination in completing the task and required a firm grip by both hands throughout the task.

Percent gains in the dolly cart push for the treatment group were 33.31% in comparison to 10.87% for the control group. These results were also similar to the findings of Seagraves et. al. (2003) and reflect a common task in work environment.

Inclusion of balance and coordination in this study used the sack carry as a novel work tasks that was not used in previous studies. Balance assessments have not been a focal point of research regarding individuals with mental retardation since the early 1980's. Previous research with balance isolated static balance activities with no assessment on dynamic balance tasks. The sack carry was used as a measure of dynamic balance and coordination specific to work related tasks. In our study the sack carry improved 32.7% for the treatment group as opposed to 16.2% for the control group with neither group experiencing any stumble or falls during their performance.

Muscular Strength

Gains in isometric strength measures were significant at the $p \leq .05$ at each assessment location for pre test to post test intervals. In contrast to earlier work, isometric strength measures in this study were isolated to indicate bilateral symmetry across each assessment location as opposed to upper and lower body composite scores. Strength gains were evident on all muscle groups. Average percent gains of 49.64% and 43.72% (elbow left and elbow right) were achieved by the treatment compared to 4.64% and 10.38% (elbow left and elbow right) for the control group and are displayed in Figure 5.3. Shoulder abduction (Figure 5.5) experienced a 56.97% increase in left and 58.66%

on the right side of the body compared to 22.94% increase in left and a 2.08% decrease on the right side of the body for the control group. In this study, percent gains for lower body measures for the treatment group indicated percent gains of 55.81% in left knee and 48.1% for the right knee compared to the control group gains of 9.58% for left knee and 14.07% for right knee (Figure 5.4). Retention measures for both the treatment and control group decreased at each assessment location (Figure 5.6-5.8) indicating that a specific training program can elicit gains in muscular strength development and provides a rationale for continuation of training. These results also support previous research that indicates training regimens for this population do produce significant gains but performance diminishes once training has ceased (Croce & Horvat, 1992; Zetts et. al. 1995; Seagraves et. al. 2003).

Percent gains were higher in comparison to previous work that used single subject designs to compare individuals with mental retardation over a period of time. Croce and Horvat (1992) reported increases of 34.58% in composite isometric strength and concluded that individuals with mental retardation can benefit from a resistance training intervention program but regress to baseline values when training ceases. Zetts et. al (1995) also used a similar research design methodology and training intervention with a community based program to produce similar strength gains in the treatment group. In contrast training was implemented primarily in the school setting with one weekly session in a community facility as part of the school systems program to facilitate transitional skills to the community.

## Balance

The assessment of balance requires integration of anatomical, muscular, and neurological functions and is a critical component of work tasks and essential in activities such as lifting, carrying, pushing, etc. Rider, Mahler & Ishee (1983) indicated that individuals with mental retardation are deficient in balance and is therefore a primary concern for the ability to function. Since the analysis of work sites and job skills concluded that the tasks had a component of balance and coordination as well as strength this study investigated the effect of balance and work performance measures.

Of particular interest is the increase of balance in both groups on balance assessments. On the pre test the treatment group calculated a composite score of 67 which by Neurocom International standards (2001) lower than the composite threshold for risk of falls. After intervention, the composite score increased to 81 (20.18%) from pre test measures. Although there were no significant differences at $p<.05$ between the groups when comparing balance scores, there were significant gains within each group from pre test to post test. The treatment group recorded greater gains, 20.18% as opposed to a 14.3% gain in the control group. The authors attribute this increase to the general physical activity program that was used as the control and supports efforts to maintain an ongoing activity program for individuals with mental retardation. It was expected that the treatment group would increase their balance. However, it was not expected that control group would have such large gains. Activities such as walking, throwing, skipping, kicking, and catching used for the control group appear to be helpful in producing increases in balance and coordination but not specific enough to elicit changes in strength and work performance. Nevertheless, results suggest that specific balance training can produce increases in stability, thus supporting general physical activity over a sedentary lifestyle in induce favorable changes in balance.

The weight bearing squat was also used to investigate bilateral weight distribution at varying degrees of knee flexion. This assessment was used to simulate balance during sit to stand activities, side to side movement, and bending over tasks. At the pre test assessment the treatment group displayed left side dominance at all angles of knee flexion (0º, 30º, 60º, and 90º). Although all values were within age related norms this did suggest that this group did rely on the left side (56.2%) more vigorously than the right (43.8%) which may become an issue after continuous repetition of a bending task. This discrepancy is noteworthy and may be a reason for poor balance associated with mental retardation. Whether the discrepancy is inherent or due to muscle weakness is not apparent but should be studied further. However after training, the treatment group displayed symmetry across left and right weight distribution (left 51.4% and right 48.6%). From a scientific rationale, this symmetry throughout the bending process can assist in decreasing falls during bending and lifting activities. From a practical standpoint it can decrease injury due to improper lifting techniques and aid individuals by increasing job performance.

Effects of fatigue on symmetry of lower body were investigated using 15 repetition weight bearing squat was performed with measures taken at 0 repetition, 5 repetitions, 10 repetitions, and 15 repetitions. There was no significant difference at $p < .05$ between groups on this assessment. The results from this task did not have percent gains as expected from the treatment group. One reason for this may be that 15 repetitions were not sufficient to elicit a fatigue response with this group. One exercise the treatment group performed during their training program was the squat which may have skewed the results of this assessment. Further investigation into the fatigue response to bilateral weight symmetry is needed in relation to task specific execution.

The final balance assessment investigated by this study was the step up and over. Three measures were calculated from the data: lift up index- the maximum force exerted by the step up leg; movement time- the time to complete the step over; and impact index – maximum force transmitted through the lagging leg as it lands on the surface. This assessment indicates instability during ascending or descending stairs, walking on inclines or stepping over objects which all are functional tasks performed daily and could result in falls or injury on the job. The treatment group displayed right side dominance at the pre test (40.73 left, 56.13 right) and post test (47.33 left, 58.27 right) levels for the lift up index. The % weight distribution was more evenly distributed at the post test similar to the results from the weight bearing squat. Continued right side dominance was evident at the pre assessment for the treatment group on the impact index (44.47 left, 54.2 right). After participation in the training program the treatment group displayed greater symmetry (50.5% left and 50.4%) on the landing force after stepping over an object. Movement time decreased at the post test for the treatment group with both the left leg and right leg displaying similar movement times (1.01 sec left leg and 1.02 sec right leg).

The control group improved weight distribution from pre test (36.6 left, 42.47 right) on the lift up index to post test (33.2 left, 36.4 right). The impact index assessment at the pre test were symmetrical (54 left, 54.47 right) compared to post test weight distribution (44.8 left, 54.4 right). Movement time improved from pre test (1.36 left, 1.61 right) to post test (1.19 left, 1.22 right). There were modest improvements on the lift up index and movement time weight distribution following participation in general physical activity.

Although there was no significant treatment effect, results from this study suggest that participation in a specific training program can improve weight symmetry throughout movements regularly required on manual labor related jobs. This is particularly important in reducing the occurrence of falls and/or injury on the job due to unsafe training or physical functioning capabilities by not placing too much continuous force on one specific area of the body i.e., lower back, knees or ankles.

## Conclusion

Significant improvements were noted in strength combined with marked improvements in balance to produce significant improvements in work performance tasks. Although the control group demonstrated some improvement in work performance measures, the treatment group had significantly higher gains supporting the notion that task specific training is more beneficial for individuals with mental retardation. Results from this study also support the premise that activity should be promoted over a sedentary lifestyle for individuals with mental retardation and activity can increase function.

In this study, strength measures produced the greatest gains over the training period between the treatment and control groups. This supports previous research findings but also should be noted that strength activities were primarily the focus on the daily training regiment (6 daily activities were strength related, 2 activities were balance related). The strength training program was specifically designed for muscle groups that were directly related to the work performance measures. Although the training programs were individualized this research supports integration of individuals with mental retardation in the Physical Education program. Individualized programs can be developed by an Adapted Physical Educator to assist with the planning and instruction by the Physical Educator.

This research supports the premise that increasing physical functioning for individuals with mental retardation is important but also this population needs to be provided with the opportunity to assimilate and learn task demands for employment through placement and retention practices (Bolton, Bellini, & Brookings, 2000; Horvat & Croce, 1995). Results suggest that transitional training for vocational placement may be appropriate for work related tasks but should be accompanied with the training of underlying components (coordination and strength etc.) for individuals with mental retardation.

## Recommendations for Future Research

The results from this study have expanded the area of physical functioning and work performance with individuals with mental retardation but as with much research this study has also left many questions unanswered. In order to continue to broaden the scope of this study the following areas can be addressed:

1. Increase the number of participants serviced by the intervention strategy
2. Include individuals with Down Syndrome and non-disabled to compare performance results and training effects.
3. Expand the length of the intervention strategy to include a full school calendar year.

4. Further investigate the fatigue response in muscle performance in work related tasks.

5. Investigate the relationship between performance on simulated work performance tasks and performance of similar tasks performed in the work environment.

6. Use a qualitative approach to investigate the satisfaction the individual with mental retardation perceive from their participation in the work force and address areas of need or concern.

7. Further investigate the underlying mechanics concerning decreases in performance following the ceasing of the training program.

## Implications for the Practitioner

Implications from this study have great impact for School Districts and classroom teachers. Often special education students make up a small percentage of the total school population. For this reason special education classrooms are often under serviced through resources and opportunity for academic advancement. Recent public support has focused on integrated classroom environments, although there are benefits to both the student with disabilities and the student without disabilities, this study and other research suggests that when it comes to physical education the greatest benefits comes from an individualized training program focusing on specific tasks. Individualized training programs do not support a segregated approach to instruction but rather an integrated environment that provides instruction based on the needs and demands of the student. According to recent legislation, IEP and ITP support integration when it is safe and beneficial to the student but also recognizes the importance of individualized instruction.

This research supports the placement of an Adapted Physical Education teacher in schools to provide specific training programs for students with special needs in Physical Education. Results from this study indicate that physical education programs needs to be specific and on going as supported by the improvement in performance during the training program followed by the decrease in performance once training had ceased. Training programs similar to this one can be implemented at local High Schools using facilities and equipment presently available. The Adapted Physical Education teacher is a vital team player and can assist the Physical Educator in planning and implementing a quality physical education experience for individuals with special needs.

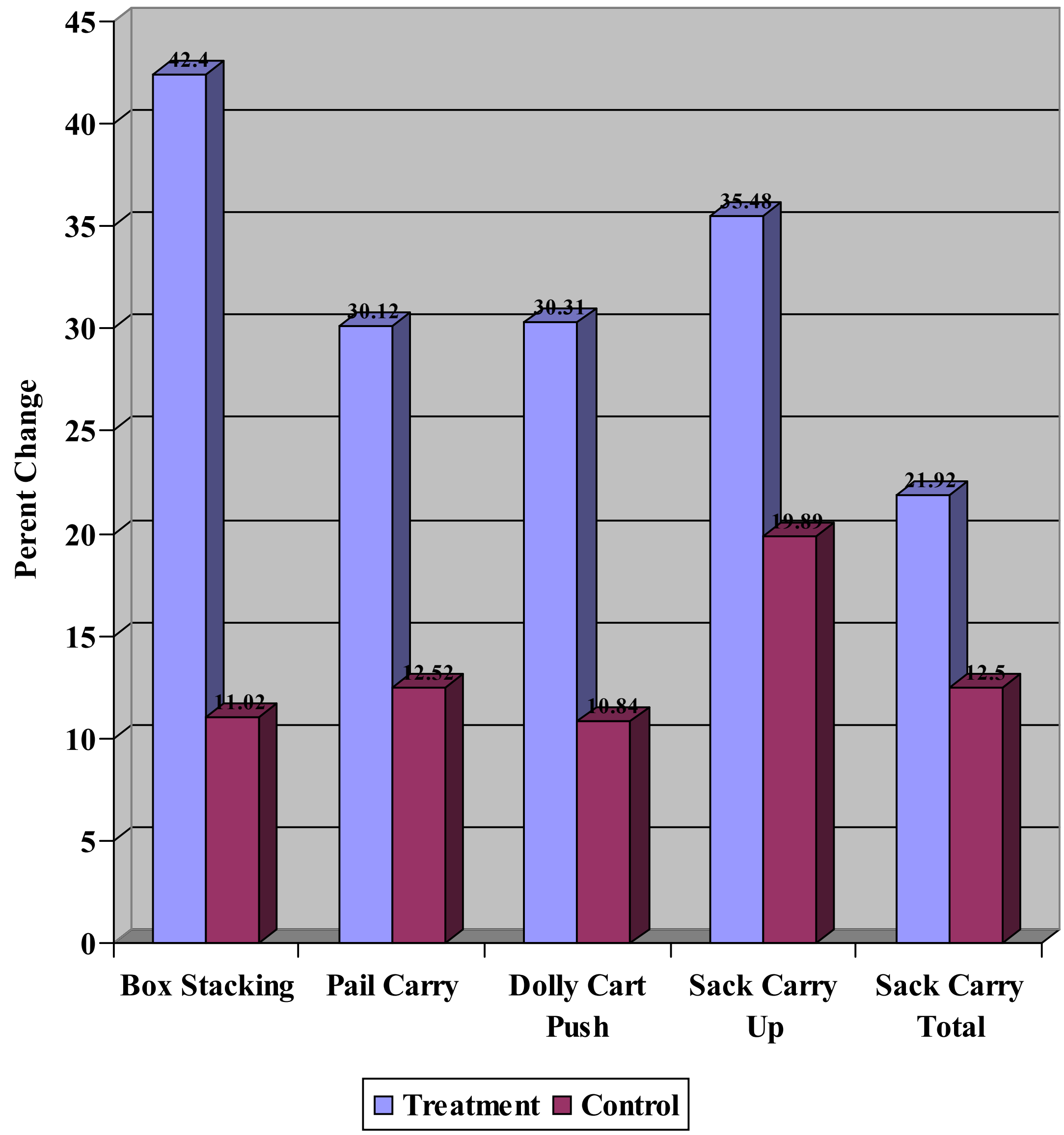


**Figure 5.1 Percent Change from Pre Test to Post Test for Vocational Tasks**

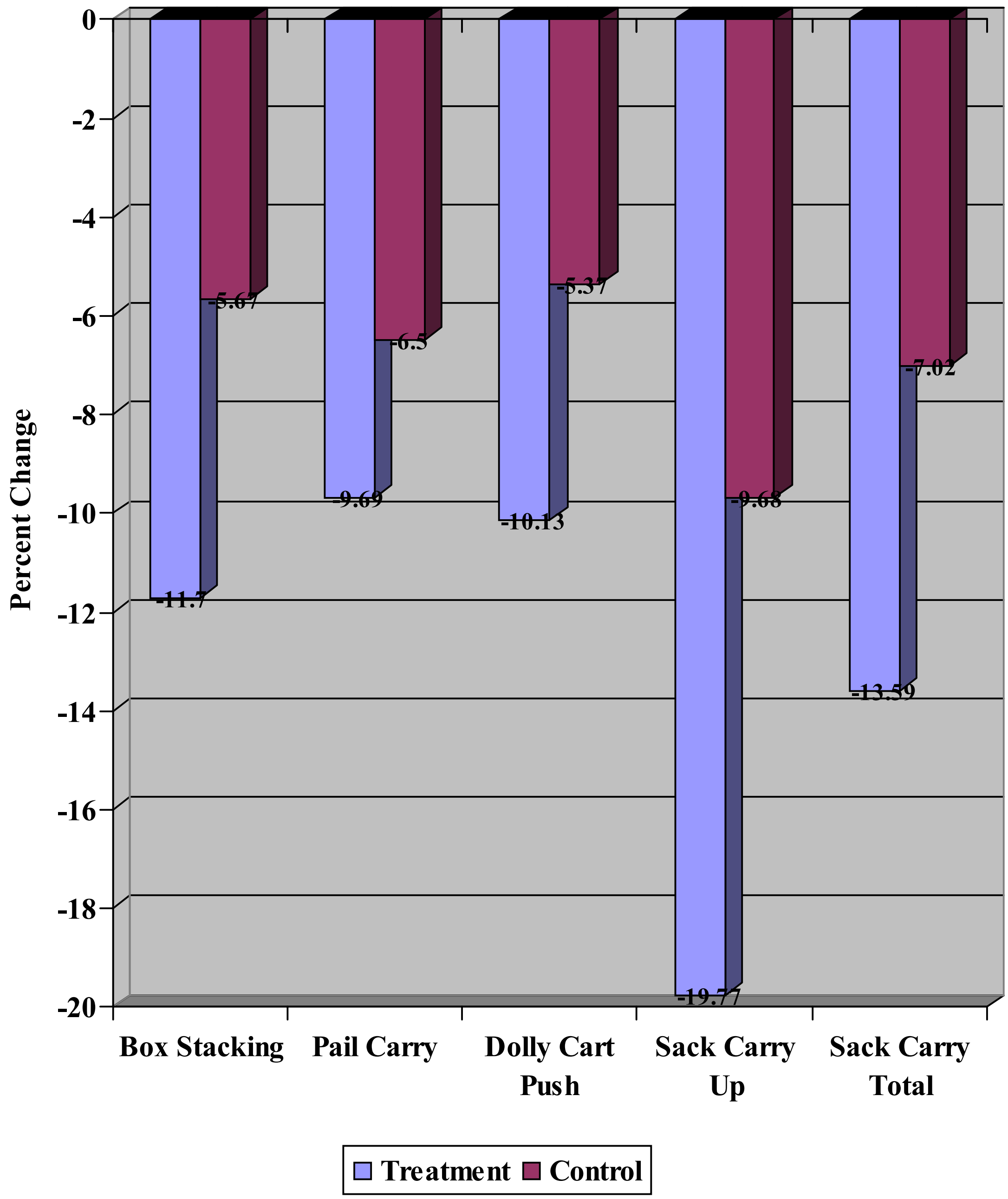


**Figure 5.2 Percent Change from Post Test to Retention for Vocational Tasks**

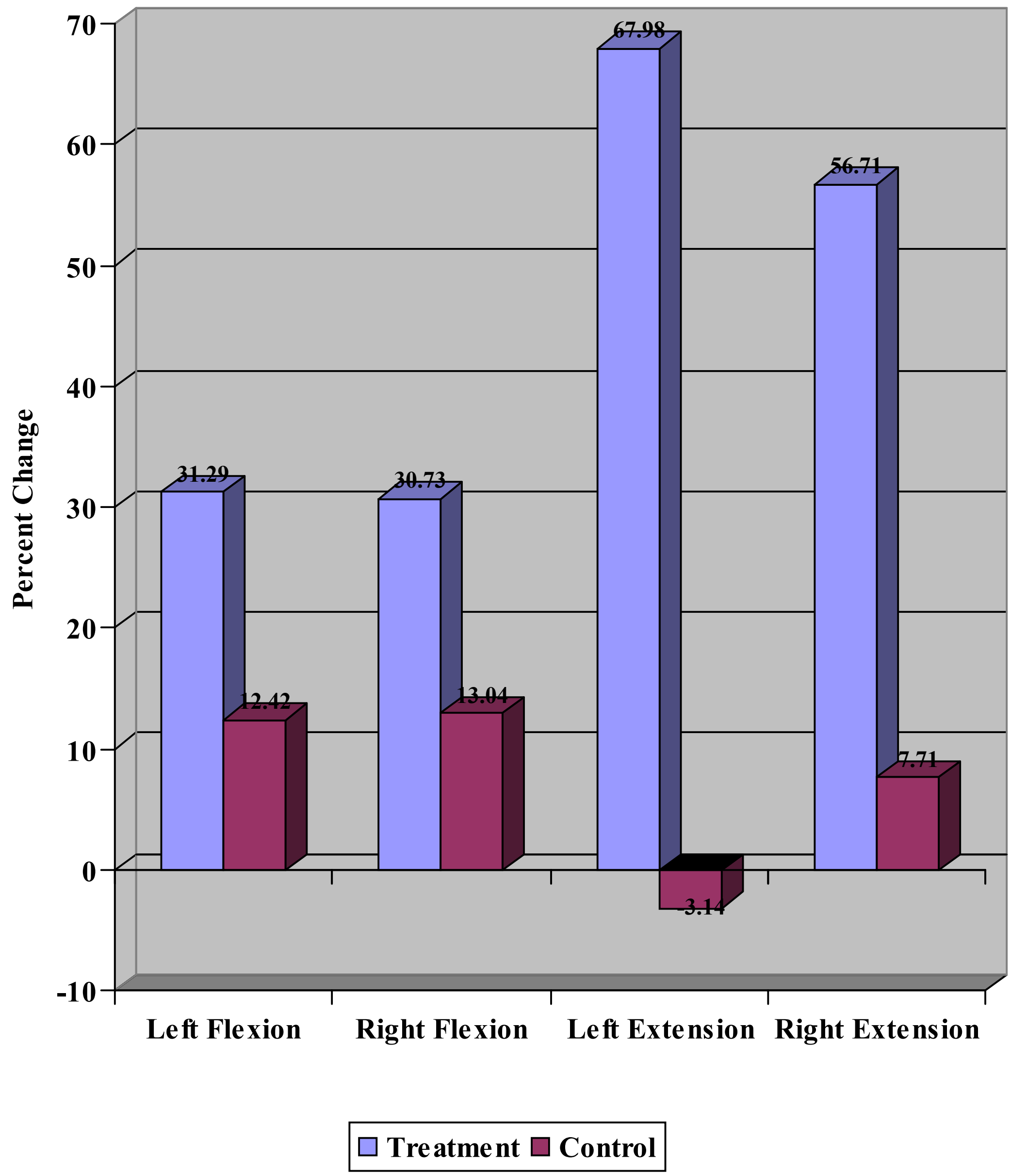


**Figure 5.3 Percent Change from Pre Test to Post Test on Isometric Elbow Strength**

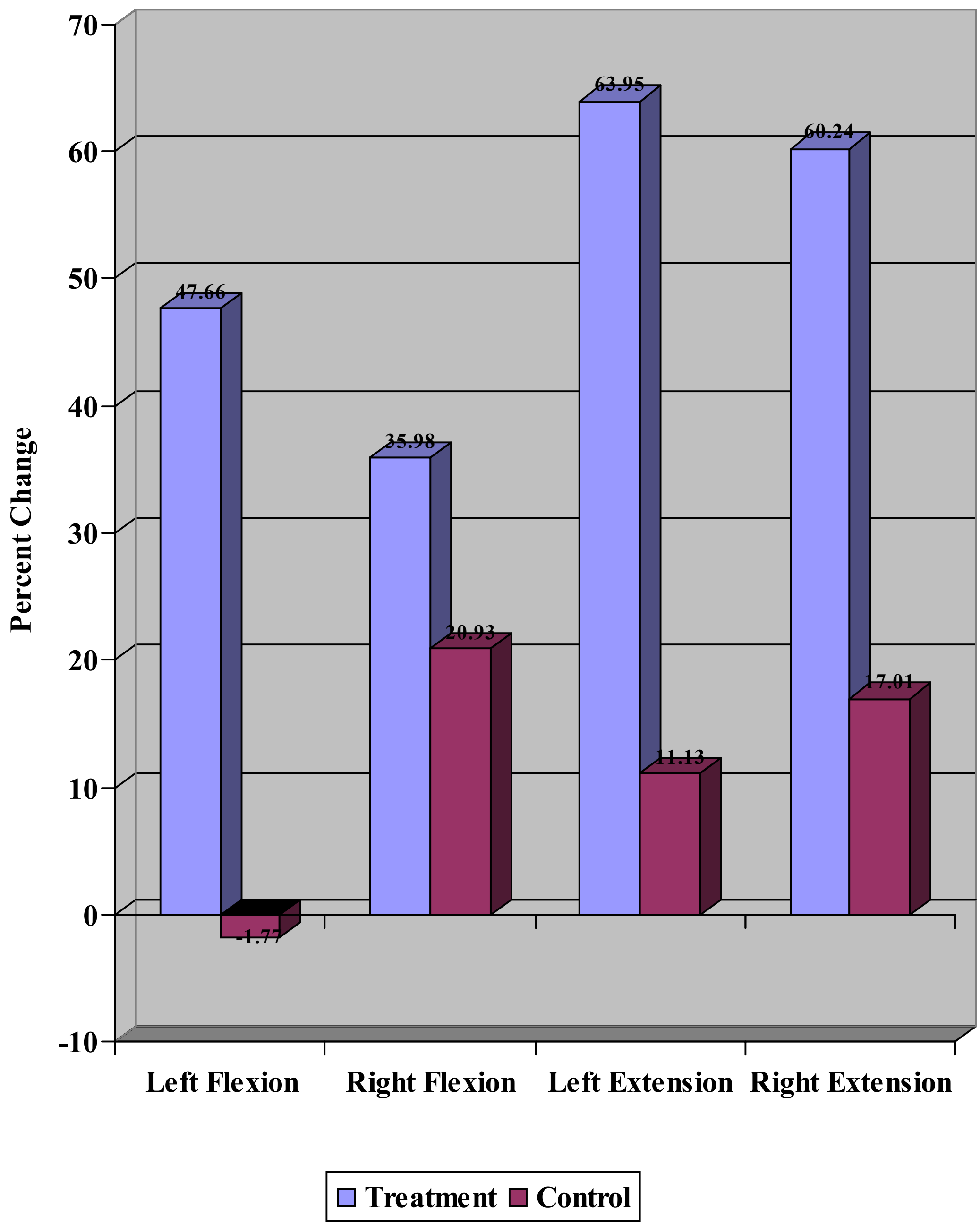


**Figure 5.4 Percent Change from Pre Test to Post Test in Isometric Knee Strength**

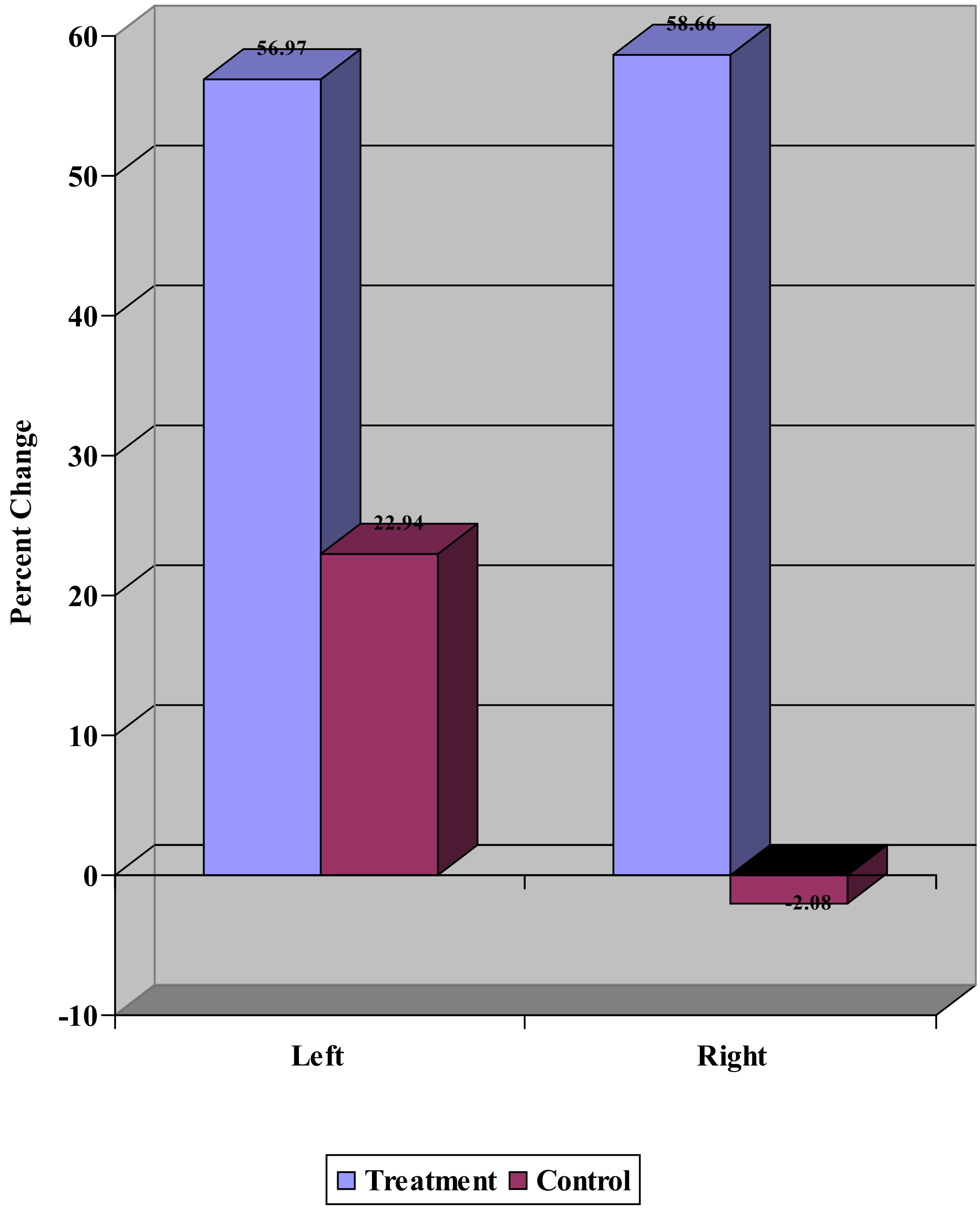


**Figure 5.5 Percent Change from Pre Test to Post Test for Isometric Shoulder Abduction Strength**

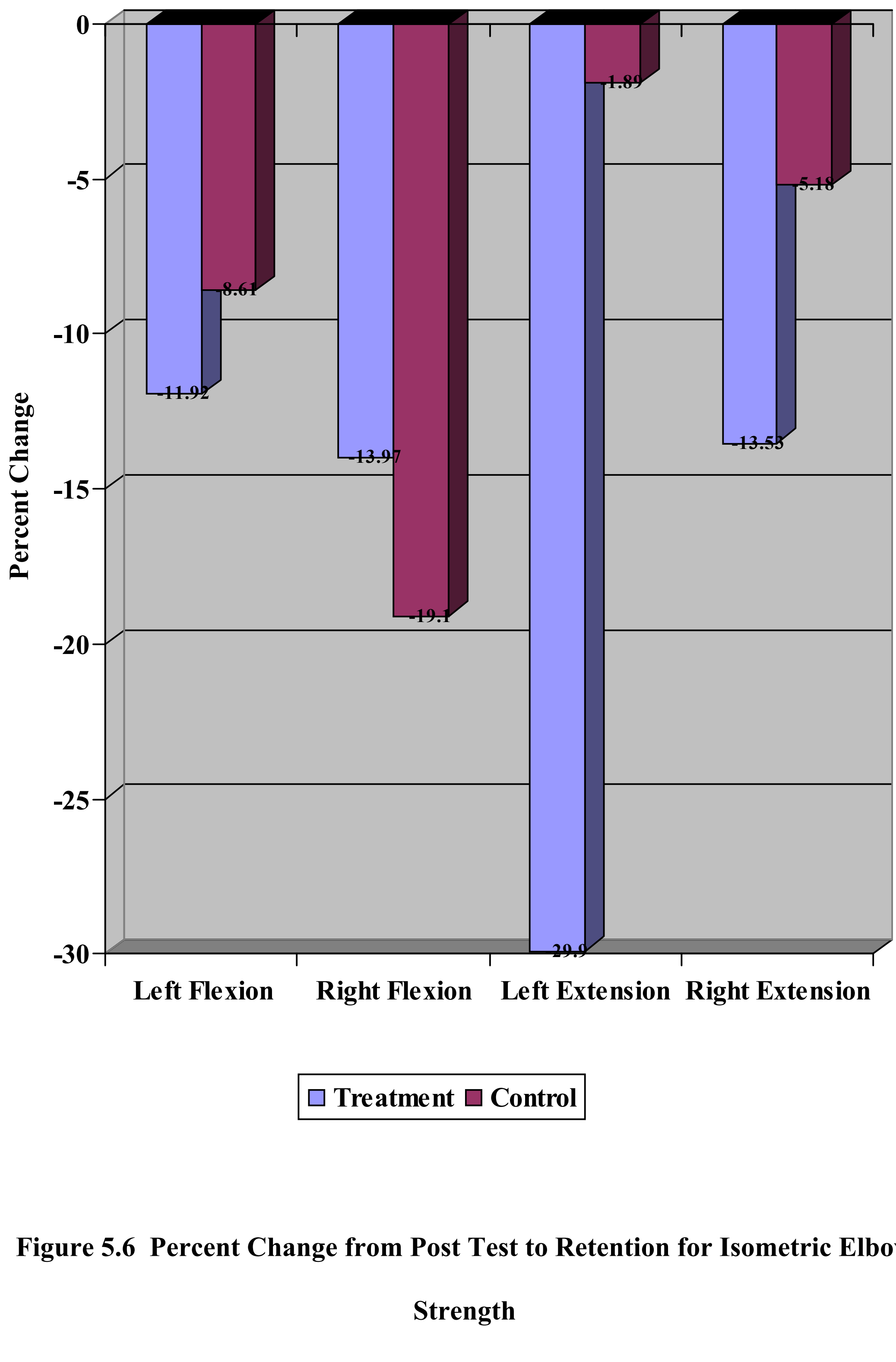


**Figure 5.6 Percent Change from Post Test to Retention for Isometric Elbow Strength**

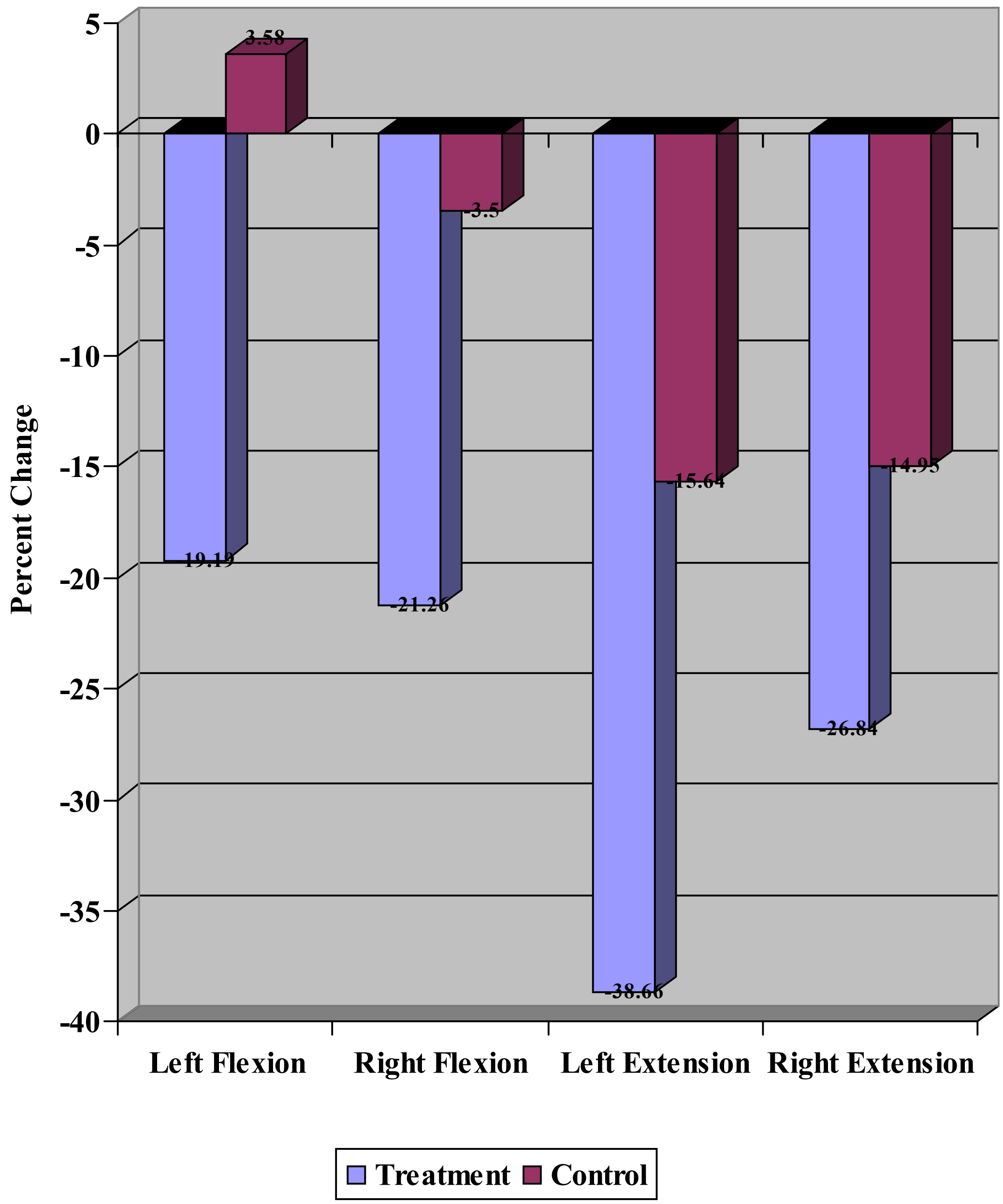


**Figure 5.7 Percent Change from Post Test to Retention for Isometric Knee Strength**

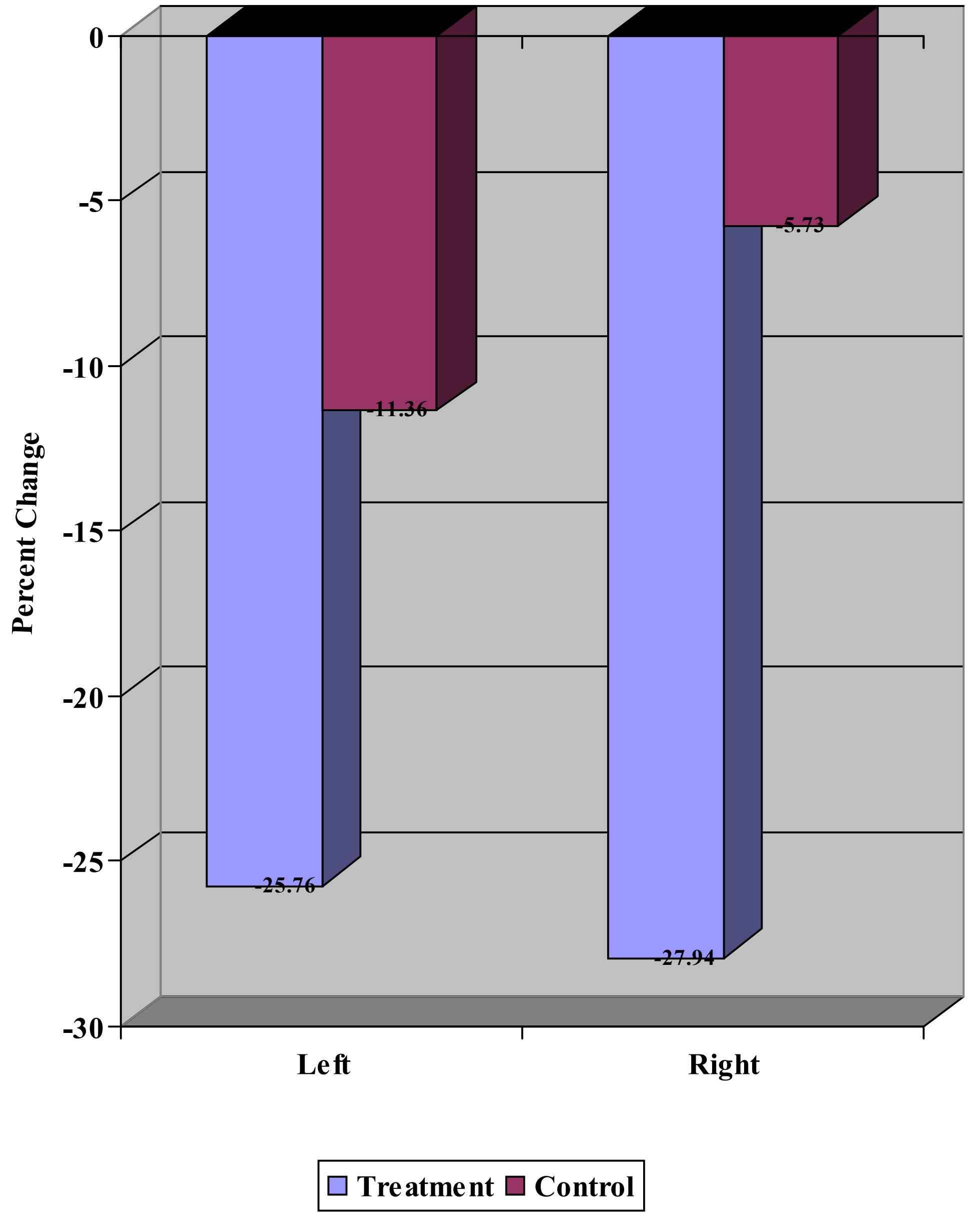


**Figure 5.8 Percent Change from Post Test to Retention for Isometric Shoulder Abduction Strength**

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# APPENDIX A

# LEGISLATION FOR INDIVIDUALS WITH DISABILITIES IN EDUCATION AND THE WORK FORCE

Legislation has reflected the growing concern for employment opportunities, training, and funding for individuals with disabilities. It is not a new concept to have government step in and protect the rights and freedoms of individuals with disabilities. This practice dates back to 1918 when the Smith-Sears Act was enacted which established funds for retraining programs for returning disabled serviceman. Much of the early legislation for individuals with disabilities was based on veterans returning from service.

Legislation directly related to individuals with disabilities in employment started in the late 50s, early 60s with the passing of the Vocational Education Act of 1963 (PL 88-210). Which coincides with the establishment of sheltered workshops. At this time in American history there was a marked increase in youth unemployment and a critical shortage of technicians, skilled workers, and a constant need to retrain workers due to automation. Under this Act funding was spent to provide vocational education for persons who have academic, socioeconomic, or other handicap that prevent them from succeeding in the regular vocational education program. Ten percent of the funds were to be spent on research and development of programs to better serve the needs of individuals with a disability (Sarkees-Wircenski & Scott, 1995).

There became a need to consolidate vocational legislation to eliminate duplication of effort and improve administrative efficiency. Thus came the Vocational Education Amendments of 1968 (PL 90-576). The purpose of this legislation was to provide access for all citizens to appropriate training and retraining. This legislation broadened the definition of vocational education and included funding specifically for individuals with mental retardation, deaf or otherwise handicapped (Sarkees-Wircenski & Scott, 1995). A 21-member National Advisory Council was established which would prove to be very influential in subsequent federal legislation. State and local advisory councils were created to be involved in state and local plan development. Funding was provided for vocational education leadership and professional development and support work study programs for needy vocational students.

The Rehabilitation Act of 1973 (PL 93-112), Sections 503 and Section 504 affirmed the rights of individuals with a disability in the workplace. Section 503 required employers with federal contracts to initiate affirmative action to hire individuals with a disability. Employers were expected to make reasonable accommodations for these individuals to maintain employment. Section 504 prohibited discrimination of individuals on the basis of their disability. Employers were expected to provide benefits, aids, services, and opportunities equal to those provided to non disabled employees.

The Education Amendments of 1974 (PL 93-380) encouraged the development of Individualized Education Plan (IEP) for each child which was classified as special needs. Parents and guardians, and teachers were encouraged to participate in the development of IEPs. This legislation introduced the concept of career education. Career education was not a program but rather a continuum that was to begin with early childhood and extend into old age. Career education was considered a process.

Up until this point no legislation dealt with ensuring the availability of educational opportunities for individuals with disabilities. The Education for All Handicapped Children Act of 1975 (PL 94-142) marked a national effort to provide free and appropriate education for all children with a disability between the ages of 3-21. This legislation gave assurances for due process, IEP to be developed and maintained, placement in the least restrictive environment where ever possible which marked the beginning of the mainstreaming movement, bias free testing and evaluations, and protection of the confidentiality of students records. The definition of handicapped was expanded to include mentally retarded, hard of hearing, deaf, speech impaired, visually impaired, seriously emotionally disturbed, orthopedically impaired, and other health impaired or learning disabled. This was the first legislation to include physical education for individuals with disabilities.

The Job Training Partnership Act of 1982 (PL 97-300) was passed in an effort to assist vocational education and the private sector to collaborate in providing training and placement in employment situations. The purpose was to increase the role of private business and industry in the training and employment of unskilled adults and disadvantaged youths. Seventy percent of the funds were to be spent on training. Services such as job search assistance, job counseling, remedial education and basic skills training, on the job training, and follow up services were to be provided to disadvantaged youth.

Funds were provided through the Education Handicapped Act Amendments of 1983 (PL 98-199) to support the development of cooperative models planning and development for individuals with disabilities. This Act also provided transitional services for individuals with disabilities as they move from secondary to postsecondary education, employment, or adult services. Funding for transitioning from school to work was also provided for in the Rehabilitation Act Amendments of 1984 (PL 98-221) for youth with disabilities. Funding for supported employment opportunities were provided in the Rehabilitation Act Amendments of 1986 (PL 99-506).

The Carl D. Perkins Vocational Education Act of 1984 (PL 98-524) was initiated to improve the skills of the labor force and prepare individuals for employment opportunities.

Title II, Part A, Section 204 of this Act provided assurances for individuals with disabilities regarding education and employment. This Act ensured that individuals with disabilities would be provided with equal access to recruitment, enrollment and placement activities. Individuals with a disability would receive equal access to a full range of vocational programs, including cooperative education and apprenticeship programs. The IEP would include vocational education and educational programs would be provided in the least restrictive environment where appropriate. Parents would receive information concerning vocational education programs no later than the beginning of the student's grade nine year. Provisions were provided for individuals enrolled in vocational education programs to receive special services including adaptation of curriculum, instruction, equipment, and facilities to meet the desired needs of the individual. Services to provide guidance, counseling, and career development were to be provided to facilitate the transition from school to post school employment and career opportunities (Sarkees-Wircenski & Scott, 1995).

The Americans with Disabilities Act (ADA) of 1990 (PL 101-336) attempted to eliminate discrimination of individuals with disabilities in areas such as employment, public accommodation, transportation, state and local government services and telecommunications. Public or private schools were required to make any program, service or activity accessible to and usable by students with disabilities. The legislation attempted to level the playing field in posting job notices, setting job qualifications, interviewing, testing of applicants, reasonable accommodations and training. This Act addressed the physical working environment and required employers to provide physical accessible buildings.

The most important piece of legislation passed for educating children with disabilities was the Individuals with Disabilities Education Act (IDEA) (PL 101-476). This legislation expanded on the 11 categories covered by special programs to include autism and traumatic brain injury. Expanded IEP and established ITP (Individual Transition Plans) as part of the IEP by the age of 16 for all students in special education programs. Workplace and training sites were included in the definition of special education instructional settings. The ITP was further expanded upon in the Individuals with Disabilities Education Act Amendments of 1997 which lowered the age of initiation to 14 from 16 years of age. The term transition services were defined as a means of coordinating a set of activities for a student with a disability that is designed wining an outcome oriented process, which promotes movement from school to post school activities including post secondary education, employment, and adult services (Sarkees-Wircenski & Scott, 1995).

The School to Work Opportunities Act (STWOA) of 1994 (PL 103-239) attempted to address the national skill shortage in America. Funds were provided to programs that prepared students with knowledge, skills, abilities, and information about occupation and the labor market to assist with the transition from school to post school employment. Three areas of learning were involved including: school based activities (career counseling, integration of academic and vocational education), work based activities (work experience, job training, mentoring), and connecting activities (matching students with employers, liaisons between education and work).

# APPENDIX B

## TRAINING PROGRAMS

Resistance Strength Training Program

Balance Program

Low Intensity Recreational Activity Program

## Strength Training Program

The following is an outline of the three day workout plan:

**Day 1** (All exercises completed with dyna bands)

Bench Press

Heel Raises

Push Ups

Squats

Shoulder Press

**Day 2**

Bicep Curls

Tricep Extension

Sit Ups

Lunges

Flies

**Day 3** (Exercises performed at Ramsey Center using weight room equipment)

Leg Curls

Leg Extension

Chest Press

Overhead Press

Lat Pull Down

Upright Row

Squat Press

**Balance Program**

Two balance stations were performed at each work out session. Students progressed at their own pace from #1 - #7.

Sample balance stations

1. Balance on one leg for 10 seconds. Repeat on other leg
2. Balance on one knee and one hand, hold for 10 seconds. Balance on the other knee and hand.
3. Repeat tasks with eyes closed
4. Walk forward and then backward along a line
5. Walk sideways along a line
6. Perform activities #4, #5 with hands on hips, with eyes closed, walk heel to toe, carrying an object
7. Explore balance through the use of balance boards, incline board

## Low Intensity Recreational Activities

Activities participated in by control group

These activities were modified and began with appropriate lead up activities

Frisbee

Volleyball

Basketball

Bocce

Flag Football

Walking tour of campus

Softball

Floor hockey

Indoor soccer

Pickle ball

# APPENDIX C

## CONSENT FORMS

Parental Consent Form

Student Consent Form

Parental Consent Form

I agree to allow my child __________________ to take part in a research study titled "The Effects of Muscular Strength and Balance on Work Performance Measures of High School Students with Mental Retardation", which is being conducted by Karen Smail, University of Georgia, Department of Physical Education and Sport Studies, 706-542-5947, under the direction of Dr. Michael Horvat, Department of Physical Education and Sport Studies, University of Georgia, 706-542-4455. I do not have to allow my child to take part in this study; my child and I can stop taking part at any time without giving any reason, and without penalty. I can ask that any information related to my child be returned to me, removed from the research records, or destroyed. My child's participation or non participation in this research will have no bearing on his/her class standing.

The following points have been explained to me:

1. The reason for this study is to determine if a physical education fitness and balance program can change work performance skills. My child may benefit by increasing his/her physical fitness, balance and work related skills. In addition, the information gained may provide information for future program planning.
2. If my child participates in this study he/she will participate in an exercise program which involves light weight lifting using exercise tubing, balance activities, work related skills (such as lifting boxes, lunch trays, and chairs), stretching, and aerobic activity. He/She will also have his/her height, weight, muscular strength, balance, and work performance assessed before and after the program. Each exercise session will last approximately sixty minutes and will take place at my child's school during the school day. This study will last 10 weeks.
3. The discomforts or stresses that may be faced during this study are muscle soreness and fatigue. Muscle soreness may result from the use of muscles that have not been previously exercised, and fatigue may result from participant in the program. The program will be structured so that exercise is started slowly and progresses in intensity to minimize both muscle soreness and fatigue.
4. All exercise sessions will be closely monitored by the researcher, the classroom teacher, and the class para professional to reduce the risk of an accident. In addition my child will be given instruction in proper techniques of each exercise by the researcher.
5. The results of this study will be confidential, and will not be released in any identifiable form without consent, unless otherwise required by law. Written information produced from this study will use fictional names for the participants. All data collected will also be coded with fictional names.
6. The researcher will answer any further questions about the research now or during the course of the project, and can be reached by telephone at: 706-542-9841.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to let my child participate in this study. I have been given a copy of this form.

______________________________ ______________________________

Signature of Researcher Date Signature of parent/guardian Date

Please sign both copies. Keep one and return the other to school with your child.

For questions or problems about your rights call or write: Chris A. Joseph, Ph.D., Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-6514; E-Mail Address IRB@uga.edu

Student Consent Form

I, ___________________________, agree to take part in a research study that will be conducted during my class by Karen Smail. This is something that I do not have to do. If I start and decide I do not want to continue I may stop at any time without any penalty. None of my scores will be shared with any one else but Ms. Karen Smail, and will be destroyed if I ask.

The following things have been explained to me:

1. The reason for this study is to see if a strength/balance training program will change work performance skills. During this study, I may increase my physical fitness and work related skills.
2. If I decide to do this study I will be asked to lift weight, stretch, use stationary bikes for aerobic activity, and perform work related tasks. Each exercise session will take place during my regular school time with my regular teacher.
3. My muscles may become sore from exercise. This is normal and will not be permanent. I may also become tired.
4. My teachers will be in each exercise session to help and show me how to do all exercises.
5. None of my scores will be seen by anybody other than my teachers
6. I may ask questions at any time.

I understand the things explained above. My questions have been answered, and I agree to participate in this study. I have been given a copy of this form.

_____________________________      _____________________________

Signature of Researcher Date      Signature of Student Date

Please sign both copies. Keep one and return the other to your teacher.

For questions or problems about your rights please call or write: Chris A. Joseph, Ph.D., Human Participants Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia, 30602-7411; Telephone (706) 542-6514 E-Mail Address IRB@uga.edu.

# APPENDIX D

## DATA COLLECTION FORMS

Box Stacking

Pail Carry

Dolly Cart Push

Sack Carry

Manual Muscle Testing

**Work Performance Data Sheet**

Pre Assessment

Mid Assessment

Post Assessment

Retention

(circle the appropriate assessment)

Remind students:

* keep back straight
* lift box don't drag
* use legs to lift box

## Box Stacking

(1 minute assessment)

| **Weight** | **Name of Student** | **Total number of Boxes Stacking** |
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**Work Performance Data Sheet**

Pre Assessment

Mid Assessment

Post Assessment

Retention

(circle the appropriate assessment)

## Pail Carry

(30 second assessment)

| Age | Name of Student | Total distance covered in inches |
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**Work Performance Data Sheet**

Pre Assessment

Mid Assessment

Post Assessment

Retention

(circle the appropriate assessment)

# Dolly Cart Push

(30 second assessment)

| Height | Name of Student | Total distance covered in inches |
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**Work Performance Data Sheet**

Pre Assessment

Mid Assessment

Post Assessment

Retention

(circle the appropriate assessment)

## Sack Carry

| Name of Student | Time up the Stairs | Total Time | Stumbles/Falls |
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**Manual Muscle Testing Data Sheet**

Pre Assessment

Mid Assessment

Post Assessment

Retention
(circle appropriate assessment)

Name of Subject: ____________________________

| **Right** | | | | | | **Left** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Muscle Group** | **Trial 1** | **2** | **3** | **Mean** | | **Trial 1** | **2** | **3** | **Mean** |
| Elbow Flexion | | | | | | | | | |
| Elbow Extension | | | | | | | | | |
| Knee Flexion | | | | | | | | | |
| Knee Extension | | | | | | | | | |
| Shoulder Abduction | | | | | | | | | |