

2006

Biochemical / Functional / Health Related Benefits of Elderly Resistance Exercise Review of Literature and Exercise Information

Bruce Carney
Fort Hays State University

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**Culminating Experience
Fall Semester 2006
Fort Hays State University**

**“Biochemical / Functional / Health Related Benefits of Elderly Resistance
Exercise Review of Literature and Exercise Information”**

**November 19, 2006
MLS – Health & Human Performance
Bruce E. Carney**

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Introduction:

At a time in history when life expectancy is increasing, there are concerns about the quality of life when we are living longer. Independent functioning for seniors is becoming increasingly important. Exercise for seniors is perhaps the next big revolution for the exercise business. As baby boomers wish to stay “with it”, exercise, particularly, resistance training may be the ticket. There are concerns of health care cost increasing as years are added to one's life. As science helps to increase one's life years, science should help aid in improving the quality of life for those years.

Problem Background:

Many questions arise as to what works for seniors to live their years as independently as possible with out pain. A few of those questions are - What can seniors handle as far as exercise, particularly resistance training? Are certain exercises worth the time as to benefit the quality of life? Does resistance training have benefits for seniors?

Theoretical Considerations:

The theoretical considerations to be concerned with are especially important when it comes to exercise for seniors. A fragile body cannot take the same vigorous exercise as earlier years in one's life. This paper will look at research that has taken place, in which, provides the reader with useful information. Primary these studies look at physiological changes of certain forms of exercise that benefit senior's health.

Statement of Purpose and Objectives:

The purpose of this culminating experience is as follows:

1. To develop an effective sample training plan for all seniors to improve independent functioning.
2. To provide the reader with information about benefits and physiological changes of resistance training exercise.
3. To provide the reader with information to promote the importance of resistance training for seniors.
4. To provide the readers with a measurement plan as to recognize changes from a baseline point to determine areas of need.

The objectives of this culminating experience are as follows:

1. To enhance the reader and the author's knowledge in the area of senior fitness as it pertains to:
 - a. The benefits of various forms of exercise and particularly resistance training.

- b. Using testing materials as a way to enhance progression, measure functionality and effectiveness of a particular program.
 - c. Review of literature currently guiding today's benefits in resistance exercise for seniors.
2. To determine what may be considered for seniors to improve their quality of life.

Summary: It is my hope that this multifaceted literature can generate some of the items to be considered for the exercising senior. Hopefully I have treaded upon some information that informs the reader of who, what, why and how of this particular topic. I have tried to create information needed to promote, obtain, enhance, and decipher for the reader. This project could be used to possibly improve a trainer's knowledge as well as give information to the exercising senior.

REVIEW OF LITERATURE

Introductory Statement

I. The Elderly and Physiological Changes

Muscle strength decline averages 15% to 20 % per decade after the age of 50 and this can be devastating to seniors in the performance of daily activities (American College of Sports Medicine, 1998; Sheppard, 1997, as cited in Rikki R. E., & Jones C. J., 2001). *Aerobic capacity* levels also decline approximately at the rate of 5% to 15% per decade after the age of 30, this loss can result to the extent of 50% loss in aerobic capacity by the age of 70 (Hangberg, 1994; Jackson et al., 1995; Jackson et al. 1996, as cited in Rikki, & Jones 2001). For healthy sedentary individuals over the age of 65, the lack of range of motion (*flexibility*) exercise can cause a significant disability as high as 30 % (Chakravarty & Webley, 1993). Magee (1992, as cited in Rikki & Jones, 2001) reported findings in *flexibility* that reduced range of motion can increase pain and can cause postural instability. Studies indicate that the rate of decline of *agility and dynamic balance* decline in aging is similar to other variables (Rikli & Jones, 1999b). Beginning around at the age of 30, adults usually begin to gain *weight* at the rate of one pound per year at the age of 60 for women and the age of 50 for men. At these ages, weight stabilization occurs and then a decline in weight occurs thereafter. *Body Mass Index* (BMI, a weight/ height measurement) which correlates more with body weight than body height, has been used for years to generalize healthy weight management. (Sheppard, 1997, as cited in Rikki & Jones, 2001).

How does resistance training fit into curbing the year's that seniors spend living with chronic disabilities? Many studies indicate positive finding in resistance training for

seniors. First, we will examine the connection between resistance training and the effects on functional and health-related improvements by identifying and reporting on physiological changes such as bone density, frail elderly and the key physiological parameters, such as muscular strength, aerobic / cardio endurance, flexibility, agility/dynamic balance and body mass index. Next, we review specific findings and report the much unknown biochemical / hormonal / metabolic changes and benefits from resistance training on seniors. Finally, it is the attempt of this review to answer the question; do specific biochemical benefits correlate with the key physiological parameters and other physiological findings of resistance training to seniors?

II. Direct Functional and Health Related Effects

Resistance Training and the Frail Elderly

Is resistance possible for the frail elderly? Yes, many studies indicate it is possible. Three studies indicate the positive effects of resistance training for the elderly. Studies indicate this in a Pennsylvania State University, USDA Human Nutrition Research Center on Aging at Tufts University, and a Yale study. In the Pennsylvania State University study, 100 frail nursing home residents were randomly assigned a control group and a training group. The trained patients experienced significant gains in strength, functional status and spontaneous activity levels ([American Federation for Aging Research, 2004](#)). A Tufts University/USDA Human Research Center finding studied ten, 90 plus year old frail nursing home residents in an eight week, high intensity resistance training program. In the study, nine of the ten finished, and averaged a gain

in strength of 174%. Thigh muscles increased by 9% and walking speed increased 48% (Ouellette, LeBrasseur, Bean, Phillips, Stein & Frontera, 2004). The Resistance Training and the Frail Elderly study at Yale consisted of 188, 75+ year old frail elderly, most with disabilities. This study was a six-month program with trainers and with one month after on their own. One group received physical therapy at home and the control group received no therapy but received health related educational materials. Results concluded that the physical therapy group disability rating score was 45% lower than average scores of the control group. The controls groups health also declined during this study. The study did proclaim that the moderate fragility, benefited, but the severely impaired did not (Gill, Gottschalk, Peduzzi, Allore & Byers, 2002).

Resistance Training and BMI

Most of the public would say that aerobics would be key to long term weight loss. Studies show that the absence of resistance training with too much cardio can be devastating to long term fat-loss (King, 2000). Many reports or articles report that weight training is the only scientific way lose weight and increase lean muscle tissue. King (2000) also reports that fat, or as many call dead weight, only burns five calories per day per pound of fat. On the other hand active muscle burns about 20 calories per day.

Resistance Training and Aerobic / Cardio Effects

The aerobic / cardio benefits from resistance training for the elderly population have been well studied and peer reviewed. A study at Tufts reported 16 women with heart failure were testing for benefits of resistance training. These results netted an increase of 50 meters for a six-minute walk. This study showed increased exercise capacity and improved skeletal muscle, however, heart function was unchanged ([Pu, Johnson, Forman, Hausdorff, Roubenoff, & Foldvari, 2001](#)).

Fifty-seven male participants recovering from heart attacks underwent aerobic exercise, and all had low, medium or high resistance training applied in a Cardio Rehabilitation study. Of the 57 participants, 30 of the 57 men had heart complications during aerobic exercising, (abnormal rhythms, chest pain, blood pressure rises or drops). Only one had problems during resistance training. This demonstrated that resistance training was also safer as well as beneficial ([American Federation for Aging Research, 2004](#)). A study reported in Archives of Internal Medicine that resistance training does have aerobic benefits. Results demonstrated an increase of oxygen consumption by 20% ([Vincent, Braith, Feldman, Kallas, & Lowenthal, 2002](#)).

Resistance Training and Muscular Strength & Dynamic Balance /Agility

Sarcopenia can be defined as the age-related loss of muscle mass, strength and function. Exercises designed to improve muscle strength should be recommended as a counter measure to sarcopenia of old age ([Waters, Baumgartner & Garry, 2000](#);

[Vandervoort & Symons, 2001](#)). The Canadian Cardiac Rehabilitation study of 57 male participants recovering from heart attacks increased maximum strength increased in the low intensity group by 10%, maximum strength increased by 12% in the medium group and by 14% in the high intensity group. Another study at Boston University, which involved 42 stroke survivors, over the age of 50, concluded the fact of improved extremity strength and reduced functional limitation. This study included a 12-week, high intensity, progressive training program for the lower body ([Fiatarone, Marks, Ryan, Meredith, Lipsitz, & Evans, 1990](#)). A Tufts University of 39 menopausal women who participated in a resistance training program also recorded improved balance due to muscle strength of the lower body ([Nelson, Fiatarone, Morganti, Trice, Greenberg, & Evans, 1994](#)).

Resistance Training and Bone Density

Two studies indicated positive effects to bone density for the elderly from resistance training. First, the same Tufts University study in the last section, which included 39 postmenopausal women, one half participated and the other did not. The results recorded increased bone mineral density of the hip and spine among the trained women ([Nelson, et. al., 1994](#)). The second study, an Australian study, reported findings of increases in mineral density, and the strength group had a greater increase at the vulnerable hip joint. This study divided postmenopausal women into three groups – one group engaged in strength training, one in fitness and the other with no exercise. All of the groups were given calcium supplements ([Kerr, Deborah; Ackland, Timothy; Maslen,](#)

[Barbara; Morton, Alan; Price, & Richard, 2001](#)). The third study consisted of 62 men and women at an average age of 68.4 years +/- 6 years, which was conducted at the Center of Exercise for Science at the University of Florida at Gainesville. The subjects participated for 6 months in either a low or high intensity resistance-training program. For both groups the maximum reps increased and the total strength for both groups increased by 17%. The findings of bone density of the femoral neck significantly ($P < 0.05$) increased by 1.96% for the high intensity group ([Vincent et. al., 2002](#)).

III. Biochemical, Hormonal. & Metabolism Effects

Resistance Training and Biochemical, Hormonal & Metabolism Effects

[Boston University \(1995\)](#) completed a study regarding the effects of resistance training for the elderly and protein metabolism. The net results simply concluded that resistance training increased resting energy expenditure and increased requirements for dietary protein.

One of the most compelling studies from Claude B. Pepper Older Americans Independence Center of resistance training and the frail elderly centers around the understanding of the biochemical reasons that resistance training might reverse atrophy in frail older adults. Tumor necrosis factor-alpha (TNF-alpha) which circulates our body is thought to cause muscle atrophy. Normally TNF- alpha is present in higher levels of the frail elderly than in younger controls. The findings of this study found that frail elderly

assigned to resistance training revealed that their levels of TNF-alpha dropped and new muscle protein rose ([Greiwe, Chen, Rubin, Yarasheski, & Semenkovich, 2001](#)).

Studies have shown the Toll-like receptor 4 (TLR4) to stimulate the inflammatory cytokine production. A Boston University and Sargent College of Allied Health Professionals study included 20 elderly postmenopausal women, of whom 10 were trained (chronic) and 10 untrained (acute). The untrained group did exercise 3 sets, 9 exercises, 10 reps at 80% of maximum and the trained group consisted of having had prior resistance exercise training (2x / wk for previous 24 months). Results of this study indicate that there was less surface level TLR4 with the untrained group but cytokine levels were not significantly changed. It is the conclusion of this study that the anti-inflammatory effect may take more training time ([McFarlin, Flynn, & Campbell, 2004](#)).

The Third National Health and Nutrition Examination Survey ([NHANES III as cited in Rikki & Jones, 2001](#)) stated that of the U. S. population 65 years of age and older, more than 18% have diabetes. How effective is resistance training to improving glycemic control in older adults with type 2 diabetes? Another study completed resulted with very positive findings. Sixteen weeks of progressive resistance training three times a week resulted in reduced plasma glycosylated hemoglobin levels and increased muscle glycogen stores. The participants of this study reduced the dose of medication in 72% of the exercisers compared to control group, and they also reduced their blood pressure ([Castaneda, Layne, Munoz-Orians, Gordon, Walsmith, Foldvari, Roubenoff, Tucker, & Nelson, 2002](#)).

IV. Closing Statement

There are many reasons for fitness to be of such importance in our life as well as more importance of our later years in life. In the United States the cost of health care associated with technology-induced inactivity is now approaching 1 trillion dollars per year. (Booth, Gordon, Carlson, & Hamilton, 2000 as cited in Rikki & Jones, 2001). Cost of services is certainly a concern for everyone over more years of life, considering our life expectancy has risen as technology and medical advances have improved. Americans are living longer over the age of 70 in a review of Healthy 2000 and functions such as bathing and dressing become much more difficult to perform (U.S. Department of Health and Human Services, 1999 as cited in Rikki & Jones, 2001). In a 1996 surgeon general's report on physical activity and health, it pointed out the relationship between sedentary lifestyles and the onset of higher chronic conditions that lead to frailty and disability in later years of life (U.S. Department of Health and Human Services, 1996, as cited in Rikki & Jones, 2001). Americans now spend an average of 11.7 years with chronic disabilities, which limits many activities of daily living (U.S. Department of Health and Human Services, 1990 as cited in Rikki & Jones, 2001). As the trend for life expectancy is to increase, the greater the possibilities of living longer with chronic disabilities may continue. The question here is, can we reduce the average number of years living with chronic disabilities or will that continue to rise as well? There is no question that age-less physical activity for seniors may be the magic pill. The literature reviewed concludes that research shows that the increase in resistance

exercise is possible at any age to help regain lost strength, and *muscle mass*, leading to improved functional mobility (Evans, 1965; Fiatarone et al., 1990; Fiatarone et al., 1994; McCartney et al., 1996 as cited in Rikki & Jones, 2001). Studies also made the finding that half of the *aerobic / cardio endurance* decline can be erased by physical activity. (Hangberg, 1994; Jackson et al., 1995; Jackson et al. 1996 as cited by Rikki & Jones, 2001). *Flexibility* of both upper and lower body can also be improved through regular physical activity (HUBLEY-KOZEY, WALL & HOGAN, 1995; MOREY et al. 1991; RIKLI & EDWARDS, 1991 as cited in Rikki & Jones, 2001). *BMI's* can be manipulated through regular physical activity. (Shephard, 1997 as cited in Rikki & Jones, 2001). *Agility and dynamic* can also be prevented by physical exercise. (Rikli & Jones, 1999b as cited in Rikki & Jones, 2001).

As new technology improves so can new research to report biochemical changes that result from various physical activities, such as resistance training for the elderly. Regular resistance training may offset the increase in inflammatory cytokines, which may reduce the risk of developing diseases (McFarlin, Flynn & Campbell, 2004). Results of resistant training produce positive findings regarding the battle against diabetes for older women (Castaneda, Layne, Munoz-Orians, Gordon, Walsmith, & Foldvari, et. al., 2004). Metabolism is increased for the need of dietary protein with lifting seniors. The Claude B. Pepper Older Americans Independence Center study found that atrophy might be reversed with resistance training, as part of the elderly lifestyle (Greiwe, Cheng, Rubin, Yarasheski, Semenkovich, 2001).

In conclusion, new research does indicate specific biochemical benefits to seniors do correlate with the key physiological parameters and other physiological findings

resulting from resistance training. New research, with improved technology, technology able to identify changes in biochemicals, hormones or metabolism resulting from resistance training takes findings to another level for answering new questions. The answers not only tell if, but possibly how and why, as well. Perhaps continued research in the specialized area of biochemical changes resulting from resistance training in the elderly can improve many statistics. Statistics such as, years living with out disabilities, lowered high health care costs, and more years of independent living. I think continued statistics in the area of the average number of year's seniors live with chronic disabilities will be well anticipated.

Research can inform the reader of new information in many ways, including hands on information. The hands on information of this paper can inform the reader to better prepare for the long haul of life, particularly resistance training for the elderly? The information located in the appendixes of this paper includes samples for accomplishing the tasks of an exercise program for the elderly. To accomplish a plan you have to inform the prospected client of the benefits via perhaps a streamlined presentation located in "Appendix E" separate of this paper. Once implemented the prospect should have a plan to include short, long term goals, obstacles, strategies and basic ideas of actives located in "Appendix C". It is a must to have a specific work out plan of daily activities located in "Appendix B". After completing the daily exercises the art of recording the baseline and progress of the activities is very helpful to maintain the program, located in "Appendix A". The information located in "Appendix D" includes samples of measuring the prospect to remain physically active and independent in those later years.

Appendix A

Activity Recordkeeping

Week of: 12/17/07

Name:

Record # of minutes per day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>Lifestyle activity: Indicate any moderately strenuous housework, yard work, recreation, Sports, etc. If low active, should add structured exercise (see below).</p>	Walk to mailbox twice daily (20 min.) Pulled weeds (60 min)	Walk to mailbox twice daily (20 min) Pulled weeds (60 min)	Walk to mailbox twice daily (20 min)	Walk to mailbox twice daily (20 min) Washed windows (60 min)	Walk to mailbox twice daily (20 min)	Walk to mailbox twice daily (20 min) Vacuumed house (30 min)	Walk to mailbox twice daily (20 min)
<p>Structured Exercise: Aerobic exercise – brisk walking, jogging, aerobic, exercise, cycling, treadmill, etc. (Need 20-30 min 3-5 times a week.)</p> <p>Strengthening exercise – can use elastic band/tubing, hand weights, weight machines, or calisthenics. (Work upper and lower muscles at least 2 times a week.)</p>	Curl vegetable cans 10x		Exercise class 25 min. Exercise class 20 min.		Exercise class 25 min. Exercise class 20 min.		ADD BRISK WALK (starting this week) 20 min.
<p>Daily totals: Are you getting 30-40 min of moderate exercise on most days?</p>	80 min.	80 min.	65 min.	80 min.	65 min.	50 min	40 min.
<p>Also important: Flexibility/stretching – should stretch all muscle/joint areas 2-3 times a week, preferably daily.</p> <p>Agility/balance activities – especially important for those experiencing loss of balance.</p>			Plenty of stretching at exercise class Plenty of agility/balance at exercise class		Plenty of stretching at exercise class Plenty of agility/balance exercise class		

Appendix B

Senior fitness workout plan – Day 1 block

Work out times and length: Tuesday and Thursday – 45-minute sessions

Warm-up: 10 minutes total

1. march in place to music, arms forward (**turning the doorknob**)- 16 times, arms to side 16 times, arms raised (**high to cupboard**) - 16 times
2. step right close with left, step left close with right 8 times, repeat 8, then 16 count
3. swing arms to right while stepping right – 8 times, swing arms to left while stepping left – 8 times , swings arms to left while stepping right – 8 times, swing arms to right while stepping left – 8 times (**agility/balance**)
4. rest by sitting and drink water

Lesson Focus:

Muscular strength (upper and lower body), aerobic endurance, flexibility (upper and lower body), agility/ dynamic balance, body mass

Game/Activity and Cool down:

1. Sitting in chair, arms to side hanging with weight 30 seconds
2. Sitting in chair, bring weights to thigh, raise 8 times, 2 counts to chest, 2 counts to thigh, rest, repeat 8x, rest, 16x, repeat 24x
3. Standing, arms forward with weights, tip weights (**like pouring coffee**) 8x,rest, 16x,rest, 24x, rest
4. Drink and should shrugs
5. Lower leg stretch – stand by chair, left leg back, right foot flat on floor, bend right knee slightly – repeat other side, 30 seconds each.
6. Sit in chair, extend right leg up with toes pointed to ceiling, then rotate ankle, and reverse rotation, repeat other leg, 30 seconds each.
7. Sit in chair, right hand on edge, left hand extend to right and turn body (**looking in the backseat of car**), repeat opposite side, 8x each.
8. Drink and rest
9. Stand with balls, hand dribble by, toss from left to right – right to left, 8x, 16x, 24x, about two minutes, (hand eye coordination)
10. Sit with elastic bands, place bands on ankles, move legs right to left, bring leg back to center, 8x, repeat 8x, then left to right and back to center, 8x, then repeat 8x.
11. Standing with bands, extend right arms alternatively upwards, then to side 16x each.
12. Standing raise both arms from side with palms up and lower in front of chest in prayer mode, 4 x, repeat 4x.
13. Standing, raise right leg and lower right, then other leg, 4x each, then repeat 4x
14. Standing walk a imaginary tightrope and then backup on tightrope.
15. Give yourself a hug! – Borg scale, record

Equipment: chairs against wall, weights – 2lb. increments up to 10lbs., elastic bands, 8 inch balls, & music

Safety factors: monitor at all times, use Borg scale at end of class, make sure chairs are firm against wall, proper spacing provided for seniors, speed never a factor.

Appendix C

Personal Goal/ Activity Plans

Step 1. Describe at least one *long-term goals (1 month, 1 year, long range)* you like to achieve that could result from increased exercise. Goals can be specific, such as improving SFT walking scores from 500 to 600 yards in 6 minutes, or losing 10 pounds before grand-daughters weeding next summer. Goals can be more general, such as increasing one’s participation in moderate physical activity to the recommended 30-40 minutes per day on most days.

Long-Term Goals or major exercise objectives: 1 -1 month, 2- 1 year, 3- long range

- 1. feeling better about myself, and increase endurance and flexibility.
- 2. lessening waistline, able to walk the mall longer,. generally move shoulder joints better
- 3. simply feel better with daily activities, less ache in “thighs and shoulders” during the day.

Step 2. Describe realistic *short-term goals*, expressed as two-week activity plan that will move you toward your goals. Be specific relative to your planned activities and proposed schedule.

Activity Plans

Days/Times

- 1. Keeping up with “the count” in march exercise – T, Th 9:00 –9:45
- 2. Coordinate step right arms left, always seem to not coordinate this – T, Th 9:00 –9:45
- 3. Increase flexibility on shoulder joints- take SFT test T, Th 9:00 –9:45
- 4. Do not drop balls during ball hand dribble exercise T, Th 9:00 – 9:45
- 5. Pull weeds without being sore the next day. M, W, F for 1 hour 2-3 per week
- 6. Increase walk longer than to the mailbox. 1 days a week in the morning – prefer Saturday

Step 3. Describe any potential obstacles that might keep you from following your plans and possible strategies for overcoming them.

Obstacle

Strategy for Overcoming (Rewards)

- 1. Heart murmur from rheumatic fever as a child. Increase endurance exercises slowly.
- 2. Sore shoulder joints. Flexibility exercise joint slowly. Do not bounce
- 3. Money for workout class. Continue to carry Preferred Care Health Insurance to pay for class.
- 4. Ride to classes. Get rides with a friend or arrange rides with sons and/or daughters if possible.
- 5. Winter months to slippery – no weeds to pull. Increase one day at exercise class or post list of calorie burners exercise indoors – have discipline.

Step 4. Formalize your commitment to the above plan by signing on the line below. Discuss your plans with a friend, family member, or your exercise leader. Ask him or her to sign off as a witness and be willing to discuss your progress at least once a week.

Your Signature _____ Date _____

Witness Signature _____ Date _____

Appendix D

1.

Scorecard: Senior Fitness Test

Date 12/27/07

Name ??????? M ___ F _x_ Age 78 Ht 59" Wt 122

Test Item	Trial 1	Trial 2	Comments
1. Chair Stand Test (# in 30 sec)	<u>18</u>	N/A	
2. Arm Curl (# in 30 sec)	<u>14</u>	N/A	
3. 6-Minute Walk (# of yd)	_____	N/A	
4. 2-Minute Step Test* (# of steps)	<u>49</u>	N/A	
5. Chair Sit-and-Reach (nearest 1/2 in.: + or -)	<u>0</u>	<u>+2</u>	Extended leg. R or L
6. Back Scratch (nearest 1/2 in.: + or -)	<u>-7</u>	<u>-6</u>	Hand over: R or L shoulder
7. 8-Ft Up-and-Go (nearest 1/10 sec)	<u>4.6</u>	<u>4.6</u>	

* Omit 2-minute step test if 6-minute walk test is given.

Participant's Test Scores

Test Session
1 highly fit elderly volunteer

Date
06/27/2006

Participant	Chair Stand	Arm Curl	6-Min Walk	2-Min Step	Chair Sit-and-Reach	Back Scratch	8-Ft Up-and-Go	Height Ft.	Height In.	Weight Lb.	Body Mass Index
Name	18	14	0	49	2	-6	4.6	4	11	122	24.6

2.

Conclusions of results: 90% 50% NA 9% 57% 14% 85% (percentiles)

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