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Effects of Pole Walking on Older Adults Following Six Weeks of Training

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EFFECTS OF POLE WALKING ON OLDER ADULTS FOLLOWING SIX WEEKS
OF TRAINING

by

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University of North Dakota, 2017

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A Scholarly Project

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine and Health Sciences

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for the degree of

Doctor of Physical Therapy

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2019

This Scholarly Project, submitted by Samantha Forsch and Raevyn Haugland in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.


(Graduate School Advisor)


(Chairperson, Physical Therapy)

PERMISSION

Title Effects of Pole Walking on Older Adults Following Six Weeks of Training

Department Physical Therapy

Degree Doctor of Physical Therapy

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Signatures Samantha Fisher
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Date 12/06/2018

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ABSTRACT

Introduction: Age-related changes in adults over 60 include reduced mobility and function as well as an increase in frailty. Conventional walking has been shown to be an effective physical activity to maintain mobility and improve function and overall health and fitness. Specifically, walking speed has been identified as a crucial predicting factor for fall risk and decreased functional mobility. For this reason, clinicians considered the element of walking speed as the sixth vital sign. Pole walking has gained popularity over the years and may provide additional benefits, when compared to conventional walking, such as improved stride and step length, faster gait velocity and cadence, increased strength, enhanced postural alignment, advanced dynamic balance, weight loss, and improved cardiovascular responses following exercise.

Purpose: The purpose of this study is to determine the effects of pole walking on overall physical functioning of community-ambulators 60 years of age and older.

Methods: Eleven healthy older adults participated and completed pre- and post-participation fitness screens and surveys. The fitness screen included implementation of the Senior Fitness Test (SFT) battery, gait analysis through use of the GAITRite, and posture images. Each individual was provided and fit with walking poles and received general instruction on walking technique. All subjects participated in the experimental group, completing 45-minute exercise sessions, consisting of warm-up, pole walking, and cool down, two times per week, for six weeks.

Results: Data analysis consisted of paired t-tests ($\alpha = 0.05$) to identify comparisons throughout SFT tests, posture, and gait parameters. Significant improvements were identified within the 30-second chair stand test, 2-minute step test, heart rate, posture, and weight, as well as gait parameters including: step length, gait velocity, cadence, and degree of toe-in/out.

Conclusion: Based on the evidence provided, it can be concluded that, in healthy older adults, pole walking can improve lower extremity strength, endurance, enhance posture, decrease weight, and improve multiple gait parameters. It may be hypothesized that other populations with pathologies, that inhibit the efficiency of gait, could reap the benefits that regular pole walking provides and experience substantial improvements regarding parameters as discussed within this study population. Pole walking is applicable and appropriate to a wide array of individuals and provides a motivating and optimistic mindset that encourages physical therapy patients to be an active participant in their care and improve their quality of life.

CHAPTER I

INTRODUCTION

As the population of older adults and the elderly steadily increases at a faster rate than any other population, the incidence of reduced mobility, function, and frailty also increases. Figueiredo et al,¹ states that in 2009, 11% of the world population was over the age of 60 and due to the decline in old-age mortality and low fertility rates, this population is expected to increase to 22% by the year 2050. Age-related changes that affect gait as early as 60 years of age include shorter step length, decline in gait velocity, reduced stride length, decreased trunk-pelvis coordination, and decreased range of motion (ROM) of the lower extremity joints, all of which impact stability in gait and result in increased body rigidity when walking.^{2,3,4}

Many health care professionals have concluded that it is critical to observe walking speed as a functional vital sign or “sixth vital sign,” especially when working with older community-dwelling adults and the geriatric populations. Walking speed is a valid, reliable, and sensitive measure that may be used to assess and monitor overall health and functional status throughout the population and can be performed to identify cognitive and physical dysfunction or decline across all ages.⁵ Gait variability is a well-documented predictor for future falls, hospitalizations, nursing home placements, mortality, poor quality of life, and movement dysfunction due to poor or declining health status, impaired neurological function, and decreased muscular facilitation.^{2,6,7,8}

Conventional, or normal unassisted, walking is the primary mode of physical activity performed by older adults and has been shown to improve body anthropometric measurements and total body fat composition; however, pole walking offers further benefit when employed with intent and correct techniques.^{9,10} Additional benefits include: increased heart rate and oxygen consumption without an increase in perceived exertion and fatigue; greater activation of core and upper extremity musculature (erector spinae, multifidus, external obliques, rectus abdominis, deltoid, latissimus dorsi, triceps brachii, biceps brachii) enhanced energy expenditure and aerobic effects; improved dynamic balance and stability; reduced load transmitted through the lower back, hip, and knees fostered promotion of optimal posture and aided in balance and stability.^{9,11-14}

According to the American College of Sports Medicine (ACSM), it is recommended that older adults (≥ 65 years) engage in both aerobic and resistance training activities regularly in order to maintain health, mobility, and safety.¹⁵ Pole walking has been shown to increase upper body strength, serving as a combination of aerobic and resistance training, and may also prevent joint damage attributed to intense activities in these particular categories.^{9,16} Elderly, obese, and sedentary individuals have lower physical activity levels within the general population and often have difficulty maintaining recommended levels.¹⁷ Therefore, pole walking has great potential to increase regular physical activity adherence and lead to improved health and fitness through its appropriateness to all fitness levels, convenience, and unique training parameters within a wide variety of environments.¹⁶⁻¹⁸

Pole walking, or Nordic Walking (NW), originated in Finland as a mode of exercise conditioning for cross country skiers and has gained popularity, relative to its

playfulness and accessibility, since its development in the 1980s-90s.² Since then, it has spread across into the Western nations. In the United States, pole walking has also been referred to as Exerstriding.¹⁹ It is defined as walking in a reciprocal gait pattern with the implementation of poles for the purpose of enhancing exercise. This technique utilizes more normalized gait patterns and higher arm position with continuous handshake-like grip.¹⁴ Additionally, Exerstriding is performed with the walking poles in front of the individual with a gentle and rhythmic push-off occurring near the toes with each step, as compared to traditional NW. Nordic walking, in contrast, requires employment of a forward lean posture during activity, powerful push-off through the walking poles near the heels of the feet with each step, and a loose hand grip that is typically assisted by a wrist strap to allow for an alternating grip and release motion of the hands on the poles combined with high velocity activity such as trekking or hiking.²⁰

When compared to regular brisk walking, without poles, pole walking increases oxygen uptake, positively affects heart rate, blood pressure, upper extremity activation, and caloric expenditure.^{19, 21} However, rate of perceived exertion and maximal oxygen consumption do not significantly increase. Pole walking has been hypothesized to reduce vertical knee joint forces and improve overall quality of life, especially in those diagnosed with osteoarthritis.²² Secondarily, the use of walking poles has been shown to be comparable to common assistive devices such canes and walkers.²³ Therefore, walking poles have shown positive psychological and social impacts on the individual as they adopt an enabled versus disabled mindset regarding their health condition or diagnosis.

Pole walking has gained popularity due to these proposed health benefits in all ages, however, research is limited. The purpose of this study is to determine the effects of pole walking on overall physical functioning of community-ambulators 60 years of age and older. Specific aspects being identified and observed in this study include gait, posture, balance, strength, and cardiovascular effects. It has been hypothesized that the use of walking poles can improve the efficiency of gait and balance, increase upper extremity and grip strength, impact cardiovascular responses to exercise, and aid in weight loss efforts. Effects on physical functioning will be studied following a six week pole walking program utilizing the Exerstrider technique to determine the appropriateness of pole walking as a safe and effective exercise modality for individuals whom are healthy community ambulators and at least 60 years of age.

CHAPTER II

METHODOLOGY

This research received University of North Dakota approval through the Institutional Review Board (IRB-201804-293) (Appendix A). Each participant was given a copy of and signed a consent form which included consent to video and/or obtain photos (Appendix B).

Participants

Eleven participants, three males and eight females, were recruited through word of mouth to complete the study. The participants ranged in age from 60-70 years ($m = 64.27$), average height was 66 inches. All participants met the criteria for participating in the walking pole study. Exclusion criteria restricted participation of individuals that were younger than 60 years of age, required use of an assistive device, non-community ambulators, any present health issues or injuries that inhibit participation in a walking pole training program.

Following the consent process, the participants completed a pre-participation survey and Senior Fitness Test (SFT) fitness screen. All participants then completed a six week pole walking program. At the conclusion of the study reassessments of all tests were performed and a post-participation survey was administered.

Intervention

Participants were encouraged to attend group exercise sessions, consisting of warm-up, pole walking, and cool-down, twice per week. If unable to do so, they were

instructed to complete 30 minutes of pole walking on their own, including the warm-up and cool-down exercises. Warm-up activities (Appendix C) performed included rhythmic knee bends, heel-toe rocking, mini-squats, marching in place, stepping jacks, arm lifts, twisting side stretches, shoulder press, chest press, arm circles, and head circles. Subjects walked with poles at a self-paced speed for 30 minutes, researchers recorded the distance for each session. After each walking session, heart rate and oxygen saturation were recorded with a pulse oximeter. A cool-down program (Appendix D) included forward bend, lunges, quadriceps and hamstring stretch, overhead reach, side-bending, and twisting side stretch, without the poles a cross body arm hold and overhead triceps stretch. Each stretch was held for a minimum of 30 seconds. All activities, pole walking or otherwise, were recorded in activity logs on a weekly basis.

Exerstrider[®] (Exerstrider, Madison, WI) walking poles with a “button lock” for stability were used for this study.²⁰ Each participant was fitted with walking poles as per Exerstrider manual using the following procedure: participants in normal standing posture, tips of the walking poles were placed evenly with the toes of the participant's shoes, elbows were bent at a 90-degree-angle, and the forearms parallel to the floor. After fitting, the participants were instructed in proper Exerstriding technique using a reciprocal gait pattern at a comfortable pace. Ten out of 11 participants used a boot-style tip (Figure 1), designed to provide cushion from the forces applied through the poles and to provide traction. One participant preferred the standard tip over the boot-style.

Instrumentation/Procedure

Participants completed pre- and post-intervention survey and a battery of tests that were designed for the older adult to assess functional fitness. The tests were



Figure 1. Walking Poles and Boot Tips

completed in the order as recommended by Rikli and Jones' SFT manual.²⁴ Additional tests included vitals, grip strength, gait, and posture.

Pre-Participation Survey

After each participant completed the consent form, they were given a pre-participation survey which consisted of demographic information such as age, gender, employment status, etc (Appendix E). Additional questions included current walking status, prior use of walking poles, report of health concerns or recent injuries that may inhibit walking with walking poles, participation of regular physical activity, and a physical activity measure.

Post-Participation Survey

Following completion of the study, a post-participation survey was collected. Information gathered included, general opinion of using walking poles, perceived improvements in balance and posture, likelihood of continuing use the walking poles, any new activities since the start of the study and a physical activity measure (Appendix F). Each section had space for participants to leave comments.

Senior Fitness Test

The SFT is commonly used to measure the functional ability of older adults who are living independently.²⁴ It includes seven assessments that include general upper and lower extremity strength, aerobic endurance, flexibility, and dynamic balance. The fitness test is administered in a specified order to minimize fatigue of the individual completing the test. The order is as follows: 30-second chair stand test, 30-second arm curl test, height and weight measurement, 2-minute step test, vitals measurement including HR and BP, chair sit-and-reach test, back scratch test, finishing with the 8-foot up-and-go test. The 2-minute step test can be substituted for the 6-minute walk test. Completing this measure also stresses the cardiovascular system which allows the assessment of endurance.

Each of the tests were explained and demonstrations were provided as needed to each participant. A pulse oximeter was used to record heart rate and oxygen saturation, and manual blood pressure was taken before, during, and after fitness screening.

In a study completed at the California State University at Fullerton, the SFT was compared to other fitness measures commonly used in the older adult and elderly population. As stated in this article, the test-retest reliability and validity indicators for individual items of the SFT had a range of .80 to .98.²⁵ The SFT includes normative fitness standards that allows the individuals completing it to be compared with others that match age and gender categories. Each measure of the SFT, test-retest reliability was reported in the instruction manual.

30-Second Chair Stand Test

The 30-second chair stand test measures lower body strength. It starts with the participant seated in a folding chair with a height of 17 inches that is placed against a wall.²⁴ Instructions include being seated in the middle of the chair with the feet flat on the floor, arms are to be crossed in front of the chest. On “Go,” the participant is to rise to a full stand then return to a fully seated position. Each participant was given the opportunity to practice one or two repetitions. The objective of the test is to complete as many full repetitions as possible in 30 seconds while staying within safety limits. The number of repetitions are recorded, and if the person was more than halfway to standing at the end of 30 seconds it was counted as a full stand. Table 1 describes the age related fitness standards, in repetitions, as reported in the SFT manual while Table 2 lists the CDC’s reported average scores, in repetitions, for the 30-second sit to stand.²⁶ When this test was applied by Rikli and Jones,²⁴ to community dwelling elderly, the 30-second chair stand test had excellent test-retest reliability ($r = .89$, 95% CI). The 30-second chair stand test in all participants $R = .89$ ($n = 76$, CI 95% = .79 - .93).^{24,27}

Table 1. SFT Fitness Standards for Older Adults, 30-second Sit to Stand Test (reps)²⁴

	60-64 (yrs)	65-69 (yrs)	70-74 (yrs)
Women	15	15	14
Men	17	16	15

Table 2. CDC STEADI Chair Stand Below Average Scores (reps) for Older Adults²⁶

	60-64 (yrs)	65-69 (yrs)	70-74 (yrs)
Women	<12	<11	<10
Men	<14	<12	<12

Rikli and Jones²⁴ found differences in gender, age, and varying levels of fitness. Those that had higher physical activity had slightly higher scores.

30-Second Arm Curl Test

The 30-second arm curl test measures upper body strength.²⁴ The participant starts seated in a folding chair with the height of 17 inches that is placed against a wall. Females complete the arm curls with a five pound dumbbell and males complete the test with an eight pound dumbbell. To start, the weight is held in a neutral with the elbow tucked to the side and bent at a 90-degree angle in a handshake position. The participant is then instructed to bend the elbow fully, with the palm facing the shoulder; then extending the elbow fully, with the palm facing the wall. A practice repetition is allowed to feel the movement and then is instructed to complete as many repetitions as possible in the 30 second time frame. Table 3 delineates the fitness standards for the arm curl test as defined in the SFT manual. Throughout the test the elbow is to stay close to the body, and the wrist stabilized. The item is scored with the total number of arm curls completed at the end of the time frame, if the arm is more than halfway through the movement during the test it counts as a curl. As reported in the SFT manual, test-retest reliability in all participants $r = .81$ ($n = 78$, $CI\ 95\% = .72 - .88$).

Table 3. SFT Fitness Standards for Older Adults, Arm Curl Test (in reps)²⁴

	60-64 (yrs)	65-69 (yrs)	70-74 (yrs)
Women	17	17	16
Men	19	18	17

Height and Weight

Height, in inches, was measured with the participant was barefoot on a stadiometer and instructed to stand normally. Weight was measured in pounds using a physician beam scale. Any extra articles of clothing were removed during the measurement of weight.

2-Minute Step Test

The 2-minute step test is used to evaluate aerobic endurance.²⁴ In this study, it was used in place of the 6-minute walk test. Heart rate and BP was measured before starting the test. On each participant, the step height was estimated using the halfway point between the iliac crest to the patella as per the SFT procedure. To give the participant a reference point to how high they were stepping, an adjustable table was used. When “go” was said, the participant marched in place for two minutes, they were encouraged to get as many steps as possible without running. The number of steps was recorded based on the right knee, if the knee was at or above the table height, the step was counted. If the knee did not reach table height, the step was not counted and the participant was given verbal feedback to lift the knees higher. Table 4 reports standards of the 2-minute step test (reps), as defined in SFT manual. Immediately after the completion of the 2-minute step test, heart rate, oxygen saturation, and blood pressure were measured. The same data was collected after two minutes of resting time. Based on the time span in which the heart rate recovered and the blood pressure that was recorded immediately after testing, it was measured at the end of testing in participants that had blood pressure that was of concern.

Table 4. SFT Functional Fitness Standards for Older Adults, 2-minute Step Test (reps)²⁴

	60-64	65-69	70-74
Women	97	93	89
Men	106	101	95

Validity of the self-paced 2-minute step test has been established through comparisons to other aerobic endurance measures such as the Rockport 1-mile walk which indicated moderate correlation ($r = .73$); and treadmill performance was also used to compare which indicated moderate correlation ($r = .74$).²⁸ In a systematic review conducted by Bohannon and Crouch,²⁹ only one study addressed the reliability of the 2-minute step test. Rikli and Jones²⁴ were the authors of this study and reported the test-retest reliability coefficient as .90.

Chair Sit-and-Reach Test

The chair sit and reach test is used to assess lower body flexibility, with focus being on the hamstrings.²⁴ The participant starts seated with the crease between the top of the leg and the buttocks should be even with the front edge of a standard 17 inch height chair. One leg is bent at 90 degrees and the other is extended with the knee straight. The participant is then instructed to bring both arms in front of them, with the hands overlapping so the middle fingers are even with one another. Then they are instructed to reach forward, primarily at the hip, and hold for at least two seconds. The distance from the tips of the middle fingers to the toe end of the shoe is measured. If the participant does not reach the toes, a negative score is recorded; if past the toes, a positive score is recorded (cm). Both legs were measured to detect change after the training period.

Back Scratch Test

The back scratch test assesses upper-body, primarily shoulder, flexibility.²⁴ The participant stands for this measure, and is asked to reach over the shoulder, palm down and fingers extended on one hand, and place the other hand behind the back with the dorsum of the hand on the back reaching towards the other hand. The participant is given a choice of the preferred hand within the SFT protocol; however in this study both were measured in centimeters. The distance between the two middle fingers were measured. When the fingers overlapped a positive score was recorded, otherwise a negative score was recorded. The participants were given practice trials and two additional scores were measured with the best score kept for data collection.

8-Foot Up and Go Test

The final test in this battery of procedures is the 8-foot up-and-go test. This measures agility and dynamic balance.²⁴ The participant starts sitting in a 17-inch high folding chair that is up against the wall for stability. They are instructed to come to standing, walk around the cone, and return to sitting as quick as safely possible without running. The participant performed two trials, and completed two timed trials. On the signal of “go” the timer starts regardless of the participant has moved yet and time is stopped when the person sits down on the chair. They are encouraged to move as quickly as possible without running and maintaining safety. Both timed trials are recorded, however; the fastest time was used in the data set as per SFT manual. Table 5 reports standards of the 8-foot up and go test, in seconds, as indicated in the SFT manual.

Table 5. SFT Functional Fitness Standards for Older Adults, 8-Foot Up and Go (sec)²⁴

	60-64 (yrs)	65-69 (yrs)	70-74 (yrs)
Women	5.0	5.3	5.6
Men	4.8	5.1	5.5

Grip Strength

Grip strength was measured in each participant with a standard JamarTM hand dynamometer is considered to be the most precise instrument for this measure with good inter-rater and test-retest reliability.^{30,31} According to Fritschi et al,³¹ grip strength correlates to functional limitations and premature development of disability. Although it is not part of the SFT, it is an important measure in function. Grip strength was measured one hand at a time, but measured and recorded bilaterally. The participant was seated for this measure, with the elbow bent to 90 degrees and kept tucked against the trunk. Three trials were taken, and the average of the trials was recorded. Table 6 illustrates mean grip strength values found in older adults as observed by Desrosiers et al.³⁰

Table 6. Mean Grip Strength in Older Adults (in lbs)³⁰

	60-69 (R)	60-69 (L)	70-79 (R)	70-79 (L)
Women	51.81	52.03	52.25	48.50
Men	100.53	96.12	93.48	89.29

In a systematic review completed by Bohannon,³² the test-retest reliability of grip strength was assessed across multiple populations in which older adults were included. They included older adults that had an age range of 60.2 years to 83.9 years of age. In community dwelling older adults, grip strength measurements can be considered to have good to excellent test-retest reliability (ICC = .97 [mean]), (SEM(kg) = 1.9 [mean]).

Standing Posture

During the time of fitness screening, photos were obtained to assess posture. At the pre-participation screening, photos were taken of resting standing posture without poles. Three views were obtained including facing the front, facing the posture grid, and a left lateral view as seen in Figure 2 and Figure 3. Each participant was asked to stand about 6-8 inches away from the grid for each picture; in each position the participant was asked to take 4-5 steps in place and then “stand comfortably and look straight ahead.” The photos were taken from a distance of eight feet which was measured for consistency regardless of participant height. At the time of the post-participation screening, the same positions were assessed. Pictures were also taken of the posture with the walking poles. Posture of each participant was analyzed using two independent reviewers and any disputes were settled by a third independent reviewer.

GAITRite

In order to assess changes associated with gait in older individuals, each of the participants were asked to walk on the GAITRite. This instrument measures spatiotemporal gait parameters through sensors on an instrumented walkway. When comparing the GAITRite to the Clinical Stride Analyser (CSA), the ICC for speed, cadence, and stride length demonstrated excellent agreement for preferred, slow, and fast speeds at 95% CI (ICC (2,1) = .99).³³ The ICC for gait speed, cadence and stride length indicated good reliability at preferred and fast speeds (ICC (3,1) = .92 - .97). However, at the self-selected slow speed, the ICC's for speed (.85), cadence (.78), and stride length (.91) did not demonstrate the same reliability.



Figure 2. Postural analysis views without poles.

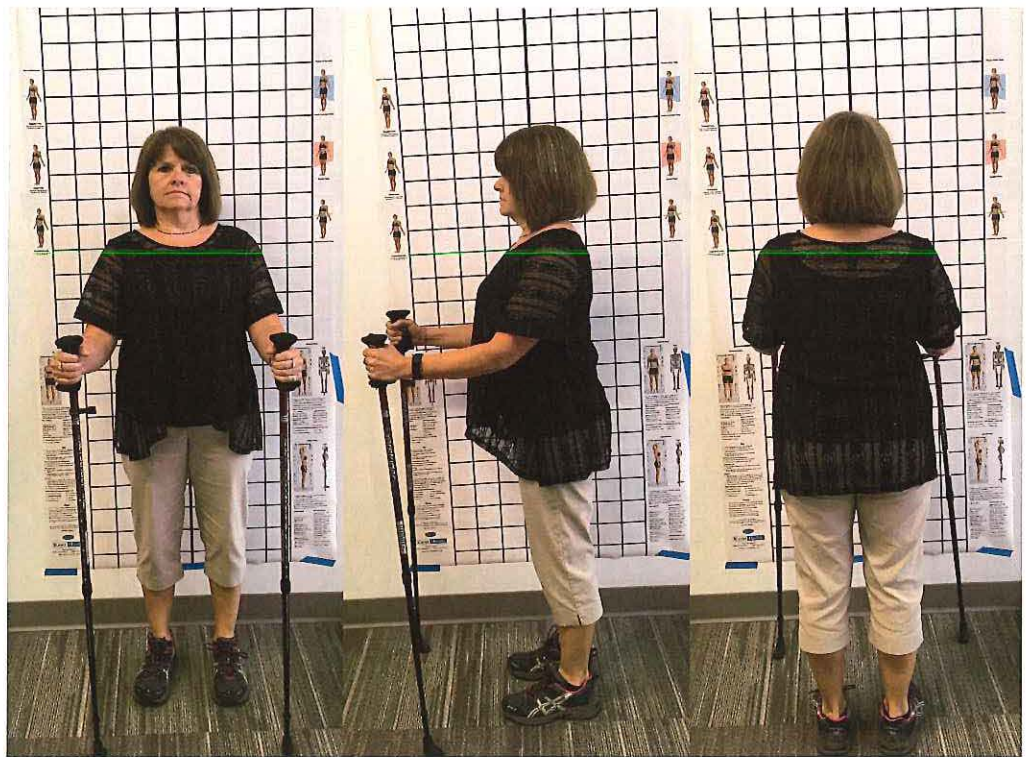


Figure 3. Posture analysis views with poles.

Overall, it is been proven to be a valid and reliable measure for spatial and temporal parameters of gait. Three trials were performed at two speeds, normal and fast walking pace, an average of each speed was recorded for data analysis. The measures were repeated at the post-participation screening with the addition of normal paced walking with walking poles.

Pulse Oximetry

Using an automated pulse oximeter, pulse and oxygen saturation were recorded at the beginning of pre-participation fitness screen, at the completion of the 2-minute step test, and two minutes after the 2-minute step test. The procedure was completed at the post-participation fitness screen. At the completion of each group walking session, heart rate and oxygen saturation were measured and recorded.

Activity Log

Throughout the six weeks of training, each participant was instructed to fill out an activity log that tracked lifestyle activity, frequency and minutes of pole walking, and structured exercise categories like aerobic, strength, flexibility, and balance. The activity log provided proof of compliance with pole walking as well as proof of other activities that would have an effect on fitness levels of each participant (Appendix G).

Data Analysis

Frequencies were calculated for subject demographics. Frequencies were calculated for SFT and gait parameters. Means and standard deviations were calculated for SFT, grip strength, and GAITRite data. Paired samples t-test were used to identify differences between times of measurement (Time 1, Time 2) for the SFT, grip strength, and GAITRite measurements. Paired samples t-test was used to identify differences in

GAITRite parameters when walking with or without poles. For statistical tests investigating differences between times or conditions, both parametric (paired samples t-tests) and nonparametric (Wilcoxon) tests were computed as not all variables were normally distributed. Findings of the parametric and non-parametric tests relative to decisions for the null hypotheses were identical in all cases. Results from the parametric paired t-tests are reported. Significance was set as $\alpha = .05$ for all tests.

CHAPTER III

RESULTS

All eleven participants completed all components of the study including the pre-participation and post-participation survey, SFT, and activity logs. There was 100% compliance with pole walking sessions twice per week. Each walking session had an average distance of 1.65 miles (8695.22 ft); which was completed outside on a paved walking loop with a group leader for each session. Immediately after completing 30 minutes of walking, heart rates and oxygen saturation was recorded for each participant. The post-participation fitness screening was completed within one week from completion of the study.

Pre-Participation Survey

In this study, the participants completed a pre-survey in which they indicated employment status, any health conditions, previous walking pole use, if they regularly participate in physical activity, and activity level. The results of the pre-participation survey are listed below in Table 7 and 8. Approximately half of the participants were employed full time. Only one participant indicated difficulty with walking occasionally, due to chronic low back pain but at the time of the study felt able to fully participate.

Post-Participation Survey

On the post-participation survey, participants were asked to rate on a scale from 0-10 how much they liked using the walking poles, 0 being not at all and 10 indicating the highest score. All participants rated walking pole satisfaction seven or higher

Table 7. Pre-Participation Survey Results (n=11)

Survey Questions	Yes	No
Employed Full Time	6	5
Do you currently have difficulty walking?	1	10
Have you ever used walking poles prior to this study?	7	4
Do you have any health concerns or recent injuries that may impair your participation in a walking pole program?	1	10
Do you participate in regular physical activity?	8	3

Table 8. Self-Reported Pre-Participation Activity Level (n = 11)

How would you describe your activity level?	Sedentary	Lightly Active	Moderately Active	Very Active
# of participants (n = 11)	1	3	5	2

(mean = 8.36). Participants commented poles helped to engage the whole body during walking and better workout and more calories burned. Perceived limitations noted by the participants of the walking poles included difficulty turning and inability to carry other items such as a water bottle. Majority of participants reported perceived improvement in balance and posture and stated that they would continue to use walking poles after the completion of the study. Table 9 and 10 identify the results of the post-participation survey.

Senior Fitness Test

Significant results, pre- to post-testing, were observed in 30-second chair stand test, 2-minute step test, 8-foot up-and-go, heart rate, and weight. The eleven participants had an overall improvement in SFT scores, when compared to the mean, following

Table 9. Post-Participation Survey Results (n=11)

Survey Questions	Yes	No
Do you feel that walking poles improved your balance?	5	4
Do you feel that walking poles improved your posture?	8	3
Would you continue to use walking poles outside of this study?	8	3
Have you started any new activities since the start of the study?	5	6

Table 10. Post-Participation Activity Level

How would you describe your activity level?	Sedentary	Lightly Active	Moderately Active	Very Active
# of participants (n=11)	0	4	7	0

participation in the study. An average increase of approximately two additional chair stands (repetitions) were observed among the group following post-intervention testing of the 30-second chair stand test. The participants demonstrated a 10.5% increase in 2-minute step test scores following intervention. Post-participation 8-foot-up-and-go measurements illustrated, on average, a 0.25 second decrease in time to complete the test. When heart rate was recorded after completing the 2-minute step test, there was a decrease by 8 bpm when compared pre-participation to post-participation, indicating improved cardiovascular function. Participants had an average loss of three pounds over the course of the study. There was no significant difference in height, sit and reach, or back scratch test. Paired t-test results are provided below in Table 11.

Grip Strength

When pre-participation grip strength was compared to post-participation grip strength, there were no significant changes. The mean indicated very minimal changes in

Table 11. Paired t-Test Results for SFT

Test	Session	M ± SD	<i>t</i>	df	p
30-sec Chair Stand (sec)	Pre	15.73 ± 5.55	3.62	10	.005**
	Post	17.55 ± 6.12			
30-sec Arm Curl (reps)	Pre	19.55 ± 6.12	1.44	10	.180
	Post	21.73 ± 4.69			
Height (cm)	Pre	65.99 ± 4.83	1.75	10	.110
	Post	66.09 ± 4.77			
Weight (lbs)	Pre	187.12 ± 40.03	2.26	9	.050*
	Post	184.74 ± 40.13			
2-min Step Test (reps)	Pre	101.00 ± 19.15	4.63	10	.001***
	Post	112.64 ± 20.26			
HR Post 2-min Step Test	Pre	92.70 ± 11.28	3.39	9	.008**
	Post	84.60 ± 12.18			
Left Sit and Reach (cm)	Pre	-4.85 ± 8.77	1.53	9	.162
	Post	-2.30 ± 8.35			
Right Sit and Reach (cm)	Pre	-3.28 ± 10.06	0.71	8	.497
	Post	-1.89 ± 9.35			
Back Scratch Left (cm)	Pre	-13.75 ± 7.63	0.73	7	.490
	Post	-12.94 ± 8.89			
Back Scratch Right (cm)	Pre	-8.66 ± 8.90	1.09	10	.302
	Post	-8.09 ± 8.38			
8-Foot Up and Go (sec)	Pre	5.51 ± 0.58	2.38	10	.039*
	Post	5.26 ± 0.69			

* denotes statistical significance ($p < .05$)

**denotes statistical significance ($p \leq .01$)

***denotes statistical significance ($p \leq .001$)

grip strength when comparing the same hand pre-intervention to post-intervention fitness screens. Table 12 depicts the results of the paired t-test results for grip strength.

Table 12. Paired t-Test Results for Grip Strength

Test	Session	M ± SD	<i>t</i>	df	p
Left Grip Strength (lbs)	Pre	62.68 ± 19.60	.085	10	.934
	Post	62.88 ± 19.21			
Right Grip Strength (lbs)	Pre	65.68 ± 24.72	.514	9	.620
	Post	67.06 ± 19.31			

Posture

Each participant's posture was evaluated through independent reviewers, if any discrepancies arose an independent third reviewer made the decision. In this study, the third reviewer was not required. Out of the eleven, one participant did not have improved posture based on reviewer analysis. On the post-participation survey, all participants indicated improved posture after completing the pole walking program.

GAITRite Analysis

Upon comparison of pre- and post-testing of gait, there were significant changes in multiple parameters. Toe-in/toe-out angle on the right proved to be significant. Normal paced gait velocity without poles and toe-in/toe-out data was significant. Normal paced gait velocity at post-participation with and without walking poles, normal paced cadence without walking poles, and stride length on the right were reported as significant. Table 13 illustrates the GAITRite data while reporting both significant and non-significant values.

Pulse Oximetry

Data indicated that the pulse oximetry, specifically oxygen saturation, did not indicate significant difference. The change in the mean was not significant; this could be attributed to the fitness levels of the participants at the pre-participation screening.

Activity Logs

Over the course of the study, each participant was responsible for logging their daily activities. On the pre-participation survey, there was one individual that rated themselves as sedentary, three that rated themselves as lightly active, five that indicated they were moderately active, and two that indicated they were very active. On the post-participation survey the same scale was given to the participants, no participants rated themselves as sedentary, four categorized themselves as lightly active, and seven participants indicated that they were moderately active. However, none of the participants rated themselves as very active.

Through the use of self-reported activity logs, compliance with the pole walking program was tracked. During this study, participants were asked to pole walk at least twice per week and encouraged to walk with the group. Upon completion of the activity logs, it was noted that there was 100% compliance with the walking program.

Table 13. Paired t-Test Results for GAITRite

Test	Session	M±SD	<i>t</i>	df	p
Left Stride Length Normal Pace (cm)	Pre	140.31 ± 12.99	2.17	10	.055
	Post	145.16 ± 8.04			
Right Stride Length Normal Pace (cm)	Pre	139.87 ± 12.59	2.30	10	.044*
	Post	145.21 ± 8.25			
Normal Pace Gait Velocity - without poles (cm/s)	Pre	138.65 ± 11.80	3.23	10	.009**
	Post	147.83 ± 8.6			
Normal Cadence - without Poles (steps/min)	Pre	119.16 ± 9.97	2.83	10	.018*
	Post	122.45 ± 8.13			
Left Toe In/Out - without Poles (degree)	Pre	4.36 ± 5.07	0.27	10	.796
	Post	4.18 ± 4.69			
Right Toe In/Out - without Poles (degree)	Pre	8.45 ± 5.75	0.34	10	.742
	Post	8.27 ± 5.02			
Post Left Toe In/Out (degree)	Without Poles	4.18 ± 4.69	3.49	10	.006**
	With Poles	2.27 ± 4.47			
Post Right Toe In/Out (degree)	Without Poles	8.27 ± 5.02	4.49	10	.001***
	With Poles	6.0 ± 5.51			
Post Normal Pace Gait Velocity (cm/s)	Without Poles	147.83 ± 8.64	2.60	10	.027*
	With Poles	160.44 ± 12.76			

*denotes statistical significance ($p \leq .05$)

**denotes statistical significance ($p \leq .01$)

***denotes statistical significance ($p \leq .001$)

CHAPTER IV

DISCUSSION

The purpose of this study was to determine the effects of pole walking on overall physical functioning of community-ambulators 60 years of age and older. Specific aspects under investigation included gait, posture, balance, strength, and cardiovascular effects. As described in the results section, there were significant changes in multiple gait parameters such as velocity, stride and step length, cadence, and the degree to which the participant toes in or out when walking. Fitness improvements were also evident in the 30-second chair stand test, 8-foot up-and-go, 2-minute step test, heart rate reading two-minutes following completion of the 2-minute step test, and body weight.

Posture analyses found all subjects but one had improved posture when compared from pre- to post-participation photographs. The participant with no postural improvement indicated perception of improved posture on the post survey, although there were no visible improvements noted by the researchers. It may be hypothesized that the sensory input provided by the walking poles cued the user to maintain enhanced attention to her postural alignment and further believing that significant improvements were made, however, only the degree of personal attention and reference were adjusted.

During re-evaluation of fitness, the 30-second chair stand test, 8-foot up-and-go, 2-minute step test, heart rate two-minutes following completion of the 2-minute step test, and weight were all identified as significant. This can be attributed to six weeks of

training, which improved cardiovascular endurance and lower extremity strength. The subjects of this study were comparable to age and gender related norms for each test as described in methodology.

Study Comparisons

Many aspects of fitness generated significant changes following intervention in this study. These differences included improvements in 30-second chair stand, 8-foot up-and-go, 2-minute step test, heart rate two-minutes following completion of the 2-minute step test, step length, stride length, gait velocity and cadence, weight, and posture.

Evidence was generated by this study's significant findings of improved 30-second chair stand, 2-minute step test, and heart rate following step test scores. Takeshima et al⁹ concluded that pole walking provides increased benefits regarding overall cardiovascular and respiratory fitness, strength, and flexibility for community-dwelling older adults (65 years of age and older) whom do not have any contraindications for physical activity. These researchers implemented a 12 week program with exercise sessions held three times per week. Warm-up lasted 10-15 minutes, walking pole intervention 30-40 minutes, and cool-down activities for 10-15 minutes, which is comparable to the present study protocol. Both traditional walking and pole walking have been proven to increase health and fitness for older adults. However, pole walking can be directly associated with additional muscular strength and endurance outcomes with regular training and practice.

In this present study, subjects increased 2-minute step test scores by approximately 10.5% as a group and participated in biweekly sessions of 45-minute lengths for 6 weeks. Similarly, Parkatti et al³⁴ recruited sedentary older adults, 68 to 71

years of age to complete a 9 week pole walking program. Researchers reported a 14% increase in 2-minute step test scores following intervention, further quantifying endurance improvements. Intervention consisted of 60-minute biweekly sessions of supervised pole walking on an indoor track.

A study by Ossowski et al,³⁵ primarily consisting of elderly women, ages 60-75 years, identified a significant improvement in cardiovascular endurance following a 15-week pole walking program. Physical fitness measures included two EUROFIT tests - 'sit up' and 'sit-and-reach' as well as a 'Cooper walking test' over a two kilometer distance. Endurance improvement was identified by the walking test timed results, in seconds, following pole walking intervention. Researchers concluded that experimental group subjects achieved statistical significance regarding their walking test time by 4.21% ($p < .05$). Additionally, a decrease in overall endurance was observed in the participants who did not perform walking pole intervention.

Increased step and stride length and improved cadence and gait velocity measures are consistent findings within the literature regarding the use of walking poles. Shim et al³⁶ observed increased step and stride length measures and noted a reduction in time spent from foot flat to heel off during walking pole training on a treadmill. Park et al¹¹ state that such gait improvements stem from the coordination and involvement of the upper extremities. Dispersion of body weight through multiple contact points allows for more efficient energy expenditure and increases walking speed due to increased momentum generated by the upper body. It has also been concluded that pole walking increased the overall recruitment of the gastrocnemius-soleus complex, which improved ankle stability and, therefore, resulted in enhanced, quick forward propulsion in the

terminal stance phase of the gait cycle. Pole walking requires increased upper extremity muscle force to boost weight bearing of the body during the stance phase of the gait cycle, improving balance, stability, and enhances metabolism implemented for movement.

The present study, consisting of healthy, active older adults, achieved statistically significant weight loss changes of approximately three pounds. When incorporating the upper extremities into physical interventions, an increase in heart rate and energy expenditure follows, further resulting in weight loss. This is especially relevant to the use of walking poles; as the upper extremities aid in the initiation of a reciprocal pattern and guide the body through space. Sokeliene and Cesnaitiene³⁷ concluded that pole walking produced positive effects for weight loss and directly reduced overall body weight of active and inactive participants between the ages of 60 and 70 years. Previously active participants experienced a 2% reduction in weight (~ 2.21 pounds), whereas inactive individuals that completed the pole walking intervention achieved a 5% reduction (~ 7.87 pounds). Waist-to-hip ratio means also decreased along with this weight reduction. When compared to conventional walking, it was confirmed that pole walking consumes more calories and reinforces weight loss efforts without increased fatigue or perceived exertion. Pole walking has also been hypothesized to increasing upper extremity strength.³⁸ As upper extremity strength, metabolism, and heart rate increases, weight loss may also result due to training efforts with walking poles.

Postural improvements were another significant finding observed post hoc. Dalton and Nantel³⁹ pole walking study found approximately 91% of all participants had significant postural changes as observed by two independent reviewers. It utilized

motion capture techniques to analyze gait and posture and concluded that the participants also made significant improvements in posture.³⁹ The relation between these results illustrate that postural changes of such significance can be readily detected with a trained eye following a pole walking program.

Results of the post-participation surveys indicate that majority of the subjects reported that they would continue using walking poles and also that they perceived improved health, fitness, and balance during and after practice. Fritschi et al⁴⁰ addressed the factors relating to walking pole participation concluded that this activity aided in the perception of heightened health benefits. Additionally, walking poles presumably provided an increased sense of stability, therefore, decreasing the fear of falling. For these reasons, pole walking has been deemed as an appropriate alternative to conventional walking and health promotion programs geared towards middle-aged and older adults.

Limitations

Limitations of this study include small sample size (n = 11), no control group, female dominant sample, and all participants were healthy community ambulating older adults. For the sake of time and resources, this study coordinated well with a small sample size; however, to further investigate and generalize the functional effects of pole walking on older adults, a larger and more diverse population should be addressed and included.

The small sample size limited the study's ability to create a control group. The absence of this group did not allow for comparison of traditional walking interventions to pole walking. All participants were in good health and eight out of 11 performed regular

physical activity of light to moderate intensity prior to the study. For this reason, the reported results were directly related to the pole walking intervention. However, it is not possible to identify or hypothesize how pole walking may affect, and to what degree, individuals with chronic illnesses or other systemic diagnoses.

As the current study population consisted of eight females and only three males, additional groups should seek for increased male inclusion to address gender-specific differences and fitness benefits. Additionally, focus was placed primarily on older individuals. However, pole walking, specifically Nordic Walking, may also be incorporated into a comprehensive training program for other age groups such as individuals from 40-60 years of age and 70+ years as well as younger individuals (20-40) and athletes.

Based on significant findings within the healthy population, it may be hypothesized that individuals with compromised health and chronic diagnoses such as arthritis, multiple sclerosis, Parkinson's disease, diabetes, and stroke will also experience similar changes.¹⁸ There is great potential to increase functional mobility, endurance, and strength with regular pole walking intervention for these populations.

Recommendations

The small sample size included in this pilot study helped achieve 100% compliance. Group instruction and walking sessions fostered a sense of community for the subjects and may have boosted individual motivation to increase their level of physical activity. Eight of the eleven subjects indicated on the post-participation survey that they would willingly continue with similar pole walking activities as a way to

increase physical activity through a fun, new cardiovascular endurance activity and improve posture.

Due to the limitations of this small pilot study, it would be advantageous of other studies to evaluate the maintenance of improvements over time, for example, six months to a year following initial intervention. Involving individuals of varying ages such as young adults (20-40 years of age), middle-aged adults (40-60 years), and the elderly (> 70 years) would provide insight to individual age group differences and fitness benefits. As the current study predominantly consisted of women (8 out of 11 participants), additional efforts to recruit male subjects may allow for identification of gender differences and further hypothesize fitness benefits for a particular age group as a whole. Implementation of a control group that does not use walking poles would provide evidence that supports the outcomes of training with walking poles. Another way to more accurately measure the effects of pole walking would be to limit other structured activities in order to identify training effects that were primarily from using walking poles. Additional suggestions include recruitment of individuals with chronic conditions, such as stroke, Parkinson's disease, multiple sclerosis, and diabetes to further assess the potential magnitude of improvements that can be encountered through the regular use and practice of walking poles.

CHAPTER V

CONCLUSION

Based on the evidence gathered in the study, it can be concluded that, in healthy older adults, pole walking two times per week can improve lower extremity strength, endurance, enhance posture, and decrease weight. There were significant findings in multiple gait parameters such as: increased gait velocity, cadence, step length, stride length, and improved symmetry of toe-in/-out angle. This study demonstrates the positive health benefits that regular pole walking can provide within a healthy and fit population. It could be hypothesized that individuals with certain disabilities that inhibit efficiency of gait, could possibly reap the benefits that regular pole walking provides. While conventional walking may still be used as physical activity, the addition of walking poles engages the muscles of the upper body and trunk which, in turn, has greater effects on metabolic processes while reducing the effects of fatigue and perceived exertion on the participant.

Pole walking can provide a motivating and optimistic mode of exercise for individuals considering new fitness routines or ambulation for those searching for an alternative, functional assistive device that does not insinuate physical disability. A positive mindset and view regarding this particular device can increase physical therapy patients' overall treatment compliance and significantly improve quality of life. The versatility of walking pole's use and appropriateness for all ages, genders, diagnoses, and

fitness levels allows for the practice to be incorporated into physical therapy intervention, daily living tasks, and fitness practices for a wide variety of individuals.

APPENDIX A – IRB APPROVAL

Institutional Review Board
Twamley Hall, Room 106
264 Centennial Dr Stop 7134
Grand Forks, ND 58202-7134
Phone: 701.777.4279
Fax: 701.777.6708
Email: UND.irb@research.UND.edu

April 12, 2018

Principal Investigator:	Meridee Danks, DPT
Project Title:	Effects of Pole Walking on Older Adults Following Weeks of Training
IRB Project Number:	IRB-201804-293
Project Review Level:	Expedited 4
Date of IRB Approval:	04/06/2018
Expiration Date of This Approval:	04/05/2019
Consent Form Approval Date:	04/06/2018

The application form and all included documentation for the above-referenced project have been reviewed and approved via the procedures of the University of North Dakota Institutional Review Board.

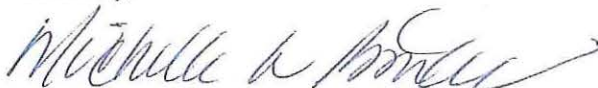
Attached is your original consent form that has been stamped with the UND IRB approval and expiration dates. Please maintain this original on file. **You must use this original, stamped consent form to make copies for participant enrollment. No other consent form should be used.** It must be signed by each participant prior to initiation of any research procedures. In addition, each participant must be given a copy of the consent form.

Prior to implementation, submit any changes to or departures from the protocol or consent form to the IRB for approval. No changes to approved research may take place without prior IRB approval.

You have approval for this project through the above-listed expiration date. When this research is completed, please submit a termination form to the IRB. If the research will last longer than one year, an annual review and progress report must be submitted to the IRB prior to the submission deadline to ensure adequate time for IRB review.

The forms to assist you in filing your project termination, annual review and progress report, adverse event/unanticipated problem, protocol change, etc. may be accessed on the IRB website:
<http://und.edu/research/resources/human-subjects/>

Sincerely,



Michelle L. Bowles, M.P.A., CIP
IRB Manager

MLB/sb
Enclosures

Cc: Chair, Physical Therapy

University of North Dakota Human Subjects Review Form
January 2015 Version

All research with human participants conducted by faculty, staff, and students associated with the University of North Dakota, must be reviewed and approved as prescribed by the University's policies and procedures governing the use of human subjects. It is the intent of the University of North Dakota (UND), through the Institutional Review Board (IRB) and Research Development and Compliance (RD&C), to assist investigators engaged in human subject research to conduct their research along ethical guidelines reflecting professional as well as community standards. The University has an obligation to ensure that all research involving human subjects meets regulations established by the United States Code of Federal Regulations (CFR). When completing the Human Subjects Review Form, use the "IRB Checklist" for additional guidance.

Please provide the information requested below. Handwritten forms are not accepted - responses must be typed on the form.

Principal Investigator: Meridee Danks

Telephone: 701-777-2831

E-mail Address: meridee.danks@med.und.edu

Complete Mailing Address: 1301 North Columbia Road Stop 9037

School/College: University of North Dakota

Department: Physical Therapy

Student Advisor (if applicable):

Telephone: _____

E-mail Address: _____

Address or Box #: _____

School/College: _____

Department: _____

***All/IRB applications must include a Key Personnel Listing.

Project Title: Effects of Pole Walking on Older Adults Following Weeks of Training

Proposed Project Dates: Beginning Date: April 2018

Completion Date: Ongoing

(Including data analysis)

Funding agencies supporting this research: N/A

Did the grant proposal with the funding entity go through UND Grants & Contracts Admin.? YES or NO

Attach a copy of the grant proposal. Do not include any budgetary information. The IRB will not be able to review the study without a copy of the grant proposal submitted to the funding agency.

Does any researcher associated with this project have an economic interest in the research, or act as an officer or a director of any outside entity whose financial interests would reasonably appear to be affected by the research? If yes, submit on a separate piece of paper an additional explanation of the financial interest. The Principal Investigator and any researcher associated with this project should have a Financial Interests Disclosure Document on file with their department.

YES or NO

Will any research participants be obtained from another organization outside the University of North Dakota (e.g., hospitals, schools, public agencies, American Indian tribes/reservations)?

YES or NO

Will any data be collected at or obtained from another organization outside the University of North Dakota?

YES or NO

If yes to either of the previous two questions, list all organizations:

requires the participant to walk at a comfortable and fast speed for 10 m three trials, an average gait speed is then determined. Time to complete -5 minutes.

2. Senior Fitness Test (SFT) - includes Chair Stand Test, 30-second five pound arm curl, Chair Sit-and-Reach Test, Back Scratch Test, 8-Foot Up and Go Test and Six-Minute Walk Test (6-MWT) or Two-Minute Step Test. Total time to complete -15 minutes.
 - a. Chair Stand Test - participant is asked to stand up and sit down as many times as possible in 30 seconds. Testing lower body strength. Number of repetitions are then counted and recorded. Time to complete -1-2 minutes.
 - b. 30-Second 5# Arm Curl - participant is asked to lift 5# dumb bell weight for 30 seconds for each arm. Testing upper body strength. Number of repetitions are then counted and recorded. Time to complete -1-2 minutes.
 - c. Chair Sit-and-Reach Test - participant is asked to reach hand to tip of the toe while sitting on a chair, measurement is taken from tip of fingers to tip of toe. This measures hamstring tightness.
 - d. Back Scratch Test - participant is asked to reach one hand over the shoulder and other up middle of back, the number of inches between middle fingers is measured. Testing upper body flexibility.
 - e. 8-foot Up and Go Test - participant sits in a standard chair and is asked to stand up and walk to a line 8-feet away, turn around and go sit back down. This is an agility test. Time is recorded. One practice trial is given prior to scoring. Time to complete -2 minutes
 - f. Endurance Test - Six-Minute Walk Test (6-MWT), is a walking endurance test. It provides information on blood pressure, heart rate, distance walked, and breaks needed to walk for 6 minutes. Time to complete -8 minutes. Or, Two-Minute Step Test- participants raise each knee to a point midway between knee-cap & top hip bone, the number of steps are counted. Time - 2 min.
3. Grip Strength will be measured using a standard dynamometer. Participants will be asked to squeeze the dynamometer maximally times 3 trials for each hand. An average pounds will be recorded. Time to complete -3 minutes.
4. Height will be measured with Stadiometer both with and without the walking poles. This will be used to measure if there is posture change with use of walking poles. Time to complete - 2 minutes.
5. Posture standing will be recorded by use of iPad, photographs/video will be taken from front and side views with a posture grid in the back ground. Time to complete -2 minutes.
6. Participants will complete a weekly activity log during training program to monitor any changes in activity.

At post testing, a post-survey assessing the participant benefits and perception of pole walking will be administered. Time to complete -2-3 minutes.

Walking Pole Training Protocol - participants will meet as a group 2x/week for 6 weeks. At first session, walking poles will be properly fitted to each participant and instruction given on proper use of walking poles. Each training session will include 5 -10 minutes of warm up stretching activities, 30 minutes of pole walking, and 5-10 minutes cool down/stretching period. Total class time should take -45 minutes. Heart rate and Rate of Perceived Exertion (RPE) will be monitored at each training session. Participants will be allowed to choose his/hers comfortable walking pace during training sessions. Walking poles will be provided by researcher. If participant is unable to attend class they will be asked to perform 30 minutes of pole walking on his/her own.

- e) Describe audio/visual procedures and proper disposal of tapes.
- f) Describe the qualifications of the individuals conducting all procedures used in the study. Meridee Danks has been a practicing physical therapist for 33 years and has a specialty certification in Neurological Physical Therapy. UND PT students will be supervised and trained as needed.

- g) Describe compensation procedures (payment or class credit for the subjects, etc.).
Participants will be put in a drawing for a chance to receive a pair of walking poles following completion of research. A single pair of walking poles will be given out.

Attachments Necessary: Copies of all instruments (such as survey/interview questions, data collection forms completed by subjects, etc.) must be attached to this proposal.

3. Risk Identification.

- a) Clearly describe the anticipated risks to the subject/others including any physical, emotional, and financial risks that might result from this study.
There is a minimal risk of losing balance or falling during gait assessments and training sessions. Only subjects that are healthy and community ambulators are being allowed to participate. The subject will be instructed that they are able to quit the activity at any time if they do not feel safe.
- b) Indicate whether there will be a way to link subject responses and/or data sheets to consent forms, and if so, what the justification is for having that link.
There will be initial link between data sheets and consent forms. All data sheets will be coded and no

N/A

- d) If the **PI** will be the lead-investigator for a multi-center study, or if the PI's organization will be the lead site in a multi-center study, include information about the management of information obtained in multi-site research that might be relevant to the protection of research participants, such as unanticipated problems involving risks to participants or others, interim results, or protocol modifications.

N/A

4. Subject Protection.

- a) Describe precautions you will take to minimize potential risks to the subjects (e.g., sterile conditions, informing subjects that some individuals may have strong emotional reactions to the procedures, debriefing, etc.).
We will ensure a safe environment with limited distractions, adequate space, and a clear walking path minimizing obstacles. Subjects will be informed that they are able to stop any activity they do not feel safe performing. All walking activity will be directly supervised by research personnel.
- b) Describe procedures you will implement to protect confidentiality and privacy of participants (such as coding subject data, removing identifying information, reporting data in aggregate form, not violating a participants space, not intruding where one is not welcome or trusted, not observing or recording what people expect not to be public, etc.). If participants who are likely to be vulnerable to coercion and undue influence are to be included in the research, define provisions to protect the privacy and interests of these participants and additional safeguards implemented to protect the rights and welfare of these participants.
All data will be coded and identifying information will be removed once all data is gathered. Any reporting will be in aggregate form.
- c) Indicate that the subject will be provided with a copy of the consent form and how this will be done.
Each subject will be provided with a copy of the consent form prior to participation.
- d) Describe the protocol regarding record retention. Please indicate that research data from this study and consent forms will both be retained in separate locked locations for a minimum of three years following the completion of the study.
Describe: 1) the storage location of the research data (separate from consent forms and subject personal data)
2) who will have access to the data
3) how the data will be destroyed
4) the storage location of consent forms and personal data (separate from research data)
5) how the consent forms will be destroyed

- 1) The research data will be stored separately from the consent form and other personal data
 - 2) Only researchers will have access to the data
 - 3) The data will be kept a minimum of three years and will be shredded once data analysis is completed.
 - 4) Consent forms or personal data will be stored in separate files in a locked office of the researcher.
 - 5) Consent forms will be kept a minimum of three years and will be shredded once data analysis is completed.
- e) Describe procedures to deal with adverse reactions (referrals to helping agencies, procedures for dealing with trauma, etc.). Suggestions to contact a physician will be made if subjects have any concerns arise.
- f) Include an explanation of medical treatment available if injury or adverse reaction occurs and responsibility for costs involved.
Subject will be referred for medical treatment if required for any injury that may occur during assessment. The responsibility of cost related to any treatment will be the responsibility of the subject.

III. Benefits of the Study

Clearly describe the benefits to the subject and to society resulting from this study (such as learning experiences, services received, etc.). **Please note:** extra credit and/or payment are not benefits and should be listed in the Protocol Description section under Methodology.

Subjects will be able to have their strength, posture and gait assessed at no cost. They will also be able to experiment with walking poles. They will be able if any benefit of using walking poles to improve their posture and gait. The research will provide benefit to the general society by seeing the effectiveness of walking poles on posture and gait in the elderly.

IV. Consent Form

Clearly describe the consent process below and be sure to include the following information in your description (Note: Simply stating 'see attached consent form' is not sufficient. The items listed below must be addressed on this form.):

- 1) The person who will conduct the consent interview
 - 2) The person who will provide consent or permission
 - 3) Any waiting period between informing the prospective participant and obtaining consent
 - 4) Steps taken to minimize the possibility of coercion or undue influence
 - 5) The language (English, French, German, etc.) to be used by those obtaining consent
 - 6) The language (English, French, German, etc.) understood by the prospective participant or the legally authorized representative
 - 7) The information to be communicated to the prospective participant or the legally authorized representative
- 1) Meridee Danks will supervise the informed consent interview.
 - 2) The individual that is volunteering for the study will provide consent to participate.
 - 3) Participants will be given the consent form to read and allowed to ask any questions prior to obtaining consent.
 - 4) Prospective subjects will be told research is voluntary and if they do participate that they will be able to stop at any time without any penalty.
 - 5) English language will be used in obtaining consent.
 - 6) English speaking prospective participants will be recruited.
 - 7) The consent form will indicate the assessments to be performed and the amount of time to perform them and who will be performing the assessments.

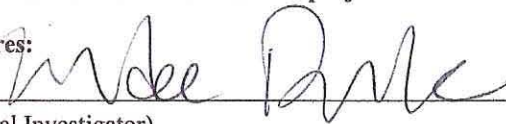
A copy of the consent form must be attached to this proposal. If no consent form is to be used, document the procedures to be used to protect human subjects, and complete the Application for Waiver or Alteration of Informed Consent Requirements. Refer to form IC 701-A, Informed Consent Checklist, and make sure that all the required elements are included. **Please note:** All records attained must be retained for a period of time sufficient to meet federal, state, and local regulations; sponsor requirements; and organizational policies. The consent form must be written in language that can easily be read by the subject population and any use of jargon or technical language should be avoided. **The consent form should be written at no higher than an 8th grade reading level** and must be written in the second person (please see the example on the RD&C website). A two inch by two inch blank space must be left on the bottom of each page of the consent form for the IRB approval stamp.

Necessary attachments:

- [Signed Student Consent to Release of Educational Record Form](#) (students and medical residents only);
- [Investigator Letter of Assurance of Compliance](#); (all researchers)
- [Consent form, or Waiver or Alteration of Informed Consent Requirements](#) (Form IC 702-B)
- [Key Personnel Listing](#)
- Surveys, interview questions, etc. (if applicable);
- Printed web screens (if survey is over the Internet); and
- Advertisements (flyer, social media postings, email/letters, etc.).

By signing below, you are verifying that the information provided in the Human Subjects Review Form and attached information is accurate and that the project will be completed as indicated.

Signatures:



(Principal Investigator)

4/4/18

Date:

(Student Advisor)

Date:

*****All students and medical residents must list a faculty member as a student advisor on the first page of the application and must have that person sign the application.*****

Requirements for submitting proposals:

Additional information can be found on the IRB website at: <http://und.edu/research/resources/human-subjects/index.cfm>

Original, signed proposals and all attachments, along with the necessary number of copies (see below), should be submitted to: Institutional Review Board, 264 Centennial Drive Stop 7134, Grand Forks, ND 58202-7134, or brought to Room 106, Twamley Hall.

Required Number of Copies:

- Expedited Review: Submit the signed original and 1 copy of the entire proposal.
- Full Board Review: Submit the signed original and 22 copies of the entire proposal by the deadline listed on the IRB website: <http://und.edu/research/resources/human-subjects/meeting-schedule.cfm>
- Clinical Medical Subcommittee and Full Board Review: Submit the signed original and 24 copies of the entire proposal by the deadline listed on the IRB website: <http://und.edu/research/resources/human-subjects/meeting-schedule.cfm>

Prior to receiving IRB approval, researchers must complete the required IRB human subjects' education. Please go to: <http://und.edu/research/resources/human-subjects/human-subject-education.cfm>

The criteria for determining what category your proposal will be reviewed under is listed on page 3 of the IRB Checklist. Your reviewer will assign a review category to your proposal. Should your protocol require full Board review, you will need to provide additional copies. Further information can be found on the IRB website regarding required copies and IRB review categories, or you may call the IRB office at 701 777-4279.

In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 5 copies if the proposal is clinical-medical. If the proposed work is being conducted for a pharmaceutical company, 5 copies of the company's protocol must be provided.

**UNIVERSITY OF NORTH DAKOTA
INSTITUTIONAL REVIEW BOARD
KEY PERSONNEL LISTING**

Names of Research Personnel		Position (select from drop-down menu)	Highest Academic Degree (High School, B.S., M.A., Ph.D., M.D., etc.)	Responsibilities (check all that apply)					
First Name	Last Name			Consent Subjects	Recruit Subjects	Research Design	Intervention	Data Analysis	
1	Meridee	Danks	Faculty	DPT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	Michelle	LeBrecque	Faculty	DPT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Schawnn	Decker	Faculty	DPT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Samantha	Forsch	Graduate student	B.S.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Raevyn	Haugland	Graduate student	B.S.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>* Attach proof of education in human subjects research for all non-UND personnel</i>									
Revised 03/15/2017									

Participants Needed

6-Week Walking Pole Study

- **Participants must be:**
 - 60 years of age or older
 - Healthy
 - Community walker
- **Research will include:**
 - Instruction and quick fitness evaluation
 - 6 weeks of walking pole training program held 2 times per week for approximately 45 minutes
 - Following the study, participants will have a post - program fitness evaluation
- **Participation is free. If eligible, you will be entered into a drawing for a pair of Walking Poles.**

**If interested, contact Meridee Danks by phone at
701-777-3861 or by email at
meridee.danks@med.und.edu.**

APPENDIX B – CONSENT FORM

**THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH**

TITLE: Effects of Pole Walking on Older Adults Following Six Weeks of Training

PROJECT DIRECTOR: *Meridee Danks, DPT*

PHONE #: 701-777-3861

DEPARTMENT: *Physical Therapy*

STATEMENT OF RESEARCH

A person who is to participate in the research study must give his or her informed consent for such participation. This consent must be based on your understanding of the nature and risks of the research. This document provides information that is important for this understanding. Research projects include only subjects who choose to take part. Please take your time in making deciding whether or not you would like to participate. If you have any questions, please ask.

WHAT IS THE PURPOSE OF THIS STUDY?

You are invited to partake in a research study regarding the use of walking poles and their effects on physical functioning, stability, balance, and posture. Pole walking is a new and simple type of fitness walking using specially designed poles. Two poles are used while walking, each pole moving with the opposite leg (left pole with the right leg and right pole with the left leg). The poles help with your balance and exercise your arms while you walk. Your participation will allow for the determination of walking pole benefits among healthy, community walkers over the age of 60. The aim of this study is to examine the effects of pole walking on physical functioning of the healthy older adults after completing a walking program.

HOW MANY PEOPLE WILL PARTICIPATE?

At least 8 individuals will participate in the study at the University of North Dakota.

WHAT WILL HAPPEN DURING THIS STUDY?

As a participant in this study, you will enter the room and be given a demographic and general health survey at the pre-study evaluation, each lasting approximately 30 minutes. Your blood pressure, heart rate, and breathing will be tested. If any abnormal readings are found, you will be asked to get your doctors approval to participate in the study. You will then move through a series of five stations that consist of a walk across an instrumented walkway (GAITRite) that records footprints and walking measures; a Senior Fitness Test (SFT), which includes current height and weight measurements, 30-second chair-stand test, 30-second arm curl, grip strength assessment, Chair Sit-and Reach Test, Back Scratch Test, 8-foot up and go test, and 6 Minute Walk Test or 2 Minute Step Test (blood pressure, heart rate and breathing will be

Approval Date: <u>APR 6 2018</u>
Expiration Date: <u>APR 5 2019</u>
University of North Dakota IRB

assessed again following this test), assessing strength and endurance; and picture or video recordings via iPads may be used to document your standing and walking posture.

Following evaluation and documentation, you will be fitted with a set of walking poles that will be used for the duration of the pole walking training program. You will receive thorough instruction regarding use of poles with walking prior to starting walking program. The group walking program meets 2 times per week for 6 weeks. Each session will include 5-10 minutes of warm-up stretching activities, 30 minutes of pole walking, with rest breaks as needed, and a 5-10 minute of cool down/stretching period at the end. Total class time is estimated to be ~45 minutes. Walking poles will be provided. Each participant will fill out a weekly activity log during the 6-week training program. If you are unable to make it to a session you will be asked to try and complete 30 minutes of walking on your own. A post-training survey and post-evaluation will be performed using same test as pre-evaluation.

WHAT ARE THE RISKS OF THE STUDY?

There is a minimal risk of losing your balance or falling during gait assessments and training sessions. Risk will be minimized through proper instruction and assistance during evaluations and training session maneuvers. Only subjects that are healthy, community walkers will be allowed to participate. Your participation is voluntary and you will be able to quit the activity at any time if you do not feel safe.

WHAT ARE THE BENEFITS OF THIS STUDY?

You will be able to have their strength, posture, and gait assessed at no cost. Also, you will be able to experiment with walking poles and partake in a 6-week walking program. You will be able to assess whether or not they personally benefit from the use of walking poles to improve their posture, gait, and balance. The research will also provide benefit to the general public by determining the effectiveness of walking poles on posture and gait in older adults during community ambulation.

WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

There are no monetary costs associated with your participation in this research study, however, we are asking for a short-term time commitment.

WILL I BE PAID FOR PARTICIPATING?

You will not be paid for your participation in this study. Your name will be entered into a drawing for a free pair of walking poles following the group walking program.

CONFIDENTIALITY

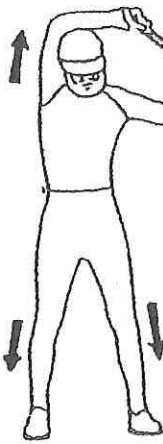
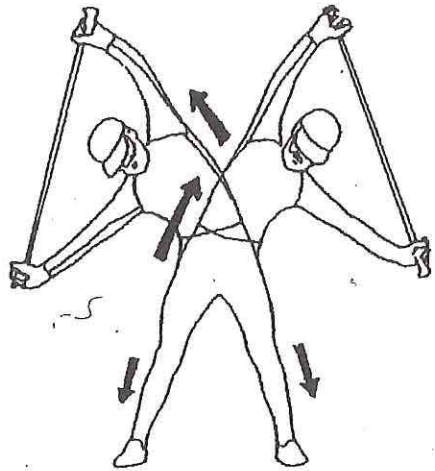
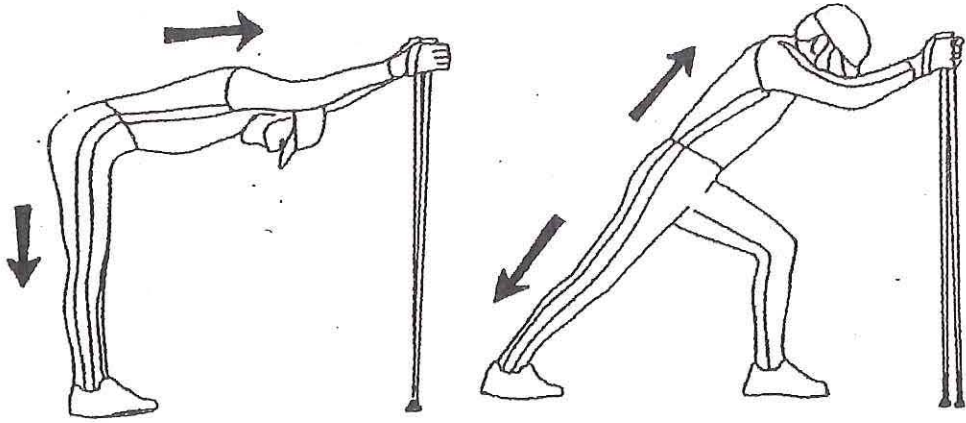
The records of this study will be kept private to the extent permitted by the law. In any report about this study that might be published, you will not be identified. Government agencies and the University of North Dakota Institutional Review Board may review your study record. Any information that is obtained in this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. If we write

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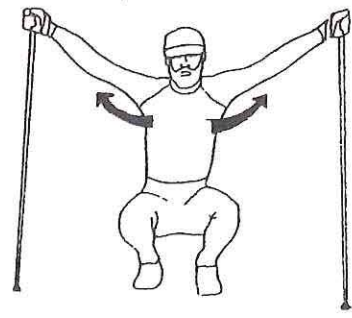
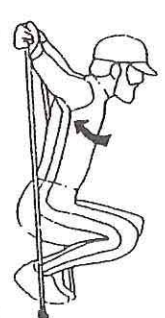
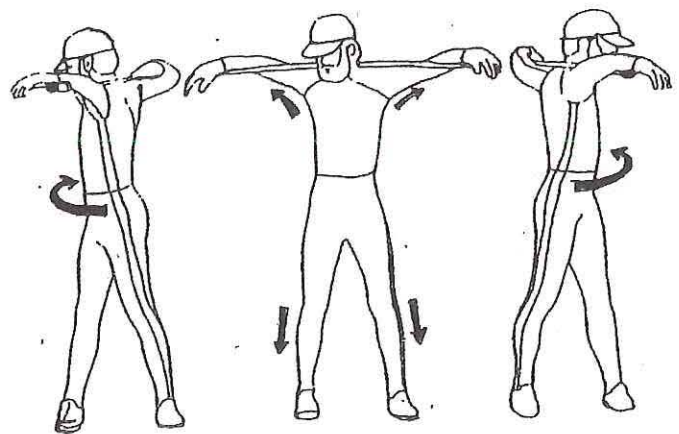
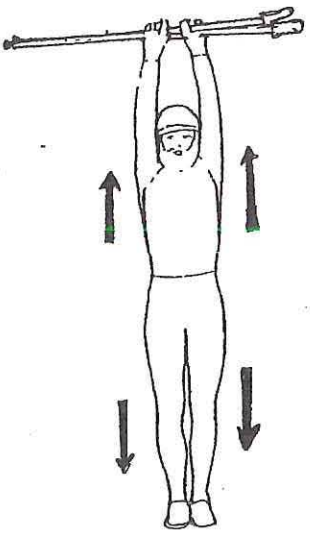
APPENDIX C – WARM UP

Pole Walking Warm.Up Routine (~6min)

- **30 second Rhythmic knee bends**
- **10 Heel.toe rocks**
- **10 Mini.squats** – feet shoulder6width apart, keeping knees behind toes
- **30 second Marching in place** – poles on ground in front of you
- **30 second Marching in place** – holding poles, swinging arms
- **10 Stepping jacks**
- **10 Arm lifts** – poles together, holding ends of poles with hands
- **10 Twisting side stretch** – poles together, holding ends of poles with hands
- **10 Shoulder press** – poles together, holding ends of poles with hands
- **10 Chest press** – poles together, holding ends of poles with hands
- **10 Arm circles (each direction)**
 - Forward
 - Backward
- **5 Head/neck circles (each direction)**
 - Left
 - Right



Arrows indicate the direction of the stretch.



APPENDIX D – COOL DOWN

Cool-Down & Stretching (~6min) – HOLD stretches for 20-30 seconds

• ***With poles:***

- Forward trunk bend
- Forward lunge – left & right (L & R)
- Quadriceps (Front thigh) stretch – L & R
- Hamstring (Back thigh) & Calf stretch – L & R
- Overhead reach
- Sidebend – L & R
- Twisting side stretch – L & R

• ***Without poles:***

- Triceps stretch (bent elbow, over shoulder hold) – L & R
- Cross-body arm hold – L & R

APPENDIX E – PRE-PARTICIPATION SURVEY

Walking Pole Pre-Participation Demographic Survey

Age: _____ Gender (circle one): M F

Employment: Retired Employed Volunteer
Please specify: (# hrs/week & type)

1. Do you currently have difficulty walking? Yes No
If "yes," please specify:

2. Have you ever used walking poles prior to this study? Yes No
If "yes," how often?

3. Do you have any health concerns or recent injuries that may impair your participation in a walking pole program? Yes No
If "yes," please list and explain:

4. Do you participate in regular physical activity? Yes No
If "yes," please specify type of exercise and how often you engage in this activity:

5. How would you describe your activity level? (please check one)

- _____ Sedentary = little to no regular activity
 _____ Lightly Active = at least 20 minutes of exercise 1-3 times per week
 _____ Moderately Active = at least 30-60 minutes of exercise 3-4 times per week
 _____ Very Active = 60 minutes of exercise 5-7 times per week

APPENDIX F – POST-PARTICIPATION SURVEY

Post-Participation Survey

1. Please rate how much you liked using walking poles on a scale from 0-10, 0 indicating not at all, 10 being the highest score. (circle one)

0 1 2 3 4 5 6 7 8 9 10

2. What did you like the most about walking with poles?

3. What did you like least about walking with poles?

4. Do you feel that walking poles improved your balance? Yes No

5. Do you feel that walking poles improved your posture? Yes No

Comments:

6. Would you continue to use walking poles outside of this study? Yes No
If yes, when would you use them?

7. Have you started any new activities since the start of the study? Yes No
If yes, explain.

8. How would you describe your activity level? (please check one)

_____ Sedentary = little to no regular activity

_____ Lightly Active = at least 20 minutes of exercise 1-3 times per week

_____ Moderately Active = at least 30-60 minutes of exercise 3-4 times per week

_____ Very Active = 60 minutes of exercise 5-7 times per week

APPENDIX G – ACTIVITY LOG

Activity Record**Week of May 27****Name _____****Record number of minutes per day of each activity below:**

Activity	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Pole Walking: Goal is for 2x/week							
Lifestyle activity: Indicate any moderately strenuous housework, yard work, recreation, sports & so on.							
Structured Aerobic Exercise: Brisk walking, jogging, cycling, treadmill, & so on							
Structured exercise: Strengthening: Resistive tubing hand weights, weight machines, or calisthenics.							
TOTAL Min/DAY of Mod Exercise							
Flexibility and Stretching Activities							
Agility & Balance Activities							

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