Project Title: Physical Function in Older Adults in the Stay Strong, Stay Healthy Program

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Research Background and Objectives

The University of Missouri's Stay Strong, Stay Healthy (SSSH) program is an eight week strength training class for older adults. SSSH is modeled after the evidence-based StrongWomen program developed by researchers at Friedman School of Nutrition Sciences at Tufts University[1,2]. While the original Tufts program included only women, University of Missouri Extension has adapted the curriculum to also include men. Strength training programs, like SSSH, can increase muscle mass and strength[3], improve bone density and reduce the risk of osteoporosis and related fractures[4], improve diabetes, heart disease, arthritis, depression, and obesity[5]; and increase self-confidence, sleep and vitality[6] in older adults. Specifically, the SSSH program increases elderly individuals' confidence in their physical strength and balance[7]. The present study will elucidate the effects of the SSSH program on specific measures of balance, muscle capacity, and skeletal health in a cohort of older adults from Central Missouri.

The primary objective of this research study is to track physiologic changes and determine the effectiveness of the SSSH exercise intervention in older adults. Participant's balance, gait, muscle strength, body composition, and skeletal health will be compared to a walking group and to a sedentary control group prior to and immediately following the eight week exercise intervention.

Participant centered objectives include:

- Participants will improve their balance, thus reducing their risk for falls.
- Participants will increase their muscle strength and improve body composition.
- Participants will increase their rate of bone formation.
- Participants will improve their cognition and sleep habits.
- Participants will increase their physical activity

Recruitment Process

The Stay Strong, Stay Healthy program is conducted throughout the state of Missouri. Class sessions are advertised by posting flyers and in newspapers. At the University of Missouri-Columbia, the SSSH program is advertised by posting flyers around campus and utilizing the email group for retired MU employees. Dr. Baker and research staff will also present the research study participation opportunity at pre SSSH sessions in Columbia and surrounding areas. We will be available to answer questions via email and phone for any potential participants prior to their first visit on campus. The inclusion and exclusion criteria listed below in addition to the PAR-Q form will make up the initial screening form. During the recruitment process research staff will use this form to quickly screen potential participants for overt exclusion criteria, thus reducing the number of "screen failure" participants who will have to coordinate travel to campus for the first consenting visit. No personal health information is contained in these forms and all questions are yes/no, and this data will

only be recorded for screening failures to inform selection bias. The inclusion of this form is purely the research team's attempt to reduce patient burden as travel can be very difficult for this patient population.

Inclusion/Exclusion Criteria

Participants will be included in the study if they:

- Are male or female ≥60 years of age
- Are sedentary (no strength training and <30min/wk of other physical activity in the past 3 months)
- Are ambulatory (cane or walker permitted)
- Are free from current physical injury or illness preventing physical activity

Participants will be excluded in the study if they:

- Answered YES to two or more questions on the PAR-Q form
- Are female subjects who have not fully gone through menopause
- Were a previous SSSH participant
- Have dementia/Alzheimer's or other cognitive impairments that would limit ability to follow directions

Consent Process

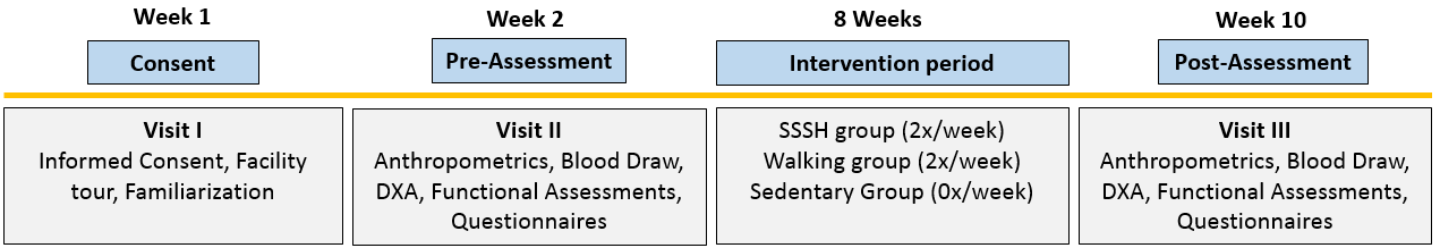
Only research staff cleared to obtain written consent will escort participants to a private room in Gwynn Hall, where all screening and consenting will take place. After participants have cleared the initial screening checklist (the PAR-Q form and inclusion/exclusion criteria), research staff will deliberately and clearly explain each aspect of the informed consent. Participants will be encouraged to ask questions and will be reminded of the voluntary nature of their participation prior to signing the informed consent form. Signed informed consents will be collected and securely stored in Dr. Duren's office. At this time, participants will also be given an additional copy of the informed consent for future reference.

Number of Subjects

Using G*Power (V3.1) sample size calculations were completed using estimated and calculated effect sizes from previously published SSSH research [7-9]. Estimated low and medium effect sizes resulted in a sample size ranging from 12-55. Calculated effect sizes for the 30 second sit to stand (balance), DXA (body composition), and the Self Administered Gerocognitive Examination (cognitive function) resulted in a sample size ranging from 9 to 43. We believe nearly 50 participants total are needed to reach statistical power for this study; however, assuming 15% attrition rates, 60 participants (up to 20 per group) will be recruited for the study.

Study Procedures/Design/Treatment Plan

Participants who chose to enroll will be required to provide approximately five hours of their time total, in addition to intervention exercise activities. The first visit will consist of the initial screening form and the informed consent, followed by a facility tour, and familiarization of the testing procedures and will take one hour. The second and third visits are identical in procedure and time required and will consist of a urine sample, blood draw, anthropometrics, DXA scans, and functional performance assessments, and questionnaires. These two visits lasting 2 hours each will occur immediately before and after the eight week intervention period. Each visit and all questionnaires and procedures are explained in greater detail below. This organizational timeline of study activities will also be made available for participants.



Visit I

Location: The first visit will take place in the Exercise Physiology Laboratory in Gwynn Hall, subsequent tours of McKee Gymnasium may also occur.

Duration: 1 hour

During the first visit to campus participants will go over the initial screening form which includes the Physical Activity Questionnaire (PAR-Q), a risk assessment for chronic disease characteristics that may increase risk of exercise injury, and the inclusion and exclusion criteria. If participants are cleared they will then be given the informed consent and allowed ample time to ask questions about the study requirements. All possible precautions will be taken to avoid inadvertent coercion in the recruitment process. The research team will stress that participation is completely voluntary and can be terminated at any time for any reason.

Once participants clear the initial screening process and sign the informed consent (a copy of the informed consent will be provided to the participant at this time), participants will be given a tour of the McKeee Gymnasium where they will become familiar with all testing procedures. Qualified subjects will be scheduled for Visit II.

Visits II & III

Location: The first part of these visits will take place in the Exercise Physiology Laboratory in Gwynn Hall, followed by function performance testing in McKee Gymnasium.

Duration: 2 hours

The methods for Visit II and Visit III are identical and will occur the week prior to the SSSH intervention beginning and the week after the intervention is over. Both of these visits will include a urine sample, blood draw, and DXA scans followed by functional performance testing and questionnaires. Questionnaires include pre/post General Health Survey, the Pittsburgh Sleep Quality Index survey, and the Self Administered Gerocognitive Examination. Each procedure is described in detail below.

Anthropometrics: Participant height and weight will be measured and their BMI (kg/m^2) will be calculated. Participant resting blood pressure (mmHg) will also be taken.

Urine sample: Participants will be asked to provide a urine sample to ensure proper hydration for DXA scans.

Blood Draw: 7-10 ml of blood will be drawn from the subject using a butterfly needle and vacutainer. These samples will be allowed time to clot and then spun in serum separator tubes. Serum will then be aliquotted into microtubes and stored till bone turnover assay can be ran. Samples will be stored in Gwynn Hall and analyzed at the Missouri Orthopaedic Institute.

DXA Scan: The total body DXA scan requires participants to lie still for approximately 6 minutes on a padded table. Specific scans of each proximal femur and the lumbar spine will also occur. Participants are exposed to a small amount of radiation during the scan equivalent to about 1/1000 of a similar Computed Tomography scan. Participants will undergo the same scanning procedures before and after the intervention period. After testing is complete for the visit, research staff and participants will discuss the DXA results and a copy will be provided.

10 meter Walking Test (10MWT): the test is designed to measure gait speed. The test requires participants to walk for 10 meters and the time taken to cover this distance will be recorded. This will be repeated three times and the scores will be averaged. Participants will perform the same test after completion of intervention period.

CDC Balance Test: The CDC Balance test is a widely used balance assessment where participants take on four different postures and must maintain balance. Participants will complete each posture as described in the CDC protocol. In addition, we will have participants complete this task on two force plates in order to record more sensitive data. Participants will perform the same test after completion of intervention period.

Grip Strength: Hand strength is measured by using a Jamar hand dynamometer. This test requires the subject to hold the dynamometer and squeeze with maximum isometric effort, which is maintained for about 3-5 seconds. Three trials will be performed and the greatest value will be reported. Participants will perform the same test after completion of intervention period.

Back Scratch and Sit and Reach Flexibility Tests: Both of these static flexibility tests are commonly used in older adults. The back scratch test required participants to reach one arm behind their back and try to touch it with the other hand that is above their head. The distance each hand is away from each other or overlaps provides an upper body flexibility score. Both sides will be tested. The sit and reach test can be completed on the floor or from a chair to accommodate older adults who cannot safely get on the floor. During this test, participants try to reach their toes with their legs straight. The distance the hands are away from the toes or the distance they overlap the toes provides a lower body flexibility score.

Timed up and go (TUG) and 30 second sit to stand (30STS) Tests: Both of these dynamic tests are used to assess a participant's balance and lower body strength. The TUG requires participants to rise from a seated position, walk around a cone 8 ft away and return to their seated position. Participants will be timed during this test. The 30STS has two commonly reported variations. First, is how quickly a participant can rise from a seated position, fully stand, and return to the seated position five times. The second iteration is how many times can a participant complete this same complete motion in 30 seconds. We will measure both. Additionally the 30STS will be completed on two force plates to better understand lower body power and balance. Participants will perform the same test after completion of intervention period.

Once participants have enrolled in the study Dr. Duren will randomize the participants into either the experimental group, walking group, or sedentary group. They will be notified of their assignment based on their preferred communication method by Dr. Duren.

Participants who are assigned the SSSH program will engage in eight weeks of strength training and will be able to take those classes free of charge. Normal SSSH sessions follow the same general principles. All exercise training sessions are completed under the supervision of trained exercise personnel. The classes consist of group strength training, balance and flexibility twice a week for eight weeks. Each session begins with a 5 min warm-up period, followed by two sets of ten repetitions of eight strength exercises including, but not limited to wide leg squat, standing leg curl, knee extension, side hip raise, biceps curl, overhead press, seated row and toe stand. Exercises are subject to change and will vary with each individual as needed to ensure progression and specificity. Classes end with a 5 minute cool down period including light stretching and breathing exercises.

Participants who are assigned to the walking group will be asked to refrain from any strength training or auxiliary forms of physical activity outside of the designated walking group. Two times per week SSSH personnel will guide these walking groups for about 45 minutes of total exercise time. Participants who complete the study will be automatically enrolled in the next SSSH program free of charge.

Participants who are assigned to the sedentary control group will be asked to refrain from any strength training or auxiliary forms of physical activity for the duration of the study. Participants who complete the study will be automatically enrolled in the next SSSH program free of charge.

Statistical Analysis- All data will be tested for normality. Baseline characteristics will be assessed using a one-way ANOVA. A repeated measures ANOVA with between and within effects will be used to track physiological changes over time in each group. Pearson's correlations will be used to better understand relationships between variables. Rates of change will also be calculated and will be assessed using t-tests.

Potential Risks/Adverse Events

The research team has taken extensive measures to reduce risk and the potential for adverse events. Both participant and research staff safety are a priority. We will minimize these risk by taking the following precautions:

- Standard aseptic technique will be used for drawing blood and only trained personnel will complete blood sample, DXA scans, and functional testing.
- This research does not involve vulnerable populations and we are not collecting any highly sensitive personal or medical information (e.g. social security numbers, banking information, HIPAA information) and do not expect any of the collected data to impact a participant's employment, insurability, social status, or reputation if it were to become public.
- Subjects' information will be coded and will be stored on University of Missouri secure database and we will follow a strict protocol to ensure patient confidentiality at all times.
- Subjects are asked to perform balance assessment tests close to a wall under the supervision of trained personnel to avoid falls. Trained research staff will always be within reach to aid a participant if they lose their balance. Participants will never be left alone to complete a task.

Any serious adverse events will be reported directly to the IRB, please see the Data Safety Monitoring Plan below for more details. In case of emergency, the electromyography, dual x-ray absorptiometry, or blood drawing process will be immediately stopped. We will dial 911 in the case of emergency.

Anticipated Benefits
Potential benefits experienced by the participant include: decreased risk of fall and frailty; improve sleep and cognition; increased muscle mass and strength; and improvements in bone turnover rates. Potential benefits to society include the curbing of the declining physical and mental capacity among seniors, which are key risk factors for falls. Strength training has been shown to mitigate these factors in seniors, ultimately saving the healthcare system billions of dollars in associated costs.

Compensation
All participants who enroll in the study will be eligible for waived class fees for one eight week SSSH intervention, valued at $65. Participants who are randomized into the SSSH intervention will have the waiver immediately applied. Participants randomized into either the walking group or the sedentary control group will be able to enroll in the SSSH program free of charge after the research study is complete. All participants who complete the study will also be compensated $100 via check for their time.

Costs
The costs for this study and procedures will be paid through internal departmental grant funding through the Department of Nutrition and Exercise Physiology and University of Missouri-Extension. For instance, laboratory fees associated with the blood draw and DXA scans will be waived by the Department of Nutrition and Exercise Physiology. Equipment and personnel costs will be covered by both entities.

Total Personnel Costs = $16,517 Total Equipment Costs = $7,249 Total Participant Compensation = $6,000

Data Safety Monitoring Plan
In order to protect the participants' personal information, data, and right to privacy this research team will take extensive precautions to maintain confidentiality. After the participant has cleared the initial screening forms and signed the informed consent all remaining surveys, questionnaires, DXA results, blood samples, and data sheets will only contain the participant' identification code. The key linking names and participant identification codes will be accessible to Dr. Dana Duren and she will only share the key with the research team once unblinding is necessary. All paper records will be kept in a locked filing cabinet in Dr. Duren's MU office (she is a Professor and Director of Orthopaedic Research and is familiar with handling confidential documents). Computerized records of experimental data will be similarly coded and will be maintained on a password protected MU secure computer. Copies of signed consent forms, as well as the experimental log book, are kept in a locked file cabinet in Dr. Duren's office. Participants will not be individually identified in any publications.

Additionally, all adverse events and/or unanticipated problems will be evaluated by Drs. Duren, Ball, and Baker as they occur, for subject safety and appropriate follow-up assessment, treatment, or care. All adverse events and/or unanticipated problems will be evaluated and assessed to answer the following questions: Is the event unexpected? Is the event related or possibly related to participation in the research? Does the event suggest that the research places subjects or others at a greater risk of harm than previously known or recognized? If all three answers are "yes", the event will be reported to the IRB within 5 days of the investigator becoming aware of the event. While reviewing each event, the PI(s) will determine if it is safe for the subject to continue participating in the trial and if it is safe to continue enrollment and research activity for all subjects.

Multiple Sites

University of Missouri is the only site where research activities will occur. All required approvals are in order for the three specific rooms where data will be collected and analyzed.

References/Appendices

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