Effects of StrongPeople Strong Bodies on Functional Fitness: A Community-Based Randomized Trial

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ABSTRACT

Purpose: Despite the established benefits of strength training among older adults, access to strength training facilities in rural communities is limited. Local community educator–led classes using affordable equipment that can be easily stored and moved (e.g., handheld weights) offer a feasible approach for improving strength training access among older rural adults; however, very few studies have examined the effects of these types of community-based classes led by nonexercise specialists. The objective of this study was to evaluate the effects of a community-based progressive strength training program led by Cooperative Extension county educators on functional fitness and physical activity among older rural adults. **Methods:** Adults 50 yr and older recruited from rural Montana counties were randomized to a 12-wk, 1-h, twice-weekly, progressive strength training program, or a delayed intervention control group. Data were collected at baseline and postintervention via accelerometry, functional fitness tests, and questionnaires about physical activity, social support, and exercise attitudes. Linear mixed models and general additive models, adjusted for sex and age, were used to assess pre–post changes in outcomes between groups. **Results:** Intervention participants ($n = 83$) experienced significantly greater improvements in aerobic endurance, upper body strength, lower body strength, exercise-related social support from friends, and attitudes toward exercise (all $P < 0.01$) compared with control participants ($n = 84$); improvements were both statistically significant and functionally meaningful. **Conclusions:** The present study provides strong evidence in support of strength training for older adults in community settings, led by nonexercise professionals, to improve cardiorespiratory fitness, strength, social support for physical activity, and attitudes toward exercise. **Trial Registration:** The study was registered at ClinicalTrials.gov (Identifier: [NCT04203563]).

BACKGROUND

A large body of evidence demonstrates the beneficial impacts of strength training on functional fitness, bone density, and muscle mass among older adults (1). Importantly, improvements in musculoskeletal function can delay the onset of disability and dependence (2). Despite the numerous benefits of strength training, particularly for older adults, less than 25% of US adults older than 55 yr meet muscle strengthening guidelines, and rates are lower for those who are female, are older than 65 yr, and/or live in rural areas (3). These three demographic groups also are more likely to have functional limitations (4,5).

Many resistance training studies with older adults use exercise machines. Although these studies easily facilitate resistance progression, they are less accessible for use in rural community settings because of space and cost considerations. Some studies have used basic equipment (e.g., ankle weights, dumbbells) in resistance training with older adults and observed improvements in strength, balance, physical function, bone density, flexibility, and/or body composition (6–18), although two studies found limited or no improvements in strength (19) or bone density (20). Of the studies that used basic equipment with older adults, only six were randomized trials (6,8,9,14, 15,20). In rural communities, the model most feasible for long-term program maintenance is having classes using basic equipment and led by community educators rather than exercise specialists. Of the six randomized trials using basic equipment, five were led by exercise specialists (i.e., physical therapists) or members of the research team (6,8,14,15,20).

The community-based *StrongPeople Strong Bodies* (*SPSB*) strength training program holds promise to address this gap in research. SPSB was developed based on the body of research on progressive strength training among older adults. The curriculum was designed to support community educators in leading

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strength training classes using basic equipment and emphasizes exercise safety (e.g., proper technique) and gradual progression in intensity. In nonrandomized studies, SPSB has demonstrated improvements in strength, flexibility, aerobic fitness, agility, and general physical activity behaviors in midlife and older women when delivered by Extension educators (17, 21). In one rural nonrandomized trial, SPSB was adapted for a breast cancer survivorship program and classes were led by certified cancer exercise trainers; participants improved strength, flexibility, and balance (22). The present study is the first randomized controlled trial of SPSB and aimed to evaluate effects on functional fitness and physical activity outcomes among rural men and women 50 yr and older.

METHODS

Design and Sample

Participants 50 yr and older were recruited from six rural counties in Montana and randomized to the SPSB intervention or a delayed intervention control. Counties were classified as Rural–Urban Commuting Area code 7 or higher and designated as a medically underserved area or population by the Health Resources and Services Administration (23). In addition, the median household income of the selected communities was at least 15% lower than the state level. Control participants were asked to maintain their current physical activity level and not to strength train or take exercise classes for the first 12 wk of the study and were invited to participate in the classes after outcome assessment. Exclusion criteria included having strength trained in the past 12 months, previous enrollment in SPSB, enrolled/planning to enroll in a healthy lifestyle program, cognitive impairment, or inability to obtain authorization from a health care provider to participate, when applicable. All study activities were reviewed and approved by the Montana State University Institutional Review Board, and all participants provided written informed consent before participation. The study was registered at ClinicalTrials.gov (Identifier: NCT04203563).

Randomization

The blinded study statistician determined randomization assignment. After baseline assessments, randomization assignments were revealed to program leaders and participants.

Sample Size

Sample size estimates were based on comparing the intervention and control groups with respect to change (pre–post) across the 12-wk intervention period. The current trial was powered to detect changes (Cohen's $d = 0.20$) in physical function, anthropometric, and behavioral outcomes. Assuming two measurement time points, $\alpha = 0.05$, continuous outcomes, and a correlation between time points of $r = 0.50$, power analyses revealed that approximately 75 participants per group would provide power = 0.80. To account for 10% to 15% attrition, we aimed to recruit 84 participants per group.

Cooperative Extension

The study was conducted through Cooperative Extension, which is affiliated with land grant universities in each state, with an office in or near most of the nation's counties (24). For more than a century, Extension has been offering research-based programs through informal, community education, reaching millions of people across the United States (24). Extension provides a national network of community educators, which is ideal for widespread dissemination for programs such as SPSB.

Intervention

The original research that formed the foundation of SPSB (called StrongWomen at that time) was a study examining the effects of strength training on bone density and other risk factors for osteoporosis; the study was the first to show that midlife and older women could improve bone density and muscle mass through strength training (25). SPSB was developed soon after to translate those research findings into a formalized community-based program for implementation by Extension educators and other allied health professionals.

The SPSB program consisted of in-person hour-long group progressive strength training classes held twice weekly over 12 wk. Classes were held in various community locations (e.g., churches) and were facilitated by Extension educators who were experienced health promotion class leaders. Educators had been leading SPSB classes for an average of 6 yr. The educators participated in a full-day face-to-face group intervention training, which included guidance on strength training techniques for older adults, including how and when to prompt safe increases in exercise intensity. In addition, they participated in a 1-h one-on-one fidelity and progression training within 2 wk of beginning the intervention. Leaders were trained by the SPSB Program Director, an SPSB Ambassador (SPSB leader trained to train other leaders), and the state Extension Health and Wellness Specialist. Intervention classes included a warm-up (walking/marching), cool-down (stretching/flexibility exercises), and three sets of eight repetitions of the following exercises: wide leg squat, standing leg curl, knee extension, side hip raise, bicep curl, overhead press, and bent forward fly (see Supplemental Digital Content 1, http://links.lww.com/TJACSM/A138, which illustrates the exercises performed in the SPSB program) All strengthening exercises were performed using free weights (dumbbells and adjustable ankle weights) or no weights (i.e., bodyweight exercises). Participants in the intervention group were encouraged to complete this strength training routine at home 1 d per week, in addition to the 2 d in class.

To obtain maximum gains from strength training programs, it is imperative for participants to work out at the proper intensity and progress. Leaders were familiar with a 5-point Strength Training Intensity Scale, which ranged from 1 (very easy) to 5 (extremely hard); participants worked at a level 2 (easy) or 3 (moderate) while they learned proper exercise technique. When participants had mastered the technique, leaders encouraged them to work at a 4 ("Hard: More than moderate at first, and becoming difficult by the time you complete four or five repetitions. You can make the effort 10 times in good form, but need to rest afterwards.") Leaders used an Exercise Intensity Indicator with questions and answers to encourage participants to increase the weight lifted for a particular exercise when they could complete more than 10 repetitions with good form (e.g., After completing 10 repetitions, do you need to rest because the weight is too heavy to complete more repetitions in good form? *Yes:* Participant is working at the proper intensity and should not increase weight).

Measures

Data were collected at baseline and postintervention. Blinded research staff collected the anthropometric and physiologic data from participants at local Extension offices or other convenient locations, such as community centers. Participants completed questionnaires to assess demographic characteristics and self-reported measures. Using standardized forms, program leaders recorded participant attendance, and participants completed logs to track weight resistance progression. Participants recorded weight lifted during at-home exercise sessions on the same log sheets.

PHYSICAL ACTIVITY RELATED MEASURES

Physical activity outcomes included objective physical activity, self-reported physical activity, exercise social support, and exercise attitudes. Objective physical activity was measured using ActiGraph Model GT3XE accelerometers worn for 7 d at each assessment time point (ActiGraph LLC, Pensacola, FL). Accelerometer data were cleaned and scored using ActiLife software (ActiGraph LLC). Data were recorded at 30 Hz and analyzed using an epoch length of 60 s. Wear time intervals were identified using a widely used algorithm (26). Additional inclusion parameters included daily wear times of ≥600 $\text{min}\cdot\text{d}^{-1}$ and overall wear time of ≥3000 min over four or more days. Accelerometer outcomes included average daily step counts, sedentary time, and physical activity time. Freedson cut-points were used to determine total time spent in varying intensities of physical activity (i.e., sedentary, light, moderate, or vigorous) (27). For each intensity category, total time (in minutes) was divided by the number of valid wear days to calculate average minutes per day. Weekly duration of moderate-to-vigorous physical activity (MVPA) was calculated by multiplying average daily MVPA by 7. Weekly MVPA was used to classify participants as meeting physical activity recommendations (≥150 $\text{min}\cdot\text{wk}^{-1}$) or not meeting recommendations (<150 $\text{min}\cdot\text{wk}^{-1}$) (28).

Self-reported physical activity was assessed using the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire (29) and the International Physical Activity Questionnaire (IPAQ) Short Form (30). The CHAMPS questionnaire includes 41 questions about the weekly frequency and duration of various physical activities (e.g., walking, hiking, gardening). Durations are reported using the following response categories: <1, 1–2.5, 3–4.5, 5–6.5, 7–8.5, and ≥9 h. Weekly durations of all exercise-related activities were recoded (<1 h, 0.5; 1–2.5 h, 1.75; 3–4.5 h, 3.75; 5–6.5 h, 5.75; 7–8.5 h, 7.75; ≥9 h, 9.75) and summed to create a total physical activity duration score (hours per week). The CHAMPS questionnaire has acceptable test–retest reliability (intraclass correlation coefficients = 0.56–0.70) and is moderately associated with accelerometry measures (Spearman rank order correlation = 0.27–0.37) (31). The IPAQ Short Form consists of six questions about the frequency and duration of vigorous intensity, moderate intensity, and walking activities over the past 7 d. Frequency is reported in days per week, and duration is reported in minutes per day. Durations of each intensity type (i.e., vigorous, moderate, walking) were converted to hours per day and multiplied by the corresponding frequency to create a weekly duration score. Weekly durations for all three intensities were summed to create a total physical activity duration score (hours per week). The IPAQ Short Form has very good repeatability, with test–retest Spearman correlation coefficients averaging 0.7 and moderate agreement with accelerometry measures (Spearman coefficient = 0.30) (30).

Exercise social support was evaluated using the Sallis Social Support for Exercise survey (32), and exercise attitudes were assessed using the American Association of Retired Persons attitudes and behaviors survey for older adults (33). The Sallis Social Support for Exercise survey consists of 13 items about various exercise-related actions made by family and friends of the respondent over the past 3 months. Respondents are asked to rate the frequency of each action on a scale of 1 to 5 (1, none; 5, very often). Items are rated twice: once for family members and once for friends, acquaintances, or coworkers. Ratings for 10 of 13 items were summed to create an overall "family participation" score and an overall "friends participation" score, with higher scores indicating greater social support. The Sallis Social Support for Exercise survey has acceptable test–retest reliability (r = 0.55–0.86) and internal consistency (α = 0.61–0.91) (32). The American Association of Retired Persons survey includes 14 statements about attitudes related to exercise and fitness. Respondents are asked to indicate the extent to which they agree with each statement on a scale of 1 to 5 (1, strongly disagree; 5, strongly agree). Negative statements were reverse coded (5, strongly disagree; 1, strongly agree), and all items were summed to create an overall exercise attitudes score, with higher scores indicating more favorable attitudes.

PHYSICAL FUNCTION RELATED MEASURES

Functional fitness was assessed by trained research personnel using the Senior Fitness Test, a valid and reliable series of tests to measure strength, flexibility, endurance, balance, and agility among older adults (34). Tests include the 30-s chair stand (lower extremity strength), 30-s arm curl (upper extremity strength), chair sit-and-reach (lower body flexibility), back scratch (upper body flexibility), 2-min step test (aerobic endurance), and 8-ft up-and-go (agility and dynamic balance). Testing procedures were followed as outlined in the *Senior Fitness Test Manual* (34).

Analysis

Baseline demographic characteristics and outcome variables were summarized using means (SD) for continuous variables and frequencies (percentages) for categorical variables. t-Tests (continuous), Mann-Whitney U tests (continuous, nonnormally distributed), or χ^2 tests of independence (categorical) were used to compare differences in baseline characteristics between the intervention and control groups.

Linear mixed models were used to assess changes in normally distributed outcome variables within and between treatment groups (SAS PROC MIXED procedure) and adjusted for sex, age, and site (random effect). This analytic approach uses all available data from randomized participants rather than complete cases alone and provides comparable estimates to multiple imputation analyses (35,36). Changes in nonnormally distributed outcome variables were assessed using general additive models (SAS PROC GAM procedure), also using all available data, adjusted for sex and age. Log-binomial models were used to assess changes in the probability of meeting physical activity recommendations (SAS PROC GENMOD procedure).

To better understand the effects of the intervention on sex, age, and dose, all analyses were repeated for female participants 60 yr and older (the sample of older male participants was inadequate for analysis) as well as with intervention participants who averaged two or more sessions per week versus those who averaged less than two sessions per week. Analyses were conducted in 2020 and 2021 using IBM SPSS Statistics for Macintosh (version 25.0; IBM Corp., Armonk, NY; 2017) and SAS v9.4 (SAS Institute Inc., Cary, NC; 2018). P values of ≤0.05 were considered significant.

RESULTS

Fig. 1 shows the Consolidated Standards of Reporting Trials (CONSORT) flow diagram for the study. A total of 167 participants were enrolled in the study and randomized to intervention (n = 83) or delayed intervention control (n = 84). Participants were primarily female (78%), non-Hispanic White (91%), married (70%), and either employed (45%) or retired (48%). Table 1 presents participant baseline characteristics by treatment group. No adverse events or unintended effects were reported. The number of participants in intervention groups (group strength training classes) ranged from 10 to 19 participants, with an average of 15 participants.

Intervention participants experienced greater improvements in aerobic endurance (2-min step test: difference, 12.10 steps; $P < 0.001$), upper body strength (arm curl: difference, 1.77 reps per 30-s interval; $P = 0.01$), and lower body strength (chair stand: difference, 1.81 reps per 30-s interval; $P = 0.001$) compared with controls (Table 2). There were no differences between the intervention and control groups for agility and dynamic balance (8-ft up-and-go), upper body flexibility (back scratch), or lower body flexibility (sit and reach). Decreases in accelerometer-measured physical activity (counts per day and minutes per day) and self-reported physical activity (hours per week) were observed among both intervention and control participants. Although no significant differences were observed between groups, these decreases were smaller in magnitude among intervention participants (Table 2). Approximately 35% of participants met physical activity recommendations at baseline, and participants were less likely to meet these recommendations postintervention, with no significant differences between groups (Table 2). Compared with the controls, intervention participants reported improvements in exercise-related social support from friends (difference, 4.22; $P < 0.005$) and attitudes toward exercise (difference, 2.83; $P < 0.001$). No significant differences in social support from family members were observed between groups (Table 2).

Comparable findings were observed among female participants 60 yr and older. Intervention participants experienced greater improvements in lower body strength (difference, 1.76 reps; $P = 0.009$) and aerobic endurance (difference, 17.63 steps; $P < 0.001$) compared with controls (Table 3). The intervention group significantly improved agility and dynamic balance (8-ft up-and-go), but the difference between groups was not significant; neither of the 60-yr-and-older groups significantly improved upper body flexibility (back scratch) or lower body flexibility

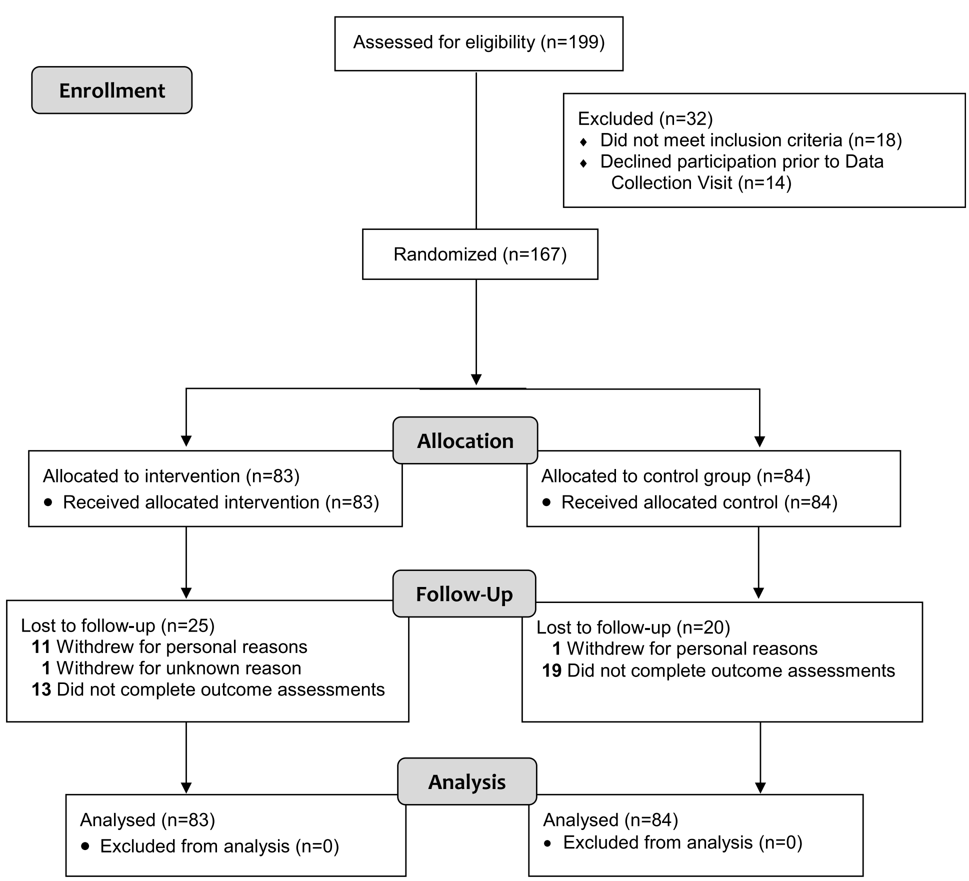

Figure 1: Consolidated Standards of Reporting Trials (CONSORT) flow diagram.

TABLE 1.
Baseline Characteristics of StrongPeople Strong Bodies Study Participants (n = 167).

	Intervention (n = 83)		Control (n = 84)	
Characteristic	n	Mean (SD) or %	n	Mean (SD) or %
Age (y)	83	64.8 (7.9)	84	65.1 (7.5)
Sex				
Female	67	80.7	63	75.0
Male	16	19.3	21	25.0
Race/Ethnicity*				
Non-Hispanic White	77	95.1	65	85.5
Hispanic/Latino	1	1.2	2	2.6
Non-Hispanic Black	0	0.0	1	1.3
American Indian/ Alaskan Native	0	0.0	8	10.5
Other	3	3.7	0	0.0
Education				
High school diploma or less	16	19.8	17	22.4
Technical/ vocational degree	7	8.6	4	5.3
Some college	24	29.6	21	27.6
College degree	26	32.1	23	30.3
Postgraduation/ professional degree	8	9.9	11	14.5
Marital status				
Married or cohabiting	57	70.4	54	71.0
Living alone	24	29.6	22	29.0
Employment				
Working	37	45.7	34	44.7
Not working	44	54.3	42	55.3

*$P \leq 0.01$.

(sit and reach). There were no differences between groups for physical activity, as measured by accelerometer or self-report (Table 3). Intervention participants also reported improvements in exercise attitudes (difference, 3.77; $P < 0.001$) compared with controls.

Several differences in functional fitness and physical activity measures were observed when comparing intervention participants with higher (two or more total sessions per week, including class and at-home sessions) or lower (less than two total sessions per week) exercise sessions. Participants with higher exercise sessions had greater improvements in lower body flexibility (difference, 3.91 cm; $P = 0.04$), total physical activity duration (CHAMPS: difference, 5.81 h·wk^{-1}; $P = 0.01$; IPAQ: difference, 4.28 h·wk^{-1}; $P = 0.05$), average light-intensity physical activity (accelerometer: difference, 56.07 min·d^{-1}; $P = 0.01$) compared with those with fewer exercise sessions per week (Table 4).

Ninety-three percent of intervention participants reported progressions in weight resistance by the end of the intervention. Percentage increases in weight resistance varied from 59% to 128% across intervention sites, corresponding to an increase of 2.2 to 5.3 lb of weight lifted. The amount of weight lifted varied by exercise: for wide leg squat, the average increase was 6 lb (minimum −6 lb, maximum 40 lb); for hamstring leg curl, the average increase was 3 lb (minimum −6 lb, maximum 11 lb); for knee extension, the average increase was 3 lb (minimum −6 lb, maximum 11 lb); for side hip raise, the average increase was 3 lb (minimum −6 lb, maximum 11 lb); for bicep curl, the average increase was 4 lb (minimum −2 lb, maximum 25 lb); for overhead shoulder press, the average increase was 3 lb (minimum −2 lb, maximum 25 lb); and for bent forward fly, the average increase was 3 lb (minimum −6 lb, maximum 15 lb).

DISCUSSION

Community educator–led strength training programs that use basic equipment offer a feasible model for improving musculoskeletal fitness among rural older adults. The present study adds to this limited yet important area of research by examining functional fitness and physical activity outcomes among older adults participating in a randomized controlled community-based strength training program led by Extension educators.

Intervention participants experienced greater improvements in aerobic endurance, upper and lower body strength, exercise-related social support from friends, and attitudes toward exercise than controls; improvements were both statistically and functionally meaningful. Findings were comparable when examining only female participants 60 yr and older. The majority of participants also reported progressions in weight resistance (pounds of weight lifted) over the course of the program. For a 65-yr-old woman, the average change from baseline to the end of the intervention in Senior Fitness Test measures by intervention participants would correlate to an improvement from the 50th to 85th percentile for lower body strength, 85th to 100th percentile for upper body strength, and 40th to 65th percentile for aerobic endurance. For a 65-yr-old man, the changes from baseline would correlate to improvement from the 40th to 65th percentile for lower body strength, 60th to 90th percentile for upper body strength, and 20th to 50th percentile for aerobic endurance.

Only one other randomized controlled strength training trial was previously conducted among older adults using basic equipment and community educators. Health educators were randomly assigned to deliver a twice-weekly, 8-wk strength program with behavioral change strategies (n = 60 participants after the program) or without these strategies (n = 19 participants after then program) (9). Similar to the present study, they

TABLE 2.
Change in Functional Fitness and Physical Activity–Related Measures among StrongPeople Strong Bodies Participants (*n* = 167).

	Intervention (*n* = 83)		Control (*n* = 84)		Between Groups
	Baseline Mean (SD) or %	Pre-to-Post Change (SE)	Baseline Mean (SD) or %	Pre-to-Post Change (SE)	Difference in Change (SE)
Functional fitness					
8-ft up-and-go (s)	6.2 (2.3)	−0.57 (0.41)	6.7 (2.5)	−0.71 (0.35)	0.13 (0.54)
Arm curl (reps)	20.0 (5.7)	**4.79 (0.51)*** **	19.1 (5.6)	**3.02 (0.50)*** **	**1.77 (0.71)** **
Chair stand (reps)	13.8 (4.4)	**3.30 (0.40)*** **	13.4 (5.1)	**1.49 (0.38)*** **	**1.81 (0.55)*** **
Back scratch (cm)	−4.5 (15.6)	−1.47 (1.99)	−4.8 (15.8)	**−3.84 (1.94)* **	2.36 (2.77)
Sit and reach (cm)	6.6 (8.2)	1.74 (1.29)	3.0 (8.9)	−0.38 (1.37)	2.12 (1.90)
2-min step test (steps)	82.6 (18.6)	**17.4 (2.40)*** **	83.4 (23.5)	**5.29 (2.35)* **	**12.10 (3.34)*** **
Accelerometer					
Average daily steps (counts per day)	12,913 (4,260)	**−900.62 (415.26)* **	13,347 (4.771)	**−1981.15 (402.21)*** **	1080.53 (578.13)
Light activity (min·d^{-1})	314.0 (83.8)	−12.42 (6.85)	314.4 (88.3)	**−26.74 (6.64)*** **	14.30 (9.54)
MVPA (min·d^{-1})	18.1 (17.6)	**−6.10 (2.59)* **	19.9 (25.9)	−6.65 (3.73)	0.77 (4.59)
Sedentary time (min·d^{-1})	489.2 (101.2)	**29.03 (14.24)* **	492.6 (95.7)	**46.74 (13.77)*** **	−17.71 (19.81)
Total physical activity					
CHAMPS (h·wk^{-1})	11.6 (9.8)	−2.18 (1.48)	9.6 (9.1)	**−2.99 (1.21)** **	0.82 (1.90)
IPAQ (h·wk^{-1})	8.3 (12.4)	**−3.67 (1.54)* **	6.7 (9.7)	**−2.96 (1.33)* **	−0.71 (2.04)
Meeting physical activity Recommendations[a]	35.5	**0.41 (1.37)** **	33.8	0.67 (1.27)	0.61 (1.49)
Exercise social support					
Family (range, 10–50)	17.7 (8.7)	0.88 (1.45)	18.0 (7.1)	−0.49 (1.32)	1.44 (1.99)
Friends (range, 10–50)	14.4 (5.8)	**3.94 (1.12)*** **	14.5 (4.9)	−0.23 (1.01)	**4.22 (1.50)** **
Exercise attitudes (range, 14–70)	35.3 (5.4)	**1.88 (0.46)*** **	36.6 (6.1)	**−0.95 (0.45)* **	**2.83 (0.64)*** **

Boldface indicates significant differences ($P \leq 0.05$). Differences were evaluated using linear mixed models (continuous, normal outcomes), nonparametric additive models (continuous, nonnormal outcomes), or log-binomial models (binary outcomes). Models were adjusted for participant age and sex.

*$P \leq 0.05$.

**$P \leq 0.01$.

***$P \leq 0.001$.

[a] Estimates are risk ratios.

CHAMPS, Community Healthy Activities Model Program for Seniors; IPAQ, International Physical Activity Questionnaire; MVPA, moderate-to-vigorous physical activity.

found that participants in both programs improved aerobic endurance, lower body strength, and lower and upper body flexibility (9). Participants in the program that included behavioral change strategies also improved upper body strength and agility (9). In comparison, improvements in functional fitness among SPSB participants were similar or, in some cases,

TABLE 3.
Change in Functional Fitness and Physical Activity–Related Measures among StrongPeople Strong Bodies Participants, Women 60 Yr or Older (*n* = 93).

	Intervention (*n* = 48)		Control (*n* = 45)		Between Groups
	Baseline Mean (SD) or %	Pre-to-Post Change (SE)	Baseline Mean (SD) or %	Pre-to-Post Change (SE)	Difference in Change (SE)
Functional fitness					
8-ft up-and-go (s)	6.6 (2.7)	**−1.05 (0.48)***	6.9 (2.3)	−0.49 (0.49)	−0.57 (0.69)
Arm curl (reps)	18.6 (5.0)	**3.96 (0.61)*****	17.2 (4.2)	**3.33 (0.60)*****	0.63 (0.86)
Chair stand (reps)	12.7 (4.1)	**3.26 (0.47)*****	12.8 (4.2)	**1.50 (0.46)****	**1.76 (0.65)****
Back scratch (cm)	−3.8 (11.0)	0.52 (2.30)	−2.9 (15.4)	−4.29 (2.25)	4.81 (3.22)
Sit and reach (cm)	6.5 (8.8)	2.50 (1.75)	3.9 (7.7)	−0.44 (1.51)	2.94 (2.30)
2-min step test (steps)	79.7 (19.5)	**20.02 (3.61)*****	81.5 (22.4)	2.39 (3.60)	**17.63 (5.10)*****
Accelerometer					
Average daily steps (counts per day)	11,839 (4,085)	−713.79 (444.52)	13,772 (4,935)	**−1721.44 (491.73)*****	1007.65 (663.00)
Light activity ($\text{min}\cdot\text{d}^{-1}$)	299.8 (83.5)	−8.09 (8.61)	325.9 (85.4)	**−29.34 (9.53)****	21.25 (12.84)
MVPA ($\text{min}\cdot\text{d}^{-1}$)	12.6 (14.8)	−2.73 (2.78)	19.2 (27.2)	−8.20 (5.64)	5.73 (5.99)
Sedentary time ($\text{min}\cdot\text{d}^{-1}$)	502.2 (103.4)	16.22 (17.77)	484.0 (84.5)	**43.85 (19.40)***	−27.63 (26.32)
Total physical activity					
CHAMPS ($\text{h}\cdot\text{wk}^{-1}$)	11.5 (9.4)	−2.35 (1.75)	10.1 (11.2)	**−4.09 (1.92)***	1.75 (2.59)
IPAQ ($\text{h}\cdot\text{wk}^{-1}$)	7.2 (10.6)	−3.21 (1.80)	5.9 (6.6)	−1.14 (1.72)	−2.07 (2.50)
Meeting physical activity Recommendations[a]	41.7	0.35 (1.76)	46.7	**0.39 (1.56)***	0.89 (2.05)
Exercise social support					
Family (range, 10–50)	17.1 (8.1)	0.32 (1.83)	18.3 (7.5)	−0.094 (2.22)	0.41 (2.89)
Friends (range, 10–50)	14.9 (5.9)	2.51 (1.41)	14.7 (5.0)	0.043 (1.47)	2.59 (2.06)
Exercise attitudes (range, 14–70)	35.5 (6.1)	**2.12 (0.62)*****	37.2 (6.8)	**−1.65 (0.65)****	**3.77 (0.90)*****

Boldface indicates significant differences ($P \le 0.05$). Differences were evaluated using linear mixed models (continuous, normal outcomes), nonparametric general additive models (continuous, nonnormal outcomes), or log-binomial models (binary outcomes).

*$P \le 0.05$.

**$P \le 0.01$.

***$P \le 0.001$.

[a] Estimates are risk ratios.

CHAMPS, Community Healthy Activities Model Program for Seniors; IPAQ, International Physical Activity Questionnaire; MVPA, moderate-to-vigorous physical activity.

better (i.e., upper body strength, lower body strength, and aerobic endurance). Agility, balance, and flexibility are important for fall prevention (37). Although there were no significant differences between groups for agility and dynamic balance or flexibility in this study, these measures have improved in other SPSB studies (21).

TABLE 4.
Change in Functional Fitness and Physical Activity–Related Measures among SPSB Intervention Participants by Number of Exercise Sessions (*n* = 83).

	≥2 Sessions per Week (*n* = 39)		<2 Sessions per Week (*n* = 44)		Between Groups
	Baseline Mean	Pre-to-Post Change (SE)	Baseline Mean	Pre-to-Post Change (SE)	Difference in Change (SE)
Functional fitness					
8-ft up-and-go (s)	6.35	−1.01 (0.55)	6.09	−0.05 (0.58)	−0.70 (0.62)
Arm curl (reps)	19.70	**5.18 (0.76)*****	20.26	**4.3 (0.83)*****	0.32 (1.38)
Chair stand (reps)	14.01	**3.49 (0.51)*****	13.63	**3.05 (0.58***)**	0.82 (0.97)
Back scratch (cm)	−6.81	−0.86 (0.77)	−2.40	−1.77 (3.14)	−3.51 (3.79)
Sit and reach (cm)	7.45	2.49 (1.39)	5.82	0.22 (1.51)	**3.91 (1.91)***
2-min step test (steps)	83.15	**16.69 (3.17)*****	82.12	**18.35 (3.47)*****	−0.63 (4.60)
Accelerometer					
Average daily steps (counts per day)	13092	−563.40 (535.50)	12728.00	**−1561.90 (716.93)***	1362.57 (1092.83)
Light activity (min·d^{-1})	321.65	1.32 (8.03)	307.04	**−40.14 (10.93)*****	**56.07 (20.39)****
MVPA (min·d^{-1})	18.58	**−6.17 (2.19)****	17.38	**−6.65 (2.89)**	1.68 (3.95)
Sedentary time (min·d^{-1})	498.65	18.94 (18.93)	480.26	43.91 (24.57)	−6.59 (31.10)
Total physical activity					
CHAMPS (h·wk^{-1})	11.11	1.40 (1.20)	12.04	**−5.35 (1.88)****	**5.81 (2.07)****
IPAQ (h·wk^{-1})	6.94	−0.01 (1.89)	9.54	**−6.90 (1.78)*****	**4.28 (2.19)***
Exercise social support					
Family (range, 10–50)	16.94	1.75 (1.34)	18.18	0.77 (1.51)	−0.27 (2.16)
Friends (range, 10–50)	14.46	**4.39 (0.96)*****	14.12	**2.73 (1.19)***	2.00 (1.61)
Exercise attitudes (range, 14–70)	35.35	**1.76 (0.60)****	35.31	**02.07 (0.74)****	−0.27 (1.32)

Boldface indicates significant differences ($P \leq 0.05$). Differences were evaluated using linear mixed models (continuous, normal outcomes).
*$P \leq 0.05$.
**$P \leq 0.01$.
***$P \leq 0.001$.
CHAMPS, Community Healthy Activities Model Program for Seniors; IPAQ, International Physical Activity Questionnaire; MVPA, moderate-to-vigorous physical activity; SPSB, StrongPeople Strong Bodies.

Social support and attitudes toward exercise are important predictors of sustained physical activity behavior change for older adults (38–40). Some studies have suggested that social support from family members may be more important than social support from friends (41,42). The Sallis Social Support for Exercise survey indicates that respondents should include acquaintances and/or coworkers when reporting on social support received from friends. Thus, participants may have included other SPSB participants and/or the class leader when reporting exercise social support postintervention, which likely contributed to the improved score. For example, participants may have responded that friends (including SPSB classmates and/or the class leader) "exercised with me" or "discussed exercise with me" more often than at baseline (before meeting classmates and the leader).

Participants were provided with weights and were encouraged to perform the strength training exercises at home once per week; they also were encouraged to perform the exercises at home if they missed a class. A few differences in functional fitness and physical activity measures were observed when comparing intervention participants with higher average number of exercise sessions per week (two or more vs less than two): lower body flexibility, light physical activity, and total physical activity, indicating that more benefits may be achieved with at least two strength training sessions per week.

Although the intervention group in the 12-wk program improved in aerobic endurance, strength, and other measures, it is worth noting that average in-class attendance was about 15 of 24 classes (twice weekly for 12 wk). If at-home workouts are included, for a total of three workouts per week for 12 wk (two in class and one at home), then an average of 18 workouts were completed in 3 months, or 50% of the 36 workouts prescribed. Thus, significant improvements were made with only about half the dose of the prescribed program.

Intervention and control participants significantly decreased objective and self-reported overall physical activity levels from baseline to postintervention, with no difference between groups. Seasonal differences in leisure time physical activity have been observed in previous studies, with physical activity levels often lower during winter months (43). The decrease in physical activity may be partially explained by Montana weather. Baseline measurements were conducted in September when the weather was quite temperate (average ~60°F), whereas postintervention measurements were taken in December (average ~30°F) when conditions were less conducive to outdoor activities (e.g., snow, ice, darkness). Although indoor exercise options may be available in some rural areas (e.g., fitness facilities, shared-use school gyms) (44), winter weather may contribute to a decrease not only in outdoor activities but also in comfort in driving to places for indoor activities. Because it is designed to be an indoor program, SPSB can be performed throughout the year, across all seasons, particularly if offered online. One reason to prioritize improving affordable broadband Internet access for older adults and people in rural areas is to support the availability of virtual physical activity classes (45). For example, during the COVID-19 pandemic, in Wisconsin, SPSB was quickly adapted to a virtual format, and program leaders received additional training to ensure they had the necessary skills and capacity to facilitate SPSB classes in virtual settings. Forty-five leaders were trained, 191 series of classes were offered, and nearly 5000 individuals participated in the virtual classes.

Given the lack of racial diversity within this rural Montana setting, a majority of participants were non-Hispanic White. Results need to be replicated in diverse populations.

Because rural populations are at greater risk for functional limitations, we selected a rural group for the present study. However, this model could be easily implemented with older adults in urban and suburban settings to assess effectiveness in these contexts. We recognize that to maintain health benefits, strength training must be continued, and that, ideally, studies will collect follow-up data to determine if the programs and results are sustained.

IMPACT

This study demonstrates the effectiveness of progressive strength training using basic equipment and led by nonexercise professionals on functional fitness in adults 50 yr and older.

CONCLUSIONS

The present study provides strong evidence in support of strength training for older adults in community settings to improve cardiorespiratory fitness, strength, social support for physical activity, and attitudes toward exercise. We recommend that future studies examine adaptations of the SPSB program with more frequent classes (e.g., 3 d per week) as well as online sessions to maximize effectiveness and reach.

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