Research Article

Habit Formation Intervention to Reduce Frailty Risk Factors: A Feasibility Study

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Importance: Frailty is common, detrimental, and costly in later life. Interventions can reduce the risk for frailty.

Objective: To assess the feasibility of a frailty prevention intervention.

Design: A two-arm, prospective randomized controlled trial with blinded participant allocation and data collection at baseline and 1 wk postintervention by data collectors blinded to participant assignment.

Setting: Community.

Participants: Thirty community-dwelling, English-speaking, older African-Americans who were classified as prefrail were randomly recruited from a university research subject registry.

Intervention: The habit formation treatment was delivered face to face during 12 weekly home-based sessions approximately 45 min in length.

Outcomes and Measures: We assessed feasibility as reflected in participant recruitment, retention, session attendance, and program satisfaction. Clinical outcomes included sedentary time and dietary quality (primary) as well as frailty status, physical activity, physical function, depression, quality of life, and anthropometry (secondary). Habit formation (mechanism of change) was assessed in the treatment group only.

Results: Twenty women (*M* age = 73.5 yr) completed the study. The recruitment rate was 69.8%, and we retained 95.2% of participants through the end of the study, with session attendance rates of 98.1% and 88.6% for the treatment and control groups, respectively, and mean acceptability scores of 30.3 and 28.0 for the treatment and control groups, respectively. Changes in primary and secondary clinical outcomes were largely in the expected direction.

Conclusions and Relevance: The intervention was feasible to deliver. Although future efficacy studies are needed, our preliminary data suggest the potential of an occupational therapy intervention to reduce frailty risk.

What This Article Adds: Although it may be possible to slow or prevent the progression to frailty by modifying existing habits and occupations, few occupational therapy interventions address frailty. Our data provide new and much-needed insights about the potential feasibility of an occupational therapy intervention to reduce frailty risk.

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Approximately 50% of U.S. older adults are *prefrail*, an intermediate stage between robustness and frailty (Bandeen-Roche et al., 2015). Prefrail older adults are 2–3 times more likely to develop frailty than nonfrail older adults (Fried et al., 2001). *Frailty* is defined as a decline in resilience across one or more domains of functioning (e.g., physical, social, psychological) that reduces a person's ability to respond to or recover from stressors (Bergman et al., 2007). In turn, acute social or health stressors can trigger a cascade of negative sequelae, including premature morbidity, mortality, disability in basic and instrumental activities of daily living, and institutionalization (Fried et al., 2001). Although prefrailty is a marker of increased risk for decline, interventions targeting behavioral determinants of frailty can slow or prevent the progression to frailty (Apóstolo et al., 2018).

Frailty is distinct from related phenomena, such as disability or comorbidity, and it is not a normal part of aging (Fried et al., 2001). Although prefrailty is a marker of increased risk for decline, it is also a time-limited window of opportunity. Interventions targeting

behavioral determinants of frailty can slow or prevent the progression to frailty (Apóstolo et al., 2018).

Dietary quality and sedentary time (ST) have both been associated with frailty development and progression (Apóstolo et al., 2018). For example, a study of 2,154 older adults showed that poor- to medium-quality diets, defined by a Healthy Eating Index (HEI) scores of <51/100 and ≥51–80/100, respectively, were associated with a 40% and 92% respective increase in risk for frailty compared with older adults with good-quality diets (HEI score >80; Hengeveld et al., 2019). Regarding ST, a systematic review of studies with more than 1 million combined participants demonstrated that ST (activity with an intensity of ≤1.5 metabolic equivalents [MET]) had an independent, deleterious association with frailty that was not attenuated by engagement in moderate to vigorous physical activity (MVPA; Kehler et al., 2018).

To reduce frailty risk, older adults must modify long-established occupations, activity patterns, and dietary habits. With their training in activity analysis, habit formation, and environmental modification, occupational therapy practitioners are uniquely suited to assist clients in forming frailty-protective habits and routines and in modifying established occupations to be more health promoting (Fritz & Cutchin, 2016). Moreover, a review of habit formation studies suggested that habit formation strategies (i.e., environmental modification) result in dietary and physical activity (PA) habit change across a range of behaviors and populations (Fritz, Hu, Gahman, et al., 2020). Thus, it is plausible that a habit formation approach could result in similar dietary and activity-related habit changes in the context of frailty and that those changes could translate to reduced frailty risk. Despite the potential of occupational therapy intervention to address the problem of frailty, occupational therapy interventions for frailty are scarce (Fritz et al., 2019).

We previously piloted a low-dose (four-session), frailty prevention intervention targeting habit formation with older African-Americans classified as prefrail (Fritz, Hu, Tarraf, & Patel, 2020). The preliminary results were promising. The treatment resulted in positive changes in habit formation; yet, qualitative data collected during the trial suggested that a higher treatment dose and a home-based delivery structure were desired to remove barriers and potentially achieve a greater impact. The purpose of this article is to further build the evidence base supporting the potential benefit of frailty prevention interventions. Specifically, we report the results of a recently completed feasibility study. The study's specific aims were to (1) assess the feasibility of delivering the revised and more intensive home-based treatment, (2) assess the acceptability of the intervention and trial protocol to participants, and (3) estimate the potential effect of the intervention on dietary quality and ST.

Method

Conceptual Framework and Translation to Treatment Content

The intervention was guided by a framework synthesized from the literature on frailty reduction and habit formation as well as constructs from social cognitive theory (SCT). The treatment therefore included education about the concept of frailty and habit and behavioral skills training on how to develop new or extinguish existing habits (e.g., how to break down larger actions into less complex behaviors, how to modify contexts to support habit formation). Drawing from SCT (Bandura, 2004), our treatment included strategies for increasing self-efficacy: enacted mastery, modeling, and verbal persuasion. The interventionist modeled task performance and prompted participant replication, which allowed for modeling and enacted mastery. Treatment participants also received coaching and feedback, which functioned as a form of verbal persuasion. The treatment also included information about frailty-protective behaviors, goal setting, action planning, self-monitoring, and barrier-resolution skills training to foster self-efficacy, the mastery of the intervention content, and the application of habit formation strategies in daily life.

Study Design

All study procedures were approved by the Wayne State University institutional review board (126216B3E). The two-arm randomized controlled trial was registered at ClinicalTrials.gov (NCT03585972). Between September 1 and October 31, 2019, we recruited our sample of older African-Americans who were classified as prefrail from a university registry of community-dwelling African-Americans age 55 yr and older who were interested in participating in research. The trial ran from September 2019 to February 2020. Our target sample size of $N = 24$ was based on the number of participants deemed necessary to evaluate feasibility.

Participant Recruitment

A trained research assistant (RA) screened registry participants using the Paulson–Lichtenberg Frailty Index (PLFI; Paulson & Lichtenberg, 2015). The PLFI assesses five criteria for frailty: (1) weakness, (2) slowness, (3) low PA, (4) exhaustion or fatigue, and (5) wasting. The presence of one or two criteria indicates prefrailty, and three or more criteria indicate frailty.

Inclusion Criteria

In addition to being classified as prefrail, to be invited to join the study, participants had to be English speaking, African-American, and age 55 yr and older. We focused exclusively on African-Americans because they are 2 to 4 times more likely to develop frailty than their White counterparts and do so at younger

ages (Hirsch et al., 2006) and because they have been overwhelmingly excluded from frailty research.

Exclusion Criteria

We excluded people who self-reported a psychiatric disorder; had moderate or severe cognitive impairment; reported typical daily pain ratings of ≥7 on a 10-point Likert scale; used a wheelchair for mobility; or received home care services, occupational or physical therapy, or dialysis. We also excluded people enrolled in another health promotion program focused on PA, ST, or diet. Finally, we excluded those with baseline HEI scores of ≥85/100 because their diet would already be very close to ideal (mean U.S. population score = 59). Study randomization was implemented in REDCap, a secure data management software (Harris et al., 2009), using block randomization of blocks of two, four, or six. Randomization was carried out by a coordinator not involved in other study activities. Data collectors were blinded to arm assignment.

Procedures

Control Condition

We mailed 12 weekly newsletters covering a range of healthy aging topics to control group participants. With the exception of one newsletter covering general dietary guidelines for adults, the information provided did not overlap with treatment content. After each mailing, a trained RA called participants to discuss the materials.

Habit Formation Treatment Condition

The 12-wk intervention was delivered to each participant by one interventionist, an occupational therapist who received 18 hr of training to deliver the intervention. Treatment was delivered through 12 face-to-face, home-based sessions. Session 1 focused on welcoming the participant to the program and delivering educational content about prefrailty, frailty protective behaviors, and the concept of habit formation. Session 2 focused on pain; its management; and the relationship among pain, ST, and activity. Sessions 3–11 included weekly habit formation treatment focused on reducing ST, increasing PA (through exercise, enjoyable daily occupations, and leisure interests), and modifying dietary patterns. A closing session occurred in Week 12 and was designed to review participants' progress with their goals, create maintenance plans, and provide treatment closure.

To optimize habit formation, the interventionist engaged participants in a conversation about their daily routines and occupations to assist participants in selecting low-complexity behaviors that could be performed daily or nearly every day, that did not require additional resources or materials to implement, and that could be integrated into the existing structure and flow of everyday activities. Activity analysis was used to break down complex behaviors (e.g., exercise) into component parts (e.g., putting on tennis shoes). Thus, the behavior that was most likely to result in initiation of the more complex activity was the focus of the habit formation plan.

After the participant and interventionist identified a target behavior, they worked together to create and document a habit formation plan, which included (1) identifying the target behavior, (2) linking a recurring situation to the behavioral performance (e.g., after a shower, before dinner), and (3) identifying an environmental modification that could prompt or support behavioral engagement. The plan also included identifying any potential barriers to plan implementation and ways to resolve them. Each week, the interventionist evaluated participants' progress with their habit plans.

Fidelity Tracking

Session-specific worksheets were used by the interventionist to document session content, dose, and any protocol deviations. The primary investigator (PI, or first author) also observed and scored three treatment sessions during the study to ensure that all treatment components were delivered as intended (e.g., that the interventionist guided the participant through goal setting). The PI and interventionist debriefed each other after each fidelity check. The interventionist also completed weekly logs that included the habit plan and environmental modification proposed for each participant. The study coordinator monitored the fidelity of the control group phone calls through random observation of calls.

Outcomes and Measures

We followed Consolidated Standards of Reporting Trials (CONSORT) guidelines (Eldridge et al., 2016) and collected multiple measures of trial feasibility, including recruitment and retention rates, session attendance, and intervention acceptability. Intervention acceptability was measured by the Client Satisfaction Questionnaire (Attkisson & Zwick, 1982). Higher scores indicate higher satisfaction with the intervention (range = 0–32). Feasibility criteria were set a priori at 80% for retention (including attrition resulting from death and hospitalization), 80% for session engagement, 50% for participant recruitment, and a score of 29 for intervention acceptability.

Primary Outcomes (Measured at Week 0 and 1 Week Postintervention)

ST was measured via the activPAL wireless activity tracker (PAL Technologies, Glasgow, Scotland; Lyden et al., 2017); activPAL is a validated triaxial accelerometer with a commercialized program to calculate minutes of activity. Evidence suggests that more frequent and longer bouts of ST are associated with frailty and poor health (Kehler & Theou, 2019). Because ST bouts are most commonly measured in 30- or 60-min increments (Kehler & Theou, 2019), we

used the activPAL software to calculate mean minutes of total ST (minutes per day), sum of 30-min ST bouts, and sum of 60-min ST bouts as well as the number of 30-min ST bouts and 60-min ST bouts per day. Participants wore the activPAL device on their thigh for 7 days to collect data on sedentary behaviors during their waking hours. Dietary quality was measured using the HEI and was operationalized as the total HEI score generated from the National Cancer Institute's Automated Self-Administered 24-hr (ASA24; Ma et al., 2009) dietary assessment tool. Because multiple recalls increase data quality, and because quality is higher when the recall is completed with the assistance of a RA (Ma et al., 2009), RAs were trained by the PI to complete the ASA24 with participants on 2 nonconsecutive days. Training consisted of 4 to 6 hr of didactic education. The RAs then completed one self-diary in the system based on their own daily dietary intake followed by completing 2 days of data entry based on the PI's 24-hr dietary intake.

Secondary Outcomes (Measured at Week 0 and 1 Week Postintervention)

Prefrailty status was measured using the Cardiovascular Health Study frailty criteria (Fried et al., 2001), a composite index consisting of the following components: (1) self-reported weight maintenance; (2) walking speed (the mean time of two trials for the time taken to walk 15 ft reported in seconds); (3) grip strength (mean score of grip strength reported in pounds of three trials on the dominant hand using a calibrated Jamar dynamometer); (4) exhaustion, measured as a response of *all of the time* or *most of the time* to two items ("I felt that everything I did was an effort in the last week," and "I could not get going in the last week") reported on a 4-point Likert scale; and (5) total kilocalories of energy expended over a 7-day period, measured via the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire (Stewart et al., 2001).

We measured minutes per week of MVPA using CHAMPS and the activPAL device. MVPA was determined from activPAL by selecting all activity with an intensity of 3 MET. Physical function was measured via the Short Physical Performance Battery (Guralnik et al., 1994) subtests for lower extremity strength and balance. Depressive symptoms were measured using the Geriatric Depression Scale (GDS; Kieffer & Reese, 2002). Participant anthropometry included waist circumference (in inches) measured by a girthometer (Gulick II tape measure; Country Technology, Inc., Gays Mills, WI), height (in centimeters) by a stadiometer, and weight (in pounds) by medical scales. Body mass index (BMI) was also calculated on the basis of anthropometry data. Quality of life was measured using the 26-item validated World Health Organization Quality of Life, Short Form (WHOQOL–BREF; Skevington et al., 2004). Reductions in ST and increases in MVPA could lead to improvements in physical functioning. Those improvements could affect occupational performance. Therefore, we chose to assess changes in occupational performance using the Canadian Occupational Performance Measure (COPM; Law et al., 2014; treatment group only).

Mechanisms of Behavior Change (Treatment Group Only)

Changes in habit formation are hypothesized to lead to improved MVPA, reduced ST, and improved diet. Habit formation was measured every 2 wk from Sessions 3 to 11 using the validated, four-item Self-Report Behavioral Automaticity Index (SRBAI; Gardner et al., 2012). The SRBAI measures perceptions of behavioral automaticity for an identified behavior.

Descriptive Variables (Measured at Week 0)

To characterize our sample, we collected data on age, typical daily pain rating, gender, education level, work status, household income, and comorbidity (i.e., the number of comorbid conditions).

Data Analysis

Feasibility outcomes, such as recruitment, retention, and attendance data, were analyzed using descriptive statistics. We tested differences in baseline characteristics between groups using independent t tests or χ^2 and Fisher's exact tests to ensure that the randomization process worked. For the primary and secondary outcomes, effect sizes of pre- and posttest changes of each group were estimated by paired t tests. Effect sizes were represented by Cohen's d, where 0.2 indicates small, 0.5 indicates moderate, and 0.8 indicates large effects (Fritz et al., 2012). Regarding mechanisms of behavior change, pre- and postintervention habit formation was tested by paired t tests or the Wilcoxon signed-rank test if the data were skewed. Because the focus of the study was to evaluate the feasibility of the treatment program (vs. determining efficacy), our target sample size was based on the number of participants that could feasibly be recruited and complete the 12-wk intervention during the 6-mo study period. All statistical analyses were conducted with IBM SPSS Statistics (Version 26.0). The criterion for significance is at the probability level of .05 for all tests.

Results

Participants in this study were all women, with a mean age of 73.5 (SD = 10.0), a typical daily pain mean rating of 2.6 (SD = 2.3) out of 10, an average of 3.6 (SD = 2.0) comorbidities, and a depressive symptom mean score of 1.8 (SD = 1.8; range = 0–15). The randomization was successful. No between-group differences were found among baseline characteristics between treatment and control groups (Table 1).

Feasibility

The overall recruitment rate was 69.8%. Reasons for not participating in the study are presented in Figure 1. We retained 95.2% of participants through the end of the study. The treatment group session attendance rate was 98.1%; only 1 participant missed two sessions because of scheduling issues. The interventionist spent an average of 45.7 min (SD = 10.3) in each treatment session. The control group session attendance rate was 88.6%, with an average session time of 7.4 min (SD = 9.5); control participants missed sessions because of health issues (n = 8) or because they were not available during the scheduled phone call (n = 7). Both groups reported high intervention acceptability on the Client Satisfaction Questionnaire (treatment group, M = 30.3, SD = 1.9; control group, M = 28.0, SD = 3.9). Our measurement battery was feasible to administer. However, we did have 1 participant throw away the activPAL sensor after she became convinced it contributed to her neck pain. Fidelity checks suggested that the study interventionist initially struggled to construct habit plans according to the stud protocol. Those challenges were identified early and remediated through additional training. The problem arose from the interventionist, a therapist with >25 yr of experience, defaulting to a clinical style of goals writing versus the structure set forth by the intervention protocol.

Clinical and Behavioral Outcomes

Primary Outcomes

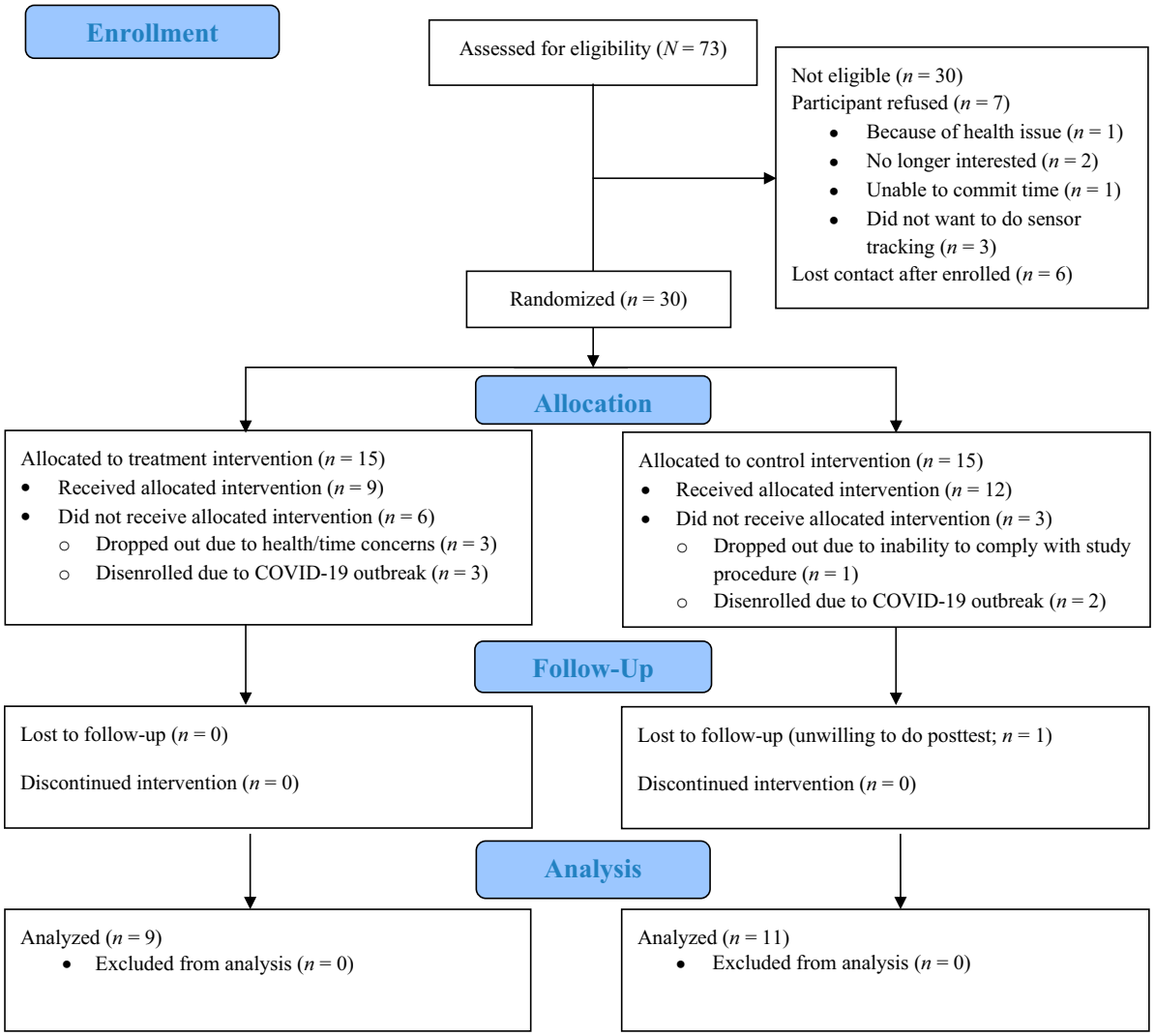
Participants in both groups demonstrated an increase in ST at posttest, with the control group demonstrating a mean greater increase (>100%) in ST compared with the treatment group (Table 2).

Table 1. Participant Demographic Characteristics

Characteristic	*n* (%)		
	Total (N = 20)	Treatment (n = 9)	Control (n = 11)
Age, yr, *M* (*SD*)	73.5 (10.0)	72.1 (12.4)	74.6 (8.1)
Typical daily pain rating, *M* (*SD*)	2.6 (2.3)	2.3 (2.7)	2.8 (2.1)
No. of comorbidities, *M* (*SD*)	3.6 (2.0)	3.7 (2.3)	3.5 (1.7)
Depressive symptoms (GDS scores), *M* (*SD*)	1.8 (1.8)	2.3 (2.5)	1.3 (0.8)
Education level			
High school graduate or GED	4 (20)	3 (33.3)	1 (9.1)
Some college or technical school	6 (30)	1 (11.1)	5 (45.5)
College graduate (bachelor's degree)	3 (15)	1 (11.1)	2 (18.2)
Graduate degree	7 (35)	4 (44.4)	3 (27.3)
Work status[a]			
Working part time (<35 hr/wk)	3 (15)	1 (11.1)	2 (18.2)
Retired	16 (80)	7 (77.8)	9 (81.8)
Not able to work because of disability	2 (10)	2 (22.2)	0 (0)
Working without pay (e.g., caregiver)	1 (5)	1 (11.1)	0 (0)
Income, $			
Declined to answer	4 (20)	2 (22.2)	2 (18.2)
<5,000	1 (5)	1 (11.1)	0 (0)
5,000–9,999	1 (5)	1 (11.1)	0 (0)
10,000–14,999	0 (0)	0 (0)	0 (0)
15,000–19,999	3 (15)	2 (22.2)	1 (9.1)
20,000–29,999	2 (10)	1 (11.1)	1 (9.1)
30,000–39,999	3 (15)	1 (11.1)	2 (18.2)
40,000–49,999	2 (10)	1 (11.1)	1 (9.1)
50,000–59,999	2 (10)	0 (0)	2 (18.2)
60,000–69,999	1 (5)	0 (0)	1 (9.1)
≥70,000	1 (5)	0 (0)	1 (9.1)

Note. No baseline characteristic differences were found between groups, as confirmed by the nonsignificant results of Fisher exact tests or independent *t* tests. GDS = Geriatric Depression Scale; GED = General Educational Development.
[a]Some participants selected two work status roles (e.g., retired and working part time); thus, totals may exceed the number of participants.

Figure 1. Participant flow diagram.



Note. COVID-19 = coronavirus disease 2019.

Treatment group participants decreased the number of 30-min bouts of ST by a mean of 0.4 counts per day ($SD = 0.7$, $d = 0.3$) and the number of 60-min bouts by a mean of 0.1 ($SD = 1.0$, $d = 0.3$) at posttest. In contrast, the control group participants increased the number of 30- and 60-min bouts by a mean of 0.9 ($SD = 1.1$, $d = 0.9$) and 0.5 ($SD = 0.9$, $d = 0.6$) counts per day, respectively. Both groups demonstrated a small increase in dietary quality, as evidenced by an increased HEI score at posttest (treatment group, $M = 2.5$, $SD = 15.7$, $d = 0.2$; control group, $M = 0.2$, $SD = 12.8$, $d = 0.0$).

Secondary Outcomes

Both groups demonstrated reduced frailty risk. Treatment group participants demonstrated a mean reduction in risk of 0.5 ($SD = 1.2$, $d = 0.4$), whereas the control group demonstrated a mean reduction in risk of 0.1 ($SD = 1.2$, $d = 0.1$). On the basis of CHAMPS scores, the treatment group increased their total minutes of MVPA ($M = 291.7$, $SD = 398.4$, $d = 0.7$). The activPAL-estimated MVPA minutes showed only a minimal increase ($M = 1.7$, $SD = 48.5$, $d = 0.0$). The control group demonstrated a decrease in both total CHAMPS- and activPAL-derived MVPA minutes ($M = 68.2$, $SD = 227.0$, $d = 0.3$, and $M = 36.3$, $SD = 150.7$, $d = 0.2$, respectively). Both groups demonstrated reduced GDS scores (treatment, $M = 1.6$, $SD = 1.8$, $d = 0.9$; control, $M = 0.4$, $SD = 1.1$, $d = 0.3$). Both groups showed small to no changes in physical function and anthropometry at posttest. For quality of life, control group participants showed a large decrease in the Social Relationships domain of the WHOQOL–BREF ($M = 9.1$, $SD = 10.2$, $d = 0.9$), but no differences were found across other quality-of-life domains. For the COPM, treatment group participants showed large increases in both Performance ($M = 0.6$, $SD = 0.6$, $d = 1.0$) and Satisfaction ($M = 2.1$, $SD = 1.4$, d = 1.2) scores.

Table 2. Effect Sizes of Pre- to Posttest Changes of Each Group for Primary and Secondary Outcomes

	Treatment				Control			
	M (*SD*)		Paired *t* test		*M* (*SD*)		Paired *t* test	
Outcome Variable	Pretest	Posttest	95% CI	Cohen's *d*	Pretest	Posttest	95% CI	Cohen's *d*
Primary Outcomes								
ST (min/day)	551.9 (128.1)	565.0 (129.7)	[−101.9, 75.8]	0.1	555.5 (166.4)	582.3 (191.0)	[−74.7, 15.8]	0.4
Sum of 30-min ST bouts (min/day)	288.4 (153.9)	306.8 (167.1)	[−71.5, 34.6]	0.3	261.4 (133.5)	328.2 (165.6)	[−120.2, −13.5]	0.4
Sum of 60-min ST bouts (min/day)	158.4 (160.7)	177.8 (158.5)	[−79.9, 41.2]	0.3	147.6 (96.0)	199.6 (146.6)	[−112.4, 8.5]	0.6
No. of 30-min ST bouts (count/day)	4.4 (1.6)	4.0 (1.3)	[−0.2, 1.0]	0.5	3.7 (2.2)	4.6 (2.3)	[−1.7, −0.1]	0.8
No. of 60-min ST bouts (count/day)	1.3 (1.5)	1.1 (1.1)	[−0.7, 1.0]	−0.1	0.9 (0.7)	1.4 (1.3)	[−1.2, 0.1]	0.6
Dietary quality (HEI)	44.4 (17.4)	46.9 (14.3)	[−14.6, 9.6]	0.2	46.7 (11.9)	46.9 (7.5)	[−8.8, 8.4]	0.0
Secondary Outcomes								
Prefrailty status (Fried et al.'s, 2001, criteria)	1.9 (1.5)	1.6 (1.4)	[−0.5, 1.5]	−0.4	0.9 (1.0)	0.9 (0.7)	[−0.7, 0.9]	−0.1
Duration of PA (min/wk)								
CHAMPS, all PA	505.0 (579.4)	841.7 (556.7)	[−1,275.8, 1,825.8]	0.4	538.6 (497.4)	501.8 (216.8)	[−580.0, 2,127.3]	0.1
CHAMPS, moderate–vigorous PA	36.7 (77.6)	328.3 (384.7)	[−3,105.7, 373.8]	0.7	152.7 (236.7)	84.6 (83.6)	[−440.0, 1,142.2]	0.3
activPAL, moderate–vigorous PA	233.9 (157.5)	235.5 (136.8)	[−43.2, 46.6]	0.0	247.4 (151.8)	211.2 (144.4)	[−144.1, 71.5]	0.2
Physical function (SPPB)								
Total	6.8 (2.8)	7.6 (2.2)	[−2.4, 0.6]	0.6	7.1 (2.4)	7.3 (2.5)	[−1.2, 0.9]	0.1
Balance	3.0 (1.4)	3.1 (0.9)	[−0.8, 0.6]	0.2	3.0 (1.3)	3.3 (1.5)	[−0.8, 0.4]	0.2
Gait	2.3 (1.2)	2.9 (1.1)	[−1.4, 0.1]	0.7	2.3 (0.8)	2.5 (1.0)	[−0.4, 0.4]	0.0
Chair stand	1.8 (1.4)	1.6 (1.1)	[−0.7, 0.7]	0.0	1.3 (0.7)	1.4 (1.3)	[−0.5, 0.5]	0.0
Depressive symptoms (GDS)	2.3 (2.5)	3.9 (4.2)	[−2.9, −0.2]	0.9	1.3 (0.8)	1.6 (1.4)	[−1.1, 0.4]	0.3
Waist circumference (in.)	40.8 (6.2)	40.1 (4.5)	[−1.5, 2.8]	−0.3	39.7 (4.8)	40.0 (4.4)	[−1.2, 0.7]	0.2
Weight (lb)	172.0 (34.3)	172.5 (32.3)	[−5.9, 4.9]	0.1	177.8 (37.7)	179.5 (35.1)	[−5.9, 2.5]	0.3

(*Continued*)

Table 2. Effect Sizes of Pre- to Posttest Changes of Each Group for Primary and Secondary Outcomes (*Cont.*)

	Treatment				Control			
	M (*SD*)		Paired *t* test		*M* (*SD*)		Paired *t* test	
Outcome Variable	Pretest	Posttest	95% CI	Cohen's *d*	Pretest	Posttest	95% CI	Cohen's *d*
Body mass index	29.9 (5.5)	30.0 (5.4)	[−1.0, 0.8]	0.1	30.8 (6.4)	30.6 (6.0)	[−1.6, 2.1]	−0.1
Quality of life (WHOQOL–BREF)								
Physical	78.1 (18.5)	78.6 (16.6)	[−8.0, 7.1]	0.1	72.7 (12.5)	73.1 (15.8)	[−7.1, 6.4]	0.0
Psychological	72.2 (14.9)	74.1 (20.0)	[−12.2, 8.5]	0.1	83.3 (8.9)	81.1 (8.2)	[−1.6, 6.1]	−0.4
Social Relationships	63.9 (15.6)	63.9 (22.1)	[−12.0, 12.0]	0.0	82.6 (8.7)	73.5 (14.4)	[2.3, 15.9]	−0.9
Environment	73.6 (19.1)	72.6 (23.8)	[−6.6, 8.6]	−0.1	79.8 (11.6)	83.0 (9.9)	[−8.3, 2.0]	0.4
COPM (n = 6)[a]								
Performance	4.6 (2.0)	5.3 (2.3)	[0.1, 1.0]	1.0				
Satisfaction	3.6 (2.4)	5.7 (2.8)	[0.5, 2.9]	1.2				
Mechanisms of Behavior Change								
SRBAI (n = 9)								
Total (N' = 89)	1.86 (0.87)	4.69 (1.24)	[1.2, 3.0]	1.9				
Week 3 (n' = 12)	1.94 (0.88)	4.06 (1.33)	[2.4, 4.0]	2.6				
Week 4 (n' = 12)	1.44 (0.59)	4.67 (1.10)	[2.2, 3.2]	3.2				
Week 6 (n' = 12)	1.90 (0.83)	4.60 (0.66)	[2.1, 3.6]	2.6				
Week 7 (n' = 10)	1.85 (0.82)	4.70 (1.26)	[2.3, 4.2]	2.3				
Week 8 (n' = 11)	1.25 (0.39)	4.52 (1.58)	[1.5, 4.0]	1.6				
Week 9 (n' = 10)	2.45 (1.30)	5.20 (0.62)	[1.6, 3.9]	1.5				
Week 10 (n' = 12)	1.85 (0.82)	4.60 (1.55)	[1.6, 4.4]	1.5				
Week 11 (n' = 10)	2.33 (0.69)	5.30 (1.41)	[1.2, 3.0]	1.5				

Note. No habits were formed in Week 2, 5, or 12. CHAMPS = Community Healthy Activities Model Program for Seniors; CI = confidence interval; COPM = Canadian Occupational Performance Measure; GDS = Geriatric Depression Scale; HEI = Healthy Eating Index; n' = habit number (each number reflects the habit developed during each week of the intervention); PA = physical activity; SPPB = Short Physical Performance Battery; SRBAI = Self-Report Behavioral Automaticity Index; ST = sedentary time; WHOQOL–BREF = World Health Organization Quality of Life, Short Form.
[a]Treatment group only.

Mechanisms of Behavior Change

Treatment group participants demonstrated total and weekly SRBAI scores with moderate to large effect sizes (see Table 2).

Discussion

We evaluated the feasibility of a 12-wk occupational therapist–delivered frailty prevention program. Our data suggest that the program was feasible to implement and acceptable to participants. It is notable that we experienced high retention rates despite the 12-wk length of treatment. We attribute the high retention rates, in part, to our decision to offer home-based treatment. Because many experienced transportation barriers, offering in-home treatment likely reduced a considerable barrier to intervention participation. Although our control condition retention rates were also high, the acceptability score was below our targeted threshold. Control condition participants received weekly contact, but they received a much smaller dose, and the interactions were over the phone. These data suggest that our control condition was not designed to sufficiently control for differences in attention; a future study should better mirror the processes and structures of the treatment condition and include weekly in-person visits of a more similar duration for control condition participants.

We found that the interventionist initially struggled with constructing habit plans according to the protocol despite demonstrating the ability to do so during mock sessions before intervention delivery. Our protocol specified that habit plans must be based on discrete behaviors that are linked to a well-defined and recurring situational cue (e.g., "When I pack my lunch for work, I will include one rice cake instead of a chocolate brownie"). We found that our interventionist initially defaulted to documenting the habit plan more similarly to how one might document a clinical goal (e.g., "participant will eat a rice cake 5 days per week") or occasionally helped a participant develop a habit of not doing something (the absence of action cannot be a habit). Our experience suggests the need for more robust training and ongoing fidelity checks in a larger trial to reduce protocol drift because therapists might default to their own goal-writing habits.

Although the goal of the study was not to assess efficacy, and although our sample size does not allow for meaningful inferences about efficacy, trends in our data are largely in the expected direction. A notable exception to this trend is our result that ST increased in both groups. The trial ran from September 2019 to February 2020 and thus ran through the holiday season, which was not ideal. People are less active during the winter months, especially older adults, and especially in colder climates such as where the study was located (Chan & Ryan, 2009). For example, one study conducted among 580 middle-age adults found that winter weather accounted for a reduction in PA by 51 min per day in women and 16 min per day in men (Matthews et al., 2001). Considering the timing of our trial, the treatment may have had a protective effect by reducing the degree of increase in ST among treatment group participants.

In addition, because growing evidence suggests that the number and length of ST bouts may be more important to frailty prevention than total ST (Kehler & Theou, 2019), the reductions in the number of 30- and 60-min ST bouts in the treatment group are encouraging. The timing of the trial may also partially explain the less than anticipated change in HEI scores. It is possible that the mean change of only 2.5 points reflects the fact that although participants developed some healthy dietary habits, those efforts may have been overshadowed by high levels of holiday food consumption. Lastly, our data show large standard deviations among activPAL- and CHAMPS-measured MVPA outcomes. These findings could be explained by variable activity levels naturally occurring among our small sample and the presence of three outliers. A subsequent, larger sample trial is needed to better understand potential treatment effects.

Limitations

Our study has several limitations. Our small sample was wholly composed of African-Americans recruited from a university research registry. Although registry members have no obligation to participate in research, the fact that they belong to the registry could indicate that they are different in important ways (e.g., motivation to change habits) from the general population. Because of our small and unique sample, our data should be interpreted with caution. We believe, however, that our data suggest the promise of a home-based, occupational therapist–delivered frailty prevention program.

Implications for Occupational Therapy Practice

Our results suggest that it is feasible to deliver home-based intervention to attenuate frailty. Researchers and practitioners can contribute further to efforts to reduce frailty by

- Becoming familiar with frailty and frailty screening measures and integrating these measures into research or clinical practice to identify at-risk older adults and to evaluate their response to interventions.
- Informing older adults who are prefrail of the risks associated with frailty and the potential benefits of adopting frailty-protective behaviors.

Conclusion

Our study suggests that a 12-wk occupational therapist–delivered frailty prevention program was feasible to deliver in the home setting and acceptable to

participants. Although a trial with a larger sample is needed to better understand potential treatment effects, our data suggest that a habit formation approach could be used to promote health and maintain function among prefrail older adults living in low-resource settings.

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