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Otago Exercise Program in the United States: Comparison of 2 Implementation Models

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Background. The Otago Exercise Program (OEP) is an evidence-based fall prevention program delivered by a physical therapist in 6 visits over a year. Despite documented effectiveness, there has been limited adoption of the OEP by physical therapists in the United States. To facilitate dissemination, 2 models have been developed: (1) the US OEP provided by a physical therapist or physical therapist assistant in the home or outpatient setting and (2) the community OEP provided by a non–physical therapist and a physical therapist consultant. It is unknown whether such modifications result in similar outcomes.

Objective. The aims of this study were to identify the components of these 2 models, to compare participant characteristics for those components reached by each model, and to examine outcome changes by model and between models.

Design. This was a translational cohort study with physical therapists implementing the US OEP and trained providers implementing the community OEP.

Methods. Data for physical performance, sociodemographic characteristics, and self-perception of function were collected at baseline and at 8 weeks.

Results. Participants in the community OEP were significantly younger and reported more falls compared with those in US OEP. Both sites reported significant improvements in most physical and self-reported measures of function, with larger effect sizes reported by the community OEP for the Timed “Up & Go” Test. There was no significant difference in improvements in outcome measures between sites.

Limitations. This was an evaluation of a translational research project with limited control over delivery processes. The sample was 96% white, which may limit application to a more diverse population.

Conclusion. Alternative, less expensive implementation models of the OEP can achieve results similar to those achieved with traditional methods, especially improvements in Timed “Up & Go” Test scores. The data suggest that the action of doing the exercises may be the essential element of the OEP, providing opportunities to develop and test new delivery models to ensure that the best outcomes are achieved by participants.

One out of 3 adults over age 65 years fall each year,[1] posing a significant impact on their quality of life and a significant burden on the health care system.[2] For community-dwelling older adults, participation in strength and balance exercises can effectively improve mobility and protect against a fall or fall-related injury.[3] For interventions to be most effective among people at risk for falling, the majority of exercises should be performed in a standing position, focus on strength of the lower extremity muscle groups, and be structured and progressive in intensity and balance challenge.[4]

Although strong evidence supports the effectiveness of these interventions, much variability exists in how these interventions are implemented in clinical practice.[5] Data show that prescribing the correct dose or intensity of balance and strength training may not be the standard of care for many physical therapists.[6,7]

Evidence-based fall prevention programs, such as the Otago Exercise Program (OEP), offer a potential solution. The OEP was developed and evaluated in New Zealand in the late 1990s. The original randomized controlled trials reported improvements in functional outcomes and a 35% reduction in falls for older adults at high risk for falling.[8,9] These results have been replicated in multiple studies in different settings.10–13 The

program consists of 5 warm-up exercises and 17 strength and balance exercises, which are progressed over the course of the plan of care. The original program was designed for a physical therapist to evaluate and treat an older adult client in his or her home for 6 visits over a 1-year period. The first 4 visits were in the first 2 months of the program (ie, initial visit and visits a week, 2 weeks, and 4 weeks later), then follow-up visits were conducted at 6 and 12 months, with monthly "checkin" telephone calls during the course of the program.[9] The physical therapist selected the appropriate exercises from the 17 strength and balance exercises and progressed the intensity and chal-lenge of the exercises over the course of the program.[14] This model set the stage for client engagement and ownership of their exercise program (the program works only if the client does the exercises). The OEP has achieved high levels of adherence, with more than 35% of participants stating they performed the exercises 3 times a week 1 year after the start of the program.[8,9]

US OEP

The OEP was selected by the Centers for Disease Control and Prevention (CDC) in 2011 as 1 of 4 evidence-based fall prevention programs to be disseminated as part of the State-Driven Fall Prevention Project.[15] The OEP also was identified as an evidence-based fall prevention program in 2014 by the Administration for Community Living. As such, Area Agencies on Aging (AAAs) and senior centers can partner with physical therapists to offer the OEP as part of statewide initiatives to address falls.[16] To meet this new and growing need for physical therapists to offer the OEP, a strategic plan was developed to disseminate the program. To facilitate a national rollout, a website was created to house and centralize a standardized training manual, an online training program, and an online database.[17] Physical therapists and health professionals (providers) who completed the online training were eligible to implement the OEP in their practice.[17]

One of the key differences between implementation of the program in the United States and the original research was that participants in the original study were excluded if they were currently working with a physical therapist.[9] However, in the United States, the most common way for an older adult to be prescribed the OEP is as part of a rehabilitation program for clients who have significant balance impairments. Given that the OEP is most effective for older adults who are frail and at high risk for falling,[18] it was hypothesized that these older adults would meet the Medicare criteria for physical therapy and that physical therapists could integrate the OEP into the plan of care.

Despite the effectiveness of the OEP, there has been limited adoption and implementation by physical therapists in the United States. Barriers to implementation include misconceptions about billing and documentation practices, increased paperwork burden for therapists, inability to bill for follow-up telephone calls, and the misalignment between the frequency of visits and Medicare documentation policies.[17,19] Several of these barriers have resulted in the integration of 3 key program modifications to facilitate adoption and implementation in the United States (US OEP): (1) delivery of the program in the home or outpatient setting, (2) delivery by a physical therapist or physical therapist assistant, and (3) a focus on the first 8 weeks of the program being the "clinical management phase" and the remaining 4 to 10 months of the program being the "self-management phase."

Even with these modifications, the program length and requirement for a physical therapist or physical therapist assistant to deliver the program has impeded widespread adoption and implementation. These barriers have spawned innovative delivery models designed to reach clients who would benefit from the US OEP at a lower cost. These models include offering the OEP in the group exercise setting, as part of Programs of All-Inclusive Care for the Elderly offerings, virtual programs,[20] and using providers other than physical therapists (community OEP) to deliver the program.

Development of the Community OEP

The community OEP model is one where exercise sessions are delivered by a non-physical therapist, but overseen by a physical therapist in a consultant role. In this model, the physical therapist can intervene

with clients at high risk for falling as appropriate but does not conduct the one-on-one sessions or the telephone calls with clients. This model appealed to NorthWest Senior & Disability Services (NWSDS), an AAA in Oregon. The NWSDS had identified a large number of clients, including those eligible for Medicare and Medicaid, who had experienced fall-related injuries and hospitalizations. These falls were resulting in a significant impact on quality of life and financial burden to the state. To address this issue, NWSDS wanted to leverage the public health fall prevention initiatives in Oregon[15] with state health promotion dollars made available to the AAA for evidence-based programs directed at the clients at high risk for falling that they serve.[21]

Due to the efforts of the Oregon Department of Health to disseminate the US OEP, NWSDS was aware of its effectiveness and felt it was a valuable program to offer to clients. However, the limited availability of physical therapists and physical therapist assistants and reimbursement challenges for this population made it difficult to implement the US OEP. The NWSDS proposed to implement an innovative dissemination model that leveraged the resources available to serve as many clients as possible. The community OEP used an experienced certified occupational therapist assistant (COTA) to screen and select appropriate OEP exercises, certified personal trainers to deliver the program, and a physical therapist consultant to provide program oversight.

A key difference in the community OEP was that although physicians were notified of their client's participation in the program, no physician or physical therapy referral was needed for clients to participate. Referrals to NWSDS were made by case workers from NWSDS, drivers of the Meals on Wheels Program, local coordinated care organizations, and community members and their families.

The COTA received all referrals and performed an evaluation prior to community OEP visit 1 to determine whether the client was appropriate. Criteria developed by NWSDS to determine eligibility for participation included: able to walk safely with or without a device in the home and able to do the exercises independently or with the help of a caregiver. If deemed appropriate, the client signed all necessary paperwork, including a waiver of liability. During the initial evaluation, the COTA completed all baseline data collection and developed the initial care plan, including appropriate OEP exercises. The plan was reviewed by the physical therapist consultant, and any recommendations were immediately incorporated. Physicians were notified about the client's participation in the program. The client was then scheduled for community OEP visit 1. At this visit, the client was taught the OEP exercises selected by the COTA and approved by the physical therapist. Subsequent visits were performed by the personal trainer.

All new and current cases were reviewed with the physical therapist consultant in a weekly team meeting including the COTA and personal trainers. The team reviewed progress, adherence, and tolerance for each participant and used the International Classification of Functioning, Disability and Health (ICF) model to recognize and review complications or barriers related to interpersonal factors (eg, personality, environment, caregiver support).[22] The role of the physical therapist was most apparent for outlier cases who demonstrated limited progress or poor attendance. The physical therapist was uniquely capable to lead the team through problem-solving discussions surrounding medical complications and comorbidities of dizziness, vertigo, pain, hypotension, and others. On occasion, these discussions led to an internal referral to the nurse of dietitian on staff at NWSDS or to an external referral (eg, outpatient physical therapy, primary care provider, other).

These alternative OEP models maintain fidelity to the exercises prescribed and the frequency and intensity of the exercise sessions, but they modify who delivers the program or monitors adherence (eg, physical therapist for initial visit only and non-physical therapist supervision, self-monitoring versus group exercise, non-physical therapist versus physical therapist). It is unknown whether these modifications influence the effectiveness of the US OEP for older adults with frailty.

The community OEP is substantially less expensive than the US OEP and has the potential for greater

reach. However, it is not known whether delivering the US OEP by a nonclinician will result in similar outcomes. Therefore, the purposes of this study were: (1) to describe the common and unique components of the community OEP and US OEP models, (2) to identify differences in the types of individuals who participated in these OEP models, (3) to examine changes in functional performance and perceived functional performance among clients participating in these OEP models, and (4) to compare functional performance and perceived functional performance changes between OEP models.

Method

Characteristics of Different Programmatic Models

Outcomes data were collected from clients participating in the 2 distinct implementation models. A comparison of programmatic characteristics among the original New Zealand OEP, US OEP, and community OEP models is presented in Table 1. For the purposes of this study, the OEP evaluation and follow-up visits were implemented on a one-on-one basis for both US OEP and community OEP models.

US OEP Recruitment and Data Collection

Data for the US OEP were from 27 physical therapists representing 11 rehabilitation agencies based in 8 states (Colorado, Oregon, Pennsylvania, Connecticut, North Carolina, South Carolina, Nebraska, and New Hampshire). These therapists agreed to integrate the US OEP into the plan of care for appropriate clients. Each therapist was given access to an online database and recorded outcomes for clients receiving the US OEP as part of the plan of care. Therapists learned about this project through national dissemination channels (eg, presentations at national meetings, promotion through national listservs, monthly webinars). As part of participating in the online data collection project, therapists could access their own client and agency outcomes data to prove the efficiency and efficacy of the program to clients, physicians, and potential referral sources.

Community OEP

Data for the community OEP was collected and inputted by the COTA. The NWSDS had one account in the database, and data collected from all clients receiving the community OEP were inputted using the same process used by the US OEP therapists.

Participants

This was a translational study of implementation; therefore, there were no specific inclusion or exclusion criteria for participants entered into the database. Those implementing either OEP (eg, physical therapists, COTAs) were instructed to follow established guidelines as to which clients were the most appropriate for the OEP[14] and were encouraged to enter those individuals into the database. We did not exclude participant entry in the database based on age or function. The only inclusion criterion was that individuals in the database should have been prescribed the OEP.

Data Collection

The data collection process was the same for both models. The database was created and housed at the Center for Health Promotion and Disease Prevention at the University of North Carolina, Chapel Hill. Agencies that were currently implementing or planning to implement the OEP with clients and that wanted to track outcomes were offered the opportunity to register with a secure database. Each agency had to register at least one provider to track outcomes, and that provider was responsible for collecting and entering all data for the clients. Any agency that entered data on fewer than 2 clients was not included in the analysis. Each provider had a unique login and dashboard. Providers entered in de-identified subjective and performance data for each client. Only data for clients who were participating in the OEP were entered into the database. The provider was responsible for entering data at baseline, 8 weeks, 6 months, and discharge. Each provider had access to his or her own dashboard, and each agency could receive reports on its own providers. No providers or agencies could access data outside of their own agency. There were no unique identifiers or personal health information recorded in the database.

Table 1.
Comparisons of OEP Interventionsa

Variable	Original OEP	US OEP	Community OEP
Who delivers?	Delivered by a physical therapist in the home	Physical therapist does the initial evaluation and exercise prescription. Physical therapist or physical therapist assistant does follow-up visits.	Physical therapist acts as a consultant, available to discuss or evaluate clients as needed. COTA does initial exercise prescription and progression under supervision of physical therapist. Personal trainers were used to assist COTA in completing monthly visits and telephone calls. COTA and personal trainers had completed OEP online training. COTA and personal trainers met with physical therapist weekly to review client progress.
Duration of program/frequenc-y of visits	6 visits over a year 4 visits in 8 wk (physical therapist management phase) Follow-up visits at 6 and 12 mo (self-management phase)	Many outpatient physical therapists are typically able to do 4 visits in 8 wk, with 1 or 2 follow-up visits during weeks 12–24. Few physical therapists can keep clients on caseload for 1 y with so few visits due to Medicare documentation regulations. Few home health physical therapists can do the low frequency of visits. Many clients discharged at 8 wk (after physical therapist management phase).	Year-long program 3 visits with COTA in first 3 wk Face-to-face visits 1×/mo for 6 mo and then every other month up to 1 y with COTA or personal trainer Average of 10–12 face-to-face visits per year
Telephone calls	Follow-up telephone calls by therapist 1×/mo for months 3–12	Few agencies can afford the nonreimbursable time to complete monthly telephone calls. Calls typically not done by the physical therapist	Weekly telephone calls completed by COTA/personal trainers up to 6 mo and then reduced to 1–2×/mo on months with no visit
Location	Done in the home	Done in the home Due to challenges delivering the program in the home, the program has successfully been done in an outpatient clinic or group setting.	Done in the home, in adult foster homes, or in assisted living facilities; wherever the client is residing
Ankle weights	Uses ankle weights	Yes	Yes
Progression	Client progressed in intensity of exercises over the course of the program	Yes, by physical therapist	Yes, by COTA with physical therapist oversight
Walking	Walking exercise prescribed when client is ready	Yes	Yes
Payment mechanism	Medicare reimburses	Typically, physical therapists can be reimbursed for the first 4 visits. Physical therapists can be reimbursed for the follow-up visits at 6 mo and beyond if the client meets all necessary criteria and the physical therapist completes all necessary documentation to remain on caseload per Medicare. Medicare does not reimburse telephone calls.	No billing of physical therapist services to Medicare Physical therapist consultant, COTA, and certified personal trainers are funded by grant monies procured by the Area Agency on Aging. Case management monies for dual eligible also can be used to partially cover delivery costs.
Typical documentation requirements	Documentation for study purposes	Outpatient setting: evaluation to include functional limitation reporting, physician approval, treatment notes for each treatment day, monthly progress note with reassessment of functional limitations, recertification documentation for 60 d (home health) and 90 d (outpatient), advanced beneficiary of noncoverage if transition to private pay if patient wants to continue but no longer needs skilled therapy or if patient has reached cap[50] Home health setting: complete OASIS form, face-to-face assessment with prescribing clinician, daily progress notes, reassessments during appropriate time frames and visits; typical episode of care is 60 d, and to extend requires additional reassessments[49]	Evaluation and progress notes by COTA

[a] OEP = Otago Exercise Program, COTA = certified occupational therapist assistant.

The majority of data collected was similar to information typically collected when a client begins an episode of rehabilitation. During or after an initial encounter with the client, the provider would collect demographics, fall history, self-perception of health, activity levels, and difficulty performing different activities. The provider administered the Timed "Up & Go" Test (TUG),[23,24] the 30-Second Chair Rise Test,[25,26] and the Four-Stage Balance Test.[27] Each of these tests has been validated to screen for increased risk for falls and functional decline and is part of a standard screen for fall risk.[28,29] Providers were asked to repeat these measures at 8 weeks, 6 months, and discharge and to document additional implementation information such as the number of physical therapy visits, client adherence, and number of falls experienced during the episode of care.

Providers either entered in the de-identified data in real time during the initial evaluation or completed a paper copy and entered the information at a later date. The database automatically assigned an identification number, and providers could input first name and last initial for tracking purposes. As this was a crowd-sourced project, it was not a requirement that all data fields be completed. Once the data was entered, the researchers had access to the de-identified data for analysis.

Measures

Primary outcome measures for this study included the 3 functional tests referenced above (ie, TUG, 30-Second Chair Rise Test, and Four-Stage Balance Test). The TUG and 30-Second Chair Rise Test were treated as continuous variables in analyses. The Four-Stage Balance Test was treated as a categorical variable in analyses (ie, participants achieving stage 3 or 4 are considered to be at less risk for falls).

Secondary outcome measures included those related to perceived functional performance. More specifically, these measures included self-reported health status ("excellent," "very good," "good," "fair," and "poor"), satisfaction with current activity levels ("very," "mostly," "somewhat," or "not at all"), and confidence in their ability to keep themselves from falling (4-point scale ranging from "strongly agree" to "strongly disagree").[30] Self-reported functional ability was further assessed by the reported level of difficulty in performing various activities (eg, climbing one flight of stairs) on a 4-point scale ranging from "no difficulty" (scored 1) to "unable to do" (scored 4).31 Finally, participants were asked how often they restrict their activities because of difficulties in walking ("always," "sometimes," "seldom," or "never").

To identify client characteristics for participants who were reached, providers were asked to collect information about sociodemographic characteristics (ie, age, sex, race, ethnicity), fear of falling (no, yes), and falls history in the past year (ie, number of falls they experienced, number of injuries, number of emergency department visits, and number of hospitalizations).

Data Analysis

Baseline characteristics were examined for all participants and compared to identify any significant differences between groups. Various analyses were performed to examine change from baseline to postassessment for functional performance and perceived functional performance outcomes for each site. Linear mixed models (using SAS PROC MIXED procedure) were fitted for continuous outcome variables. Linear mixed effects models are likelihood-based approaches that use all available data in model estimation and provide unbiased estimates of the intervention effects under the assumption of missing at random.[32] General estimating equation models with logit link function (using SAS PROC GENMOD procedure) were used to examine changes from baseline to postassessment for binary outcome variables. All of the regression models included appropriate covariance structure to account for the correlation among repeated measures from the same participant. To compare the intervention effects of the 2 implementation models, we included the implementation model, time point, and interaction between the implementation model and time point as fixed effects in all longitudinal models. The regression parameter for time point estimates changes from baseline to postassessment for each outcome variable, whereas the interaction term indicates whether the

changes were significantly different between the 2 types of models.[33] To eliminate any systematic bias and examine the direct effects of this intervention, regression analyses controlled for the participants' age and sex, the number of falls they reported in the past 12 month, the number of weeks they received physical therapy prior to beginning the OEP, and the delivery site where the client was reached.

An effect size (d = [posttest mean – pretest mean]/standard deviation of changes) using estimates of changes from the linear mixed models was computed for each continuous outcome variable. An effect size of $d = 0.2$ was considered small, $d = 0.5$ was considered medium, and $d = 0.8$ was considered large.[34] Odds ratios (ORs) were calculated for categorical variables based on the change in the proportion of participants who achieved either stage 3 or 4 of the Four-Stage Balance Test and rated themselves at the level of excellent or very good health, as very satisfied with activity levels, as strongly agree in confidence to prevent a fall, and as having no difficulty performing the different mobility tasks.

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Results

Sample Characteristics

Baseline data characterizing participants were collected on 108 community OEP participants and 102 US OEP participants. As shown in Table 2, the 2 groups were similar in race and sex and in rates of fear of falling (88.8% and 85.5%, respectively). The community OEP group was significantly younger (mean age = 76.8 years, SD = 13.5) than the US OEP group (mean age = 83.40 years, SD = 8.23). The community OEP group also had significantly higher rates of falls in the past year (mean = 2.18, SD = 2.03) compared with the US OEP group (mean = 1.05, SD = 1.46). At baseline, participants in the community OEP group, on average, performed significantly worse on the 30-S Chair Rise Test (mean number of chair rises = 4.92, SD = 4.40) compared with their US OEP group counterparts (mean number of chair rises = 7.77, SD = 4.34). Table 3 shows changes in functional performance and self-perceived functional performance outcomes from baseline to postintervention for participants in the community and US OEP models.

Community OEP

Participants in the community OEP demonstrated significant improvements on all physical performance measures (ie, primary outcomes). The adjusted mean change in TUG scores was –6.55 seconds (SE = 1.46), representing an effect size of 0.59. This change was statistically significant ($P < .001$). The 30-Second Chair Rise Test scores increased significantly from baseline to postintervention, with an adjusted mean change of 1.54 chair rises (SE = 0.42) ($P < .001$), which represents an effect size of 0.44. For the Four-Stage Balance Test, the proportion of participants capable of reaching stage 3 or stage 4 increased from baseline to postintervention (odds ratio [OR] = 1.97, P = .013).

Participants in the community OEP demonstrated significant improvements in perceived functional performance outcomes from baseline to postintervention (ie, secondary outcomes). Significant improvements were reported for all measures except self-reported health, where the proportion of participants who reported being in excellent or very good health increased from baseline to postintervention (OR = 1.36, P = .389). The proportion of participants who reported that they were very or mostly satisfied with physical activity levels (OR = 3.04, P = .002) and those who felt confident that they will not fall ("agree" or "strongly agree") (OR = 4.84, $P < .001$) significantly increased from baseline to postintervention. Significant improvements from baseline to postintervention also were observed for participants reporting no difficulty walking one block (OR = 1.91, P = .039), stooping/crouching/kneeling (OR = 2.59, P = .038), and getting out of a straight-back chair (OR = 2.13, P = .008). The proportion of participants who never or seldom restricted their activities because

of difficulties in walking significantly increased from baseline to postintervention (OR = 3.25, P < .001).

US OEP

Participants in the US OEP also demonstrated significant improvements on most physical performance measures (ie, primary outcomes). The adjusted mean change in TUG scores was –2.80 seconds (SE = 1.77), representing an effect size of 0.25. However, this change was not statistically significant (P = .116). The 30-Second Chair Rise Test scores increased significantly, with an adjusted mean change of 1.75 rises (SE = 0.56) (P = .002), which represents an effect size of 0.50. The Four-Stage Balance Test demonstrated a significant increase in the proportion of participants capable of reaching stage 3 or stage 4 (OR = 4.44, P < .001).

For self-reported health, the proportion of participants who reported being in excellent or very good health significantly increased (OR = 2.60, P = .004), as did the proportion of participants who reported being very or mostly satisfied with physical activity levels (OR = 5.24, P < .001). The proportion of participants who felt confident that they will not fall ("agree" or "strongly agree") significantly increased from baseline to postintervention (OR = 5.34, P < .001). Significant improvements from baseline to postintervention also were observed for participants reporting no difficulty walking one block (OR = 2.89, P = .033), stooping/ crouching/kneeling (OR = 5.58, P = .011), getting out of a straight-back chair (OR = 2.54, P = .014), and climbing one flight of stairs (OR = 3.46, P = .028). The proportion of participants who never or seldom restricted their activities because of difficulties in walking also increased from baseline to postintervention (OR=2.81, P=.008).

Both groups demonstrated similar attrition rates, with data for 8-week outcome measures collected for 60 of the 108 participants in the community OEP (55%) and 55 of the 102 participants in the US OEP (54%). When comparing changes across the 2 OEP models, there were no significant differences in primary or secondary outcomes.

Discussion

Bringing evidence-based fall prevention programs to scale is necessary to address the increased numbers of falls among an aging population. Some evidence-based programs, such as the OEP, were originally developed and tested for delivery by licensed health care professionals and achieved excellent results.[9,18] However, due to increased costs for a physical therapist to deliver this type of program and barriers to reimbursement and billing, it may not be a feasible for physical therapists to be the only OEP providers. This situation creates opportunities for other professionals and providers to offer the intervention to older adults at potentially a lower cost. This is one of the first studies to compare outcomes between a community-based version of the OEP delivered by non-physical therapists with general oversight by a physical therapist and the US OEP delivered by a physical therapist. This study demonstrated there were no significant differences in outcome measures between the 2 models. This finding supports the community OEP as potentially a more efficient and cost-effective delivery system for appropriate clients.

Compared with the US OEP, the participants in the community OEP were frailer. Even though they were younger, they had significantly higher rates of falls, more falls with injury, and worse 30-Second Chair Rise Test scores at baseline.[35] Because the program was implemented by an AAA and the majority of referrals came from services provided by the AAA to underserved clients, it is not surprising that the population served had more impairments and falls. Approximately 30% of individuals also were dual-eligible for Medicare and Medicaid, indicating reach to a population with high rates of multiple chronic conditions and disability, which are indicators of increased fall risk.[36,37]

Participants in the US OEP demonstrated significant improvements on the 30-Second Chair Rise Test, Four-Stage Balance Test, and self-report measures of function. This finding supports that participation in a structured and progressive balance and strengthening program results in improved performance outcomes.
Table 2.

Client Characteristics by OEP Model at Baseline[a]

Variable	n	Total (N=210)	Community OEP (n=108)	US OEP (n=102)	χ^2 or *t*	*P*
Age (y), mean (SD)	210	80.02 (11.67)	76.83 (13.46)	83.40 (8.23)	4.29	<.001
Sex	210				3.266	.072
Male		66 (31.4%)	40 (37.0%)	26 (25.5%)		
Female		144 (68.6%)	68 (63.0%)	76 (74.5%)		
Hispanic	210				0.007	.934
No		202 (96.2%)	104 (96.3%)	98 (96.1%)		
Yes		8 (3.8%)	4 (3.7%)	4 (3.9%)		
Race	202				2.278	.517
White		193 (95.5%)	100 (96.2%)	93 (94.9%)		
Black or African American		5 (2.5%)	3 (2.9%)	2 (2.0%)		
Asian		2 (1.0%)	0 (1.0%)	2 (2.0%)		
Native Hawaiian or other Pacific Islander		0 (0%)	0 (0%)	0 (0%)		
American Indian or Alaska Native		2 (1.0%)	1 (1.0%)	1 (1.0%)		
Fear of falling	176				0.412	.521
No		22 (12.5%)	12 (11.2%)	10 (14.5%)		
Yes		154 (87.5%)	95 (88.8%)	59 (85.5%)		
Fall in past 12 mo	181				6.998	.008
No		72 (39.8%)	34 (31.8%)	38 (51.4%)		
Yes		109 (60.2%)	73 (68.2%)	36 (48.6%)		
No. of falls in past 12 mo, mean (SD)	181	1.72 (±1.90)	2.18 (±2.03)	1.05 (±1.46)	–4.33	<.001
No. of falls resulting in injuries, mean (SD)	178	0.58 (±1.03)	0.65 (±1.19)	0.46 (±0.73)	–1.31	.191
No. of falls resulting in emergency department visits, mean (SD)	177	0.25 (±0.61)	0.27 (±0.68)	0.23 (±0.48)	–0.55	.583
No. of falls resulting in hospitalization, mean (SD)	178	0.16 (±0.54)	0.22 (±0.65)	0.06 (±0.29)	–2.35	.020
No. of weeks of physical therapy prior to OEP, mean (SD)	171	1.63 (±3.17)	0 (±0)	4.36 (±3.88)	9.00	<.001
No. of physical therapy visits prior to OEP, mean (SD)	171	3.11 (±6.31)	0 (±0)	8.30 (±7.98)	8.32	<.001
Primary Outcomes						
Variable	**n**	**Total**	**Community OEP**	**US OEP**	**χ^2 or *t***	***P***
TUG times (s), mean (SD)	188	26.23 (±23.45)	28.76 (±20.94)	23.17 (±25.97)	–1.60	.112
30-Second Chair Rise Test, mean (SD)	187	6.15 (±4.59)	4.92 (±4.40)	7.77 (±4.34)	4.41	<.001
Stage 3 or 4 of Four-Stage Balance Test	174	42 (24.1%)	24 (25.5%)	18 (22.5%)	0.217	.641
Secondary Outcomes						
Variable	**n**	**Total**	**Community OEP**	**US OEP**	**χ^2**	***P***
Excellent or very good health status	187	43 (23.0%)	22 (20.6%)	21 (26.3%)	0.837	.360
Very or mostly satisfied with physical activity levels	185	48 (26.0%)	24 (22.4%)	24 (30.8%)	1.633	.201
Feel confident not falling (strongly agree or agree)	187	90 (48.1%)	51 (47.7%)	39 (48.8%)	0.216	.883
No difficulty in walking across room	186	89 (47.9%)	52 (48.6%)	37 (46.8%)	0.057	.812
No difficulty in walking one block	186	35 (18.8%)	25 (23.4%)	10 (12.7%)	3.410	.065
No difficulty in stooping, crouching, kneeling	184	13 (7.1%)	8 (7.6%)	5 (6.4%)	0.089	.766
No difficulty in getting out of a straight back chair	186	71 (38.2%)	46 (43.0%)	25 (31.7%)	2.479	.115
No difficulty in climbing one flight of stairs	184	24 (13.0%)	14 (13.1%)	10 (13.0%)	0.0004	.985
Never or seldom restrict activities because of difficulties in walking	185	44 (23.8%)	22 (20.6%)	22 (28.2%)	1.454	.228

[a] Data reported as mean (SD) except for data reported as percentages. OEP = Otago Exercise Program, TUG = Timed “Up & Go” Test.

Table 3.
Adjusted Performance Changes From Baseline to Postintervention Survey

		Community OEP					US OEP				
Variable	n	Adjusted Mean Change,[a] Mean (SE)	OR[b]	*P*[c]	Effect Size	n	Adjusted Mean Change,[a] Mean (SE)	OR[b]	*P*[c]	Effect Size	*P* for Difference Between Groups[d]
Functional performance (primary)											
Timed "Up & Go" Test times for all participants (s)	60	–6.55 (1.46)		<.001	0.59	54	–2.80 (1.77)		.116	0.25	.105
30-Second Chair Rise Test	60	1.54 (0.42)		<.001	0.44	50	1.75 (0.56)		.002	0.50	.778
Stage 3 or 4 of Four-Stage Balance Test	59		1.97	.013		55		4.44	<.001		.090
Perceived functional performance (secondary)											
"Excellent" or "very good" health status	60		1.36	.389		42		2.60	.004		.189
Very or mostly satisfied with physical activity levels	57		3.04	.002		42		5.24	<.001		.327
Feel confident not falling ("strongly agree" or "agree")	60		4.84	<.001		42		5.34	<.001		.869
No difficulty in walking across room	59		1.90	.054		42		2.06	.058		.880
No difficulty in walking one block	58		1.91	.039		42		2.89	.033		.441
No difficulty in stooping, crouching, kneeling	59		2.59	.038		42		5.58	.011		.312
No difficulty in getting out of a straight-back chair	60		2.13	.008		42		2.54	.014		.711
No difficulty in climbing one flight of stairs	60		1.82	.073		42		3.46	.028		.333
Never or seldom restrict activities because of difficulties in walking	60		3.25	<.001		42		2.81	.008		.756

[a] Mean changes based on linear mixed models adjusted for baseline age, sex, Otago Exercise Program (OEP) model, number of falls in past 8 weeks, and number of weeks of physical therapy prior to OEP.

[b] Odds ratios (ORs) from general estimating equation logistic regression modeling the probability of response=1 at an alpha of .05. All models account for repeated measures from the same participant and are adjusted for baseline age, sex, OEP model, number of falls in past 8 weeks, and number of weeks of physical therapy prior to OEP. An OR greater than 1 represents an improvement in functional performance.

[c] P value with null hypothesis: adjusted mean=0 or adjusted OR=1.

[d] P value with null hypothesis: adjusted mean change of US OEP compared with adjusted mean change of community OEP or adjusted OR for US OEP compared with adjusted OR for community OEP.

Although the average TUG time was still well above the 12-second cutoff recommended by the CDC's Stopping Elderly Accidents, Death Injuries (STEADI) tool,[28,38] participants demonstrated an average decrease in TUG time of 2.6 seconds, which put the TUG mean scores for the group below the cutoff established by Podsiadlo et al[39] for independence with mobility and transfers. Of note, there was an almost 4-fold increase in the proportion of participants who reported "no difficulty in bending, crouching, or kneeling" and an almost 2-fold increase in the proportion of those reporting they "never restrict activities because of difficulty in walking." These improvements in self-perception of abilities can be linked to the training effect of the OEP, which incorporates a series of functional lower extremity strength training exercises (rising from a chair, squatting) and a walking program. These changes also may represent an increase in each participant's ability to do these activities and, therefore, maintain the function gains achieved by participating in the OEP.

The community OEP demonstrated significant improvements in functional and self-perceived measures at 8 weeks, with some notable differences. Consistent with the characteristics of a more frail

population, this group demonstrated significant improvements in TUG times but still was considered to be in the at-risk category.[39] Similar trends were demonstrated for the other 2 measures (improvements, but still at risk).[38] The frailer population is typically safe to engage in structured and progressive exercise programs.[40,41] However, studies have shown that older adults with frailty achieve better outcomes when participating in interventions that are longer than 8 weeks in duration.[9,42,43] The degree of frailty in this particular group suggests that the OEP is effective at improving strength and balance; however, it may be that greater improvements could be seen after 6 to 12 months. As such, longer follow-up periods are needed in future studies.

Based on the absence of significant outcome changes between OEP models in this study, the findings indicate that similar outcomes can be achieved when the US OEP is delivered by someone other than a physical therapist. These findings suggest that exercise prescription by a physical therapist may not be an essential element of the OEP. Given the large population of older adults who can benefit from the OEP and the limited number of physical therapists trained and able to implement the program, the community OEP may offer a viable solution.

Although this study documents the success of the community OEP, the value and potential role of the physical therapist should not be discounted. The participants in the community OEP were more frail than those in the US OEP, and it may be surprising that they were able to successfully improve outcomes without skilled physical therapy. Older adults who are appropriate and eligible for the OEP are typically more frail and at a higher risk of falling than those enrolled in tai chi or other community-based programs,[44] yet they can still benefit from participating in structured and progressive exercise programs supervised by a nonclinician. However, given the potential of multiple impairments and fall risk factors, it is very important that a physical therapist be available to: (1) complete a differential diagnosis, (2) determine whether the individual is appropriate for the OEP, and (3) evaluate and treat identified impairments if deemed necessary. The community OEP allows physical therapists to triage clients to those who would greatly benefit from skilled physical therapy and to those who would benefit from structured and progressive strength and balance training, but who do not necessarily require the skill of a physical therapist to succeed, which may ultimately decrease the cost of implementing the program.

Similar modifications were made to the Stepping On program when it was disseminated in the United States.[45] In the original research, Stepping On was an education, exercise, and behavior change intervention delivered to small groups of older adults in 7 sessions by an occupational therapist.[45] In a randomized controlled trial, it demonstrated a 31% reduction in falls.[46] The current US health care system has no mechanism to reimburse an occupational therapist to teach a Stepping On class, so a model that deployed fitness professionals and lay leaders was created and tested. Participants in testing of the lay model reported similar improvements in mobility and self-perceived function as in the original research,[47] and the intervention showed a population-based decrease in reported falls.[47,48]

The current study highlights that physical therapists do not necessarily have to work with each older adult client on a one-on-one basis to see improvements from OEP. This approach offers opportunities to develop new models, which may be as effective. For example, if a client participating in the US OEP demonstrates significant improvements, there may be a question about the need for skilled therapy. When this happens, the client will be discharged from the program before he or she has completed the 6- or 12-month mark. The community OEP allows older adults to continue participating until they have achieved their goals. The community OEP also includes additional elements to support adherence such as the weekly telephone calls. Several of those implementing the US OEP have opted out of the telephone calls due to lack of reimbursement,17 which has posed a significant implementation barrier.

The community OEP may offer much greater reach than the US OEP. Over the course of a year, the COTA and personal trainers were able to deliver the OEP to more than 100 participants. The main reason for

this extensive reach is the geographic location. Many of the participants were in a defined geographic area, which reduced travel time to each individual's home. Often, within a physical therapy practice, referrals can come from a wide geographic area, which can present extensive challenges to efficiency. In addition, physical therapists in the home health setting are limited in their ability to see clients at such a low frequency and to keep a client on caseload for more than 60 days.[49] This limitation makes it very challenging to keep clients who are making slow and steady gains on caseload to achieve the optimal outcomes. Alternatively, physical therapists also have limited ability to identify and address those clients who are beginning to decline but who do not yet require skilled physical therapy.[50] The community OEP has far more flexibility to achieve this goal, and potentially at a lower cost than the US OEP. It was estimated that the average cost to implement the community OEP was $585 per client, inclusive of administrative costs (L. Goto, written communication, March 2016).

Limitations

This study was an evaluation of a translational research project. As such, there was little control over how the data were collected. To address this limitation, data fields were aligned with those of a traditional physical therapy evaluation, so there was no expectation or need to train therapists in performing functional tests or subjective measures. Neither the physical therapists nor the non-physical therapists reported any challenges with reporting data. Although random assignment was not used to assign participants to the US OEP or community OEP model (a shortcoming of this study), the groups had similar rates of data completeness and accuracy. Neither group reported values that were deemed outliers or incorrect. Second, there was also no control over how the OEP was actually implemented, which should be addressed in future studies. Third, there was no ability to follow up with clients who dropped out of the intervention from baseline to follow-up. Data were collected on 210 participants at baseline. Each model reported rates for loss to follow-up of 54% or higher. We do not know whether this is a true attrition rate or the therapist simply did not input the 8-week data. The translational nature of this project made it impossible to determine why some clients started the program but never finished. A final limitation was the lack of diversity in our participants from both models, with more than 95% of participants described as non-Hispanic white. Even though the participants' demographics mirrored Medicare demographics, findings may not be generalizable beyond this study to a more diverse population.

In conclusion, alternative, less expensive implementation models of the OEP can achieve results similar to those achieved with traditional methods. Given the similarities in effectiveness between the 2 models in this study, the action of doing the exercises may be the essential element of the OEP, which provides opportunities to develop and test new delivery models to ensure that the best outcomes are achieved by participants. Further research is needed to identify the characteristics of older adults who are most likely to succeed in a home-based personal trainer model, in a group-based setting, or in a virtual model, as well as to clarify the roles and responsibilities of the providers who deliver the program. These new dissemination models offer the ability to bring the OEP to scale at lower cost and have potential to create new roles in fall risk management for physical therapists.

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Ethics Approval

This project was deemed exempt from the Institutional Review Board by the University of North Carolina, Chapel Hill, Office of Human Research Ethics.

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Disclosures and Presentations

The authors declare no conflicts of interest.

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