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Exercise and Social Activity Improve Everyday Function in Long-term Care Residents

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Older adults living in residential long-term care (LTC) facilities (assisted living and nursing homes) often experience progressive decline in everyday function, defined as the ability to adequately perform cognitively complex tasks like dialing a telephone and functional tasks requiring gross motor function, such as walking and getting up out of a chair. Conditions that may accelerate decline in everyday function are prevalent in LTC, including cognitive impairment, depression, and sleep disorders.[1] Despite the known benefits of physical activity and social interaction, LTC residents spend up to 65% of their time inert and alone in their rooms.[2]

Interventions addressing specific functional deficits, like immobility, have been shown to provide significant benefits to LTC residents. For example, walking has been found to improve mobility, reduce depression, and have beneficial effects on cognition.[3] Yet, there have been few studies of interventions to improve everyday function in LTC residents, who are often debilitated and cognitively impaired. Whether multicomponent interventions designed to increase physical activity and social engagement and improve sleep in LTC residents will improve everyday function is unclear.

Thus, this study examined the effects of 7 weeks of high-intensity resistance strength training and walking (E), individualized social activities (SA), combined E and SA (ESA),

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and usual care (UC) on everyday function in LTC residents and looked at the relationship between change in everyday function and sleep. We hypothesized that 1) residents who received E and ESA would have significantly better everyday function than those who received UC and SA, and 2) changes from baseline to post-intervention in everyday function would be significantly associated with changes in sleep.

METHODS

Participants

Data for this study were derived from a randomized controlled trial, The Effect of Activities and Exercise on Sleep (NINR R01NR7771; KC Richards, PI), which compared the effects of E, SA, and ESA with usual care on nighttime sleep time in LTC residents.[4] In the original trial, 379 residents of 10 nursing homes and 3 assisted living centers were approached to participate in the study.[4] Of these, 355 consented to enroll in the study, and 193 participants were randomized to 1 of 4 groups and completed the study.[4] The Nursing Home Physical Performance Test (NHPPT) was added to the randomized controlled clinical trial after approximately 1 year of data collection.[5] Participants included in this analysis had baseline and post-intervention polysomnography (PSG) data and baseline deficits in everyday function, as defined by a score of <23 out of 24 on the NHPPT total score. All potential participants' everyday function scores were <23. Five participants were missing either post-intervention PSG data for NHPPT data and were excluded this analysis leaving a final sample of 119.

The study design, inclusion/exclusion criteria, protocol, and the intervention and control conditions have been described in detail elsewhere.[4] Inclusion criteria were age ≥55; and a Mini-Mental State Examination (MMSE) score of 4-29 (severe to mild or no cognitive impairment); <7 hours of total nighttime sleep and ≥30 minutes daytime sleep during 5 days/5 nights of actigraphy; ≥2 weeks residence in LTC; able to stand with little or no assistance; and stable doses of all medications and no planned change during the next 7 weeks. Scores on the MMSE range from 0 to 30 with higher scores indicating greater cognitive function.[6] Test-retest reliability is 0.83 and correlates with similar measures range from 0.66 to 0.88.[7] Based on our work[8] and the work of others,[9] cognitively impaired LTC residents with an MMSE ≥ 4 have sufficient verbal skills to report pain and can safely perform resistance training, with assistance.

Exclusion criteria included near-terminal medical disorder, unresolved malignancy, treatment with chemotherapy or pharmacological dose of steroids, and unstable cardiovascular disease. Residents with obstructive sleep apnea or periodic limb movement disorder were not excluded; instead, they were stratified into those with an apnea–hypopnea index of ≥5 or periodic limb movement with an arousal index ≥5, or neither condition as determined by PSG. Sample size for this analysis was determined by the availability of pre- and post-NHPPT and polysomnography data. Randomization was achieved using a computerized random number generator with random block sizes.

Ethics

Once Institutional Review Board approval was received, research assistants assessed possible participants for capacity to provide informed consent; legal guardians provided written consent, if necessary. Assent was obtained before each session. Physician consent was required for participation in an exercise program.

Interventions

The interventions have been described in detail elsewhere.[4] Briefly, the E group had 7 weeks of nurse-supervised high-intensity resistance strength training that focused on leg strength (hip-extension/leg-press) and arm strength (seated chest-press). Muscle strength was determined using the One-Repetition Maximum (1RM) test, which measures the maximum amount of weight that a muscle can move one time. The test was conducted on all participants at baseline to establish base-level strength and during the 7-week intervention to provide feedback for progression of the exercise program. Strength gain was calculated by determining the difference between baseline and final 1RM test. On Mondays, Wednesdays, and Fridays, participants trained for 40 minutes; each session consisted of a warm-up and cool-down (1 set of 8 repetitions at 20% 1RM) and exercise (3 sets of 8 repetitions on legs and arms). Weight lifted was gradually increased as tolerated. On Tuesdays and Thursdays, participants walked at a comfortable pace for up to 45 minutes in 1 single or multiple sessions.[10]

The SA group had 1 hour of individualized social activity 5 days a week for 7 weeks, as developed and tested in a previous study.[11] The activities included petting a stuffed cat for those with severe cognitive impairment; tossing a ball for those with moderate cognitive impairment; and playing checkers for those with mild cognitive impairment. The activities were individualized using four primary participant characteristics: work and social history, cognition, and functional status. The ESA group had 7 weeks of resistance training and walking combined individualized social activities, as described above.

KR provided 40 hours of training to research staff that included information on how to adapt interventions to each resident's ability, for example, giving directions as a series of one-step commands to compensate for memory loss. To ensure standardization, exercise and social activities were randomly videotaped and reviewed.

The UC group participated in the usual social and physical activities provided in the LTC facilities. Each setting had a social activity program, but often persons with cognitive impairment were excluded. None of the settings had structured exercise programs.

Adverse Events

Adverse events have been reported in detail elsewhere.[4] Briefly, for the entire sample, 5 events (E=4; ESA=1) were possibly study-related and participants no longer continued in the study. Two participants in the E group had chest pain without evidence of myocardial damage; two participants (1 in the E group and 1 in the ESA group) had electrocardiographic changes (non-specific t-wave change and multi-focal premature

ventricular contractions respectively) after baseline 1RM testing; and 1 E group participant had back, hip, and leg pain.

The sleep technicians who collected the PSG data and the registered PSG technologist, who scored the sleep data, were blinded to group assignment. The research assistant who collected the NHPPT data was blinded to the hypothesis related to everyday function. However, the nature of the interventions prevented blinding of participants, investigators, and LTC staff.

Measures

Everyday function was measured using the NHPPT, following the protocol developed by Binder.[5] The NHPPT is designed to measure everyday function in LTC residents with or without cognitive impairment. The NHPPT contains 6 individual tests sit-to-stand, scooping applesauce, washing the face, dialing a telephone, putting-on and taking-off a sweater, and a 6-meter walk (scored 0=unable to 4=best performance). Test scores are summed to provide a total score (0 to 24, with a higher score indicating better performance). Psychometric tests suggest that the NHPPT captures constructs related to gross motor function, balance, flexibility, fine motor coordination, and task sequencing required for mobility and everyday activities. There are two methods of scoring: 1) need for assistance as determined by the test administrator and 2) time as measured by a stopwatch. Here we report performance in relation to the time for task completion since this score provides objective information on the efficacy of interventions.[12] Gait speed (meters/second) was calculated using data collected during the 6-meter walk. Test-retest reliability for the 6 tests range from 0.73 to 0.93 and Cronbach's alpha was 0.92.[5] In this study, Cronbach's alpha was 0.89.

Overnight PSG is an objective measure of sleep. As defined by the American Academy of Sleep Medicine, two nights of PSG are considered standard to reduce the first night effect and to capture variance in sleep quality across nights.[13] Attended PSG with the Grass Portable Polysomnography System (Astro-Med, Inc., West Warwick, RI) was used to measure participants' sleep in their rooms for two nights at baseline and post-intervention. PSG data were analyzed and scored using standardized methods,[14] with two exceptions. First, all non-rapid eye movement sleep (NREM) was collapsed into one indeterminate category of NREM sleep because people with cognitive impairment often have diffuse delta and theta EEG activity. Second, conventional scoring criteria for rapid eye movement (REM) atonia were disregarded as landmarks used to identify the onset of REM, such because sleep spindles, often disappear.[15] We calculated change in each sleep variable (total sleep time, NREM, REM, number of awakenings, and wake after sleep onset) by calculating the difference between baseline and post-intervention.

The Cumulative Illness Rating Scale - Geriatrics (CIRS-G), a comprehensive review of medical problems by organ system, was used to estimate chronic illness burden. The CIRS-G severity index (range 0-4, with higher scores indicating greater risk for mortality)[16] has been shown to have excellent interrater reliability (0.78 for the total score to 0.81 for the number of categories endorsed) and validity, shown by correlations based on autopsy findings.[17] For this study, Cronbach's alpha was 0.77.

Statistical Analysis

Using SPSS version 16.0 and Stata/IC 10.0, descriptive statistics were computed and groups were compared. The final sample of 119 participants include E=37; SA=32; ESA=22; and UC=28. Post-intervention NHPPT items were missing in the E (3%), SA (6%), ESA (5%) and UC (7%) groups, respectively, for individual items. Inspection of the data, however, indicated that variables were missing at random. Regression imputation was therefore used for the missing post-intervention NHPPT items using the Stata regression algorithm, which estimates missing values based on predicted values generated by a regression model. ANCOVA was used to test for group differences in post-intervention NHPPT total score (TOTALsc2, dependent variable), using the same pre-intervention NHPPT score (centering the TOTALsc1, baseline variable) as the covariate. Significant main effects of group (E, SA, ESA and UC) were further analyzed for their simple effects from the adjusted marginal scores using SPSS's pairwise comparison output. Pearson correlations were used to explore the relationships between change scores in total sleep time, sleep efficiency, REM, NREM, number of awakenings, and wake after sleep onset, and the change scores in everyday function for the entire sample. All statistical significance tests were 2-sided, and α=0.05 was considered statistically significant.

RESULTS

Pre-intervention

One hundred nineteen participants (77 women) were included in this analysis. Table 1 gives a comparison of the four study groups on demographic indicators, MMSE, CIRS-G, medication use, and everyday function measures. Participants had multiple sources contributing to loss of everyday function: 66% (n=79) had cognitive impairment based on an MMSE score ≤26[18] (Mean=23, Range 4–29); 50% (n=59) were taking anti-depressants; and mean CIRS-G severity index was 1.65 indicating a high chronic illness burden.[19] The most common health problems were heart (89%) and musculoskeletal (82%). The most common medications were antihypertensives (64%) and anti-depressants (50%).

The median NHPPT total score pre-intervention was 17.0 (M, 15.9, SD, 4.9, Range = 0-22) with 67 participants (59%) scoring ≤17.0 (range 0 to 17), indicating that over half of the participants had great difficulty with everyday function. Examination of the 6 individual NHPPT tests revealed that participants had most difficulty (score ≤2 out of a possible 4) with the face-washing task with 98/119 (82%); followed by the 6-meter walk, with 68/119 (57%). Median gait speed at baseline was 0.44 meters/second (M=0.47; SD, 0.24), and 56% (n=67) had a gait speed less than 0.47 meters/second, indicating high risk for adverse outcomes, such as falls.[20]

Adherence to the Interventions

Exercise group—Mean attendance was 29/35 days, or 81% (SD, 6.5), for the resistance training and walking exercises. The E group resistance trained with the research staff for a mean of 17/21 days, or 81%, (SD, 6.5). Mean arm strength increased by 41%, and weight pressed increased from 40.68 (SD, 21.1) to 55.39 pounds (SD, 32.3). Leg strength increased by 81.4%, and weight pressed increased from 81.8 (SD, 60.2) to 104.81 pounds (SD, 60.4).

Mean intensity of training was 75% of the 1RM. Participants walked for 12/14 days, or 86%, (SD, 1.8) for a mean of 11 minutes (SD, 10.7), and a mean distance of 418.2 meters (SD, 703.8).

Social Activity Group—Mean attendance was 33/35 days, or 94% (SD, 5.5) for a mean of 57.7/60 minutes per day (SD, 5.1). Research assistants rated participant involvement on a 4-point scale (1=poor, 4=good participation), and mean involvement was 3.9 (SD, 4.0).

Exercise and Social Activity Group—Mean attendance was 28/35 days, or 80% (SD, 6.9) for the resistance training and walking; and the group resistance trained for 15/21 days, or 81% (SD, 8.3). Mean arm strength increased by 24.7% and weight pressed increased from 47.1 (SD, 19.9) to 59.11 pounds (SD, 24.1). Leg strength increased by 81.4% and weight pressed increased from 107.7 (SD, 75.2) to 139.9 pounds (SD, 96.0). Mean training intensity was 75%. Participants walked a mean of 13/14 days, or 93%, (SD, 0.13) for a mean of 6.5 minutes (SD, 6.9) and a mean distance of 210.6 meters (SD, 282.5). The group received social activities for a mean of 35/35 days, or 100%, (SD, 8.7), for a mean of 57.8/60 minutes per day (SD, 5.0) with a mean involvement of 4.0 (SD, 0.09).

7-week post-intervention results

ANCOVA (Table 3) showed significant intervention effects on the adjusted NHPPT dependent variable scores (adjusted means, Table 2) among the group [F=4.07 (df=3,111), p=0.01], the centered baseline NHPPT covariate [F=220.73(1,111), p=0.01], and the group by centered pre-NHPPT interactions [F=4.21(3,111), p=0.01]. As determined by SPSS ANCOVA output, the effect sizes were f=0.33 for the main group effect, f=1.41 for the main Pre-NHPPT scores, and f=0.35 for the main interaction effect.[21]

The groups were compared by six individual t-tests (see Table 4). The ESA group had significantly greater unadjusted t-tests than the SA group and the UC group. The t-test was also significant for the difference between the ESA and E groups, with ESA > E (p=0.04; d=.55). However, with a Bonferroni adjustment (p = .008), the difference between ESA and E groups was not significant. No relationship was found between change in any sleep variable and change in everyday function (see Table 5).

CONCLUSIONS

In this study, 7 weeks of high intensity resistance training and walking combined with individualized social activities (ESA) resulted in significantly greater improvements in everyday function in LTC residents than social activities (SA) and usual care (UC). LTC residents usually have high levels of cognitive and physical disability, with 75% requiring assistance in three or more activities of daily living and 50% having some form of dementia.[22] Researchers have found that many LTC residents are inactive and alone up to 65% of their time.[3] Inactivity and social isolation contribute to strength loss, depression, and insomnia, with the highest rate of decline in those with dementia.[23] This study provides evidence that LTC residents with a high prevalence rate of dementia can improve in everyday function within a relatively short time.

The significant improvement seen in the ESA group may have been the result of the added effects of resistance training and walking with social activity. For example, evidence suggests that resistance training improves muscle strength,[24] walking improves mobility,[25] and has beneficial effects on cognition,[26] and social activities improve nighttime sleep[4]. Owsley, Sloane, McGwin, and Ball reported that time to complete instrumental activities of daily living (e.g. finding a telephone number) was related to memory, reasoning and processing speed in community-dwelling older adults with cognitive decline (MMSE < 22).[27] Their findings suggest that a program to improve everyday function should include a variety of activities to enhance memory and counteract the effects of physical inactivity, social disengagement, and sleep disturbances common among LTC residents.

In this study, resistance training and walking (E), without the individualized social activity, did not produce significant improvement in everyday function. The improvement observed in the mean NHPPT total score, however, may be clinically meaningful in the these residents may be at less risk for falls and hospitalizations, particularly when compared to the UC group whose function declined over 7 weeks.[28] The E group had a large increase in leg strength, and since functional ability declines an average of 20% between the ages of 40 and 60, and decline accelerates in the 6th and 7th decades,[29] these older adults may have been stronger than they had been in years.

A recent Cochrane review[3] identified 21 randomized studies comparing exercise interventions with either no intervention or alternative interventions among LTC residents that had strength as an outcome.[3] These studies contained a variety of strengthening interventions, such as dumb-bells, therabands, and resistance training, prescribed at varying intensity.[3] Not all trials demonstrated significant strength gains.[3] In one trial, LTC residents with low levels of inflammation had significant improvements in strength compared to those with high levels of inflammation as measured by blood plasma levels of tumor necrosis factor (TNF) receptors.[30] Future studies should examine whether exercise training would have the greatest benefit in subgroups of LTC residents.

Individualized social activity have been found to improve nighttime sleep,[31] help maintain physical function,[32] and reduce cognitive decline in older adults,[33] but in this study, SA did not significantly improve everyday function. Our findings are similar to those of Nijs et al.,[34] who did not find a significant improvement in NHPPT total score in LTC residents who participated in a social activity intervention.

We also found no relationship between change in any sleep parameters (total sleep time, NREM, REM, number of awakenings, and wake after sleep onset) and change in everyday function in the ESA group or the entire sample. Our findings differ from a recent cross-sectional study of community-dwelling older women where researchers found that poor nighttime sleep (<6 hours and >7.5 hours of nighttime sleep, and 1.6 hours of wake after sleep onset) was significantly associated with poorer physical function (slower gait speed, inability to complete a single chair stand and reduced grip strength).[35] Our findings may have differed because participants were not all women; they were more debilitated (some could barely stand at baseline); and 66% (n=79) had cognitive impairment based on an MMSE score ≤ 26.[18] That is, factors such as chronic illness, depression, and nutrition, may

be more closely related to everyday function than sleep in a LTC population. Another potential explanation for the different findings may be that the NHPPT taps into cognitive and physical aspects of function,[5] while performance-based measures that capture primarily mobility and muscular strength. Because there is accumulating evidence of a relationship between sleep and everyday function among adults, there is a need to further investigate this relationship in LTC residents.

Several limitations are important to note. The walking component of the E and ESA interventions was not heart rate intensity prescribed (i.e. heart rate at 60% peak VO_2);[36] thus, the true aerobic nature of the intervention is undeterminable. The control group was assigned to receive usual care. The option of an attention-only control was not used due to the high risk of increased socialization, risking contamination of the SA arm. This was a secondary data analysis and blinding of the participants, investigators, project staff and the residential staff was not possible, creating the possibility that our findings may reflect biases in data collection or patterns of missing data. However, the Cochrane collaboration tool was used to assess the risk of bias in selection, performance, detection, attrition, reporting and other potential sources.[37] Although blinding was incomplete, the objectivity of the outcome measures (PSG and NHPPT) protected against performance bias on the study results. The study's strengths include the use of PSG to objectively measure sleep, the inclusion of LTC residents with a wide range of functional and cognitive abilities, high participant adherence to interventions, and the use of well-trained staff to conduct the interventions and to collect performance-based functional measures.

In conclusion, LTC residents, with and without cognitive impairment, may benefit from a combined program of resistance training, walking, and individualized social activities. Further, clinically meaningful and statistically significant improvements in everyday function were obtained within a relatively short time (7 weeks). Unfortunately, resource constraints (cost, equipment, and lack of trained staff) often limit the availability of supervised exercise and social activities. Future studies should focus on the dose-response effects of the combined interventions in order to identify the most cost-effective methods to slow deterioration of everyday function among LTC residents.

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Table 1

Pre-Intervention Demographic and Clinical Characteristics of Study Groups

Characteristic	Exercise (n=37)	Social Activity (n=32)	Combined Exercise and Social Activity (n=22)	Control (n=28)	Statistical Comparison
Age, mean (SD)	81.7 (7.9)	80.9 (9.4)	81.0 (9.9)	81.9 (6.7)	$F_{[3,115]} = 0.11$ p = 0.96
Gender (Female), number (%)[b]	26 (70)	23 (77)	10 (45)	18 (64)	χ^2 [3] = 4.79 p = 0.19
Setting, (assisted living), number (%)	18 (49)	18 (56)	13 (60)	15 (54)	χ^2 [3] = 0.53 p = 0.91
MMSE (0-30), mean (SD)	21.8 (6.8)	22.1 (7.6)	24.3 (4.2)	23.5 (5.6)	$F_{[3,115]} = 0.91$ p = 0.44
Severe (≤10), No	3	3	0	1	χ^2 [2] = 1.14 p = 0.71
Moderately Severe (10-15), No	5	3	1	2	χ^2 [3] = 3.18 p = 0.44
Moderate (16-20), No	3	3	3	2	χ^2 [3] = 0.27 p = 1.00
Mild (21-26), No	15	11	10	14	χ^2 [3] = 1.36 p = 0.76
Normal (>26), No	11	12	8	9	χ^2 [3] = 1.00 p = 0.83
CIRS-G, SI (0-4), mean (SD)	2.28 (1.7)	1.64 (0.3)	1.66 (0.2)	1.60 (0.2)	F [3,115] = 0.66 p = 0.51
Medication Use, No (%)					
Sedative hypnotic	2 (1)	3 (11)	3 (14)	3 (11)	χ^2 [3] = 0.27 p = 1.00
Anti-depressant	19 (53)	12 (38)	19 (53)	9 (32)	χ^2 [3] = 5.20 p = 0.16
Anti-hypertensive	25 (69)	19 (59)	25 (69)	19 (69)	χ^2 [3] = 1.64 p = 0.67
Pain	9 (25)	9 (28)	9 (25)	9 (32)	χ^2 [3] = 0.00 p = 1.00
Everyday Function Measures, Mean (SD)					
Gait Speed (m/sec)	.52 (0.4)	.44 (0.3)	.52 (0.3)	.42 (0.3)	$F_{[3,115]} = 0.99$ p = 0.41
NHPPT Total Score (0-24)	15.8 (4.7)	15.3 (5.7)	17.3 (3.5)	15.9 (4.9)	$F_{[3,115]} = 0.78$ p = 0.51

Abbreviations: MMSE = Folstein Mini-Mental State Exam, CIRS-G SI = Cumulative Illness Rating Survey – Geriatrics, Severity Index; NHPPT= Nursing Home Physical Performance Test

[a]The χ^2 test was used for gender and setting. ANOVA was used for age, MMSE, CIRS-G, gait speed, and NHPPT total score. The exact χ^2 test was used for the MMSE subgroups and medications.

*P<.05

Table 2

Summary Table of Analysis of Covariance (ANCOVA) and Effect Sizes of Main Effects (Outcome Variable: NHPPT Total Score = Everyday Function)

Source	F	df	Probability	ES (f)
Group	4.07	3	0.01*	0.33
Centered Pre-NHPPT Scores	220.73	1	0.01*	1.41
Group*Pre-NHPPT Interaction	4.21	3	0.01*	0.34
Residual		111		

Abbreviations: NHPPT= Nursing Home Physical Performance Test; df = degrees of freedom; f indicates effect sizes (ES) derived from the ANCOVA pairwise comparison t-test; $f=\sqrt{ETA^2}/(1-ETA^2)$; NHPPT scores are derived from the 6 performance tasks scored according to task performance (0-24) with higher score indicating higher performance. $F_{(3,111)}$ values for the NHPPT score from a group × baseline interaction (2×2) analysis of covariance (ANCOVA) design using the baseline NHPPT as covariate.

*P<.05

Table 3

Means and Standard Deviations for NHPPT Total Score at Baseline, Post-intervention, and Analysis of Covariance (ANCOVA) Adjusted Scores

	Exercise (n=37)	Social Activity (n=322)	Exercise and Social Activity (n=22)	Usual Care (n=28)
Baseline Scores:				
Mean	15.76	15.25	17.27	15.93
Standard Deviation	4.72	5.73	3.53	4.91
Final Scores:				
Mean	15.97	15.00	17.45	15.28
Standard Deviation	3.73	6.12	4.14	5.70
ANCOVA Margins (Adjusted Scores):				
Mean	15.97	15.00	17.45	15.29
Standard Deviation	2.70	2.70	2.70	2.70

Abbreviations: NHPPT= Nursing Home Physical Performance Test.

NHPPT scores are derived from the 6 performance tasks scored according to task performance (0-24) with higher score indicating higher performance. Table values are the mean and standard deviation of scores at baseline, post-intervention, and adjusted for baseline NHPPT score (these means are different form the raw means). $F_{[3,111]}$ values for the NHPPT score from a group × baseline interaction (2×2) analysis of covariance (ANCOVA) design using the baseline NHPPT as covariate.

Table 4

Pairwise Comparisons (Outcome Variable: NHPPT Total Score = Everyday Function)

Group Contrast	df	Mean Difference	p-value (t-test)	(95% Confidence Interval)		ES (d)
				Lower	Upper	
E vs. UC	63	0.69	0.31	−2.03	0.65	0.25
E vs. SA	67	−0.97	0.14	−2.27	0.32	0.36
ESA vs. UC	48	−2.17	0.006*	−3.69	−0.64	0.80
ESA vs. SA	52	−2.46	0.001*	−3.94	−0.97	0.91

Abbreviations: NHPPT= Nursing Home Physical Performance Test; UC=usual care control; SA=individualized social activity; E=physical resistance training and walking exercise; ESA=both E and SA; d indicates ES (Cohen's) ABS ($x\bar{a}$-$x\bar{b}$/s) Mean Difference is calculated as UC-SA, UC-E, UC-ESA, SA-E, SA-ESA, and E-ESA

As expected UC vs SA had a non-significant t-test value (df=58; p=0.68). E vs ESA had a significant (df=52; p=0.04) NHPPT scores are derived from the 6 performance tasks scored according to task performance (0-24) with higher score indicating higher performance.

Table 5

Association Between Change in Everyday Function (NHPPT total score) and Change in Sleep Parameters (N=119)

	Baseline Mean (SD)	Post-intervention Mean (SD)	Change Mean (SD)	*r*
Everyday function				
NHPPT total score	15.9 (4.9)	15.8 (5.0)	−0.12 (2.9)	0.02
Sleep parameters				
Total sleep time (minutes)	315.8 (90.8)	341.9 (79.8)	25.3 (78.6)	0.02
Non-rapid eye movement sleep (minutes)	272.8 (80.1)	298.7 (72.2)	25.4 (69.6)	0.02
Rapid eye movement sleep (minutes)	42.9 (24.7)	43.2 (26.0)	−0.01 (24.6)	0.02
Number of awakenings (number)	32.4 (24.1)	32.3 (26.9)	−0.45 (17.5)	0.11
Wake after sleep onset (minutes)	116.4 (54.8)	113.7 (49.1)	−2.8 (57.4)	−0.04

NHPPT= Nursing Home Physical Performance Test; NHPPT scores are derived from the 6 performance tasks scored according to task performance (0-24) with higher score indicating higher performance.

df = n – 2

*p<.05 (two-tailed test)