2011

Functional Training as Compared to Resistive Strength Training in Older Adults with Functional Deficits

Kristine Hostager
Pacific University

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Critically Appraised Topic

Title: Functional Training as Compared to Resistive Strength Training in Older Adults with Functional Deficits.

Clinical Scenario: The patient who led me to pursue this question was an 84 year old (y.o.) female who was admitted to the skilled nursing facility (SNF) due to decreased level of independence after a hysterectomy. Co-morbidities included tremors of unclear etiology and recently diagnosed dementia. This patient presented to physical therapy with moderate low back pain, decreased gait speed, altered gait pattern of looking down and shuffling, requiring the use of a front wheeled walker (FWW) to ambulate, and difficulty with bed mobility and transfers requiring min assist and use of bed rails, elevating height of bed, and a FWW. Also, she presented with decreased endurance with rapid onset of fatigue and increased tremors. The patient's original goals included wanting to discharge home to live with her son and to be independent while home alone.

Brief Introduction: In order to answer my clinical question, I wanted to discover what the research said in regards to the benefits of functional training compared with resistance training on the functional outcomes in the geriatric population. While working in a SNF, I have seen many patients with a recent decline in functional level secondary to an illness or recent surgery. Their change in activity level and subsequent deconditioning often results in increased difficulty with ambulation and transfers. To address these problems, I have been using a combination of functional and resistance exercises. I am wondering if I should focus on one over the other, especially when patients are not able to tolerate doing very much.

My Clinical Question: Does functional training result in more clinically significant changes in strength and functional status than resistance training in older adults?

Clinical Question PICO:

Population: Older adults (>65 y.o.) with decreased level of independence and/or functional mobility.
Intervention: Functional exercises/training activities
Comparison: Resistance exercises/strength training
Outcomes: Gait speed (10MWT), timed up and go test (TUG), functional assessments or questionnaires, LE muscle strength (dynamometer)

Overall Clinical Bottom Line: The two articles included in this CAT provide moderate support for the use of 6-12 weeks of functional training for older adults with functional impairments as compared to strength training. These articles supported improvements in strength and function for both groups as compared to baseline (Krebs et al.) or a control group (de Vreede et al.); however, the change from baseline to end of treatment was significantly greater in the functional training group than in the strength training group for Assessment of Daily Activity Performance (ADAP), gait speed, and efficiency of chair rise. The two studies did not agree regarding strength measures. de Vreede, et al. demonstrated a greater increase in strength as measured by an Isometric Knee Extensor Strength test for the strength training group than the functional group. This reached statistical significance ($p=0.001$) with an effect size of 1.11 (0.56 – 1.66). Krebs and colleagues demonstrated a greater change for the functional training group in lower extremity strength as measured by a dynamometer, but this did not reach statistical significance. Thus, from these two articles it can be concluded that functional training results in more functional improvements and strength training results in strength improvements. These outcomes support the concept of specificity of training. Based on these results, it would be appropriate

to focus on functional training over resistance training with older adults experiencing any functional deficits. The generalizability of these studies was limited due to small sample size and exclusion criteria. More research is needed to strengthen the results of these studies with a larger sample size and slightly less restrictive exclusion criteria.

Search Terms: Aged, older adult, elderly, functional training, resistance training, exercise, physical function, muscle strength on Medline, EBSCOhost, and PubMed

Appraised By: Kristine Hostager, SPT
School of Physical Therapy
College of Health Professions
Pacific University
Hillsboro, OR 97123
host8742@pacificu.edu

Rationale for Chosen Articles

I performed an article search on EBSCOhost, Medline, and PubMed for any articles relating to functional outcomes after resistance and/or functional training in the geriatric population. My search terms were broad initially bringing up several hundred articles in the combined databases. I eliminated any case studies or reviews and only looked for prospective experimental trials. I also eliminated all articles older than 2000. I performed an additional search by using the key terms from the first article I found that was appropriate to check for similar articles. By scanning the abstracts of articles from both searches, I narrowed my selection down to three articles that directly compared functional exercises and resistance exercises with subjects who were older than 60.

The three articles that were closest to my clinical PICO are analyzed below:

De Vreede PL, Samson MM, van Meeteren NLU, Duursma SA, Verhaar HJJ. Functional-Task Exercise Versus Resistance Strength Exercise to Improve Daily Function in Older Women: A Randomized, Controlled Trial. *J Am Geriatr Soc* 2005; 53:2-10.

PEDro Score = 6

P: Ninety-eight women who were at least 70 y.o.
I: Functional-task exercise program.
C: Resistance exercise program.
O: Assessment of Daily Activity Performance (ADAP), timed up and go (TUG), isometric knee extensor strength (IKES), handgrip strength, isometric elbow flexor strength (IEFS), leg extension power

Manini T, Marko M, VanArnam T, Cook S, Bo Fernhall, Burke J, Ploutz-Snyder L. Efficacy of Resistance and Task-Specific Exercise in Older Adults Who Modify Tasks of Everday Life. *The Journals of Gerontology* 2007;62A(6):616-623.

PEDro Score = 4

P: Thirty-two older adults with decreased knee strength and modified level of independence.
I: Functional training protocol including chair, stair, kneeling, laundry, and vacuuming activities.

C: Resistance training consisting of leg press, leg extension, leg curl, sitting dip, arm curl, and shoulder press.
O: Number of task modifications and timed performance for 8 ADL's, knee and elbow strength (dynamometer), body composition (DEXA), self -reported physical function (SF-12v2), single leg balance, gait speed, and time to vacuum a carpet.

Krebs DE, Scarborough DM, McGibbon CA. Functional vs. Strength Training in Disabled Elderly Outpatients. *American Journal of Physical Medicine and Rehabilitation* 2007;86(2):93-103.

PEDro Score = 7

P: Fifteen older adults referred to physical therapy for at least one LE impairment.
I: Six weeks of functional training focusing on locomotor activities of daily living.
C: Six weeks of progressive resistive strength training using elastic bands and therapist contact.
O: Lower extremity strength (dynamometer), momentum and peak knee torque with sit to stand, gait speed, standing balance, SF-36.

Table 1. Comparison of PEDro scores as ranked by me for articles by de Vreede et al., Manini et al., and Krebs et al.

	De Vreede et al.	Manini et al.	Krebs et al.
Random allocation	Yes.	Yes.	Yes.
Concealed allocation	No.	No.	No.
Baseline comparability	Yes.	Yes.	No.
Blind Subjects	No.	No.	Yes.
Blind Therapists	No.	No.	No.
Blind Assessors	Yes.	No.	Yes.
Adequate Follow-Up (less than 15% drop out)	Yes. 14%	No. 26%	Yes. 0%
Intention-to-Treat	No.	No.	Yes.
Between Group	Yes.	Yes.	Yes.
Point Estimates & Variability	Yes.	Yes.	Yes.
Total Score	6	4	7

All three articles closely matched my PICO in terms of population with the article by Krebs and colleagues having the youngest subjects (youngest = 62 y.o.). These articles also closely matched my clinical intervention and comparison, which is the why I selected them. Each one had a difference set of exercises, but they were clearly divided into a functional group and a strength/resistance group. As for the outcome measures, the studies by Manini et al. and Krebs et al. included some form of measurement for lower extremity (LE) strength, sit to stand transfer, and gait speed which were the outcomes in my clinical PICO. The study by de Vreede et al. measured LE strength and sit to stand (TUG), but only assessed gait speed as part of the total ADAP score without reporting it separately. None of these studies had exceptional PEDro scores, but the study by Manini and colleagues was so low I decided to eliminate this article. My primary concerns were the lack of blinding and the high rate

of subject loss without an intention to treat analysis. The studies by de Vreede and colleagues and Krebs and colleagues had higher PEDro scores, blinded at least the assessor, and had a lower percentage of subject drop outs. Krebs et al. had a very small sample population, but at least there were no subjects lost as was the case with the study by Manini et al.

Based on the above comparisons, I have chosen to write this critically appraised topic on the articles by de Vreede, et al and Krebs, et al.

Article #1: de Vreede PL, Samson MM, van Meeteren NLU, Duursma SA, Verhaar HJJ. Functional-Task Exercise Versus Resistance Strength Exercise to Improve Daily Function in Older Women: A Randomized, Controlled Trial. *J Am Geriatr Soc* 2005; 53:2-10.

Clinical Bottom Line: The results of this study demonstrate moderate evidence that functional exercises produce greater gains in actual function when compared with resistance exercises for community dwelling older females. Specifically, the researchers used the Assessment of Daily Activity Performance to estimate the functional gains after 12 weeks of exercises. The results were able to show a large effect size in favor of the functional exercise group. However, the resistance exercise group had significantly greater strength gains than the functional exercise group as measured by the Isometric Knee Extensor Strength, but this did not translate into a higher lower extremity functional score. The primary limitations of this study were the 14% drop out rate and the very specific sample of only community dwelling females. Thus, it is uncertain whether these results could be generalized to the residents of a skilled nursing facility especially considering the extensive exclusion criteria. More research that included nursing home residents of both genders is needed to fully answer my PICO.

Article PICO:

Population: Ninety-eight women who were at least 70 y.o.
Intervention: Functional-task exercise program.
Comparison: Two groups: 1) Resistance exercise program and 2) Control group
Outcomes: Assessment of Daily Activity Performance (ADAP), timed up and go (TUG), isometric knee extensor strength (IKES), handgrip strength, isometric elbow flexor strength (IEFS), leg extension power (LEP)

Blinding: All outcome measures were assessed by a single examiner who was blinded to the group allocation of each subject. Neither the subjects nor the therapists were blinded. This would have been difficult to do and does not create a significant threat. The most likely source of bias would be from the assessor collecting the final data and this person was blinded.

Controls: There was an actual control group that received no active intervention. The subjects in this group were told to simply maintain their normal activity level. This group was important in ruling out any potential influences other than the specific interventions that would result in changes in the outcome data. There was also a comparison group that received 40 minutes of resistance exercises instead of 40 minutes of functional tasks. All other parameters were the same so that the only difference between groups was the specific type of intervention.

Randomization: Subjects were randomly allocated to the three groups by a computer generated random numbers table. There were no significant differences between the groups in the baseline measures thus confirming that the randomization process was successful.

Study: This study was a prospective randomized controlled trial. Inclusion criteria were simply being a

community-dwelling female who was at least 70 years old. Exclusion criteria included recent fractures, unstable cardiovascular or metabolic diseases, depression/emotional distress, any conditions that would prevent testing or training, history of one week of lost mobility during the past two months. Subjects were also excluded if they were already very active as defined by exercising at a sports club three or more times per week. Using these criteria and convenience sampling resulted in 98 subjects who were then randomly assigned into three groups: control (n=31), functional-task exercise (n=33), and resistance exercise (n=34). The control group received no interventions at all and subjects were instructed simply to maintain their previous activity level. Both exercise groups participated in three one-hour exercise sessions per week for a total of 12 weeks. Each session for the subjects in the functional-task exercise group consisted of a 10 minute aerobic warm-up, 40 minutes of functional core exercises focusing on moving with a vertical component, moving with a horizontal component, carrying an object, and changing between lying/sitting/standing positions, and 10 minutes of flexibility exercises for a cool down. The resistance exercise group received the exact same 10 minute aerobic warm-up and 10 minute cool down, but the 40 minutes of core exercises focused on strengthening muscle groups important to daily task without actually simulating any tasks. Thus, a progressive resistance protocol was used to specifically strengthen elbow flexors/extensors, shoulder abductors/adductors/rotators, trunk flexors/extensors, hip flexors/extensors/abductors/adductors, knee flexors/extensors, and ankle dorsiflexors/plantar flexors by using dumbbells, elastic tubing, and ankle weights. Both groups were instructed to exercise at a rating of perceived exertion (RPE) of seven to eight on a ten point scale and add more resistance/weight if their RPE was below seven.

Outcome Measures: The outcome measures were assessed at baseline and then three months later when the interventions were complete. Measurements were also taken nine months from baseline after six months of deconditioning. Although my clinical question did not directly address this aspect, it still provides relevant information regarding long-term benefits of these interventions. Functional outcomes included the Assessment of Daily Activity Performance and the timed up and go (TUG). The ADAP scores include a total score and five distinct domain scores which were upper body strength, lower body strength, flexibility, balance & coordination, and endurance. Lower extremity muscle function was assessed by measuring knee extensor strength (IKES) with a fixed strain gauge (AFG-Advanced Force Gauge) and leg extension power (LEP) with a Nottingham power rig. Authors cited an article by Samson et al. that supported both the reliability and the validity of all of these measures except the ADAP. The researchers conducted their own study which confirmed that the ADAP is a reliable tool with good correlation with other functional measures. The authors did not cite MCID's for any of the measures used in this study and none were found in the literature.

Study Losses: Between baseline and the three month re-assessment, 14 subjects (14%) withdrew. Each group lost several subjects (six from the resistance, three from the function, and five from the control), but none were related to adverse events due to either intervention. Of the 14 subjects, eight dropped out due to losing interest. Another 10 subjects withdrew between the three month assessment and the nine month assessment so study losses for the nine month assessment were 24%. Authors did not perform an intention-to-treat analysis. The authors did conduct a t-test analysis of baseline scores that confirmed there were no significant differences between subjects who completed the study and those who withdrew. All subjects were analyzed in the groups into which they were originally randomized.

Summary of internal validity: Overall, this study has good internal validity. Randomization into groups was confirmed to be successful. A single assessor who was blinded to group allocation recorded all measures. The success of this blinding was confirmed by having the assessor guess the group allocation of each subject with the assessor's accuracy only being 37%. Also, the authors selected measures that were both valid and reliable. The biggest threat to internal validity was the 14% drop out

rate at three months and 24% at nine months without an intention-to-treat analysis. However, the authors did confirm that the subjects who dropped out were similar to those who stayed in all the relevant baseline characteristics. Another minor threat is the lack of patient and therapist blinding. This may have introduced some minor bias, but would have been very difficult to avoid. Thus, overall there were no significant threats to internal validity.

Evidence: The outcomes I chose to focus on were the baseline to three month changes that occurred in the function and strength measures. I also chose to look at the nine month follow-up to make comparisons between more long-term and lasting effects of the two interventions. The outcome measures that matched my clinical PICO included the ADAP total score and TUG for functional measures and ADAP lower body strength score, IKES, and LEP for muscle strength/performance measures. Due to the lack of MCID's for these outcome measures, I chose to calculate effect sizes in order to estimate whether differences were clinically relevant.

Table 2. Comparison of control group and function group mean change scores from baseline to three month assessment.

	Function Group: Mean change ± standard deviation	Control Group: Mean change ± standard deviation.	Effect size (95% confidence intervals)
ADAP total score	6.8 ± 4.3	0.3 ± 3.8	1.59 (0.99 – 2.20)
ADAP lower body strength score	7.4 ± 4.9	1.9 ± 3.0	1.33 (0.75 – 1.91)
TUG	-0.1 ± 0.7 seconds	0.1 ± 0.7 seconds	0.29 (-0.24 – 0.81)
IKES	-7.0 ± 25.2 Newtons	-8.2 ± 37.1 Newtons	0.04 (-0.49 – 0.56)
LEP	11.2 ± 27.5 Watts	-7.0 ± 26.1 Watts	0.68 (0.14 – 1.22)

Table 2 shows the mean change between baseline and the three month reassessment for both the control group and the function group. The function group improved statistically significantly more than the control group in their ADAP scores and LEP. No statistically significant differences were found between the control and function groups in TUG and IKES scores. The effect sizes were quite small for both the TUG and IKES supporting the finding that the function group was no more effective in improving these outcome measures than no intervention at all.

Table 3. Comparison of control group and resistance group mean change scores from baseline to three month assessment.

	Resistance Group: Mean change ± standard deviation	Control Group: Mean change ± standard deviation.	Effect size (95% confidence intervals)
ADAP total score	3.2 ± 4.8	0.3 ± 3.8	0.67 (0.12 – 1.22)
ADAP lower body strength score	2.9 ± 4.8	1.9 ± 3.0	0.25 (-0.29 – 0.78)
TUG	-0.1 ± 0.7 seconds	0.1 ± 0.7 seconds	0.29 (-0.24 – 0.81)
IKES	23.7 ± 30.1 Newtons	-8.2 ± 37.1 Newtons	0.95 (0.39 – 1.51)
LEP	10.8 ± 25.8 Watts	-7.0 ± 26.1 Watts	0.69 (0.14 – 1.24)

Table 3 is the same as Table 2 except it compares the resistance group with the control group. Unlike the function group or the control group, the resistance group increased their IKES score instead of experiencing a decrease. This improvement was statistically significant and produced a large effect size of 0.95. Another notable difference is the lack of a statistically significant difference between the amounts of improvement of the resistance group compared to the control group for the ADAP lower body strength score. The effect size for ADAP lower body strength was also quite small (0.25). Apparently the improvement in IKES does not carry over to gross LE strength as measured by functional tasks in the ADAP.

Table 4. Comparison of changes in the function group and the resistance group between baseline and three month reassessment.

	Function Group: Mean change ± standard deviation	Resistance Group: Mean change ± standard deviation.	Effect size (95% confidence intervals)
ADAP total score	6.8 ± 4.3	3.2 ± 4.8	0.79 (0.26 – 1.33)
ADAP lower body strength score	7.4 ± 4.9	2.9 ± 4.8	0.93 (0.39 – 1.47)
TUG	-0.1 ± 0.7 seconds	-0.1 ± 0.7 seconds	0 (-0.52 – 0.52)
IKES	-7.0 ± 25.2 Newtons	23.7 ± 30.1 Newtons	1.11 (0.56 – 1.66)
LEP	11.2 ± 27.5 Watts	10.8 ± 25.8 Watts	0.01 (-0.50 – 0.53)

Table 4 compares the two intervention groups at three months. For the ADAP total score, the function group improved on average more than twice as much as the resistance group. This difference between groups in favor of the function group was statistically significant per author's calculations to a p value of 0.007. The effect size was relatively large (0.79) and the confidence intervals did not reach zero, suggesting a meaningful improvement in the function group over the resistance group stronger. The difference between the two groups was even greater for the lower body strength dimension of the ADAP and this was statistically significant with a p value of 0.001. The effect size was larger at 0.97. Neither group made statistically significant improvements on the TUG. The IKES, on the other hand, showed a decrease in the function group and an increase in the resistance group. This difference between groups was statistically significant ($p = 0.001$). However, the standard deviations were so large that overlap does exist indicating there was a lot of variability within the groups. The mean difference between the groups was large enough though that the effect size was quite large (1.11) and without negative confidence intervals. This means the relationship would not reverse in 95% of trials. This allows us to be more confident that there is a meaningful difference in IKES between the groups in favor of the resistance group. Although the function group appeared to have a slightly higher mean change for the LEP, this difference was not statistically significant. Also, the effect size was almost zero (0.01) with confidence intervals that went negative indicating that the relationship could reverse.

Overall these outcomes indicate that the resistance program results in improved strength and the function program results in improved function, as assessed by the outcome measures. The programs appear to result in training-specific outcomes without much carryover between strength and function. Clinically, it appears that it is appropriate to train with the outcome in mind. If a patient needs to gain strength then resistance exercises should be used. For most patients though, this study would support

using functional training since this tends to be a much more important goal than simply addressing an impairment such as specific LE weakness.

Table 5. Comparison of changes in the function group and the resistance group between baseline and nine month reassessment after six months of deconditioning.

	Function Group: Mean change ± standard deviation	Resistance Group: Mean change ± standard deviation.	Effect size (95% confidence intervals)
ADAP total score	6.1 ± 5.0	3.0 ± 4.7	0.64 (0.07 – 1.20)
ADAP lower body strength score	6.0 ± 6.2	2.9 ± 4.8	0.55 (-0.01 – 1.12)
IKES	-10.7 ± 20.6 Newtons	0.4 ± 42.1 Newtons	0.34 (-0.21 – 0.90)
LEP	17.2 ± 24.0 Watts	16.5 ± 24.1 Watts	0.03 (-0.52 – 0.58)

Table 5 presents the comparison between the two intervention groups at the nine month assessment used to assess the effect of six months of deconditioning. The functional group had a statistically significantly higher ADAP score than the control group. The resistance group did not have a difference in ADAP scores compared to the control group. This indicates that for the functional group the functional improvement achieved remained despite deconditioning (effect size 0.64). The exercise group was not different from the control group at 3 months and this relationship remained at 9 months. Neither group reached statistical significance as compared to the control group for improvement in IKES. Both groups continued to have statistically significantly higher LEP than the control group. Interestingly no significant difference was found between the two intervention groups in any of the measures at 9 months. With these results in mind, it would be beneficial clinically to use functional training to not only increase strength as measured by LEP and function as measured by the ADAP with some potential for maintaining gains even after therapy ceases.

Applicability of study results:

Benefits vs. Costs: The costs of both the resistance and the functional exercise interventions were very reasonable. The exercises were done in groups under the supervision of a physical therapist and a sports teacher. For the patients, it would require only 3 hours per week. No special equipment was used, only standard dumbbells, resistance bands, and household objects such as a chair or something practical to carry. Adverse events were minor and included muscle/joint pain and low back pain. One patient did experience a hamstring strain. Significant strength and functional gains were seen in both groups as compared to the control group. Thus, the benefits outweigh the costs.

Feasibility of Treatment: The exercise protocols for this study were careful detailed in the article so that they could be reproduced. Compliance ranged from 74% in the resistance group to 83% in the function group on average. Thus, even without perfect compliance these results could be achieved. However, 8% of the original subjects did drop out because they lost interest. This was a bigger problem in the resistance group than in the function group. The number of sessions required was within a reasonable amount for insurance companies to cover. Overall, either program could be considered equally feasible.

Summary of External Validity: The ability to generalize the results was limited by the convenience sampling and inclusion of only women who did not have any of the many conditions from the exclusion criteria. Thus, this study cannot be generalized to men and caution must be used with generalizing the results to patients seen in a nursing home since this study only included community

dwelling women. Finally, the external validity was also slightly limited by compromised internal validity as a result of a 14% drop out rate.

Article #2: Krebs DE, Scarborough DM, McGibbon CA. Functional vs. Strength Training in Disabled Elderly Outpatients. *American Journal of Physical Medicine and Rehabilitation* 2007;86(2):93-103.

Clinical Bottom Line: This study provided weak evidence supporting the use of six weeks of functional training over strength training to make clinically relevant improvements in function for older (>60 y.o.) patients with functional and lower extremity impairments. Relevant outcomes measures were used including lower extremity strength as measured by a dynamometer, gait speed, and SF-36 scores. However, no conclusions regarding effect size or MCID could be made since raw data and mean scores were not reported. Researchers noted statistically significant differences in favor of the function group for increased gait velocity and efficiency of chair rise. All other measures did not reach statistical significance. Exclusionary criteria were few thus allowing increased generalizability to subjects with co-morbidities including stroke, significant osteoarthritis, and cardiovascular pathology, which are all commonly seen in the skilled nursing setting. Although there were some promising data, a study with a much larger sample size and a control group is needed to confirm these results.

Article PICO:

Population: Fifteen older adults referred to physical therapy for at least one LE impairment.
Intervention: Six weeks of functional training focusing on locomotor activities of daily living.
Comparison: Six weeks of progressive resistive strength training using elastic bands and manual resistance.
Outcomes: Lower extremity strength (dynamometer), momentum and peak knee torque with sit to stand, gait speed, standing balance, SF-36.

Blinding: This study was double blinded. Subjects and assessors were blinded to group allocation. It was not feasible to blind the therapists. This did not create a major threat since the majority of the intervention was done independently by the patients and the therapists were not responsible for collecting any data.

Controls: There was no control group. Baseline measures were taken for both intervention groups prior to any treatment and comparisons made within and between the groups. The comparison group was similar to the intervention group for all parameters of the study except the type of exercise (30 minutes of strength training versus 30 minutes of functional training).

Randomization: Randomization into functional training and strength training groups was accomplished by use of a computer-generated table. However, researchers did not report whether the two groups were comparable at baseline.

Study: This was a randomized, blinded prospective trial. There were two groups who received distinctly different interventions without a third control group. To be included, subjects had to be at least 60 years old, ambulate 15 feet independently, demonstrate at least one functional limitation on the SF-36, and have a lower extremity impairment. Any subjects with terminal illness, progressive neurological disease, legal blindness, or acute pain were excluded from the study. There were a total of 15 subjects with six in the strength training group and nine in the functional training group. Both groups received the exact same 10 minute warm-up and cool-down exercises, but the 30 minutes in-between were specific to each group. The strength training group used graded resistance elastic bands or body weight as in a previously described and validated program for elders. The functional training

group completed functional tasks at three speeds (self selected, fast, slow). Both groups were instructed to perform exercises three to five times per week for six weeks with weekly outpatient visits to progress program and check compliance logs.

Outcome Measures: Several outcome measures used in this study were pertinent to my clinical PICO. Lower extremity strength including hip abduction, knee flexion, knee extension, plantarflexion, and dorsiflexion was measured with a dynamometer. Researchers cited previously established validity of this method from an earlier study. Maximum and average gait velocities were also measured. Various measures were collected during a chair rise to assess improvements in this functional activity, but the researchers did not cite validity or reliability of these measurements. However, they did report that decreased knee torque used to accomplish the task indicates learned efficiency as demonstrated in a previous study conducted by the authors. The short form 36 (SF-36) was used as a comprehensive functional questionnaire. Other research has demonstrated that the SF-36 is a reliable and valid tool in the elderly population (Bohannon and Depasquale). Assessments were made at baseline and then at the completion of the six weeks of training.

Study Losses: All 15 subjects who began the study completed the study in their original groups.

Summary of internal validity: Overall, the internal validity of this study was fair. The subjects were randomized, but the researchers did not determine if this was successful. However, no subjects were lost and blinding was completed for both subjects and assessors to minimize bias. The most significant threats were the possible significant differences between groups at baseline prior to intervention, lack of a control group, and the small sample size.

Evidence: Outcome measures were collected at baseline and then again after six weeks of training allowing within group comparisons of before and after and between group comparisons of change scores. Thus, all of the data collected for strength, gait velocity, chair rise, and SF-36 were relevant. The researchers did not include the raw data in their article and so all calculations were based upon the statistical tests calculated by the researchers.

Table 6. Statistical significance of difference between change scores of functional training group compared with strength training group.

	Functional Group % Change	Strength Group % Change	Between group comparison (p value)
Hip Abduction	16.40%	13.70%	0.4
Knee Flexion	9.50%	19.80%	0.25
Knee extension	33.60%	3.70%	0.11
Plantarflexion	20.20%	12.60%	0.3
Dorsiflexion	48.10%	28.30%	0.26

Statistically significant within group improvements in total strength occurred in both groups ($p = 0.003$). However, as demonstrated in Table 5, there was no statistically significant difference between groups for any of the strength measures.

The data regarding gait velocity showed statistically significant differences between change scores for functional training group and the strength training group in favor of the functional group (max gait

speed p = 0.024, average gait speed p = 0.023). Estimations of these differences based on bar graphs presented by authors yielded approximately 0.12 meters/second between groups for both maximum gait speed and for average gait speed.

The only chair rise data that reached significance was peak knee torque during rise. The functional group utilized less peak torque to accomplish the same task when comparing the two groups at the six week assessment (p = 0.033). Thus, the functional group learned to be more efficient with this task through task-specific training.

Finally, the SF-36 demonstrated statistically significant improvements in function for both groups from baseline to the six week assessment (p = 0.013). There was no statistically significant difference between groups.

Applicability of study results:
Benefits vs. Costs: Groups were approximately equal in the costs vs. benefits analysis. Both groups required the same number of treatment sessions with a therapist. The strength group did use resistive bands that would need to be purchased whereas the functional group just used objects around the home. However, these bands are not very expensive. Neither group had any adverse events due to interventions. Both groups had to invest the same amount of time. The function group may have been slightly more beneficial for improving gait speed and efficiency of chair rise for the same amount of training, but the evidence is weak.
Feasibility of Treatment: Either form of training appears to be very feasible and the number of visits required was also reasonable (1x/week). The compliance in this sample was very good for both groups, but slightly better for the strength group. So, to get the same results patients would have to comply with the training program approximately 5 days per week. For some patients, this is not feasible.

Summary of External Validity: The external validity was good overall. The ability to generalize was greatly increased by including subjects of both genders with various co-morbidities. The study did, however, have one major threat; a very small sample size. For this reason, the results should be generalized with caution. The authors referred to this as a pilot study that would benefit from a much larger follow-up study.

Synthesis/Discussion:

Although both articles closely matched my PICO, there were still some significant differences between the two studies. The study by de Vreede et al. had a larger sample size, but much more extensive exclusionary criteria limiting generalizability to females who were relatively healthy. The study by Krebs et al. had a smaller sample size, but included males and females with various medical conditions. The interventions were very similar in frequency and types of exercises with the primary difference being duration [twelve weeks (de Vreede) vs. six weeks (Krebs)].

As for the quality of the studies, de Vreede et al. had a PEDro score of six and Krebs et al. had a score of seven. However, the study by de Vreede and colleagues had a much larger sample size, greater internal validity due to successful randomization and a control group, and more complete presentation of data. These factors support relying more heavily on the results of the study by de Vreede et al.

While both studies examined functional and strength measures, the combination of different outcome measures and lack of raw data in the study by Krebs et al. limited the ability to compare their results.

Table 7. Comparison of the results from the articles by de Vreede et al. and Krebs et al.

	de Vreede et al.		Krebs et al.	
	Outcome measure	Results	Outcome measure	Results
Functional Outcome Measure	ADAP	FG > SG P value = 0.007* Effect size = 0.79 (0.26 – 1.33)	SF-36	FG = SG P value = 0.068
Lower extremity strength	IKES	SG > FG P value = 0.003* Effect size = 1.11 (0.56 – 1.66)	Knee extension - Dynamometer	FG = SG P value = 0.11
Gait Velocity	Included in ADAP	Not reported separately	Max gait velocity	FG > SG P value = 0.024*
Chair rise	TUG (fastest pace)	SG = FG P value = 1.00	Biomechanical analysis of chair rise – peak knee torque	FG > SG P value = 0.033*

FG = Functional training group, SG = Strength training group
* = statistical significance

Table 6 shows the key comparable results between the two studies. While both studies appeared to support greater functional improvements in the functional training group compared to the strength training group, only the results from the study by de Vreede et al. reached statistical significance. The results were opposite for the primary strength measures, but again only the study by de Vreede et al. demonstrated statistical significance in favor of the strength training group. For the chair rise, only Krebs et al. found a difference. This may have been due to the more sensitive biomechanical analysis used in the study by Krebs et al. compared to the TUG which is simply a timed test that includes time to rise from a chair, walking, and turning. Krebs and colleagues also demonstrated a greater improvement in gait speed in the functional group estimated at 0.12 m/s. The minimally clinically significant change found in the literature was for patient recovering from a hip fracture. This MCID was 0.1 m/s indicating that the improvement in the functional group over the strength group was clinically significant if the results from patients with hip fractures can be extrapolated to patients with other subacute conditions (Palombaro et al.). Although gait speed was not directly reported in the de Vreede et al. study, the ADAP did include a 6 minute walk test. Based on these results, it appears that training has to be specific to the desired outcome. Strength training resulted in improvements in strength with limited carry-over to function and functional training resulted in improvements in function with limited carry-over to strength. Since the goal in physical therapy is to make functional improvements in the geriatric population, this research supports using progressive functional exercises at least three times a week.

References:

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