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PHYT 752 Evidence Based Practice II
Module 4: Evidence Table

PICO: In people with multiple sclerosis, does resistance training improve gait speed and/or gait endurance when compared to other forms of exercise training?

Abbreviations: QOL= quality of life, FSST=four square step test, FRT= functional reach test, 6MWT= 6 minute walk test, MSIS=multiple sclerosis impact scale, BDI= Beck Depression Inventory, MFIS= modified fatigue impact scale, SF-36= short form-36, M:F= male: female, 2MWT= 2 minute walk test, 25FWT=25 foot walk test, 10MWT= 10 meter walk test, TUG= timed up and go, FSS=Fatigue Severity Scale, PRT= progressive resistance training, DMT= disease-modifying therapy, MSFC= MS Functional Composite, CES-D= Center for Epidemiologic Studies Depression Scale, FIM= Functional Independence Measure, RMI= Rivermead Mobility Index

Author, Year, Journal, Title	**Purpose, Design**	**Subjects**	**Intervention**	**Results ($p<0.05$)**	**Application to PICO Question**	**Comparison/ Notes**
Sabapathy NM et al, 2011 *Clin Rehabil* Comparing endurance- and resistance-exercise training in people with multiple sclerosis: a randomized pilot study	To compare how 2 types of training affect functional capacity, QOL, and mobility in people with MS. Cohort	Protocol: 8 wks of training #1, 8 wks off, 8 wks of training #2 Resistance 1st: n=11, Endurance 1st: n=5 Age: 55±7 1:3 M:F 10±10 yrs disease duration n=10 RRMS n=6progressive	Resistance: 2x/wk for 8 wks, 5 min walking warm up, 3 upper body, 3 lower body, 1 core, 1 stability exercise, 2-3 sets of 6-10 reps. 15-20 min stretch. Endurance: 2x/wk for 8 wks, 5 min walking, 2 circuits x 5min then 2 min break, 15-20 min stretching.	Pre/post scores for FRT, FSST, TUG, and 6MWT showed statistically significant ($p<0.01$) changes from before to after training with both resistance and endurance training. The MSIS-physical and MFIS-physical and psychosocial were significant with both training types. The MSIS and MFIS- physical were significant with $p<0.05$; MFIS- psychosocial was significant with $p<0.01$.	Both endurance and resistance training improved function, mobility, fatigue, and disease impact, although neither type of exercise modality improved significantly more than the other.	Depression might not have been accurately assessed; QOL of the sample was high; small sample size; people were fairly high functioning with MS; no control group; potential carry-over because of design; big differences in numbers in each group.
Kjolhede T et al, 2012 *Multiple Sclerosis* Multiple Sclerosis and Progressive Resistance Training: A Systematic Review	To determine if PRT improves strength, gait speed, fatigue, and QOL. Systematic Review	16 publications out of an initial grouping of 389 titles and abstracts. Articles met following criteria: peer-reviewed, longitudinal, training	A variety of interventions were performed in each study. This systematic review took all the results from each intervention and determined the value of PRT on impairment, functional, and	PRT does not significantly influence disease progression, mood, balance, or QOL. PRT positively influences LE muscle strength, increase muscle hypertrophy and motor unit adaptations. Some minor improvements might occur with functional tasks, although non-significant gait speed/distance	PRT seems to have some positive benefits for people with MS, but results are not strong regarding the connection between PRT and improved gait speed or distance.	One of the author's of the review published an article included in the review, so skewed conclusions may occur; only 8 of 16 studies were RCTs; sample sizes in most studies were small; statistical power was not reached in a lot

		intervention with appropriate progression. People included in the studies had EDSS <6.5.	participation factors in people with MS.	improvements. PRT may improve self-reports of fatigue and help reduce CAD risk with MS. Studies included in the review reported significance of $p<0.05$.		of the studies included; few participants have been stratified by disability, gender, age, or DMT.
DeBolt LS et al, 2004 *Arch Phys Med Rehabil* The Effects of Home-Based Resistance Exercise on Balance, Power, and Mobility in Adults with Multiple Sclerosis	To identify if PRT effects physical functioning, (gait, leg power, and balance.) To determine if a PRT HEP is accessible, cost-effective, and has good adherence. RCT	n=37 subjects, 29 female, 8 male; mean age 51.7; stratified by age (decades) and disability level using EDSS; subjects able to walk >20m without rest w/ or w/o assistive device.	Group 1: n=19, 6 instructional exercise 2 wks before baseline measures, then 3x/wk for 8 wk home-based LE resistance training program: chair raises, leg curls, forward lunges, step-ups, heel-toe raises. Group 2: 17 control subjects maintained current PA.	No significant change found in AP, ML, or velocity sway on force platform. Found a 12.7% difference (not significant) in TUG. Significant difference in the Leg Extensor Power Rig. This resistance training HEP had good adherence and is well-tolerated by people with MS.	A resistance training HEP is an inexpensive alternative to help increase, though maybe not significantly, mobility in adults with MS.	Non-probability sample; no blinding; length of the study might have limited effects; took best score of 2 trials for TUG; small sample size; exercise group started with a lower baseline power score and had greater potential for improvement.
Dodd KJ et al, 2011 *Multiple Sclerosis* Progressive resistance training did not improve walking but can improve muscle performance, quality of life, and fatigue in adults with multiple sclerosis: a randomized controlled trial	To perform a high-quality study examining physical & psychological effects of resistance training on people with RRMS, and to examine if changes persist over 12 weeks. RCT	n=71 PRT: n= 36, mean age 47.7, ambulation index 2-4, 24 didn't use AD, 22 had MFIS>38 Control group: n=35, mean age 50.4, ambulation index 2-4, 22 didn't use AD, 19 had MFIS>38.	PRT: 45 min. 2x/wk for 10 wks. 30 min recovery & socializing. Exercises: leg press, knee extension, calf raises, leg curls, and reverse leg press with 2 min rest given between sets. Progression based on 2009 ACSM guidelines Control: usual care	After training, PRT did not significantly increase 2MWT or 10MWT compared to control. PRT increased 1RM leg press & 1RM strength/endurance of reverse leg press. PRT decreased physical fatigue, total fatigue, & improved physical QOL. Moderate correlation between reverse leg press, leg press strength, and walking speed. 12 wks after training, PRT significantly improved	PRT does not significantly impact walking speed or distance in people with MS, though changes in muscle strength and endurance can occur, which have the potential to impact walking ability. PRT is safe and might help decrease muscle spasm and stiffness.	Only high-functioning MS patients with RRMS included; outcome measures used might not have been sensitive enough to identify the benefits or effects of PRT; improvements in strength might include a component of learning since exercise and testing were done on the same equipment; PRT program wasn't individualized to a

			& 1 hr/wk for 10 weeks social program.	muscle endurance for reverse leg press compared to control, with $p<0.05$.		patient's key impairments.
Romberg A et al, 2005 *J Neurol* Long-term exercise improves functional impairment but not quality of life in multiple sclerosis	To determine if a long-term resistance and aerobic exercise program affects functional impairment and/or health-related quality of life in people with mild to moderate MS. RCT	n=95 Exercise group: n=47, mean age 43.8, 63% female, 36% married, 62% full/part-time, mean 6.0 yrs with disease, 2.0 mean EDSS score, 123.4 mean FIM Control: n=48, mean age 43.9, 65% female, 25% married, 54% full/part-time, mean 5.5 yrs with disease, 2.5 EDSS score, 123.9 mean FIM.	Exercise: wks 1-3: inpatient rehab with supervised training, 5 PRT sessions, 5 aerobic sessions. Weeks 4-26: HEP according to instructions from PTs. HEP: PRT 3-4x/week & aerobic training 1x/week. Used theraband to increase difficulty. Participants called 4x to encourage adherence. Controls: received no intervention.	The exercise group significantly improved their MSFC score while the control group deteriorated. 25FWT significantly improved in the exercise group compared to the control. EDSS remained unchanged over the course of the intervention. No significant change in disability was seen from the FIM, in health-related QOL from the MSQOL-54, or in depression seen from CES-D; reported with significance of $p<0.05$.	6 months of mostly resistance training with 1x/wk aerobic exercise can improve function in people with MS, measured using the MSFC. The biggest significant change in function with this exercise program was the 25FWT, a measure of walking speed.	The sample size was not justified; there was no standardization between what the control group could or could not do; the 9HPT and PASAT components of the MSFC have been shown to be susceptible to practice effects; and randomization occurred before patients were confirmed to be eligible.
Taylor NF et al, 2006 *Disabil Rehabil* Progressive resistance exercise for people with multiple sclerosis	To determine if PRT can increase maximal muscle force, muscle endurance, functional activity, ad improve overall psychological function in people with MS.	n=9, 7 female, 2 male, mean age 45.6 yrs, mean disease duration was 6.0 yrs, categorized as mild to moderate disability, no participants used an AD. 2 participants withdrew from the study, leaving a total of n=7.	Exercise at gym 1x/week during week 1, 2, and 4. Testing wks 2 & 4, followed by 10 wks of PRT performed 60 min 2x/wk, with 6 exercises: leg press, calf raise, knee extension, lat pull down, arm press, seated row. ACSM guidelines	Training loads increased around 45% in the UE and 80% for LE. Stable baseline measures between wks 2 & 4. Significant increase in leg strength (32.6%), leg endurance (170.9%), and arm strength (14.4%.) Significant improvement in fast walking speed (6.1%), and trend toward increased walking endurance. No significant change found in	PRT showed significant improvements in pre to post-scores in LE muscle strength, endurance, walking speed, and potentially walking endurance.	The selection criteria limited a lot of people with MS so isn't generalizable to everyone with MS; the sample size was very small; no control group was compared to the intervention group.

	Cohort		for progression with 2-min rest between each. 30 min social interaction after exercise.	self-selected walking speed or timed stairs test. Physical impact of MS decreased throughout training. No change in psychological impact of MS was found.		
White LJ et al, 2004 *Multiple Sclerosis* Resistance training improves strength and functional capacity in persons with multiple sclerosis	To evaluate the effect of 8 weeks of PRT on LE strength, ambulation, fatigue, and self-reported disability in people with MS. Cohort	n=8, 7 female, 1 male, EDSS between 1-5, all subjects did light PA 3 months prior to study, mean age 46, mean BMI 27, mean self-reported EDSS 3.7.	Resistance training 2x/wk for 8 wks. Baseline results determined initial training loads. Did warm-up set (5 reps at 40% MVC). Wk 1: 1 set of 6-10 reps at 50% MVC. Wk 2: 1 set of 10-15 reps at 60% MVC. Wk 3-8: 10-15 reps at 70% MVC. Training lasted 30 min. If subjects did 15 reps 2 sessions in a row, resistance increased 2-5%.	Significant increases in muscle strength for knee extension & plantarflexion, non-significant knee flexion & dorsiflexion. Training volume wks 4-8 was significantly greater than wk 1. No significant changes seen in muscle CSA or volume, though both improved. No significant change occurred in 25FWT, but # of steps taken in 3 min significantly increased (8.7%.) MFIS fatigue decreased ($p<0.04$.) Self-reported EDSS was decreased, not significantly.	Resistance training is well tolerated, can improve strength and walking endurance, and decrease self-reported fatigue in people with MS. Though results seem to be directly correlated to strength gains, some crossover seems to exist with functional activities. In people with MS who have difficulty walking primarily because of LE muscle weakness, PRT might be effective to target the appropriate impairments and improve function.	The progressive resistance training was only moderate intensity and may not have been aggressive enough to identify changes to muscle; there is no control group; the sample size is very small; training protocol did not discuss level of supervision or interaction with participants.
Broekmans T et al, 2011 *Multiple Sclerosis* Effects of long-term resistance training and simultaneous electro-stimulation on muscle strength and function in multiple sclerosis	To determine if 20 weeks of standardized resistance training with and without simultaneous electrical stimulation increases leg muscle	n=33 PRT: n=11, 6 female, 5 male, mean EDSS 4.5, mean age 44.9, 5 RRMS, 6 progressive MS PRT+E-Stim: n=11, 6 female, 5 male, mean EDSS 4.4, man	PRT: 2 10-wk training periods based on ACSM. 60 min every 2 wks. Sessions: cycle ergometer warm up, unilateral leg press, leg curl, leg extension, 1-2 rep sets & 2 min	Training load increased in both PRT and PRT+E groups, with average training session load of PRT+E significantly higher than PRT with leg extension & leg press, not leg curl. Isometric strength same between groups, but significantly bigger than	A standardized 20-week low to moderate intensity unilateral resistance training program can improve muscle strength, but doesn't change functional mobility significantly. Simultaneous e-stim doesn't show added benefits.	Small samples size decreased power; decreased blinding of investigators; subjects were randomized based on EDSS and not muscle strength; LE testing was only unilateral but functional measures involve bilateral

	strength and overall functional mobility. RCT	age 48.7, 2 RRMS, 8 progressive MS <u>Control</u>: n=14, 11 female, 3 male, mean EDSS 4.1, mean age 49.7, 6 RRMS, 6 progressive MS	rest between. Cool-down & stretch. <u>PRT & E-Stim</u>: participants followed the same protocol, with quads activated during leg press & leg extension. <u>Control</u>: continue w/current activity.	control. No significant interaction found between max isokinetic muscle strength & endurance. Walking endurance significantly improved in PRT compared to control after 10 wks, but no significant difference seen in 2MWT, T25FW, TUG, or RMI with $p<0.05$.		strength and endurance.
Cakt BD et al, 2010 *Am J Phys Med Rehabil* Cycling progressive resistance training for people with multiple sclerosis: a randomized controlled study	To determine how cycling progressive resistance training and balance exercises affect walking speed, balance, fatigue, fear of falling, depression, and quality of life in people with MS. RCT	n=33 <u>Group 1</u>: cycling + exercise, n=14, 9 female, 5 male, mean age 36.4, mean BMI 25.2, mean duration of MS 9.2 yrs, 28.5% used AD. <u>Group 2:</u> HEP, n=10, 8 female, 2 male, mean age 43, mean BMI 24.6, mean duration of MS 6.2 yrs, 20% used AD. <u>Group 3</u>: n=9, 6 female, 3 male, mean age 35.5, mean BMI 21.3, mean duration of MS 6.6 yrs, and 37.5% used AD.	<u>PRT:</u> 2x/week for 2 mo =16 sessions. 15 sets each time: 2 min high-resistance pedaling & 2 min of low-resistance or rest. After cycling, 5 min walking + stretching, then 20-25 min of balance exercises (balance board, walk on toes, backwards, leaning to side, LE plyometrics), & 5 min stretching. <u>HEP</u>: same as PRT, without cycling. Subjects contacted 2x/month to monitor adherence. <u>Control:</u> nothing	Statistically significant improvements on 10MWT, TUG, DGI, FRT, FSS, FES, and BDI after the cycling PRT. The mean FES scores of HEP improved after training. No significant improvements in control. No differences between groups found for SF-36, but cycling PRT showed improvements in physical functional & role-physical function of SF-36 from start to finish. Moderate correlations between the 10MWT & TUG, DGI, FRT, FSS, BDI, FES. Adherence was good (93%) and no injuries occurred as a result of this program.	Cycling PRT with balance exercises are well tolerated can positively impact walking speed, balance, fear of falling, fatigue, and depression, as well as physical functioning and role-physical functioning scales of the SF-36.	There was not a disease-specific QOL scale used, small sample size and the study can't isolate whether the effectiveness of the intervention was from cycling or balance or both