Exercise & Health-Related Quality of Life in Older Community-Dwelling Adults: A Meta-Analysis of Randomized Controlled Trials

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ABSTRACT

BACKGROUND: The effects of exercise on health-related quality of life (HRQOL) in older adults are not well established. OBJECTIVE: Use the meta-analytic approach to examine the effects of exercise on HRQOL in older community-dwelling adults. METHODS: Studies were included if they met the following criteria: (1) randomized controlled trials with the unit of assignment at the participant level, (2) an exercise-only intervention group (aerobic, strength training, or both), (3) community accessible exercise interventions ≥ four weeks, (4) a non-intervention control group, (5) target population of older adults, (6) English-language studies, (7) published and unpublished (Master's theses and dissertations) studies, (8) studies published between January 1, 1973 and August 29, 2007, and (9) HRQOL data available for one or more of the 10 components in the Medical Outcomes Study 36-Item Short-Form Health Survey. A random-effects model was used for all primary analyses. RESULTS: Of the 257 studies screened, 11 representing 13 groups and a total of 617 men and women (324 exercise, 293 control), all > 50 years of age, were included. Overall, a significant (small to moderate) standardized effect size improvement was found for physical function as a result of exercise (Hedge's g = 0.41, 95% confidence interval, 0.19 to 0.64, p <0.001). This was equivalent to a common language effect size of 62% and an odds ratio of 2.14 (95% CI, 1.42 to 3.24). No significant differences were found for the other nine HRQOL outcomes. CONCLUSION: Exercise improves self-reported physical function, a component of HRQOL, in older community-dwelling adults.

INTRODUCTION

- Older adults suffer disproportionately from poor physical health and have more activity limitation (HRQOL components)
- Aging of the population will increase the number of older adults in US
- Important to identify effective interventions such as physical activity for improving HRQOL in older adults

PURPOSE

- Use the meta-analytic approach to examine the effects of physical activity across all components of HRQOL, as measured by the SF-36, in community-dwelling older adults

DATA SOURCES

1. PubMed
2. EmBase
3. Cochrane Central Register of Controlled Clinical Trials
4. Dissertation Abstracts International
5. Cross-referencing from review articles
6. List of references from producers of SF-36

STUDY SELECTION

1. RCT with unit of assignment at participant level
2. Physical activity as the only intervention (aerobic, strength training, or both)
3. Community-accessible interventions ≥ 4 weeks
4. Non-intervention control group
5. Community-dwelling adults ≥ 45 yrs
6. English-language studies
7. Published & unpublished (Master's theses & Dissertations) studies
8. Studies published between January 1, 1973 and August 29, 2007
9. HRQOL data available for 1 or more of the 10 components of the SF-36

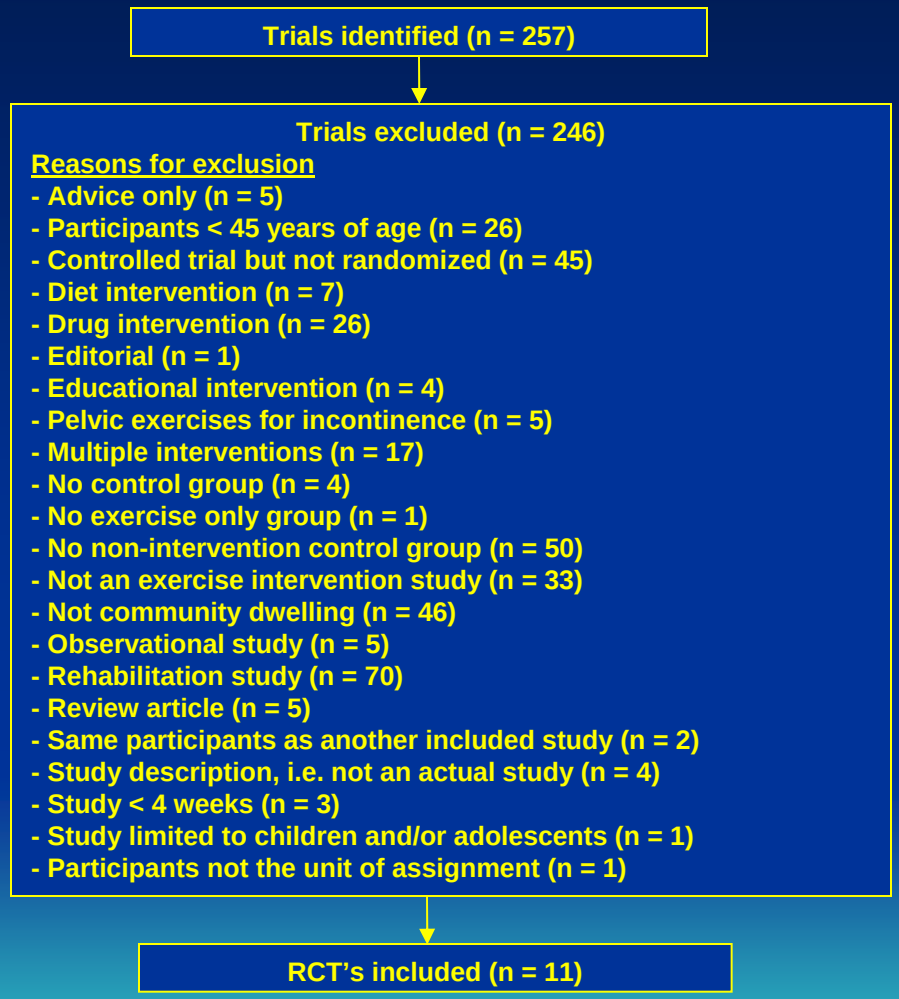
DATA ABSTRACTION

1. Coding sheet (907 items per study)
2. Major variables coded: study, subject, & physical activity program characteristics, primary outcomes
3. Dual-coding, independent of each other
4. Every item reviewed for accuracy and consistency (11,791 cells per codebook)
5. Inter-rater reliability prior to correcting discrepant items (Cohen's kappa = 0.92)

STATISTICAL ANALYSIS

1. Power Estimates for HRQOL outcomes - Medium effect size of .50
2. Study Level Effect Size for HRQOL - Hedge's *g*
3. Heterogeneity using the Q statistic and $p < 0.10$ (Cochran WG. The combination of estimates from different experiments. Biometrics 1954;10:101-29)
4. Inconsistency as $I^2 = 100\% \times (Q - df)/Q$ (Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. Br Med J 2003;327:557-60)
5. Study Quality – (0 to 5 scale) (Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJM, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials Is blinding necessary? Control Clin Trials 1996;17:1-12)

Figure 1. Flow Diagram for Selection of Studies



RESULTS

- **Study Characteristics**
  - **11 Studies**
  - **24 Groups (13 EX, 11 CON)**
  - **617 Subjects (324 EX, 293 CON)**
  - **Percent Dropout (M ± SD): EX, 16% ± 8, CON 9% ± 10%)**
  - **Study Quality: Median = 2**

Table 1. Exercise Program Characteristics

Variable	N (%)
Type of Exercise	
-Aerobic	4 (30.7)
-Strength Training	5 (38.6)
-Both	4 (30.7)
Supervision Status	
-Supervised	7 (70.0)
-Unsupervised	2 (20.0)
-Both	1 (10.0)

Notes: N, number of groups, %, percentage.

Table 2. Exercise Program Characteristics (All)

Variable	N	M ± SD	Range
Length (weeks)	**10**	**17 ± 7**	**8-26**
Frequency (days/week)	**9**	**3 ± 2.0**	**2-7**
Compliance (%)	**7**	**86 ± 13**	**56-100**

Notes: N, number of groups reporting data; M ± SD, mean ± standard deviation; Compliance, percentage of exercise sessions attended.

Table 3. Exercise Program Characteristics

Variable	N	M ± SD	Range
Aerobic			
Duration (min)	4	29 ± 18	20-56
Intensity (MHR)	3	71 ± 9	55-78
Strength Training			
Intensity (%1RM)	3	72 ± 8	63-78
Sets (#)	6	2 ± 1	1-3
Reps (#)	6	11 ± 1	10-13
Exercises (#)	6	9 ± 3	6-12

Notes: N, number of groups reporting data; M ± SD, mean ± standard deviation; min, minutes; MHR, maximum heart rate reserve; 1RM, 1 repetition maximum; #, number.

Table 4. Baseline Characteristics of Subjects (Age and Physical Health)

	Physical Activity		Control	
Variable	N	M ± SD	N	M ± SD
Age (years)	13	72.8 ± 4.8	11	71.6 ± 6.1
Physical Component Summary	4	45.6 ± 3.2	4	45.5 ± 4.9
- Physical Function	7	77.6 ± 11.5	7	79.2 ± 10.0
- Role Physical	9	70.2 ± 12.4	7	68.4 ± 13.2
- Bodily Pain	9	69.0 ± 10.7	7	68.6 ± 13.8
- General Health	10	68.8 ± 9.2	8	68.5 ± 9.5

Notes: N, number of groups; M ± SD, mean ± standard deviation; Age of subjects is the mean group age.

Table 5. Baseline Characteristics of Subjects (Mental Health)

	Physical Activity		Control	
Variable	N	M ± SD	N	M ± SD
Mental Component Summary	4	53.8 ± 2.6	4	53.5 ± 1.9
- Vitality	5	65.8 ± 5.7	5	68.1 ± 4.9
- Social Functioning	6	75.0 ± 13.9	6	75.9 ± 13.8
- Role Emotional	5	80.4 ± 3.4	5	79.3 ± 3.8
- Mental Health	5	74.9 ± 7.7	5	76.5 ± 4.9

Notes: N, number of groups; M ± SD, mean ± standard deviation.

Table 6. SF-36 Outcomes (Physical Health)

Variable	N	g (95% CI)	Q(p)	$I^{2(\%)}$
Overall physical	4	.25(-.02 to .53)	3.3(.35)	9.4
- Physical function	8	.41(.19 to .64)*	9.1(.25)	22.9
- Role physical	9	.13(-.05 to .32)	21.9(.005)†	63.6
- Bodily pain	9	.14(-.16 to .44)	21.2(.007)†	62.2
- General health	10	.17(-.19 to .53)	37.6(<0.01)†	76.1

Notes: N, number of outcomes; g(95% CI), Hedges standardized effect size, adjusted for small sample bias and 95% confidence intervals; Q(p), Heterogeneity statistic along with probability value; $I^{2(\%)}$, Consistency measure, an extension of Q; *, 95% confidence interval does not include zero (0); †, statistically significant at $p \leq 0.10$.

Table 7. SF-36 Outcomes (Mental Health)

Variable	N	g (95% CI)	Q(p)	$I^{2(\%)}$
Overall mental	4	-.16(-.81 to .50)	18.4(<0.01)†	83.7
- Vitality	5	.30(-.39 to 1.0)	28.9(<0.01)†	86.2
- Social functioning	6	.32(-.41 to 1.05)	49.8(<0.01)†	90.0
- Role-emotional	5	.26(-.11 to .64)	8.7(.07)	54.0
- Mental health	5	.57(-.14 to 1.27)	29.1(<0.01)†	86.3

Notes: N, number of outcomes; g(95% CI), Hedges standardized effect size, adjusted for small sample bias and 95% confidence intervals; Q(p), Heterogeneity statistic along with probability value; $I^{2(\%)}$, Consistency measure, an extension of Q; †, statistically significant at $p \leq 0.10$.

Figure 2. Forest Plot for Physical Function Outcomes

Study name	Hedges's g	Lower limit	Upper limit
Antunes et al. 2005	0.83	0.23	1.43
Chien et al. 2005	0.23	-0.51	0.97
Cress et al. 1999	0.24	-0.32	0.80
Damush & Damush 1999	-0.04	-0.54	0.46
de Vreede et al. 2007	0.68	0.13	1.23
Oken et al. 2006	0.19	-0.25	0.63
Rubenstein et al. 2000	0.65	0.11	1.19
Worm et al. 2001	0.70	0.09	1.31
	0.41	0.19	0.64

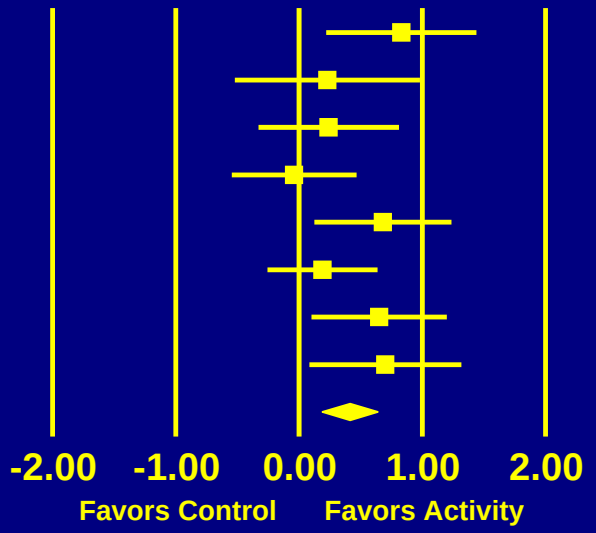


Figure 3. Physical Function (Each Study Removed Once)

Study name	Point	Lower limit	Upper limit
Antunes et al. 2005	0.36	0.14	0.58
Chien et al. 2005	0.43	0.19	0.68
Cress et al. 1999	0.44	0.19	0.69
Damush & Damush 1999	0.48	0.27	0.70
de Vreede et al. 2007	0.38	0.13	0.62
Oken et al. 2006	0.46	0.21	0.71
Rubenstein et al. 2000	0.38	0.13	0.63
Worm et al. 2001	0.38	0.14	0.62
	0.41	0.19	0.64

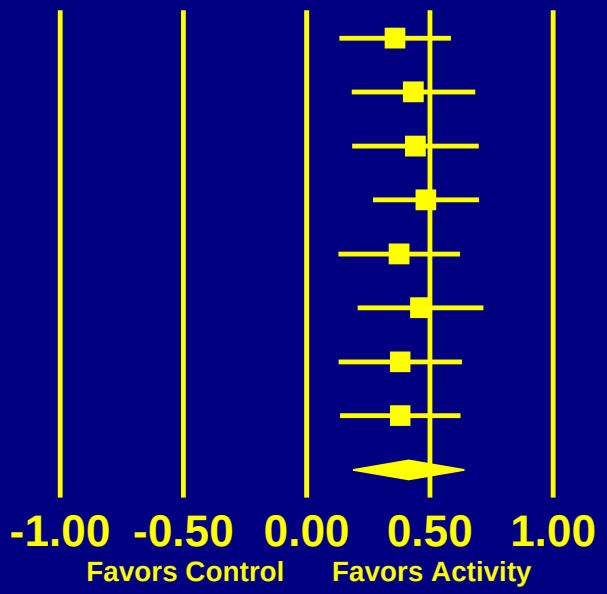
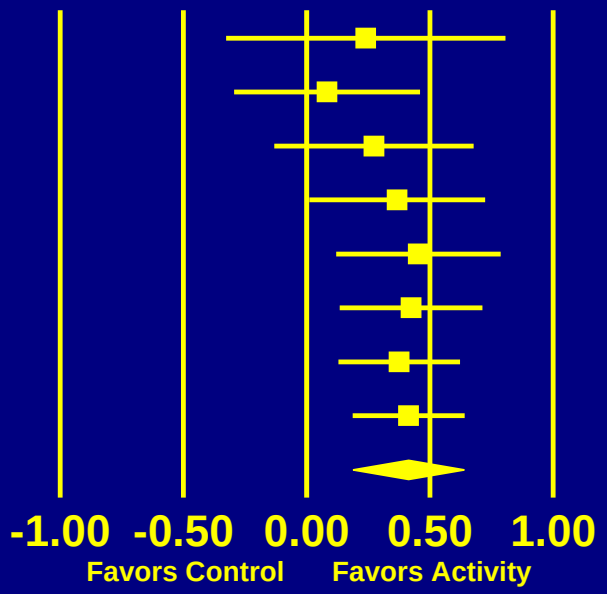


Figure 4. Cumulative Meta-Analysis for Physical Function

Study name	Cumulative statistics		
	Point	Lower limit	Upper limit
Cress et al. 1999	0.24	-0.32	0.80
Damush & Damush 1999	0.08	-0.29	0.46
Rubenstein et al. 2000	0.27	-0.13	0.67
Worm et al. 2001	0.37	0.01	0.72
Antunes et al. 2005	0.45	0.12	0.78
Chien et al. 2005	0.42	0.14	0.71
Oken et al. 2006	0.38	0.13	0.62
de Vreede et al. 2007	0.41	0.19	0.64
	0.41	0.19	0.64



IMPORTANCE

- Based on our results, we estimate that more than 1.8 million US adults 50 years of age and older could improve their physical function if 11.2% of currently non-exercising adults initiated and maintained a regular program of physical activity

LIMITATIONS

- Small sample size may have resulted in nonsignificant findings for some outcomes (for example, mental health)
- Incomplete reporting of data for some variables (for example, number of hours physical activity avoided prior to post-assessments)
- Multiple tests possibly resulting in chance finding(s)

D. CONCLUSIONS

Exercise improves self-reported physical function, a component of health-related quality of life, in older community-dwelling adults

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Disclaimer: The findings and conclusions in this poster are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.