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Journal

American Journal of Preventive Medicine, 56(1)

ISSN

0749-3797

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Publication Date

2019

DOI

10.1016/j.amepre.2018.09.006

Peer reviewed



Published in final edited form as:

Am J Prev Med. 2019 January ; 56(1): 141–146. doi:10.1016/j.amepre.2018.09.006.

Physical Activity and Performance Impact Long-term Quality of Life in Older Adults at Risk for Major Mobility Disability

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Abstract

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Author contributions: EJG, RMK, WJR, JAK, NWG, ACK, TC, SDA, JD, KR, NR, BS, and MP conceived and designed the experiments. WJR, JAK, AT, NG, ACK, TC, JD, KR, BS, and MP performed the experiments. EJG, RMK, MW, and CJL analyzed the data. EJG, WJR, JAK, AT, NG, ACK, TC, MW, JD, KR, BS, and MP contributed reagents/materials/analysis tools. EJG, RMK, WJR, JAK, NWG, ACK, TC, SDA, MW, CJL, JD, KR, NR, BS, and MP wrote the paper. RMK, WJR, ACK, NR, BS, and MP provided oversight to The LIFE Study.

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Table 2 was previously published as part of a cost-effectiveness manuscript (See Reference #11) Permission was obtained from the *Journal of Gerontology Series A* to reproduce that Table for this paper.

No financial disclosures were reported by the authors of this paper.

Introduction: Older adults are a rapidly growing segment of the U.S. population. Mobility problems that lead to further disability can be addressed through physical activity interventions. Quality of life outcome results are reported from a large trial of physical activity for sedentary older adults at risk for mobility disability.

Methods: Data were from the Lifestyle Interventions and Independence for Elders study. This multisite RCT compared physical activity to health education among 1,635 randomly assigned sedentary older adults at risk for mobility disability in 2010–2011. Measures included demographics, comorbidity, a timed 400-meter walk, the Short Physical Performance Battery, and the Quality of Well-Being Scale (0–1.0 scale). Baseline and long-term follow-up (2.6 years) health-related quality of life data were collected as a secondary outcome. Multivariate linear regression modeling was used to examine covariates of health-related quality of life over time in 2017.

Results: The sample had an overall mean Quality of Well-Being score of 0.613. Both groups declined in quality of life over time, but assignment to the physical activity intervention resulted in a slower decline in health-related quality of life scores ($p=0.03$). Intervention attendance was associated with higher health-related quality of life for both groups. Baseline characteristics including younger age, fewer comorbid conditions, non-white ethnicity, and faster 400-meter walk times were also associated with higher health-related quality of life over time.

Conclusions: Declining mobility measured by physical performance is associated with lower quality of life in sedentary older adults. Physical activity interventions can slow the decline in quality of life, and targeting specific subgroups may enhance the effects of such interventions.

INTRODUCTION

Health-related quality of life (HRQOL) systematically declines with advancing age.^{1–4} Older adults with mobility limitations have lower HRQOL than those with fewer limitations.^{5,6} Although some studies have found that physical activity (PA) can produce short-term increases in HRQOL among older adults, those gains appear temporary and data on long-term HRQOL trends are limited.^{7,8}

Data are presented from a large clinical trial in which PA prevented major mobility disability⁹ in a cost-effective manner among older sedentary individuals.¹⁰ This paper describes (1) the HRQOL of this population, (2) the impact of the intervention on HRQOL, and (3) factors associated with better HRQOL over time. Given the theoretic basis for PA improving both physical¹¹ and cognitive¹² function, key components of QOL,¹³ it was hypothesized that PA would be associated with slower decline in HRQOL over time.

METHODS

Lifestyle Interventions and Independence for Elders (LIFE) was a multisite RCT that compared PA intervention to health education (HE) over 2.6 years. PA involved walking plus strength and flexibility exercises. HE consisted of health information provided via lecture/discussion. The primary outcome was major mobility disability (inability to walk 400 meters).¹⁴ PA participants were less likely than HE participants to develop major mobility

disability, and accrued more quality-adjusted life years (QALYs),⁹ making PA cost effective.¹⁰

Study Sample

Older adults ($n=1,635$) aged 70–89 years, at risk for mobility disability, with a Short Physical Performance Battery (SPPB) score nine or less, able to walk 400 meters in <15 minutes, were recruited from nine U.S. communities in 2010–2011. Study details (informed consent and IRB approval) have been published.¹⁴

Measures—Baseline assessments included sociodemographics, health behaviors, physical performance, and HRQOL. Intervention attendance and HRQOL at 6, 12, 18, 24, and 30 months were analyzed.

Comorbidity Index was the sum of self-reported prevalence of ten common conditions: arthritis, cancer, diabetes, heart attack, heart failure, broken hip, hypertension, liver disease, lung disease, and stroke.

Physical performance was measured using the SPPB¹⁵ (chair stands, balance, and 400-meter walk). SPPB assessors assigned a score from 0 (inability to complete the function) to 4 (highest performance level) to each function. Scores on the three areas were summed.

HRQOL was assessed using the Quality of Well-being Scale–Self-Administered (QWB-SA),¹⁶ a preference-based measure that provides an overall score ranging from 0 (death) to 1.0 (asymptomatic, optimum functioning).¹⁷ The 72 items covering four domains, symptoms, social activity, PA, and mobility were rated as being present or absent on the 3 days prior to assessment. A score of 0 was assigned to deceased participants. The measure has been used previously with older adults^{5,8} and in large clinical trials.^{18–20}

Statistical Analysis—Analyses were conducted in 2017. *T*-tests and chi-square tests were used to compare the groups at baseline. QWB-SA change scores by group were analyzed using linear modeling of repeated-measures adjusting for baseline QWB-SA with compound symmetry within-person correlational structure. Multivariate linear regression modeling was used to examine broader correlates of QWB-SA change scores.

RESULTS

No significant differences were found between the PA and HE groups at baseline. (Appendix Table 1).⁹ Table 1 presents mean baseline QWB-SA scores for various patient/disease groups from other studies and the current study. The LIFE sample had a mean QWB-SA score of 0.613. LIFE participants with SPPB score less than eight and SPPB score eight or more, had significantly different baseline QWB-SA scores (0.597 and 0.626, respectively, $p<0.001$).

PA participants reported significantly slower declines in HRQOL scores over time than HE participants (0.065 vs 0.077, $p=0.03$), providing a cumulative benefit of 0.047 QALYs for the PA group¹⁰ (Table 2). Table 3 presents a multivariate regression analysis of HRQOL scores over time. When covariates were included, the intervention group remained a

significant predictor of HRQOL scores. Baseline characteristics including younger age, fewer comorbid conditions, non-white ethnicity, and faster 400-meter walk times were associated with higher HRQOL over time.

Non-white race and younger age were associated with better QOL over time. Gender was not a significant predictor when controlling for other factors. Fewer comorbid disorders and a faster 400-meter walk at baseline were also associated with better HRQOL at follow-up. Finally, across both intervention groups, better intervention attendance was associated with higher HRQOL.

DISCUSSION

PA can significantly slow the long-term decline in QOL among sedentary “at-risk” older adults. Younger, non-white participants who had fewer comorbid disorders and attended more of either intervention sessions, regardless of group assignment, gained the most benefit.

In LIFE the mean baseline QWB score is considerably lower ($0.704 - 0.613 = 0.091$) than the score for healthy older adults (Table 1), suggesting that QOL is reduced in sedentary older adults. The difference of 0.091 is substantially more than 0.03, the clinically important difference for the QWB-SA.^{21,22} By separating the subgroups by SPPB score at baseline, a consistent pattern of higher HRQOL scores associated with higher physical performance scores on the SPPB emerges. This relationship is expected but provides further evidence that the QWB-SA is sensitive to variation in physical performance measures, that measures such as SPPB are good indicators of QOL, and that waning physical performance is not just part of aging but is accompanied by reduced QOL in the form of functional limitations and adverse symptoms.

Data from Figure 1 and Table 2 show that the trajectory of HRQOL for the two intervention groups over time was significantly different. In Table 2, a clinically meaningful decline of 0.03 or more occurred after 12 months for the HE group but did not occur until after 18 months for the PA group, consistent with the findings of the main study.⁹ Maintaining this gap results in the accumulated health benefit in terms of QALYs over time.¹⁰ Although some studies have found that PA can increase QOL among sedentary older adults,^{23,24} these studies typically use shorter assessment follow-up periods, and use QOL measures that have multiple subscales (e.g., Short Form-36) that could increase chances of finding improvement because of multiple comparisons.²⁵ LIFE assessed QOL every 6 months for up to 30 months, and used the single total summary QWB-SA score. One longer-term study⁷ that used a preference-based measure, like the QWB-SA, found that over 7 years QOL scores among a community sample of older adults in the United Kingdom declined in all groups but declined less in those performing moderate to vigorous PA. Thus, despite a different study design and greater declines overall in the “at-risk” LIFE sample, the results from the study by Choi et al.⁷ are very similar to those of LIFE. The rapidly declining QOL with age in these two different samples warrants further attention, especially among those at risk for mobility disability.

Several covariates were associated with QOL scores. Healthier and younger participants may derive more benefit, possibly because they can better adhere to PA. It is unknown why white race/ethnicity would be associated with slightly less benefit. However, this is an interesting finding and worthy of further study given racial health disparities in older adults.^{26,27} Finally, intervention attendance was associated with better ongoing QOL, independent of group assignment, suggesting that both interventions provided useful content for improving QOL, making the differences between PA and HE even more robust.

Limitations

The study had limitations. Although it was designed to be geographically diverse, women and individuals that were non-Hispanic whites were overrepresented.²⁸ Also, the study examined a single QOL summary score, omitting detail about different QOL components.

CONCLUSIONS

QOL is lower among sedentary older adults with lower physical performance scores. PA can slow the rate at which disability develops,⁹ limiting declines in QOL experienced by older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

The Lifestyle Interventions and Independence for Elders Study (LIFE) is funded by a NIH/National Institute on Aging (NIA) Cooperative Agreement #U01 AG22376 and a supplement from the National Heart, Lung, and Blood Institute 3U01AG022376-05A2S, and sponsored in part by the Intramural Research Program, NIA, NIH.

The research is partially supported by the Claude D. Pepper Older Americans Independence Centers at the University of Florida (1 P30 AG028740), Wake Forest University (1 P30 AG21332), Tufts University (1P30AG031679), University of Pittsburgh (P30 AG024827), and Yale University (P30AG021342) and the NIH/National Center for Research Resources Clinical and Translational Science Awards at Stanford University (UL1 RR025744).

Tufts University is also supported by the Boston Rehabilitation Outcomes Center (1R24HD065688-01A1).

LIFE investigators are also partially supported by the following: Dr. Thomas Gill (Yale University) is the recipient of an Academic Leadership Award (K07AG3587) from the NIA. Dr. Carlos Fragoso (Spirometry Reading Center, Yale University) is the recipient of a Career Development Award from the Department of Veterans Affairs. Dr. Roger Fielding (Tufts University) is partially supported by the U.S. Department of Agriculture, under agreement No. 58-1950-0-014. Any opinions, findings, conclusion, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

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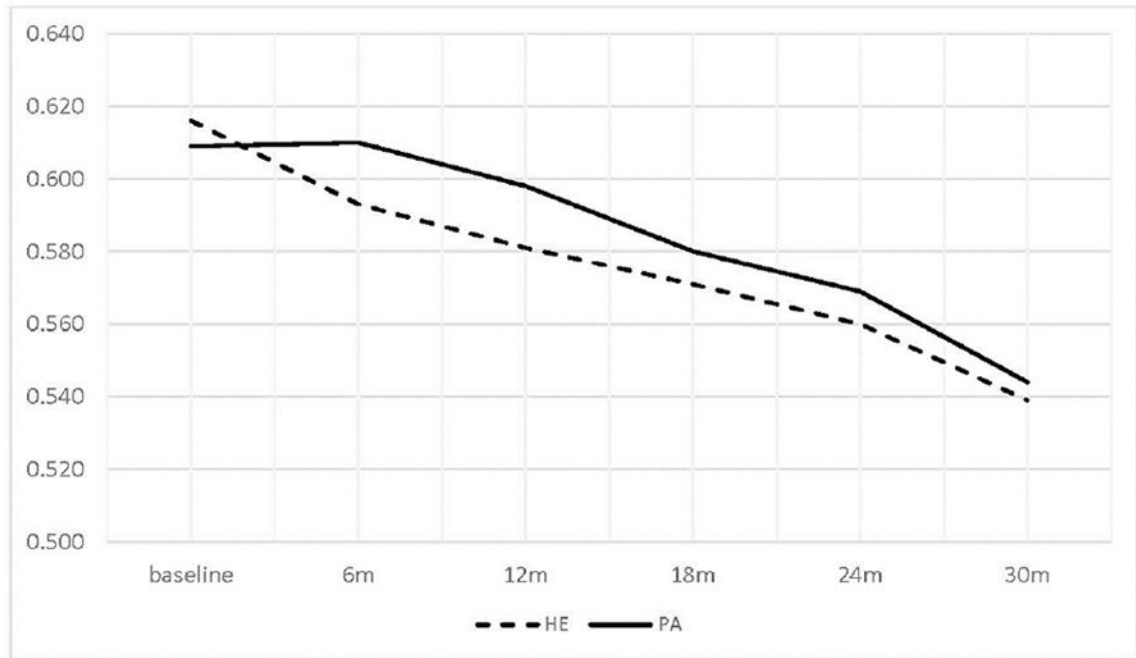


Figure 1.

Trajectory of health-related quality of life for the two intervention groups over time.

Note: The Y-axis shows Quality of Well-being Scale–Self-Administered scores. The X-axis shows the elapsed time of the intervention from baseline in months.

HE, health education; PA, physical activity.

Table 1.

Mean QWB-SA Scores and Known Covariates for Various Diseases Studied

Sample characteristics	N	Age	% Female	QWB-SA score
Healthy older adults ²⁹	301	74.7	59	0.704
Adults at risk of developing diabetes ¹⁸	3,234	51.2	68	0.689
Family medicine outpatients ³⁰	562	46.7	57	0.651
Migraineurs ³¹ (on days without headaches)	89	42.2	87	0.619
Cancer patients-Germany ³² (prostate, BPH, colon, rectal)	277	66.3	0	0.619
Older adults with mobility limitations - LIFE	1,635	78.9	67	0.613
SPPB ≥ 8	904	78.1	66	0.626
SPPB <8	731	79.9	68	0.597
400 m walk – 75%–100% (568–899 seconds)	406	77.8	55	0.641
400 m walk – 50%–74.9% (484–567 seconds)	409	78.5	66	0.632
400 m walk – 25%–49.9% (428–483 seconds)	409	79.4	73	0.606
400 m walk – 0–24.9% (280–427 seconds)	411	79.9	74	0.571
Cancer patients ³³ (metastatic melanoma, pre-treatment)	301	55.0	38	0.600
Cataract patients ³⁴ (directly prior to surgery)	233	72.5	40	0.595
Type I diabetes ³⁵	784	34.5	55	0.572
Type II diabetes ³⁵	1,257	57.6	49	0.547
Emphysema patients ³⁶ pulmonary rehabilitation)	1,218	67.0	39	0.537
Rheumatology patients ³⁰	334	55.1	84	0.516
Migraineurs ³¹ (days with headache)	89	42.2	87	0.484
Major depressive disorder ³⁷	58	45.7	22	0.414

QWB-SA, Quality of Well-Being Self-Administered; m, meters; SPPB, Short Physical Performance Battery; BPH, benign prostatic hyperplasia; LIFE, Lifestyle Interventions and Independence for Elders.

Table 2.

Quality of Well-Being Self-Administered (QWB-SA) Scores Over Time

Variable	Base	6 months	12 months	18 months	24 months	30 months
Health education	0.616 (n=809)	0.593 (n=797)	0.581 (n=787)	0.571 (n=776)	0.560 (n=767)	0.539 (n=574)
Physical activity	0.609 (n=810)	0.610 (n=782)	0.598 (n=771)	0.580 (n=764)	0.569 (n=749)	0.544 (n=568)
<i>p</i> -value						0.0468

Note: Boldface indicates statistical significance ($p < 0.05$).

QWB-SA, Quality of Well-Being Self-Administered.

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Table 3.

Multivariate Linear Regression With QWB-SA Scores Over Time as Dependent Variable (n=1,415)

Parameter	Estimate	SE	F value	p-value	Tot R ²
Intercept	0.470	0.050	87.76	< 0.0001	0.2782
Baseline QWB	0.457	0.025	341.72	< 0.0001	
Intervention group (HE vs PA)	0.016	0.006	6.78	0.0093	
Intervention attendance	0.062	0.012	27.15	< 0.0001	
White	-0.018	0.007	5.95	0.0148	
Married	-0.009	0.006	2.24	0.1344	
Age	-0.002	0.001	8.51	0.0036	
Comorbidity index	-0.008	0.003	9.33	0.0023	
Alcohol use	0.012	0.006	3.66	0.0560	
400 m walk time	-0.001	0.000	14.39	0.0002	

Note: Boldface indicates statistical significance ($p < 0.05$).

QWB-SA, Quality of Well-Being Self-Administered; m, meters; PA, physical activity; HE, health education; Estimate, Change in QWB-SA score per unit of each variable.

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