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Psychosocial effects of an exercise program in older persons who fall

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Abstract—Falling is associated with psychosocial sequelae that may influence functional performance and fall risk. Exercise can improve psychosocial factors. To address the research questions (1) Do psychosocial variables differ among persons with and without falls? and (2) Among persons who fall, can exercise improve psychosocial variables? we evaluated psychosocial and functional performance variables in older persons with and without recent falls. A pretest and posttest design with a nonequivalent control group was used. Community-residing elderly individuals participated, 66 had falls in the past year (fallers) and 77 had no falls (nonfallers). Participants completed measures of self-esteem, depression, psychological impact, and functional performance at baseline and 6 weeks. Baseline descriptive characteristics for fallers and nonfallers were similar. Fallers then completed a 6-week exercise program. Exercise benefited fallers' self-esteem, depression, mobility, social role, social activity, and anxiety. Nearly 40% of fallers were clinically depressed before exercise and 24% were depressed after ($p = 0.04$). Psychosocial variables correlated significantly with quality of functional performance ($p < 0.019$). Among fallers, moderate exercise produced a significant improvement in psychosocial variables and functional performance ($p < 0.045$).

Key words: accidental falls, aged, depression, therapeutic exercise.

INTRODUCTION

Falling and fall-related injuries among older persons continue as a common and serious public health problem. Extrinsic factors (environmental hazards) and intrinsic physical factors such as physical decline from degenerative musculoskeletal and neurological disorders are known to increase the risk of falling in community-dwelling elderly persons [1–6]. In addition, there are intrinsic psychological and social factors thought to be associated with falling, including fear, depression, anxiety, low self-confidence, reduced self-efficacy, and social isolation [5–15]. These psychological and social sequelae may go unrecognized by clinicians who may focus more on physical problems related to falls. Psychosocial factors could theoretically increase the risk of falling among elderly individuals by interacting with intrinsic physical factors and environmental factors [9,13]. Adverse psychosocial consequences may contribute to falling, may result from falling, or both.

Abbreviations: ADL = activities of daily living, AIMS = Arthritis Impact Measurement Scales, FICSIT = Frailty and Injuries: Cooperative Studies of Intervention Techniques, FOC = functional obstacle course, GDS = Geriatric Depression Scale, ISE = Index of Self-Esteem.

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The existence of a relationship between fear and falling and self-efficacy and falling has been well demonstrated in the literature [7,9,12–15]. The association of other psychosocial factors with falls has received relatively little attention from researchers. In our clinical experience with elderly patients who fall, we have observed that a significant amount of psychosocial dysfunction is common. We also have observed that the psychosocial variables among persons who fall may be related to their physical ability and functional performance and may affect their response to intervention.

Exercise is perhaps the most promising among interventions targeted to prevent falling. Exercise is effective in lowering falling risk, especially among older or frail groups considered to be at high risk [16–17]. The effectiveness of exercise in preventing falls is presumed to be through improvement in physiologic measures (such as balance, mobility, and strength), since impairments of these measures are known risk factors for falls and since these measures are modifiable with exercise [6]. Exercise may modify these physiologic variables in older persons and potentially reduce falls [17].

Exercise also may prevent falls by influencing other factors, such as the psychosocial state of older patients. Participation in exercise is known to be associated with decreased symptoms of depression and anxiety and increased self-esteem in the general population [18–21]. The optimal mode of exercise (i.e., aerobic versus nonaerobic) required to induce these psychosocial benefits is uncertain. Exercise is a particularly attractive nonpharmacologic intervention for elderly persons with symptoms of psychological dysfunction and a history of falling, because of the known tendency of psychoactive medications to increase the risk of falls in this population [22–23].

While the precise relationship between falling and most psychosocial factors remains unclear, it is plausible that an older person who falls or almost falls could become fearful or anxious about subsequent falls and serious injury and the associated potential consequences (hospitalization, disability, institutionalization, etc.). Additionally, older persons who fall could develop depression, low self-efficacy or low self-esteem, and social isolation as they lose their freedom of mobility and associated independence. Just as falling could contribute to the onset or exacerbation of adverse psychosocial factors, these psychosocial factors could possibly cause or contribute to falling. An older person with reduced physical activity after a past fall could subsequently become deconditioned and weak, develop increased joint stiffness, and become less attentive to the surrounding environment and its potential hazards.

Several studies using community-residing subjects have demonstrated an association between persons with impaired balance and mobility and a history of falls and inferior physical performance [24–27]. Likewise, evidence in the literature demonstrates a link between psychosocial symptoms (especially depression) and impaired physical performance. This finding suggests that any psychosocial factor significant enough to influence a person's mood or affect could potentially influence their physical performance [28–32]. Accordingly, performance testing appears to be a useful adjunct to appropriate psychosocial measures in determining the presence and extent of psychosocial influence on the physical domain. Performance measurement also could help to determine response of persons with psychosocial dysfunction to therapeutic interventions.

In this study, we—

1. Compare psychosocial variables in community dwelling older persons with and without a history of recent falls.
2. Examine the relationship between psychosocial factors, functional balance, and mobility performance.
3. For participants with recent falls, determine if psychosocial factors are altered by participation in supervised exercise, when compared to healthy older persons not involved in the intervention.

Our hypotheses are as follows:

1. Older persons with a history of recent falls will have a greater indication of psychosocial dysfunction than those persons without such a history will have.
2. Significant correlations will be apparent between psychosocial variables and functional performance.
3. An exercise program will improve both functional performance and psychosocial variables among older persons with a history of recent falls when compared to the standard of older individuals without falls.

METHODS

Participants

We recruited veterans from our medical center through notices mailed to all veterans enrolled in our medical center outpatient database who lived in three central Arkansas counties and who met our age criteria. In addition, we posted notices about our study in our outpatient clinics. Inclusion criteria for participants were aged 65 or older; ambulatory for at least 30 feet with or without walking aids, community dwelling, able to comprehend instructions, no known active diagnosis of or current treatment for depression or anxiety disorder, and no hospitalization(s) within the past month. The latter criterion was introduced to prevent the confounding effects of a recent acute illness on physical performance. Participants had to be free of acute medical problems. All persons signed an informed consent to participate in the study. We conducted the study using procedures approved by and in accordance with the standards of our local institutional review board. All study measurements were recorded at baseline and again 6 weeks later.

To determine eligibility for participation in the study, a physiatrist obtained a history of medical conditions and current prescription medications and conducted a focused physical examination. Participants were identified as fallers if they indicated that they had experienced during the last 12 months any involuntary change from a position of bipedal support (standing, walking, bending, reaching, etc.) to a position of no longer being supported by both feet, accompanied by (partial or full) contact with the ground or floor. For example, if someone were to lose his or her balance and fall against a wall without touching the ground or floor, this would not be considered a fall. In contrast, if someone tripped and fell to one knee on the floor, this would be considered a fall. If someone fell out of bed, it would not be a fall, since the person did not start from a standing or walking position.

Design

This study was a pretest and posttest design, with a nonequivalent control group. Individuals identified as fallers completed the pre- and postmeasures and participated in an exercise program. Older volunteers were placed in the nonequivalent control group if they reported having no falls in the past 12 months. We chose 12 months based on literature suggesting that this recall was better than that for the preceding 3 or 6 months [33,34]. Control group participants completed the same pre- and postmeasures as the fallers, but the controls were not involved in any formal exercise program. Changes within the fallers group could then be compared to the status of the nonfaller control individuals.

Exercise Intervention

The exercise program was a slightly modified version of a program described elsewhere and included stretching, postural control, endurance walking, strengthening, and repetitive muscle coordination exercises [35]. In brief, the program was developed based on exercises generally prescribed to improve balance and mobility for older adults by reducing the effects of common musculoskeletal and postural changes that may result in impairment. We enhanced the previously reported exercise program by adding lower-limb (quadriceps, hamstrings, hip extensor, and hip adductor muscles) strengthening exercises, seated armchair push-ups for the upper-limb (triceps, deltoid, upper trapezius, and supraspinatus) strengthening, as well as trunk and abdominal muscle strengthening exercises. We used elastic bands (Thera-Band®, Hygenic Corporation, Akron, Ohio) available in seven different strengths from thin to superheavy to provide a variety of resistances for the lower-limb strengthening exercises.

The program intentionally started at a relatively low level of intensity (frequency, resistance, and repetitions) of the individual exercises and was progressive. The individual participants set the actual frequency, repetitions, and resistance of the exercises so that he or she could exercise at a subjectively moderate intensity while striving to meet higher goals under the guidance of the therapist. The goal was to increase exercise intensity over the course of the entire program.

The program was supervised by a licensed physical therapist who was blinded to the participants' psychosocial and other study data. Participants exercised in small, interactive groups of six to eight. Exercise sessions were held in a rehabilitation therapy treatment area three times a week for 6 weeks (18 sessions total) during regularly scheduled late morning or early afternoon hours. Each exercise session lasted approximately 60 min, including warm-up and cooldown.

Measurements

Index of Self-Esteem (ISE)

We administered the 25-item version of the ISE developed by Hudson [36]. It uses a 5-point response scale, with scores greater than 30 indicating a lack of self-esteem. From six different studies, Hudson reported estimates of Cronbach's alpha for the ISE ranging from 0.91 to 0.95. Known groups discriminant validity was demonstrated by Hudson. Individuals aged 12 and higher can use the ISE, although no reported use is specifically with a geriatric sample.

Wong and Whitaker cross-validated predictors of future levels of depression among college students by using a battery of depression and psychosocial measures including Hudson's ISE [37,36]. The authors found that a measure of dysfunctional attitude, highly stable over time and combined with measures of stress and personality characteristics (specifically self-esteem), contributed significantly to the prediction of concurrent depression.

Geriatric Depression Scale (GDS)

The GDS developed by Yesavage et al. is considered a benchmark for evaluating clinical depression in the geriatric population [38]. The GDS uses a yes-no format most readily understood by the respondents. Yesavage reported a Cronbach's alpha internal consistency reliability for the 30-item GDS of 0.94. The use of 14 as a cutoff score for clinical depression as measured by the GDS is well supported by a number of studies [39–41].

Arthritis Impact Measurement Scales (AIMS)

The AIMS is a self-report questionnaire taking about 15 to 20 min to complete. It contains nine subscales, addressing physical, mental, and social health. The scales have demonstrated internal consistency reliability and construct validity [42,43]. The AIMS has been used in nonarthritic populations [44]. Research indicates that the AIMS is sufficiently sensitive to indicate changes over short-term clinical interventions from 1 to 3 months [42,45]. Previous power analyses indicate that, with as few as 18 subjects, one can detect changes in the AIMS overall; however, considerably more subjects (453) are needed to detect changes in the social area, including social activity, social role, and household activities [42]. In our study, participants completed the AIMS, but for analysis consistent with our objectives, we used the AIMS subscales of mobility (four items), physical activity (five items), social role (seven items), social activity (four items), activities of daily living (ADL) (four items), depression (six items), and anxiety (six items). We also summed these subscales to give a total AIMS score. All AIMS subscales and the AIMS total were scaled from 0 to 10, with a higher score representing more dysfunction.

Functional Obstacle Course (FOC)

Functional balance and mobility performance was measured with performance indicators from the FOC. The FOC layout, procedures, and scoring have been reported previously [27,46,47]. Briefly, the FOC has 12 simulations of functional mobility tasks or situations commonly encountered at home. Two performance indicators, FOC time (in seconds; lower time indicating a better performance) and FOC quality (ranging from 0, unable to complete the task, to 3, no observed difficulty or unsteadiness, per station), are derived from a videotape review by a trained and blinded rater of obstacle course performance. Interrater agreement and test-retest reliability for the FOC exceed 0.98.

Procedures

A trained research assistant collected psychosocial data during a 45 to 60 min interview. The assistant read the items and marked the participant's response. We used uniform instructions and established procedure for the FOC [47]. All evaluations were completed on the same day in the clinic during the late morning or early afternoon. The order of testing, psychosocial and FOC, was random. Exercise sessions were conducted in our hospital's therapeutic gym. If a participant missed a total of four or more sessions or three consecutive sessions, he or she would have been considered a dropout from the program.

Analysis

We correlated the baseline measures of ISE, GDS, AIMS, and the FOC using a Pearson's correlation coefficient. The hypothesis of the study was tested with a repeated-measures analysis of variance, with one between factor (faller or nonfaller) and one within subject factor (initial and final assessments). We were interested in the interaction between faller status and assessment. A significant interaction would indicate an effect of the exercise program. Additionally, in a secondary analysis of depression from pre- to postintervention, we calculated a McNemar test to determine shifts in proportions of participants classified as depressed. We chose this approach because of the nonequivalency of the faller and nonfaller groups. The level of significance was set at 0.05 for each test. All analyses were done with the SPSS version 10.0.

RESULTS

One hundred fifty-eight persons agreed to an eligibility screening. Thirteen persons were ineligible, unwilling, or unable to participate in the study. The most common reason (10 of 13, 77%) given for not participating was a lack of transportation to attend the exercise sessions. Other persons had planned activities that conflicted with scheduled treatments or evaluation times. A comparison of study entrants to nonentrants showed no significant differences in characteristics.

Two participants (both in the faller group) dropped out of the study before completing the postevaluation. The analysis for this study is based on the 143 participants (66 fallers, 77 nonfallers) who successfully completed the study. Generally, the participants were just over 70 years old, male, married, and Caucasian and they had 12 years of education (see **Table 1**). **Table 2** provides the descriptive statistics for each measure at initial and final assessment for both groups. At baseline, fallers had significantly less favorable scores than nonfallers on all scales in **Table 2** ($p < 0.05$).

Overall, the exercise program positively affected the fallers compared to the "status quo"—the nonfallers (see **Table 2**). Significant interactions indicated that fallers changed during the exercise program in their psychosocial variables compared to nonfallers not involved in a program. All but two interactions, physical activity and ADLs, were significant. The fallers had less depression (GDS) and an overall improved health status (AIMS).

We decided to conduct a secondary analysis of depression, which is common among elderly persons. Among the fallers, 39.4 percent (n = 26/66) were clinically depressed at baseline, with a GDS score of 14 or higher. Following the exercise program, only 24.2 percent (n = 16/66) were still classified as clinically depressed. Of the 16 who were depressed at the end of the intervention, 11 were clinically depressed at baseline. However, 15 who started the program as depressed were no longer depressed at the end of the 6 weeks. This shift from depressed to nondepressed status was statistically significant as measured by a McNemar test ($p = 0.04$).

Table 3 indicates the correlation at baseline of psychosocial variables, with the baseline functional performance as measured by the FOC. Self-esteem, GDS, and all AIMS subscales had significant correlation with FOC quality scores. Poorer quality was associated with poorer psychosocial status. FOC time scores had significant correlation with the total AIMS and all AIMS subscales except for AIMS depression. FOC time scores did not correlate significantly with either the self-esteem or GDS scores. Slower time through the FOC was associated with poorer levels on the psychological variables of mobility, physical activity, social role, social activity, ADLs, and anxiety.

DISCUSSION

We found that elderly fallers have poorer psychosocial status when compared to a group of nonfallers. Poorer psychosocial status was associated with poorer functional performance. Finally, exercise intervention positively affected psychosocial status for faller individuals.

Although much is known about physical factors that increase risk of falls, much less is known about psychological and social characteristics that also may contribute to this increased risk. A review of 14 studies suggests a pattern of poorer psychosocial functioning for fallers compared to nonfallers [9]. Data from a large survey of community dwelling elderly persons in Israel identified demographic (female, single, and living alone), psychological (depression, fear), and social factors (living alone, limited social interaction) as associated with falling [12]. Our results support these findings except for the demographic makeup. We found poorer psychosocial functioning in a group of fallers who mostly were married males.

Table 1.
Description of study participants.

Variable	Fallers (n = 66)	Nonfallers (n = 77)	*p* Value
Mean Age in Years (SD)	72.05 (5.04)	71.15 (0.424)	0.25
Mean Years of Education (SD)	11.75 (3.65)	12.26 (3.85)	0.42
Male (%)	92.4 (n = 62)	90.9 (n = 70)	0.77
Caucasian (%)	92.2 (n = 61)	90.4 (n = 70)	0.71
Married (%)	68.8 (n = 45)	82.9 (n = 64)	0.05

SD = standard deviation

Our results showing fallers with reduced mobility and social activity (AIMS) and FOC performance compared to nonfaller elderly adults are consistent with other studies that found reduced social activity and mobility among recent fallers [10,14]. Tinetti and Williams also found recent fallers were depressed, but not anxious. We found those with a history of falls to be both [10].

Table 2.
Study variables and results of test of interaction hypothesis (n = 66 fallers and n = 77 nonfallers).

Variable	Time	Faller		Nonfaller		*p* Value Group by Time Interaction
		Mean	SD	Mean	SD	
Index of Self-Esteem (>30 is dysfunctional)	Initial	33.48	23.55	23.34	17.05	0.023
	Final	23.67	18.51	21.43	15.64	—
Geriatric Depression Scale (>13 is clinically depressed)	Initial	14.7121	14.2405	7.3506	6.8283	0.007
	Final	8.5909	6.5091	6.2727	6.4637	—
AIMS (maximum = 10 indicating dysfunction)						
Mobility	Initial	3.3712	3.6027	0.9740	2.2637	0.011
	Final	2.1970	3.2674	0.8766	2.2858	—
Physical Activity	Initial	6.9697	2.9193	4.1558	3.3208	0.065
	Final	5.8182	3.2671	3.7662	3.0257	—
Social Role	Initial	1.7965	2.7939	0.3896	1.1734	0.045
	Final	1.2771	2.4312	0.3711	1.2987	—
Social Activity	Initial	6.4015	1.9518	5.0325	1.9607	0.001
	Final	5.2955	2.0229	5.2468	2.0895	—
ADL	Initial	1.4867	1.5726	0.6250	0.9125	0.083
	Final	1.1458	1.3542	0.5682	0.9521	—
Depression	Initial	2.6768	2.6750	1.1541	1.2953	0.003
	Final	1.5354	1.8209	0.9740	1.2862	—
Anxiety	Initial	3.6919	2.6508	2.3333	2.1751	0.01
	Final	2.4040	1.9041	2.0952	2.0632	—
Total AIMS	Initial	3.7706	1.7285	2.0949	1.3044	0.001
	Final	2.8104	1.4610	1.9854	1.3761	—
Functional Obstacle Course (FOC)						
Time (s)	Initial	379.6970	277.3883	234.8831	75.0289	0.002
	Final	324.2576	180.9333	230.7792	74.7921	—
Quality (high quality maximum = 36)	Initial	24.864	6.261	30.571	5.001	0.001
	Final	26.970	6.346	30.273	4.925	—

Note: At the initial measurement, the fallers performed significantly less favorably than the nonfallers ($p < 0.05$) for all variables studied.
AIMS = Arthritis Impact Measurement Scale
ADL = activities of daily living
SD = standard deviation

Table 3.
Correlations at baseline of pychosocial status and functional performance (n = 143).

Baseline Values	Obstacle Course Time		Obstacle Course Quality	
	Pearson Correlation	Sig (1 tailed)	Pearson Correlation	Sig (1 tailed)
Index of Self-esteem	0.071	0.201	–0.173	0.019
Geriatric Depression Scale	0.089	0.145	–0.252	0.001
Arthritis Impact Measurement Scale (AIMS)				
Mobility	0.540	0.001	–0.495	0.001
Physical Activity	0.438	0.001	–0.578	0.001
Social Role	0.573	0.001	–0.493	0.001
Social Activity	0.168	0.022	–0.242	0.002
ADL	0.461	0.001	–0.404	0.001
Depression	0.077	0.180	–0.251	0.001
Anxiety	0.149	0.038	–0.218	0.004
Total AIMS	0.495	0.001	–0.560	0.001

ADL = activities of daily living

We could not find other prospective intervention studies that have reported an association between psychosocial variables and functional balance and mobility performance. Prominent among the studies that did not report a link between psychosocial variables and balance and mobility performance are the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) trials. The FICSIT trials were multicenter cooperative frailty intervention trials funded by the U.S. National Institute on Aging in the 1990s [48]. These trials included among their common data collection instruments, psychosocial measurements, including depression measured by the GDS and/or the Center for Epidemiologic Studies-Depression scale [49]. Our finding of a modest association between psychosocial variables and FOC performance suggests a connection between psychological state and physical/functional performance. This has important implications because better performance on functional balance and mobility tests is associated with fewer physical and functional limitations and a lower risk of falls [50–51].

Although results of other studies using exercise as an intervention for depression have been reported, our study is the first that we could find to do so using community-residing older persons with a known history of recent falls. Experts recommend exercise participation for older adults because exercise has potential psychological benefits, especially in areas of psychological function (anxiety and depression) that are more prevalent among older adults [52].

King and colleagues found that mildly depressed and anxious older adults improved after exercise regardless of the type of exercise program [53]. Greater exercise participation was significantly associated with fewer depression and anxiety symptoms. In moderately depressed older individuals, McNeil and associates compared an individual exercise program to nonexercise (social) home visits or a delayed-exercise control group [54]. The exercise and social contact groups reduced depression, but only the exercise participants significantly reduced somatic symptoms. The investigators concluded that some of the positive effect of exercise on depression is due to social aspects and that exercise reduces a broader range of depressive symptoms than social contact alone. In another short-term exercise study using depressed older persons, Singh, Clements, and Fiatarone found that depression was significantly reduced [55].

Like the studies by McNeil et al. and Singh et al. [54,55], our participants who were at least mildly depressed at baseline significantly improved at postexercise. The social contact aspects of our exercise program closely approximated the Singh et al. study, which conducted common exercise sessions and, therefore, allowed both investigator-participant and interparticipant social contact.

Explanations for the positive psychological benefit of exercise are divided into cognitive or psychological and biological effects. Psychological explanations include self-efficacy, mastery and distraction, and social interaction [18–19,55]. Biological mechanisms include monoamine, endorphin, thermogenic, and visceral-afferent-feedback hypotheses [18–19]. Paluska and Schwenk suggest that an integrated biopsychological model, combining the components of each, offers the most likely explanation for the psychological benefit of exercise [18]. This integrated model is probably applicable to our exercise intervention.

Some limitations of our study deserve comment. Since our nonfallers differed at baseline from the fallers, our conclusions about exercise are confounded. The nonfallers did give us an indication of what happens over time and allowed us to gauge what happens to those who were frailer but did exercise. Although we found significant changes over a short time period, a longer follow-up is necessary to track long-term outcomes. Some studies conducting long-term follow-up found that improved psychological status was maintained as long as 12 months [19,53]. We did not specifically assess frailty in our sample population; however, we believe that potential bias may be obviated by our selection criteria, namely inclusion of community-dwelling, ambulatory individuals. Our study lacked a true control group (nonfallers who participated in our exercise program and nonexercising fallers). Inclusion of a true control group could have provided additional information that would be useful in further interpreting our findings. Two studies found no psychological changes after exercise participation by nondepressed older persons [56,57]. These studies suggest that members of our nonfaller control group who had no change in their psychosocial variables from pretest to posttest were not likely to have benefited psychosocially had they participated in the exercise intervention.

CONCLUSION

To our knowledge, our study is the first intervention study to report a decrease in depression (and anxiety) among community-residing older persons with a known history of falling. We also found an association between impaired functional balance and mobility performance and psychosocial dysfunction (depression and anxiety).

These findings are significant because:

- Depression, among other psychosocial factors, may increase the risk of subsequent falls, and likewise, the experience of falls and fall-related injuries may contribute to depression and other psychosocial factors.
- Depression has been shown by others and us to be reversible with an exercise intervention.
- Nonpharmacologic intervention, such as exercise, is preferable to psychoactive medication in an older population with a history of falls.

These results suggest that future studies addressing balance and mobility in persons who fall should include measurement of psychosocial variables and a psychosocial component of the study intervention.

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REFERENCES

1. Herndon JG, Helmick CG, Sattin RW, Stevens JA, DeVito C, Wingo PA. Chronic medical conditions and risk of fall injury events at home in older adults. J Am Geriatr Soc 1997;45:739–43.
2. Graafmans WC, Ooms ME, Hofstee HMA, Bezemer PD, Bouter LM, Lips P. Falls in the elderly: A prospective study of risk factors and risk profiles. Am J Epidemiol 1996;143:1129–36.
3. Reinsch S, MacRae P, Lachenbruch PA, Tobis JS. Why do healthy older adults fall? Behavioral and environmental risks. Phys Occup Ther Geriatr 1992;11:1–15.
4. Lipsitz LA, Jonsson PV, Kelley MM, Koestner JS. Causes and correlates of recurrent falls in ambulatory frail elderly. J Gerontol 1991;46:M114–22.
5. Nevitt MC, Cummings SR, Kidd S, Black D. Risk factors for recurrent nonsyncopal falls: A prospective study. J Am Med Assoc 1989;261:2663–68.
6. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. New Engl J Med 1988;319:1701–7.
7. Ryynänen OP, Kivelä SL, Honkanen R, Laippala P. Recurrent elderly fallers. Scand J Prim Health Care 1992; 10:277–83.
8. Kutner NG, Schechtman KB, Ory MG, Baker DI. FICSIT Group: Older adults' perceptions of their health and functioning in relation to sleep disturbance, falling, and urinary incontinence. J Am Geriatr Soc 1994;42:757–62.
9. Mossey JM. Social and psychologic factors related to falls among the elderly. Clin Geriatr Med 1985;1:541–53.

10. Tinetti ME, Williams CS. The effect of falls and fall injuries on functioning in community-dwelling older persons. J Gerontol Med Sci 1998;53A:M112–19.
11. Murphy J, Isaacs B. The postfall syndrome. Gerontology 1982;28:265–70.
12. Cwikel J. Falls among elderly people living at home: medical and social factors in a national sample. Israeli J Med Sci 1992;28:446–53.
13. Cwikel J, Fried AV, Galinsky D. Falls and psychosocial factors among community-dwelling elderly persons: A review and integration of findings from Israel. Public Health Rev 1990;17:39–50.
14. Whooley MA, Kip KE, Cauley JA, Ensrud KE, Nevitt MC, Browner WS. Depression, falls, and risk of fracture in older women. Arch Intern Med 1999;159:484–90.
15. Luukinen H, Koski K, Kivela SL, Laippala P. Social status, life changes, housing conditions, health, functional abilities and life-style as risk factors for recurrent falls among the home-dwelling elderly. Public Health 1996; 110:115–18.
16. Province MA, Hadley EC, Hornbrook MC, Lipsitz LA, Miller JP, Mulrow CD, Ory MG, et al. The effects of exercise on falls in elderly patients: A preplanned meta-analysis of the FICSIT trials. J Am Med Assoc 1995;273: 1341–47.
17. Gardner MM, Robertson MC, Campbell AJ. Exercise in preventing falls and fall-related injuries in older people: a review of randomised controlled trials. Br J Sports Med 2000;34:7–17.
18. Paluska SA, Schwenk TL. Physical activity and mental health: current concepts. Sports Med 2000;29:167–80.
19. DiLorenzo TM, Bargman EP, Stucky-Ropp R, Brassington GS, Frensch PA, LaFontaine T. Long-term effects of aerobic exercise on psychological outcomes. Prev Med 1999;28:75–85.
20. King AC, Taylor CB, Haskell WL. Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. Health Psychol 1993;12:292–300.
21. Scully D, Kremer J, Meade MM, Graham R, Dudgeon K. Physical exercise and psychological well being: a critical review. Br J Sports Med 1998;32:111–20.
22. Leipzig RM, Cumming RG, Tinetti M. Drugs and falls in older people: A systematic review and meta-analysis: I. Psychotropic drugs. J Am Geriatr Soc 1999;47:30–39.
23. Sheehan SL, Coons SJ, Robbins CA, Martin SS. Hendricks J. Latimer M. Psychoactive medication, alcohol use, and falls among older adults. J Behav Med 1995;18: 127–40.
24. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Phys Ther 2000; 80:896–903.
25. VanSwearingen JM, Paschal KA, Bonino P, Chen TW. Assessing recurrent fall risk of community-dwelling, frail older veterans using specific tests of mobility and the physical performance test of function. J Gerontol A Biol Sci Med Sci 1998;53:M457–64.
26. Thorbahn LD, Newton RA. Use of the Berg Balance Test to predict falls in elderly persons. Phys Ther 1996;76: 576–83.
27. Means KM, Rodell DE, O’Sullivan P. Use of an obstacle course to assess balance and mobility in the elderly: A validation study. Am J Phys Med Rehabil 1996;75:88–95.
28. Mendes de Leon CF, Seeman TE, Baker DI, Richardson ED, Tinetti ME. Self-efficacy, physical decline, and change in functioning in community-living elders: a prospective study. J Gerontol B Psychol Sci Soc Sci 1996;51: S183–90.
29. Pennix BWJH, Guralnik JM, Ferrucci L, Simonsick EM, Deeg DJH, Wallace RB. Depressive symptoms and physical decline in community-dwelling older persons. J Am Med Assoc 1998;279:1720–26.
30. Pennix BW, Deeg DJ, van Eijk JT, Beekman AT, Guralnik JM. Changes in depression and physical decline in older adults: a longitudinal perspective. J Affect Disord 2000;6:1–12.
31. Seeman TE, Berkman LF, Charpentier PA, Blazer DG, Albert MS, Tinetti ME. Behavioral and psychosocial predictors of physical performance: MacArthur studies of successful aging. J Gerontol A Biol Sci Med Sci 1995;50: M177–83.
32. Strawbridge WJ, Cohen RD, Shema SJ, Kaplan GA. Successful aging: predictors and associated activities. Am J Epidemiol 1996;144:135–41.
33. Cummings SR, Nevitt MC, Kidd S. Forgetting falls: the limited accuracy of recall of falls in the elderly. J Am Geriatr Soc 1988;36:613–16.
34. Hale WA, Delaney MJ, Cable T. Accuracy of patient recall and chart documentation of falls. J Am Board Fam Pract 1993;6:239–42.
35. Means KM, Rodell DE, O’Sullivan P, Cranford L. Use of a low to moderate intensity exercise program in the rehabilitation of elderly fallers: a pilot study. Arch Phys Med Rehabil 1996;77:1030–36.
36. Hudson WW. The clinical measurement package: A field manual. Homewood (IL): The Dorsey Press; 1982.
37. Wong JL, Whitaker DJ. The stability and prediction of depressive mood states in college students. J Clin Psychol 1994;50:715–22.
38. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adley M, Leirer VO. Development and validation of a

geriatric depression screening scale: A preliminary report. J Psychiatr Res 1983;17:37–49.
39. Koneig HG, Meador KG, Cohen HJ, Blazer DG. Self-rated depression scales and screening for major depression in the older hospitalized patient with medical illness. J Am Geriatr Soc 1988;36:699–706.
40. Nitcher RL, Burke WJ, Roccaforte WH, Wengel SP. A collateral source version of the Geriatric Depression Rating Scale. Am J Geriatr Psychiatry 1993;1(2):143–52.
41. Brink TA, Yesavage JA, Lum O, Heersema P, Adey M, Rose TL. Screening tests for geriatric depression. Clin Gerontol 1982;1:37–44.
42. Liang MH, Fossel AH, Larson MG. Comparison of five health status instruments for orthopedic evaluation. Med Care 1990;28:632–42.
43. Meenan RF, Gertman PM, Mason JH. Measuring health status in arthritis: The Arthritis Impact Measurement Scale. Arthritis Rheum 1980;23:146–52.
44. Lerner RK, Esterhai JL, Polomono RC, Cheatle MC, Heppenstall RB, Brighton CT. Psychosocial, functional, and quality of life assessment of patients with posttraumatic fracture nonunion, chronic refractory osteomyelitis, and lower extremity amputation. Arch Phys Med Rehabil 1991;72:120–26.
45. Anderson JJ, Firschein HE, Meenan RF. Sensitivity of a health status measure to short-term clinical changes in arthritis. Arthritis Rheum 1989;32:844–50.
46. Means KM. The obstacle course: A tool for the assessment of balance and mobility in the elderly. J Rehabil Res Dev 1996;33:413–28.
47. Means KM, O'Sullivan PS. Modifying a functional obstacle course to test balance and mobility in the community. J Rehabil Res Dev 2000;37:621–32.
48. Kline-Mangione K. Frailty research: a review of the FICSIT trials. Top Geriatr Rehabil 1995;11:61–70.
49. Buchner DM, Hornbrook MC, Kutner NG, Tinetti ME, Ory MG, Mulrow CD, Schechtman KB, et al. Development of the common data base for the FICSIT trials. J Am Geriatr Soc 1993;41:297–308.
50. Buchner DM. Successful aging: Preserving mobility in older adults. Western J Med 1997;167:258–64.
51. DiFabio RP, Seay R. Use of the "Fast Evaluation of Mobility, Balance, and Fear" in elderly community dwellers: Validity and reliability. Phys Ther 1997;77:904–17.
52. Mazzeo RS, Cavanaugh P, Evans WJ, Fiatarone M, Hagberg J, McAuley E Starzel J. American College of Sports Medicine position stand on exercise and physical activity for older adults. Med Sci Sports Exerc 1998;30:992–1008.
53. King AC, Taylor CB, Haskell WL. Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. Health Psychol 1993;12:292–300.
54. McNeil JK, LeBlanc EM, Joyner M. The effect of exercise on depressive symptoms in the moderately depressed elderly. Psychol Aging 1991;6:487–88.
55. Singh NA, Clements KM, Fiatarone MA. A randomized controlled trial of progressive resistance training in depressed elders. J Gerontol Biol Sci Med Sci 1997; 52A:M27–35.
56. Dustman, RE, Ruhling RO, Russell EM, Shearer DE, Bonekat W, Shigeoka JW, Wood JS, Bradford DC. Aerobic exercise training and improved neuropsychological function of older individuals. Neurobiol Aging 1984;5:35–42.
57. Gitlin LN, Lawton MP, Windsor-Landsberg LA, Kleban MH, Sands LP, Posner J. In search of psychological benefits; exercise in healthy older adults. J Aging Health 1992; 4:174–92.

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