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Influence of pain and depression on fear of falling, mobility, and balance in older male veterans

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Abstract—This study determined the extent to which pain and depression influenced changes in fear of falling, mobility, and balance in older veterans with mobility disorders. Data were reviewed from 95 consecutive patients (aged 60 to 95 yr) who attended the Geriatric Gait and Balance Disorders Clinic at the Malcom Randall Department of Veterans Affairs Medical Center between 1998 and 2000. All subjects performed an individualized exercise program and were assessed four times over 12 weeks with a standardized evaluation battery. We used separate hierarchical regression models to examine the influence of measures of bodily pain and depression on outcomes (Berg Balance Test, Dynamic Gait Index, and Falls Efficacy Scale). Approximately half of the patients attended all evaluation sessions. Attendance at follow-up visits was a significant predictor of improvement in all outcome measures. Pain was a significant predictor of a decrease in balance and mobility outcome scores but not fear of falling. Thus, completing the program increased the amount of improvement, while having pain decreased the amount of improvement. These data suggest that targeted interventions for pain and improving adherence to rehabilitation recommendations should be included in the rehabilitation of older veterans with balance or mobility disorders to maximize potential improvements in balance and mobility.

Key words: balance, Berg Balance Test, depression, Dynamic Gait Index, falling, Falls Efficacy Scale, fear of falling, mobility, pain, rehabilitation.

INTRODUCTION

The older adult population is the fastest growing group in the United States [1]. Manton estimates that by 2050, the number of older adults with a disability in the United States will approximately triple [2]. The associated care costs will be a growing concern over this time [3]. Older adults commonly report difficulty with mobility and a significant problem with falling. Falls are a major health problem among older adults [4–7]. In the United States, one in three adults older than 65 falls at least once each year [5–7]. This proportion and the severity of fall-related complications increases with age [6–7]. Primary fall-related injuries are fractures, head injuries, and postfall anxiety [8]. These complications lead to loss of independence through decreased mobility and increased fear of falling [9].

Abbreviations: ADL = activities of daily living, Berg = Berg Balance Scale, DGI = Dynamic Gait Index, FES = Falls Efficacy Scale, GDS = Geriatric Depression Scale, NRS = numeric rating scale, VA = Department of Veterans Affairs, VAMC = VA medical center.

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Increased fear of falling was recently identified as “the single most important predictor” of fall severity in older community-dwelling adults in Florida [4]. The decreases in mobility and independence are often serious enough to result in hospital or nursing home admission or even premature death [10–11]. In 1994, the total cost of fall injuries for older adults in the United States was $20.2 billion [12] and is projected to reach $32.4 billion (in 1994 U.S. dollars) by 2020 [4,12].

Progressive weakness and the increasing risk of falling may be ameliorated through rehabilitation programs designed to specifically target underlying impairments in strength, endurance, and balance and limitations to participation in daily activities. Exercise programs for strength and balance retraining have been identified as beneficial in falls prevention [13–14]. A recent meta-analysis of home-based programs of muscle, strength, and endurance training for high-risk participants indicated a reduction in falls risk of 35 percent [15].

Pain is a significant problem for both community-dwelling older adults and older adults in residential facilities [1] and a source of depression and suffering in older individuals [16]. Depression has been reported as being under-recognized and undertreated in older adults [17–19]. Both depression and anxiety affect the perception and sequelae of musculoskeletal pain [18], but the relationship between depression, musculoskeletal pain, and improvement made during rehabilitation for a gait and balance disorder remains unclear. In this study, we examined the influence of pain and depression on balance, mobility, and fear of falling in frail older men with significant history of falls. We hypothesized that pain and depression in combination would negatively affect the amount of change in measures of balance, mobility, and fear of falling over 12 weeks of intervention.

METHODS

Subjects

We searched the clinical database of the medical records of consecutive patients at the Geriatric Gait and Balance Disorders Clinic at the Malcom Randall Department of Veterans Affairs (VA) Medical Center (VAMC) in Gainesville, Florida, for patients who attended the clinic between 1998 and 2000. Subject characteristics are presented in **Table 1**. All patients were referred to the clinic by their physician because they had experienced at least one fall from any cause, including neurological conditions, cardiopulmonary or musculoskeletal dysfunction, peripheral neuropathy, polypharmacy, orthostatic hypotension, dementia, or vestibulopathy. The University of Florida Institutional Review Board and the VA Subcommittee for Clinical Investigation approved a waiver of informed consent for this project and granted permission for chart reviews according to Health Insurance Portability and Accountability Act standards. Patient records were searched for those patients who had a history of falling twice in the 12 months previous to referral, the

Table 1.
Subject characteristics according to whether they did (n = 51) or did not (n = 44) complete individualized exercise program. Data presented as mean ± standard deviation unless otherwise noted.

Variable	Program Completed	Program Not Completed	*p*-Value
Age, yr (No. female)	77.0 ± 6.8 (3)	77.3 ± 5.3 (0)	0.78
FES	69.6 ± 23.4	73.8 ± 15.5	0.40
Berg	39.8 ± 7.4	37.5 ± 7.7	0.19
DGI	12.2 ± 4.3	11.9 ± 4.5	0.79
Depression* (%)	21.6	25.0	0.99
Pain† (%)	21.6	27.8	0.80
Pain and Depression (%)	9.3	5.6	0.70
Currently Smoking (%)	21.2	8.3	0.08

*Defined as Geriatric Depression Scale score of >11 points on long form (*Source*: Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, Leirer VO. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res. 1982–1983;17(1):37–49. [PMID: 7183759]) and >7 points on short form (*Source*: Almeida OP, Almeida SA. Short versions of the Geriatric Depression Scale: A study of their validity for the diagnosis of a major depressive episode according to ICD-10 and DSM-IV. Int J Geriatr Psychiatry. 1999;14(10):858–65. [PMID: 10521885]).
†Defined as average pain in past week of >5 on 11-point numeric rating scale.
Berg = Berg Balance Scale, DGI = Dynamic Gait Index, FES = Falls Efficacy Scale.

ability to walk 20 feet with or without an assistive device, the ability to follow simple commands, and a score of 20 or higher on the Mini-Mental State Examination. In addition, all patients were dependent in at least two activities of daily living (ADL) [20]. Patient records were not included for review if the primary cause of falling was polypharmacy, orthostatic hypotension, dementia, or vestibulopathy as determined from the examination procedure outlined here.

Procedures

All patients participated in a multidisciplinary evaluation that included a geriatrician, physical therapist, and pharmacist. Patients were examined by a physical therapist with a standardized battery of tests and measures. After the initial evaluation, patients received instruction in a home exercise program that was tailored to each individual. Home exercises were developed according to the findings of the examination. Each patient then followed the home exercise program and returned to the clinic for monthly follow-up evaluations. The final and discharge evaluation occurred after 12 weeks. The geriatrician collected depression and pain scores. The home exercise program was designed by a staff physical therapist who remained unaware of the results of the initial psychological screening examinations. The same physical therapist performed the initial, both progress, and the final discharge evaluations.

Home Exercise Intervention

Home exercises were developed with a decision tree model. For example, if the subject demonstrated problems with stabilization (assessed in the Berg Balance Scale [Berg]) or significant weakness in the hip abductor, quadriceps, plantar flexor, or dorsiflexor muscles, specific strengthening exercises were developed for those muscle groups. These specific muscle groups were targeted based on the results of a cross-correlation of isometric strength to functionality [21] and the importance of hip abductor strength during high-level lower-limb function, including normal walking, turning, and stopping [22–26]. The goal of the strengthening was to have the patient achieve scores during standardized handheld dynamometry testing as follows: hip abductors >20 lb, quadriceps strength >50 lb, plantar flexors >50 lb, and dorsiflexors >40 lb.

If the patient was unable to walk farther than 500 ft in 2 minutes, he or she was placed on both an endurance training program for walking and an interval training program. The endurance program focused on patients being able to walk for at least 20 minutes continuously without stopping. During interval training, subjects were trained in walking agility, including fast and slow walking, walking backward, walking and turning in various directions, stopping and starting frequently, walking while carrying objects, and walking while turning the head side to side and up and down. We performed feedback-based balance control training by having subjects stand on hard and foam surfaces with their eyes open and closed and increased the difficulty by reducing the base of support on these surfaces and increasing the movement of the head and arms. Subjects were also required to walk on a variety of uneven surfaces, inclines, and stairs. The exact exercises taught to the patients varied according to their needs; however, each home exercise program was designed such that the amount of time required to perform the exercises was approximately the same for all patients.

Outcome Measures

Berg Balance Scale

The Berg was developed to assess balance in older adults. The scale has 14 items that are rated on a 5-point ordinal scale (0 to 4), on which "0" indicates the lowest level of function and "4" the highest level of function. Total scores range from 0 to 56 points. The higher the score, the more independent the patient is in tasks of balance. The Berg has been found to be internally consistent and to have a high degree of inter- and intrarater reliability [27–29].

Dynamic Gait Index

The Dynamic Gait Index (DGI) is an 8-item index scored by rating the subject's performance on the following tasks: walking on a level surface, changing speed while walking, turning the head from side to side and up and down while walking, sudden turns, obstacle negotiation, and stair negotiation [30]. Total score ranges from 0 to 24, with higher scores indicating greater independence in dynamic gait-related activities. Additionally, Whitney et al. indicated that subjects were 2.58 times more likely to have reported a fall in the previous 6 months if they scored <19 on this instrument [30].

Falls Efficacy Scale

The Falls Efficacy Scale (FES) is a 10-item scale. Patients are asked to rate on a scale of "0—no confidence" to "10—complete confidence" how confident they are that they can perform a variety of common tasks, such as prepare a meal or dress themselves, without falling. The reliability and validity of the scale have been previously demonstrated [31]. Higher scores indicate more confidence that activities can be performed without falling.

Personal Contextual Factors

Pain

All patients were asked to describe the anatomical location and quality of pain that they were experiencing in the week leading up to the examination at the clinic. Patients rated the average pain that they had experienced in the past week using a numeric rating scale (NRS) with anchors at "0—no pain" and "10—worst pain imaginable." The NRS is the preferred pain-reporting mechanism of older adults [32].

Depression

The geriatricians at the Geriatric Gait and Balance Disorders Clinic used two forms of the Geriatric Depression Scale (GDS) during the time frame reviewed for this study. The GDS is a survey used to rate depression in older adults and exists in two forms: long (30 questions) and short (15 questions). The long-form GDS has been shown to have a high internal consistency (0.94) and good test-retest reliability (0.85) [33] as has the short version [34–35]. Additionally, the GDS short form has been found to be an adequate substitute for the GDS long form [35]. GDS scores were dichotomized based on threshold criteria of 11 points for the long form [33] and 7 points for the short form [36].

Statistical Analysis

For this study, the primary outcome variables were the changes in fear of falling (FES), balance (Berg), and mobility (DGI) scores from baseline to 12 weeks. Separate hierarchical regression models were used for each variable. The first block consisted of age, baseline score for the outcome variable of interest, and an ordinal variable that indicated how many of the three follow-up visits were attended by the patient. Baseline measures of pain and depression were entered as a second block, and finally, the interaction term representing those patients with both pain and depression was entered. We multiplied centered values of pain and depression to create the separate term representing the interaction. We compared characteristics of those patients who completed the program and those who did not using independent *t*-tests. Type 1 error was maintained at 5 percent, and all statistical analyses were performed with SPSS, version 13.0 (SPSS Inc, Chicago, Illinois).

RESULTS

Of the 95 patients whose evaluation records were reviewed, 51 (54%) attended all the evaluation sessions; 55 (57%) completed at least the 1-month follow-up visit. No differences were noted in baseline measures between those patients who completed the program and those who did not (**Table 1**). Interestingly, although not significantly different, a greater proportion of patients who completed the program were current smokers. Reasons for not attending all the evaluation sessions are provided in **Table 2**. Patients referred to the clinic had multiple comorbid health conditions. However, the primary reason for falling was considered by the multidisciplinary team to be neurological in origin (parkinsonism, traumatic brain injury, or stroke) in 35 percent of patients and musculoskeletal in origin in 20 percent.

Twenty-three percent of all patients exhibited signs of depression at the time of the initial evaluation, and the same percentage indicated that they were experiencing average pain in the past week of >5 on the NRS (**Table 1**). Overall, subjects reported a mean ± standard deviation pain level of 1.8 ± 3.3 on the NRS. Thirty percent of subjects who complained of pain also experienced depression compared with nineteen percent of patients who had no pain.

Table 2.
Reasons subjects did not complete individualized exercise program (n = 44).

Reason	*n*
Vestibular or polypharmacy problem.	6
Admission as inpatient during program.	8
Referral to alternative clinic.	8
Lack of interest in participating in rehabilitation program.	3
Patient request: no reason given in medical record.	2
Nonattendance: not able to contact veteran or no response to contact.	5
Difficulty with transportation.	1
Moved out of area.	1
Reason not stated in medical record.	10

Although higher, this proportion was not statistically different (p = 0.56). Seventy-five percent of those patients who reported pain stated that their main problem was low-back pain. Of patients who completed the program, 60 percent achieved an increase in Berg scores of 5 or more, a threshold considered to indicate meaningful change in patients after stroke [37]. Forty percent of patients who completed the program improved their performance on the DGI to >19 out of 24.

For the FES, significant predictors of change were the baseline score and whether the patient completed the program ($F_{3,61}$ = 16.1, p < 0.001), which explained approximately 44 percent of the variance. Attending all sessions had a moderate positive influence (standardized beta = 0.29) on the amount of change. Adding pain and depression to the model did not significantly affect the variation in the amount of change.

Baseline score and program completion were also significant predictors of change in Berg and DGI scores. Program completion was a strong positive influence on outcome (standardized beta > 0.5). Pain was also a significant predictor of change in Berg and DGI scores ($F_{5,78}$ = 13.3, p < 0.001 and $F_{5,73}$ = 9.4, p < 0.001, respectively). The influence of pain was negative for both variables. The interaction term, representing a patient who had both pain and depression, did not explain a significant amount variance for any of the outcomes measured. The data and the entire models are summarized in **Table 3**.

Table 3.
Final hierarchical regression models.

Measure	*b*	*p*-Value	Adjusted R^2	Δ *F*-Value	*p*-Value
Falls Efficacy Scale					
Block 1					
Age	0.026	0.81			
Baseline Score	–0.590	<0.001	0.421	16.5	<0.001
Complete	0.303	0.002			
Block 2					
Pain	0.034	0.77	0.422	1.06	0.35
Depression	0.130	0.24			
Block 3					
Interaction	–0.139	0.27	0.425	1.27	0.27
Berg Balance Scale					
Block 1					
Age	0.114	0.13			
Baseline Score	–0.415	<0.001	0.348	14.9	<0.001
Complete	0.562	<0.001			
Block 2					
Pain	–0.216	0.05	0.397	4.0	0.02
Depression	0.047	0.49			
Block 3					
Interaction	–0.083	0.46	0.393	0.55	0.46
Dynamic Gait Index					
Block 1					
Age	–0.109	0.29			
Baseline Score	–0.350	0.001	0.301	11.5	<0.001
Complete	0.491	<0.001			
Block 2					
Pain	–0.211	0.049	0.341	3.12	0.05
Depression	0.062	0.60			
Block 3					
Interaction	–0.052	0.65	0.333	0.27	0.65

b = standardized beta, Complete = number of examinations completed.

DISCUSSION

In this study, 54 percent of patients referred to the clinic completed the intervention program. Although the Geriatric Gait and Balance Disorders Clinic maintains a standardized assessment procedure, it is still an outpatient clinic. Patients were unable or elected not to return for a variety of reasons common in clinical practice and some of the reasons for loss at follow-up are presented in **Table 2**. Our results indicate no systematic baseline differences between those patients who completed all the evaluation sessions and those who did not, based on the variables that were measured in this study; however, for those patients who completed the program and attended all evaluations, an improvement in balance and mobility outcomes measures was noted. Additionally, 92 percent of patients who attended the 4-week visit returned for a discharge evaluation. Although we were unable to identify published rates of program completion from another VA gait and balance clinic, our completion rate (54%) is comparable to the 48 percent noted in medical outpatient attendance [38] but less than the 66 percent attendance rate of patients with vestibular dysfunction at a balance disorder clinic noted by Brown et al. [39].

We did not collect any data regarding patient attitudes toward healthcare in general or rehabilitation specifically, but we speculate that attending all the scheduled evaluations may reflect a certain level of self-efficacy and self-interest in care from those patients who did attend. Certainly, program completion was the only variable other than baseline score that influenced the change in fear of falling. In this study, a decrease in fear was noted if a patient attended the evaluation sessions. Including methods to improve adherence to the recommendations made by the medical and rehabilitation team should improve the outcome of patients participating in these types of exercise programs. Currently, we are examining a variety of techniques to encourage patients to return for the first follow-up visit and discourage them from dropping out of the program. We hope that by increasing participation in the program, more of the veterans with gait and balance disorders will improve their ability to remain independent community dwellers.

The result that average pain was a significant predictor of change in balance and mobility is not surprising. Evidence suggests that physical activity is influenced by pain and related fear beliefs [40–41]. Those experiencing high levels of pain might participate less in daily activities than their peers and avoidance of activity may result in functional decline [40]. We speculate that appropriately tailored intervention toward the management of pain as well as the other identified impairments and functional limitations might allow older adults to remain independent longer. This speculation is supported in part by Herrick et al. in their work with older adults with persistent hip pain [42]. These authors found that persistent pain was associated with a decrease in the ability to perform ADL.

In older adults, the most prevalent chronic pain cases are those involving osteoarthritis and low-back pain [19]. Our results from this study were similar: the primary complaint for 75 percent of our patients with pain was low-back pain, although we did not collect measures of pain chronicity. Additionally, several studies indicate that fear of pain is a strong predictor of variation in exercise performance [43–45]. Pain-related fear of movement is often manifested in patients who experience chronic low-back pain that limits their daily activities [46]. Furthermore, pain-related fear or anticipated pain is a better predictor of walking velocity than actual pain in those with chronic back pain [47]. Although we did not specifically assess fear of pain in this study, we speculate that this personal factor may also be present in older adults with pain and increased fear of falling. This will be explored in future work. Previous studies have demonstrated that pain-related fear is responsive to intervention in patients with chronic low-back pain [45,48–49]. These findings, in conjunction with our results, indicate that patients with pain require specific and targeted interventions that address pain and the physical impairments and limitations identified during a multidisciplinary gait and balance intervention.

For no variables did the interaction term between pain and depression explain any significant additional variance in the change in outcome measure scores, nor did depression contribute individually. Prior research suggests that depression is likely under-recognized in older adults [17–19] and that depression affects the perception of musculoskeletal pain [18]. Additionally, Weiner et al. recently concluded that neuropsychological variables, including depression, influenced the relationship between pain and physical performance (e.g., gait speed) [50]. Based on these studies, we had expected that a patient with pain who was also depressed would do less well in a targeted intervention program than a patient with one or the other or neither.

A large proportion of patients who attended the Geriatric Gait and Balance Disorders Clinic with pain had depression (30%), while the proportion of those without pain who had depression was 19 percent. In comparison, a larger community-based study of 4,000 older men and women found that 19 percent of subjects with pain had depression, while 11 percent of people without pain had depression [51]. When only men are considered in this larger study, the proportions change to 18.0 and 13.5 percent, respectively, a difference that, similar to our results, was not significant. The main finding of interest from the Onder et al. study relative to our own, however, was that the proportion of women with pain and depression was significantly different from those without pain. Patients seen at the Geriatric Gait and Balance Disorders Clinic were overwhelmingly male (97%). The combination of these findings leads to the possibility that a sex-specific influence is involved in the interaction of pain and depression; that is, although the point estimate of the proportion of patients in our study with pain and depression was higher than reported elsewhere, the effect of the combination of these factors was not great perhaps because of a sex-specific influence.

The facts that the patients seen at our clinic were (1) predominantly male and (2) from one clinic at one VAMC also temper the findings of our investigation, limiting our ability to generalize to other settings. Likewise, our data were reviewed in retrospect and have the limitations thereof; for example, no control group data was concurrently reviewed. Additionally, we must consider the complex interactions between pain and depression. Pain is multidimensional, and subsequently, depression may fall out of our models because it represents that affective component of pain not assessed in our study. Geisser et al. propose that the lack of an observed relationship between depression and measures of chronic pain suggests that changes in affect or depressive symptoms are more highly associated with recent experience of pain. These authors go on to speculate that the relationship between affect and chronic pain may be mediated by cognitions such as catastrophizing, perceived interference with daily activities, and the anticipated fear of structural damage [52]. Currently, we are following patients using a pain-experience instrument that includes assessment of multiple domains within the pain experience, including anxiety, frustration, fear, and anger [53].

Last, the fact that nearly 50 percent of this group of patients did not finish the program should be considered. As far as a model of clinical practice, this study is in accordance with those reports of adherence to long-term exercise regimens and other intervention protocols. However, the resulting limitation of this low completion rate is that the experimental power to identify actual relationships between pain, depression, and outcome, should they exist, was low. For example, post hoc analysis of the Berg data showed that the study was powered at 46 percent for identifying depression and 60 percent for identifying an interaction between pain and depression as significant predictors of outcome in this sample of subjects.

CONCLUSIONS

We draw several conclusions from these data. First, older veterans who have fallen can improve their balance and mobility, as determined by the measures in this study, over a 12-week period. Second, pain may negatively affect the improvements, and we recommend that targeted intervention to decrease pain and improve adherence to treatment recommendations be included in the management of gait and balance disorders. Additionally, we propose that more thorough assessment techniques be included in the examination battery. Currently, we are prospectively collecting data on a variety of instruments, which we hope will provide improved insight into the pain experience of older veterans attending the clinic. Last, in contrast to our original hypothesis, depression, as defined as a score on the GDS greater than 11 points for the long form [33] and 7 points for the short form [36], did not explain significant amounts of variation in outcome scores.

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The authors have declared that no competing interests exist.

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